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14. ABSTRACT
As a smaller Air Force transitions to an Aerospace Force to start the new millennium, space offers a vantage point where no point on Earth is denied to a sensor system. Joint Vision 2010 describes

leveraging technological opportunities to achieve information superiority to enable full spectrum dominance. A key component of information superiority is airborne command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) assets. In a time of budget constraints, the Air Force must make some hard decisions regarding tradeoffs between current and future capabilities. This thesis offers a C4ISR framework to help identify categories that may bring to light some of the important issues associated with moving airborne capabilities to space. The framework is used to categorize current and future capabilities of airborne and space assets, and to compare and contrast C4ISR operations in these two environments. The seven categories in the C4ISR framework are: command and control, training, communications, surveillance, electronic intelligence, mission flexibility/versatility, and global presence. By highlighting the complexity of moving AWACS capabilities to space the paper also facilitates a better understanding of the air battle manager and space and missile operations career fields. Although the potential of space-based C4ISR systems is enormous, space-based assets will complement rather than replace air- and surface-based assets to form an integrated system with built-in redundancies. Due to technological and funding issues, not every AWACS capability can be moved to space by the year 2025. In particular, the space community does not currently have an air battle manager core competency nor do they intend to develop this in the future. United States Space Command and Air Force Space Command are interested in controlling space-based systems. The future for both the Air Battle Manager and Space and Missile Operations career fields is promising and full of new opportunities, but these two warfighters need to work together developing, integrating, and employing present and future C4ISR capabilities to win wars and save lives.

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AIRBORNE WARNING AND CONTROL SYSTEM (AWACS) AND SPACE: A FRAMEWORK TO HELP UNDERSTAND THE ISSUES

BY

MAJOR ROLAND K. VAN DEVENTER, USAF

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APPROVAL

The undersigned certify that this thesis meets masters-level standards of research, argumentation, and expression.

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Lt Col Peter L. Hays Date

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Lt Col Forrest E. Morgan Date

Disclaimer

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the United States Government, Department of Defense, the United States Air Force, or Air University.

About the Author

Major Roland K. Van Deventer was commissioned through Officers Training School in 1986. After air weapons controller training, he remained at Tyndall Air Force Base, Florida with the Southeast Air Defense Sector as an instructor, evaluator, and later Chief, Weapons and Tactics. In 1990, he transferred to the 932d Air Defense Squadron at Rockville, Iceland as Flight Commander and subsequently Chief, Standardization and Evaluation. His next assignment was Airborne Warning and Control System (AWACS) at Tinker Air Force Base in 1992 where he became a replacement training unit Flight Commander followed by Executive Officer to the Commander, Operations Group.

Major Van Deventer is a senior rated aircrew member with over 1,800 flying hours, including more than 600 hours of combat support time. He is master air battle manager with over 2,000 controlled air-to-air intercepts. He has a B.S. in Accounting from the University of Hawaii, a M.B.A. from Oklahoma City University, and a master's degree in Military Operational Art and Science from the Air Command and Staff College. He is a distinguished graduate from Weapons Controller Training School and Squadron Officer School. In July 2000, he will be assigned to J-38, Joint Staff.

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Abstract

As a smaller Air Force transitions to an Aerospace Force to start the new millennium, space offers a vantage point where no point on Earth is denied to a sensor system. *Joint Vision 2010* describes leveraging technological opportunities to achieve information superiority to enable full spectrum dominance. A key component of information superiority is airborne command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) assets. In a time of budget constraints, the Air Force must make some hard decisions regarding tradeoffs between current and future capabilities.

This thesis offers a C4ISR framework to help identify categories that may bring to light some of the important issues associated with moving airborne capabilities to space. The framework is used to categorize current and future capabilities of airborne and space assets, and to compare and contrast C4ISR operations in these two environments. The seven categories in the C4ISR framework are: command and control, training, communications, surveillance, electronic intelligence, mission flexibility/versatility, and global presence. By highlighting the complexity of moving AWACS capabilities to space the paper also facilitates a better understanding of the air battle manager and space and missile operations career fields.

Although the potential of space-based C4ISR systems is enormous, space-based assets will complement rather than replace air- and surface-based assets to form an

integrated system with built-in redundancies. Due to technological and funding issues, not every AWACS capability can be moved to space by the year 2025. In particular, the space community does not currently have an air battle manager core competency nor do they intend to develop this in the future. United States Space Command and Air Force Space Command are interested in controlling space-based systems. The future for both the Air Battle Manager and Space and Missile Operations career fields is promising and full of new opportunities, but these two warfighters need to work together developing, integrating, and employing present and future C4ISR capabilities to win wars and save lives.

Contents

Chapter 1

Introduction

> *Our vision for the future is one of integration of our systems and our people. We will use the best systems that we have available for each task, without regard to whether that system works in the air or in space, and fuse them into an integrated whole using the information systems that we are building today. In addition, we need to ensure that each of our men and women have an opportunity to understand how air and space systems fit together to do our mission.*
>
> —F. Whitten Peters, 2000
> Secretary of the Air Force

The military commander's quest for information about the enemy is nothing new or revolutionary. What continues to evolve is the means commanders use to gain and exploit this information—what *Joint Vision 2010* calls information superiority. Land armies sent scouts to the "highest ground" available to observe enemy size, components, and movement. A "higher ground" was discovered when observers in tethered balloons spied on enemy positions and relayed this information to the ground in the Battle of Fleuris in 1794.[1] With the advent of airplanes and a "new high ground," World War I witnessed aircraft used for "deep look" observations of the enemy, what is now called early warning. Aircraft fitted with the newly developed radar provided long-range early warning detection and played a key role in the allies' success during the Battle of the

[1] James P. Marshall, *Near Real Time Intelligence on the Tactical Battlefield: Requirements for a Combat Information System*, (Maxwell Air Force Base, Alabama: Air University Press, 1994), 29.

Atlantic during World War II.[2] The Gulf War saw the maturation of airborne systems providing coalition commanders with vast amounts of information about the enemy and a taste of the future. The "ultimate high ground," space has the potential to provide decision-makers and warfighters unprecedented levels of information about the enemy.

Joint Vision 2010 describes leveraging technological opportunities to achieve information superiority and enable full spectrum dominance.[3] Information superiority is "The capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[4] Currently, airborne command and control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) assets play an important force multiplier role in gaining and exploiting information superiority. The Airborne Warning and Control System (AWACS) platform provides information superiority to theater commanders with all-weather surveillance, command, control, and communications capabilities. If the Air Force's intention is to move airborne C4ISR system capabilities to space—the "ultimate high ground"—then a method must be developed to help understand the issues.

Purpose

The purpose of this research is to help understand the issues concerned with the movement of airborne C4ISR capabilities to space. This paper offers a framework to identify categories that may highlight some of the important issues for a seamless transition of these capabilities to space. Using AWACS as a case study, it is also hoped this study will promote a better understanding of the Air Battle Manager (ABM) and

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[2] Richard Overy, *Why the Allies Won* (New York: W.W. Norton and Company, 1995), 38, 50.
[3] Joint Chiefs of Staff, *Joint Vision 2010* (Washington D.C.: Department of Defense, 1996), 1-2, 16-19.
[4] Ibid., 16.

Space and Missile Operations (SMO) career fields, as well as, correct some misperceptions about these two warfighters.

Background

The Department of the Air Force's *The Aerospace Force: Defending America in the 21st Century* stated "The continuing merger of our formidable air and space capabilities and talented people will advance our evolution from the air and space force we have been toward the full spectrum of aerospace force we are becoming."[5] The Air Force believes a combination of air and space capabilities is the best path to fulfill its national security obligation. In 1994, the Chief of Staff of the Air Force, General Merrill A. McPeak, said "The AWACS is the modern day version of the cavalry. Whenever you have to circle the wagons anywhere in the world, the next thing that shows up is an AWACS request…"[6] As the military pursues information superiority and the demand for AWACS increases, the Air Force has no plans to buy any more of these sophisticated radar planes.[7] This begs a number of questions. What systems will augment or replace AWACS in the future? Where will these systems operate? What C4ISR capabilities can be space-based and when? Will an airborne AWACS continue to have a role in the future? Finally, how will these systems be integrated, and who will disseminate this information to decision-makers and warfighters?

In the case of AWACS air moving target indicator (AMTI) radar surveillance, the United States Space Command's 1998 *Long Range Plan: Implementing USSPACECOM*

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5 Department of the Air Force, *The Aerospace Force: Defending America in the 21st Century…a white paper on aerospace integration* (Washington D.C.: Department of the Air Force, 2000), 3.

6 Steven Watkins, "McPeak: No Additional AWACS," *Air Force Times* 55, no. 2 (24 October 1994): 34.

7 Ibid., 34.

Vision for 2020 offered one potential answer. The *Long Range Plan* described a space-based system that would be fully integrated with comparable theater air- and surface-based surveillance systems to provide integrated focused surveillance.[8] By the year 2020, a constellation of space-based radars with capabilities similar to AWACS is possible. But a 2000 report, the Air Force Space Command's *Strategic Master Plan for FY02 and Beyond* questioned whether or not a space-based AMTI radar duplicating AWACS was possible by 2025.[9]

The potential of "surveillance from space" is tremendous. Space offers an advantage where no point on Earth is denied to a sensor system.[10] Not bounded by overflight restrictions, a constellation of space-based radars could provide global coverage and surveillance of areas inaccessible by airborne assets. Airborne radars are limited in their range because of altitude and power, and subject to terrain masking. Surface units could conduct worldwide surveillance using space-based systems, and AWACS would be deployed when "integrated focused surveillance" is required for executing military operations in response to world crises. This would reduce AWACS deployments and support the Expeditionary Air Force concept.

Despite the potential of surveillance from space, there are some issues to overcome. Limited space lift and costs are ongoing problems for the space-based radar program. Physics dictates that an AMTI radar aperture would have to be huge and the power

8 United States Space Command, *Long Range Plan: Implementing USSPACECOM Vision for 2020* (Peterson Air Force Base, Colorado: United States Space Command, 1998), 52.

9 Air Force Space Command, *Strategic Master Plan for FY02 and Beyond* (9 February 2000), downloaded from http://www.spacecom.af.mil/hqafspc/library/ AFSPCPAOffice/2000smp.html, 11 May 2000, Chapter 6.

10 Naval Studies Board, "Information in Warfare," downloaded from http://www.nas.edu/cpsma/nsb/iw4.htm, 15 February 2000, 2.

source massive to detect fighter aircraft and cruise missiles.[11] Orbital mechanics prescribes that a significant number of satellites are required for global coverage. Flying fixed orbits with limited fuel, changing satellite orbits due to mission requirements reduces the satellite's lifespan, which currently is about 10 years.

In an era where technology seems to be the focus of military innovation, the human element tends to be overshadowed. How will airborne and space assets be integrated, and what affect will this have on information dissemination? No single space organization can duplicate all the different AWACS capabilities. Some organizations are classified, others optimized for arms control, while others are focused on ocean surveillance. Who will coordinate and process all this data from the various space-based systems into timely information for mission execution? The AWACS air battle manager performs this function using the different systems onboard AWACS to manage theater-level air wars, but none of the space specialties are similar to an ABM. If the space community wants an air battle management mission using space-based assets, then a training program to develop these competencies must be started. If the plan is for ABMs to use space-based assets to execute their mission, then an exchange between the two communities is a must to develop the best possible integrated focused surveillance system.

The lack of published literature and briefings detailing the future integration of airborne systems, such as AWACS, and space-based capabilities have created some misperceptions and misunderstandings between the air battle manager and the Air Force's space and missile operations communities. Few people in the AWACS community understand the different aspects of space operations and its potential for the

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[11] David A. Fulghum, "Space Beckons Future AWACS," *Aviation Week & Space Technology* 149, no. 12 (21 September 1998): 62.

future. Few people in the space and missile operations community understand the role of ABMs executing the different AWACS missions.

Assumptions

The author acknowledges certain limitations. First, no one can accurately predict the future, therefore, advances in future technology are speculative only. Second, this research does not look beyond the year 2025 due to lack of published literature concerning this subject. Third, in the absence of major theater wars and no serious threat to United States hegemony, the military budget remains relatively constant. This fiscal constraint means continued tradeoffs between current system requirements and research and development for future systems.

Methodology

This paper's framework helps identify categories that may highlight some of the important issues for the movement of airborne C4ISR capabilities to space. Categories are identified based on answering the question "Why is this particular airborne C4ISR asset valuable to decision-makers and warfighters?" Once the categories are identified, research is conducted to determine current and future capabilities in each category. With the research completed, a comparative analysis between airborne C4ISR and space capabilities is conducted to help identify important issues, such as operational or technological concerns. When looking at AWACS and space, seven categories are identified for potential space-based capabilities: command and control, training, communications, surveillance, electronic intelligence, mission flexibility/versatility, and global presence.

Joint Publication 1-02 (JP 1-02) defines command and control as "The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission."[12] Command and control is the organizational *process* employed by a designated commander to carry out assigned responsibilities. In the case of AWACS, executing the combatant commander's offensive, defensive, or peacetime air tasking order.

Training is teaching or exercising someone in habits of thought or action in attaining a skill. For the purposes of this paper, AWACS training is focused on the Air Battle Manager career field, although the author does acknowledge the importance of the other crewmembers that make this platform a key element of the Theater Air Control System.

Communications is "A method or means of conveying information of any kind from one person or place to another."[13] For AWACS, communications is the simultaneous voice and data processing and dissemination of real-time theater-level information with decision-makers and warfighters. Another feature is the ability to identify friendly and enemy aircraft.

Surveillance is "The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other

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[12] Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms* (Washington D.C.: Department of Defense, 15 April 1998), 85.
[13] Ibid., 89.

means."[14] AWACS is capable of conducting air and/or maritime "deep look" surveillance on demand instantaneously.

Electronic intelligence is the "Technical and geolocation intelligence derived from foreign non-communications electromagnetic radiations emanating from other than nuclear detonations or radioactive sources."[15] AWACS gains electronic intelligence from onboard electronic support measures and helps build situational awareness by passively detecting, analyzing, classifying, and locating emitters of interest.

Mission flexibility/versatility is the capability for effective reaction to any enemy threat or attack with actions appropriate and adaptable to the circumstances existing at the strategic, operational, and tactical levels of warfare.[16] While managing an area of responsibility or quickly flying to another area in theater, AWACS can perform self-protection by avoiding threats; extend or shorten mission duration; control short-notice add-on aircraft missions; and provide air and/or maritime surveillance, command and control, air battle management, communications, or any combination of the four.

Global presence is the condition of being present anywhere in the world to monitor and react to international situations. Knowing what is transpiring in near real-time is a tremendous advantage for effectively maintaining security.[17] Upon notification, AWACS can quickly respond to a global crisis with E-3s maintaining surveillance or providing combat support in an area of responsibility within 24 hours.[18] An instrument of foreign

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[14] Ibid., 422.

[15] Ibid., 147.

[16] Ibid., 170; Air Force Doctrine Document 1, *Air Force Basic Doctrine* (Maxwell Air Force Base: Doctrine Center, September 1997), 24.

[17] Air University, *Spacecast 2020-Executive Summary* (Maxwell Air Force Base, Alabama: Air University Press, 23 June 1994), 4.

[18] Thomas W. Nine, "The Future of USAF Airborne Warning & Control: A Conceptual Approach" (Maxwell Air Force Base, Alabama: Air Command and Staff College Research Report, 1999), 21.

policy, this internationally recognized symbol signifies national interest wherever deployed.

With the AWACS categories identified and defined, Chapter 2 provides a brief history on the evolution of the AWACS mission followed by a summary of current and future capabilities in each category. Chapter 3 gives a short history of the different sectors in the space community and a synopsis of current and future space capabilities in each category. Chapter 4 is the comparative analysis of each category to help highlight some of the issues concerning the movement of AWACS capabilities to space by the year 2025. This chapter will also attempt to help correct some misperceptions about the air battle manager and space and missile operations career fields. Finally, Chapter 5 summarizes the paper's findings and makes some recommendations for the continued integration of these two warfighters.

Chapter 2

Eyes of the Eagle

> *The massive contribution of the E-3 to* Desert Storm *should have come as no surprise. It had been identified as the most important single air power innovation by Western analysts since its development had revolutionized air warfare two decades previously.*
>
> —Air Vice Marshall Tony Mason, 1994
> Royal Air Force

Introduction

The Airborne Warning and Control System (AWACS) is considered the premier air battle command and control aircraft in the world today.[19] The E-3 Sentry provides all-weather surveillance, command, control, and communications needed by commanders. Allies have been aggressive in procuring this technological marvel. Currently, there are 66 AWACS aircraft worldwide. In addition to the United States' 33 E-3s, the North Atlantic Treaty Organization (NATO) has 17, Saudi Arabia owns 5, United Kingdom purchased 7, France bought 4, and Japan ordered 4 AWACS based on the modified Boeing 767 commercial jetliner.[20] Australia is also buying the 767 AWACS and Turkey is considering its purchase, with future prospects in Italy,

[19] United States Air Force, "Fact Sheet: E-3 Sentry (AWACS)," downloaded from http://www.af.mil/news/factsheets/E_3_Sentry_AWACS_.html, 12 May 2000, 1.

[20] Boeing, "E-3 AWACS in Service Worldwide," downloaded from http://www.boeing.com/defense-space/infoelect/e3awacs/index3.htm, 13 February 2000, 2.

Spain, Israel, and Asia.[21] This demand is not restricted to 767 AWACS, Israel Aircraft Industries is outfitting a Chinese-owned Ilyushin-76 with its advanced Phalcon airborne early warning system.[22] This chapter presents a brief history of the E-3 Sentry followed by current and future AWACS capabilities.

History

To help understand the issues concerning the migration of AWACS capabilities into space, it is important to know the historical evolution of the AWACS mission. Airborne early warning and control aircraft played a vital role in the Air Force since the 1950s. Initially, their role was strategic air defense of the Continental United States. Impressed with the US Navy's modified C-121 Lockheed Super Constellation transport aircraft and its state-of-the-art radar system, the Air Force ordered 142 of these fleet defense aircraft for Air Defense Command in 1951.[23] Designated the EC-121 Warning Star, they began operations in 1953. This radar aircraft was used in several critical areas of the world, to include Korea and Southeast Asia.

In Southeast Asia, Warning Star's role evolved to control of aircraft in the tactical air war over North Vietnam. By extending radar coverage deep into North Vietnam, the EC-121 proved useful for warning pilots of enemy aircraft and controlling intercepts against enemy aircraft.[24] This radar platform assisted in the first air-to-air interception and downing of a North Vietnamese fighter.[25] In addition, the aircraft controlled more than 210,000 aircraft in combat

[21] Robert Wall, "U.S. Surveillance Aircraft to Get Budget Boost," *Aviation Week & Space Technology* 152, no. 5 (31 January 2000): 32.

[22] William A. Orme, Jr., "Deal for Early-Warning Plane Hangs Over Jiang's Arrival in Israel," *New York Times* (13 April 2000).

[23] Mike Hirst, *Airborne Early Warning: Design, Development and Operations* (Over Wallop, Hampshire, United Kingdom: Osprey Publishing Limited, 1983), 65-66.

[24] William M. Momyer, *Air Power in Three Wars* (Maxwell Air Force Base, Alabama: Air University Press, 1978), 151-152.

[25] Vago Muradian, "A Watchful Eye," *Air Force Times* 56, no. 10 (9 October 1995): 13.

operations and helped rescue 80 downed aircrew members.[26] By 1962, Air Defense Command was interested in a more capable airborne warning and control system, but the conflict in Southeast Asia absorbed most of the available resources and the concept was not developed.[27]

Finally in 1966, both Air Defense Command and Tactical Air Command specified a need for a new airborne warning and control system, and the result was the now familiar Boeing E-3 Sentry, more commonly known as AWACS.[28] Synonymous with high operations and personnel tempo since initial operational capability (IOC) in 1978; E-3s flew 24 hours a day, 365 days a year in Saudi Arabia from 1979 to 1989.[29] The Air Force procured 34 of these sophisticated radar aircraft.

During the Gulf War, the AWACS role evolved to air battle management of air assets theater wide and was referred to as the "eyes of the storm."[30] In January and February 1991, E-3s flew more than 400 missions, logged over 5,000 hours in the air, controlled more than 120,000 coalition sorties, and assisted fighters in 38 of 40 air-to-air kills.[31] In addition, Air Force E-3s data-linked with other assets (such as other airborne E-3s; the US Navy Hawkeye; Airborne Battlefield Command and Control Center; Rivet Joint; US Navy warships; Patriot units; and ground radar units) to provide a comprehensive, theater wide three dimensional air surveillance

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[26] A. Joel Champion, Jr., "AWACS and the Programmer/Analyst" (Maxwell Air Force Base, Alabama: Air Command and Staff College Research Paper, 1980), 4.

[27] Robert H. Emmons, "An Analysis of AWACS" (Maxwell Air Force Base, Alabama: Air Command and Staff College Research Paper, 1971), information extracted is unclassified, 2.

[28] Hirst, 101.

[29] Champion, 5; Joseph W. Ralston, quoted in George Wilson "Leaders Heed The AWACS Lesson," *Air Force Times* 58, no. 25 (26 January 1998): 7.

[30] Robert S. Hopkins III, "Ears of the Storm," in Alan D, Campen, ed., *The First Information War: The Story of Communications, Computers and Intelligence Systems in the Persian Gulf War* (Fairfax, Virginia: AFCEA International Press, October 1992), 65.

[31] Muradian, 13.

picture.[32] This information was continuously transmitted to the Commander in Chief, Central Command and his warfighters.

Over the course of United States Air Force (USAF) AWACS history, the mission has evolved from primarily surveillance to that of executing offensive airpower. This was evident in Operation Allied Force, where USAF AWACS were requested to support NATO AWACS in executing the air campaign. According to one senior USAF official, "They [NATO AWACS] didn't do a very good job of vectoring [allied] aircraft," but he said we [United States] may not have done a very good job of training them to apply offensive firepower.[33] NATO AWACS are primarily used for surveillance, hence their NATO Airborne Early Warning designation. USAF AWACS units form air control wings and ABM training is primarily focused on offensive airpower.

Regional commanders in chief are insatiable when asking for AWACS to help them find and monitor the enemy. These requests became louder with the Block 30/35, the largest upgrade in E-3 history. With IOC in 1998, this upgrade included a passive detection system (Electronic Support Measure), Class 2 Joint Tactical Information Data System, increased computer capacity to accommodate current and future enhancements, and a satellite-based Global Positioning System to provide precise navigation. The Radar System Improvement Program (RSIP) increased radar detection range and resolution performance.[34]

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[32] Thomas W. Nine, "The Future of USAF Airborne Warning & Control: A Conceptual Approach" (Maxwell Air Force Base, Alabama: Air Command and Staff College Research Report, 1999), 5.

[33] Bruce D. Nordwall, ed., "The Good, The Bad and The Ugly," *Aviation Week & Space Technology* 151, no. 22 (29 November 1999): 27.

[34] Periscope, "E-3 AWACS (Airborne Warning and Control System) Sentry," *USNI Military Database for Air University*, downloaded from www.periscope.ucg.com/weapons/aircraft/e-r-o/ w0003125.html, 13 December 1999, 4.

An effective foreign policy instrument, AWACS is a symbol of the United States ability and readiness to support allies and oppose adversaries.[35] Affectionately known as "the eyes of the eagle,"[36] United States E-3s have deployed to trouble spots all over the world. A few of the major deployments include Saudi Arabia in 1979 to monitor the border dispute between North and South Yemen. AWACS maintained a presence in Saudi Arabia to deter possible attack from Iran during the Iran-Iraq War. They were sent to Egypt in 1981 after the assassination of President Anwar Sadat due to fears Libya would try to exploit the situation. In 1983, E-3s deployed to Egypt because Egyptian intelligence reported an impending Libyan coup attempt in Sudan and then to Sudan in response to Libyan troops entering Chad.[37] In late 1983, E-3s deployed to Puerto Rico in support of the United States invasion of Grenada. AWACS remained in Saudi Arabia due to the attack on the USS Stark in 1987. They also flew in support of the American operation to capture the Panamanian dictator General Manuel Noriega in 1989. In 1990, AWACS returned to Puerto Rico to conduct anti-narcotic surveillance missions. After just over a year's absence, E-3s also returned to Saudi Arabia in 1990 after Iraq invaded and occupied Kuwait. They also deployed to Turkey in 1991 in support of operations against Northern Iraq. In 1994, AWACS flew missions in support of the reinstatement of Jean-Bertrande Aristide as president of Haiti.[38] Finally in 1999, United States E-3s 's flew support missions during the war in Kosovo. Performing as an instrument of statecraft, this high demand for a very limited number of AWACS significantly increased the operations and personnel tempos of this platform.

[35] John K. Allen, Jr., "AWACS Diplomacy" (Maxwell Air Force Base, Alabama: Air War College Research Paper, 1985), iii.

[36] The "eyes" is the AWACS radar and the "eagle" refers to the bald eagle, a national symbol of the United States.

[37] Allen, 1, 4-11.

[38] Martin Streetly, ed., "Boeing E-3 Sentry," *Jane's Airborne Electronic Mission Systems* (Alexandria, VA: Jane's Information Group Inc., 1998). 7-10.

In 1999, the Air Force chief of staff said "Today we [Air Force] are performing more missions with fewer people. In the past decade, deployments have increased 400 percent while manpower was reduced by 40 percent."[39] The previous year, the Air Force unveiled the Expeditionary Aerospace Force (EAF) concept to help reduce operations and personnel tempos.[40] EAF's objective is to enhance the operational capabilities provided to the warfighting commanders in chief and sustain a viable force in the future.[41] To reduce operations tempo, the EAF force structure will consist of 10 aerospace expeditionary forces (AEF) on call for deployment during a 90-day window every 15 months. Certain assets, such as AWACS, are not assigned to AEFs because they continue to be tapped for every deployment. These assets are identified as high demand/low density assets because there is a high demand for their capability, but not enough assets for each AEF. Until AEFs mature, two aerospace expeditionary wings will alternate every 90 days to provide rapid force projection for global crises, which could include additional AWACS.[42] Because the stress on high demand/low density units is so great, the secretary of defense must personally authorize their deployment beyond 120 days a year.[43]

The Expeditionary Aerospace Force concept hopes to relieve tempo concerns associated with deployment commitments by spreading the load across the total force (i.e. active duty, Air National Guard, and Air Force Reserve), increasing the number of airmen assigned to specialties that deploy frequently, and making deployment schedules more routine and predictable.[44] According to Mark Gebicke, director of military operations and capabilities issues at the General

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[39] Michael E. Ryan, quoted in "Expanded Expeditionary Aerospace Force (EAF) Guidance to Supplement the FY00 Force Structure Announcement (4 March 1999)," downloaded from eaf.dtic.mil/ eafpag399.html, 3 December 1999, 3.

[40] Jennifer Palmer, "AEF's Debut Leaves Members on the Edge," *Air Force Times* 59, no. 19 (14 December 1998): 26.

[41] Expeditionary Air Force, "Expeditionary Aerospace Force (EAF) Roadmap," downloaded from eaf.dtic.mil/eafroadm699.html, 3 December 1999, 2.

[42] "EAF, Force Structure Changes Announced," *Airman* 43, no. 4 (April 1999): 10.

[43] Katherine McIntire Peters, "Flight Check," *Government Executive* 31, no. 6 (6 June 1999): 50.

Accounting Office, the single change that would encourage Air Force aviators to stay in the military was a relaxation of their deployment schedules.[45] Colonel Robert Elder, assistant director of operations at Air Combat Command, believes the EAF plan will reduce the average deployment for airmen from 120 to 90 days.[46]

But the Expeditionary Aerospace Force concept has not resolved the AWACS personnel tempo problem. Unpredictable schedules and increasing temporary deployment rates triggered a 23 percent exodus of the air battle managers (ABM) in 1992. By October 1994, there were supposed to be 42 aircrews, but only 27 were available. The personnel tempo of AWACS crews at Tinker Air Force Base, Oklahoma in 1994 averaged 166 days deployed, with many gone close to 200 days. Finally, the secretary of defense mandated the qualifying of 40 aircrews (reduced from 42 aircrews after the crash of an E-3 at Elmendorf Air Force Base, Alaska) by 31 December 1995 to reduce deployment rates of overtaxed crews of AWACS to 120 days per year.[47] For fiscal year 1999, overall AWACS aircrew temporary deployment rates at Tinker Air Force Base were under 120 days, but three ABM aircrew positions exceeded this goal, with one of them still gone over 150 days.[48]

With more than 70 percent of the career field assigned to aircraft, primarily AWACS and Joint Surveillance Target Attack Radar System (JSTARS), the Air Force hopes the 1 October 1999 rating of the career field will attract and retain air battle managers.[49] For the past eight

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[44] F. Whitten Peters, "We Don't Want to Lose You," *Air Force Times* 59, no. 15 (16 November 1998): 31.

[45] Mark Gebicke, quoted in Katherine McIntire Peters, "Flight Check," *Government Executive* 31, no. 6 (June 1999): 48.

[46] Robert Elder, cited by Katherine McIntire Peters, "Flight Check," *Government Executive* 31, no. 6 (June 1999): 48.

[47] Steven Watkins, "AWACS Relief in Sight," *Air Force Times* 55, no. 33 (20 March 1995): 4-5.

[48] Paul T. Taylor, 552d Operations Support Squadron/Analysis, telephone interview by author, 22 May 2000.

[49] Jennifer Palmer, "Air Battle Managers Get Rated Status," *Air Force Times* 60, no. 11 (18 October 1999): 35.

years, the number of ABMs separating form the Air Force has exceeded accessions.[50] Transferring experienced AWACS ABMs to stand up another high demand/low density asset, the JSTARS wing, further compounded the AWACS problem. Since 1995, programs such as voluntary recall and continuation offers have not proved lucrative in retaining experienced ABMs.[51] Currently the ABM career field remains critically manned at 74 percent and cannot afford another significant loss of highly skilled personnel.[52] The Expeditionary Aerospace Force concept is still evolving and will take several years to mature, but space provides an alternative that could help to reduce AWACS operational and personnel tempo.

AWACS Capabilities

The E-3 Sentry is a modified Boeing 707/320 commercial airframe with a rotating radar dome. With IOC in 1978, high mission tasking for USAF AWACS over the past 20 years has made the E-3 older than the B-52 and KC-135 fleets in airframe hours. The Extend Sentry Program prolongs the life of the AWACS fleet through the year 2035 to meet immediate Air Force sustainment needs, as well as future performance and mission requirements.[53] Block 30/35 was IOC in 1998, and the estimated completion date for the entire fleet is 2001.[54] RSIP modifications are scheduled for completion in 2005. Presently, the Air Force is discussing Block 40/45 modifications and possible upgrades include increased computer capabilities, multi-source integration, digital communication, data-link infrastructure, and means to receive automated air

[50] Air Force Personnel Center, "Air Battle Management News," downloaded from afas.afpc.randolph.af.mil/abm, 30 November 1999, 1.
[51] Jennifer Palmer, "Gone and Soon Forgotten? Few Former Fliers Wooed Back to Service," *Air Force Times* 59, no. 52 (2 August 1999): 16.
[52] Ibid., 16.
[53] Bart Dannels, "AWACS' Mission Challenges Executive Summary," Staff Briefing, December 1997, 13.
[54] 552d Air Control Wing, "E-3 Airborne Warning and Control System," downloaded from http://www.awacs.af.mil/552acw/acw/E3awacs.htm, 13 February 2000, 2.

tasking orders.[55] Current estimated cost of each AWACS is approximately $270 million, which places the fleet value close to $9 billion for 33 E-3s.[56]

Command and Control

The United States Air Force has five operational AWACS squadrons and their organizational structure is dependent on location. The 961st Airborne Air Control Squadron (AACS) at Kadena Air Force Base (AFB), Japan and the 962d AACS at Elmendorf AFB, Alaska are assigned to Pacific Command. The commander-in-chief of Pacific Command has combatant command (COCOM) of these assets. COCOM is the authority to perform those functions of command over assigned forces to accomplish the missions assigned to the command. COCOM is vested only with commanders of combatant commands or as directed by the president in the Unified Command Plan and cannot be delegated or transferred.[57] Interestingly, Pacific Command is the only combatant command with permanently assigned E-3s.

The 963d, 964th, and 965th AACS are located at Tinker AFB, Oklahoma and assigned to Air Combat Command. A major command, Air Combat Command is the primary provider of air combat forces to America's geographic combatant commands. When directed by the national command authority, combatant commanders are given COCOM over AWACS deployed to their area of responsibility. Operational control (OPCON) is inherent with COCOM and is the authority to perform functions of command over subordinate commands to accomplish the mission.[58] OPCON of AWACS can be transferred to any commander below the level of combatant command. Tactical control (TACON) is inherent with OPCON and is the detailed

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[55] Donald M. Gricol, Sencom Corporation/Operations Analyst with 552d Air Control Wing/Requirements, telephone interview by author, 19 May 2000.

[56] 552d Air Control Wing, "E-3 Airborne Warning and Control System," 3.

[57] Joint Publication 0-2, *Unified Action Armed Forces (UNAAF)* (Washington D.C.: Department of Defense, 24 February 1995), xi-xii.

and usually local direction and control of movements or maneuvers necessary to accomplish assigned missions or tasks. TACON may be delegated to any commander below the level of combatant command.[59]

The importance of these relationships is that warfighters can be given direct command authority over AWACS in the execution of their assigned missions, whether at the theater level or tactical level. The geographic combatant commander has COCOM, while the air component commander has OPCON, and the commander executing the mission exercises TACON. The advantage of direct control of an asset with multiple capabilities is fewer requests for other assets and less coordination time for mission execution or changes to mission requirements.

Training

The air battle manager is the focal point for executing the various AWACS missions. The basic ABM course is over eight months and is the longest non-flying course in the Air Force, which illustrates the complexity of mastering this specialty. The first block encompasses Air Force warfighting doctrine and its application in the realm of command and control. Blocks II and III cover basic radar theory and electronic warfare principles. Bock IV introduces the various surveillance systems of the Air Force and their respective characteristics. Blocks V and VI comprise the majority of the course and focus on the tasks of the weapons director. Here the student controls both simulated and live aircraft intercepts. Live training begins with the Mu-2 aircraft and builds to high performance air combat training with F-15s and visiting aircraft. Ultimately, the students learn to integrate and apply their knowledge in Blocks VII through IX. These final blocks deal with mission planning and execution in a joint force environment. The

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[58] Ibid., xii.
[59] Ibid., xii.

students participate in numerous simulated exercises to expose them to the dynamic world of air battle management.[60]

Upon graduation, students have the knowledge and skills necessary to perform duties as air battle managers. The core competencies include positioning aircraft for visual identification or missile engagements; being familiar with combat air force and threat aircraft capabilities and employment; and understanding the capabilities and limitations of each element of the Theater Air Control System, as well as the various C4ISR support elements. In addition, ABMs are familiar with composite force employment; understand and interpret the air tasking order; and have a basic understanding of data-link and communications fundamentals, to include building the required architecture. Finally, the graduate must understand basic Air Force doctrine and the importance of joint doctrine as it pertains to the integration of air forces with sister services and multinational coalitions.[61]

ABMs assigned to AWACS replacement training units (RTU) qualify in one of five mission crew disciplines based on experience level: mission crew commander (MCC), air surveillance officer (ASO), electronic combat officer (ECO), senior director (SD), or air weapons officer (AWO). Typically, the first two to three months of RTU consists of academics and simulation training to familiarize students with AWACS equipment, followed by two to three months of live flying to develop aircrew coordination. The MCC is responsible for orchestrating the safe execution of the AWACS mission. The ASO optimizes the radar and supervises the surveillance section. Coordinating with outside sources of information and electronic intelligence support from the ECO, the surveillance section identifies all airborne objects within their coverage. In

[60] 325th Training Squadron, "Air Battle Manager Course," downloaded from http://325trs.tyndall.af.mil/ABM1.htm, 13 December 1999, 1.

[61] Air Education and Training Command, "Air Battle Manager Training Course Syllabus W-MCE-13B1D" (Tyndall Air Force Base, Florida: 325th Training Squadron, August 1999), 1-2.

addition, the ASO is responsible for the data-links transmitting this air/maritime picture to other aircraft, ships, and/or ground units. The SD manages the weapons section, which includes AWOs, who control military aircraft tasked for air-to-air intercepts, air-to-ground strike attacks, refueling, combat search and rescue, as well as a host of other missions. Together, the mission crew is the "heart and soul" of this platform and is why this asset is valuable to decision-makers and warfighters.

A few highly qualified ABMs will attend the six-month United States Air Force Weapons School Command and Control Operations course. This advanced training develops expertise in E-3 radar and employment, electronic warfare, tactical digital information link, joint theater air control systems, ground theater air control systems, integrated air defense systems, suppression of enemy air defense, as well as friendly and enemy aircraft and munitions. The ABM refine their air battle management skills with live flying scenarios focusing on tactical intercepts, defensive counter air, offensive counter air, strike forces, force management, composite strike forces, and area defense. The graduate is an expert in theater air control systems, weapons, weapons related systems, tactics, and prepared to act as the technical advisor at the headquarters, wing, and squadron levels.[62]

Communications

One of its strengths, the AWACS communications suite offers the ABM a wide spectrum of capabilities to receive and disseminate information with higher headquarters, other aircraft, ground units, and ships. This platform has 24 radios to accomplish the AWACS mission. Communications include three high frequency, four very high frequency, and 17 ultra high

[62] Air Combat Commad, "USAF Weapons Instructor Course—Senior Director Course Syllabus 13B3B/C/DIDOZN." (Nellis Air Force Base, Nevada: United States Air Force Weapons School, draft copy, January 2000), 5-6, 10-11, 32-44.

frequency (UHF) radios.[63] Twelve radios are securable and include two UHF satellite communications links. The line-of-sight UHF radios have provisions for four "Have Quick" anti-jamming circuitry.[64]

Data-links include Class 2 Joint Tactical Information Distribution System (JTIDS), or Link 16; Tactical Digital Link (TADIL)-A, or Link 11; and TADIL-C, or Link 4. JTIDS is a secure, anti-jam resistant communication for information distribution, position location, and identification capabilities. TADIL-A exchanges digital information among airborne, ground-based, and shipboard systems. TADIL-C is a data-link used for air-to-air control tasks.[65]

The Broadcast Intelligence Terminal allows AWACS to receive tactical intelligence broadcast system (TIBS) data.[66] One of the most prolific producers of information, TIBS is a theater ultra-high frequency satellite or line-of-sight or satellite communications network. [67] This network uses dynamic time division multiple access protocol to provides a near real-time, multi-sensor, multi-source situational awareness and threat warning to the warfighter. The primary function of TIBS is to provide near real-time tactical information to the battle commanders for targeting, battle management, and situational awareness.[68]

The capability to distinguish friendly and enemy aircraft is essential for the ABM to manage theater-level air operations. The Telephonics AN/APX-103 Identification Friend-or-Foe/Selective Identification Feature (IFF/SIF) offers instantaneous readout on the range,

[63] Thomas A. Tassinari and Timothy A. Nollen, Communications System Operator Training Manager and Communications Technician Training Manager with 552d Operations Support Squadron/Training, telephone interview by author, 12 June 2000.

[64] Shirley S. Godsil, Sencom Corporation/Operations Analyst with 552d Air Control Wing/Requirements, telephone interview by author, 12 June 2000.

[65] Streetly, 1-3.

[66] Assistant Secretary of the Air Force (Acquisition), "AWACS Broadcast Intelligence (BI) Terminal Program," downloaded from http://www.safaq.hq.af.mil/acq_ref/stories/awacsbi.html, 3 February 2000, 1.

[67] James W. McLendon, "Information Warfare: Impacts and Concerns," in Barry R. Schneider and Lawrence E. Grinter, eds., *Battlefield of the Future* (Maxwell Air Force Base, Alabama: Air University Press, 1998), 186-187.

azimuth, elevation, code identification and friend or foe status of all targets within the radar surveillance volume.[69] Together, these AWACS communications systems provide near real-time information that can be fused into the air picture that allows warfighters to visualize the air war.

Surveillance

AWACS' capability to "look deep" and extend surveillance coverage beyond the range of surface-based radar units provides commanders early warning. The aircraft's profile is dominated by the 30-foot diameter and 11,800 pound rotodome that houses a Westinghouse AN/APY-2 slotted, phased-array radar. The air surveillance officer onboard the E-3 optimizes the radar, which has a 360-degree view, and can detect and track both air and sea targets simultaneously. With six operating modes, the air moving target indicator (AMTI) radar has a range of more than 200 miles for low flying targets and farther for targets at medium and high altitudes. It can look down to detect, identify and track low flying aircraft by eliminating ground clutter returns that confuse other radar systems.[70] The Radar System Improvement Program upgrade increased detection ranges and resolution, as well as improves reliability 10-fold.[71]

Electronic Intelligence

Block 30/35 introduced a Boeing AN/AYR-2 airborne Electronic Support Measure system that passively detects, analyzes, classifies, and fixes air and surface-based emitters of interest. Emitters such as radar and communications transmissions produce energy that can be intercepted. Using an extensive computer database, this system correlates specific data about the

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[68] Theater Air Command and Control Simulation Facility, "Tactical Information Broadcast System (TIBS) Terminal Simulator," downloaded from http://www.taccsf.kirtland.af.mil/webnodes/tibs.html, 19 May 2000, 1.

[69] Streetly, 1.

[70] 552d Air Control Wing, "E-3 Airborne Warning and Control System," 1.

[71] Periscope, "E-3 AWACS (Airborne Warning and Control System) Sentry," *USNI Military Database for Air University*, downloaded from www.periscope.ucg.com/weapons/aircraft/e-r-o/ w0003125.html, 13 December 1999, 4.

target, such as aircraft or radar type. The electronic combat officer onboard the E-3 optimizes this system, coordinate with other units to validate emitters of interest before disseminating the information to the mission crew and external agencies, and fuse this information into the air picture. This new system helps the ABM build theater-level situational awareness both inside and outside the aircraft.[72]

Mission Flexibility/Versatility. History has proven the E-3 Sentry can respond quickly and effectively to a crisis and support worldwide military deployment operations. Its jam-resistant systems have performed its mission despite experiencing heavy electronic countermeasures. With its mobility as an airborne warning control system, the Sentry has a greater chance of surviving in warfare than a fixed radar system. The E-3's flight path can be changed quickly according to mission and survival requirements. With a mission profile of more than 11 hours without refueling, the E-3's range and on-station time can be increased through in-flight refueling.[73] A force multiplier, AWACS provides the commander a wide range of employment options (air/maritime surveillance, identification, weapons control, air battle management, and communications anywhere, anytime, at his discretion). This "all-under-one-roof" capability is desired by commanders and makes this platform a high demand/low density asset

Global Presence

Although no global air surveillance system presently exists, John K. Allen's Air War College research report "AWACS Diplomacy" highlights the power projection capability of this aircraft. Symbols of national sovereignty, E-3s demonstrate United States interest in an area and

[72] Rich Brannon, "AWACS Electronic Support Measures for the Five Pound Cranium," in *MCC WSAT Newsletter*, *WSAT 00-3* (Tinker Air Force Base, Oklahoma: 552d Operations Support Squadron, April 2000), 6-8.

[73] 552d Air Control Wing, "E-3 Airborne Warning and Control System," 3.

readiness to support allies against potential threats.[74] Frequently, the first airborne asset requested by geographic combatant commanders and the last to leave, AWACS could be in-theater providing surveillance and/or combat support within 24 hours after notification.[75] As a high demand/low density asset, this tendency for commanders to lean forward has to be tempered to keep AWACS operations and personnel tempo under control.

Conclusion

To help understand the issues of moving AWACS capabilities to space, this chapter provided a brief history of evolution of the E-3 mission, followed by a summary of current and future capabilities in each of the framework's categories. A workhorse for over twenty years, the E-3 is older than the B-52 and KC-135 fleets in airframe hours. The Extend Sentry Program, Block 30/35, and RSIP will keep AWACS airborne until 2035, but will it be technologically obsolete by then? Given the fact there are no plans to procure more AWACS and the demand for information superiority increases, how can space duplicate AWACS capabilities in support of decision-makers and warfighters? The next chapter will give a short history of the different sectors in the space community and a synopsis of current and future space capabilities in each category.

[74] Allen, 1, 13.
[75] Nine, 21.

Chapter 3

Above and Beyond

> *Throughout military history, command of the high ground, first on the land and then in the air, had been a prelude to victory on the battlefield. Desert Storm has taught us that, hereafter, victory will smile on the nation that commands the ultimate high ground—space.*
>
> —General Charles A. Horner, 1993
> Commander, USSPACECOM

Introduction

The United States Space Command's (USSPACECOM) *Long Range Plan* and Air Force Space Command's (AFSPC) *Strategic Master Plan* attempt to capture the best ideas from the civil, commercial, international, and military space sectors. Published in 1998, the *Long Range Plan* was the first document that provided a comprehensive roadmap for achieving USSAPCECOM's vision for 2020: "**Dominating** the space dimension of military operations to protect US interests and investment. **Integrating** Space Forces into warfighting capabilities across the full spectrum of conflict."[76] In 2000, AFSPC released their *Strategic Master Plan* that documented a 25-year path to the future—"A globally integrated aerospace force providing continuous deterrence and prompt engagement for America and its allies—through control and exploitation of space

[76] United States Space Command, *Long Range Plan: Implementing USSPACECOM Vision for 2020* (Peterson Air Force Base, Colorado: United States Space Command, 1998), 10. Emphasis in original.

and information."[77] This vision for 2025 leads to an aerospace force capable of changing the course of events in hours, minutes, and even seconds to achieve full spectrum dominance. This chapter presents a brief history on the evolution of the space community and then identifies current and projected space capabilities in each of the AWACS categories.

History

In a time of continued budget constraints, leveraging partnerships between space sectors to share insights and technology efforts can potentially reduce costs. The *Long Range Plan* describes how global partnerships will augment military's space capabilities and is a fundamental change in space operations.[78] Because space systems are growing beyond what one organization or service can afford, one of the four supporting pillars to successfully implement the *Strategic Master Plan* is establishing and maintaining key partnerships.[79] But some functions are not amenable to commercialization, such as missile warning, signals intelligence, certain surveillance functions integrated into weapon systems, "heroically-survivable" assured communications, and space weapons.[80] Although most United States Government documents list three rather than four space sectors, the White House's Fact Sheet on National Space Policy described the important contributions of four sectors: civil, commercial, intelligence, and military.[81]

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[77] Air Force Space Command, *Strategic Master Plan for FY02 and Beyond* (9 February 2000), downloaded from http://www.spacecom.af.mil/hqafspc/library/AFSPCPAOffice/2000smp.html, 11 May 2000, Executive Summary.

[78] *Long Range Plan*, 13.

[79] *Strategic Master Plan*, Chapter 7.

[80] Thomas S. Moorman, Jr., "The Explosion of Commercial Space and the Implications for National Security," *Airpower Journal* 13, no. 1 (Spring 1999): 8.

[81] Peter L. Hays, James M. Smith, Alan R. Van Tassel, and Guy M. Walsh, "Spacepower for a New Millennium: Examining Current U.S. Capabilities and Policies," in Peter Hays, et al., eds., *Spacepower for a New Millennium: Space and U.S. National Security* (New York: McGraw-Hill, forthcoming), 2.

Civil

When people think of space, the National Aeronautics and Space Administration (NASA) immediately comes to mind. NASA was created in July 1958, dividing the civilian and military sectors of space. Funded by the government, the organization established a policy devoted to the "peaceful exploration of space for all mankind."[82] Examples include human spaceflight missions like Space Shuttle and the International Space Station; exploration programs such as Voyager, Galileo, and Mars Pathfinder; and scientific missions of the Earth Observation System and Landsat programs.

One on-going problem for all space systems is lift. Limited spacelift and cost ($10,000 per pound to orbit and up) created a need for cheaper capabilities.[83] NASA is the lead agency for the development of the next generation of Reusable Launch Vehicles (RLV) such as "Venture Star." Venture Star is a single-stage-to-orbit RLV that may dramatically increase reliability and lower the cost of putting a pound of payload into space from $10,000 to $1,000.[84] NASA's plan for beyond the Space Shuttle and the next generation RLV is the Advanced Space Transportation Program. This earth-to-orbit transportation will significantly reduce launch costs.[85]

Commercial

The explosion of commercial space probably holds more implications for military space than any other single event. This sector began in the early 1960s with the launch of the first communications satellite and has become the largest sector within the space

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[82] Moorman, 8.
[83] "Space Lift," *Air Power Journal* 9, no. 2 (Summer 1995): 62.
[84] National Aeronautics and Space Administration, "X-33: Reusable Launch Vehicle: Space Transportation," downloaded from http://x33.msfc.nasa.gov/index.html, 11 May 2000, 1.
[85] National Aeronautics and Space Administration, "Advanced Space Transportation Program," downloaded from http://stp.msfc.nasa.gov/astp/astpindex.html, 11 May 2000, 1.

community. Space communications proved an attractive venture and forms the oldest and most profitable segment of this sector. Navigation (Global Positioning System), space launch (France's Ariane rockets), and remote sensing (France's Satellite Pour l'Observation de la Terre, or SPOT, system) are three other segments of the commercial space sector that are rapidly growing.[86]

Intelligence

The successful integration of space systems during the Desert Storm and declassification of the National Reconnaissance Office's (NRO) existence in 1992 had far reaching effects on this organization. Desert Storm has been called the "first space war" because communications, navigation, weather, missile early warning, and reconnaissance satellites proved indispensable to the final success of combat operations.[87] Competing with other Department of Defense (DoD) organizations for limited funds, the NRO has begun to support the warfighter in addition to the president of the United States, national command authority, and intelligence community.

Established as a separate operating agency in 1961, the NRO is the smallest, most heavily financed, and most secret—the blackest—organization in this sector. The NRO brought together the Central Intelligence Agency and military in the procurement and operations of the overhead reconnaissance.[88] As the space-based "eyes and ears" of the United States, the NRO designs, builds, and operates space surveillance and reconnaissance systems needed to support national security interests. These satellites

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[86] Hays et al., 13.

[87] Curtis Peebles, *High Frontier: The United States Air Force and the Military Space Program* (Washington D.C.: Air Force History and Museums Program, 1997), 73.

[88] William E. Burrows, "Satellite Reconnaissance," in James E Dillard and Walter T. Hitchcock, eds. *The Intelligence Revolution and Modern Warfare* (Chicago, Illinois: Imprint Publications, 1996), 189-190.

include imaging platforms, signal intelligence satellites, radar ferrets, ocean reconnaissance satellites, and radar reconnaissance satellites.[89]

On 17 June 1998, the NRO and the Naval Research Laboratory (NRL) declassified the world's first operational signals intelligence satellite, called Galactic Radiation and Background (GRAB). This program received formal approval from President Eisenhower in 1959. Launched in 1960, the satellite was developed and operated by the NRL. GRAB's official scientific mission was to study X-rays produced by the sun, while its classified mission was to collect electronic intelligence, primarily on Soviet air defense radars.[90]

The GRAB program provided military planners with new intelligence that located and characterized Soviet radars. But due to the sensitivity of intelligence missions, tight control of these satellites became an issue. Secretary of Defense Robert McNamara eventually transferred all Navy satellite intelligence programs to the NRO in 1962, and GRAB was one of the projects given to this new, highly secret agency.

While the NRO is still an extremely secretive organization, many barriers are beginning to slowly come down. The NRO currently works closely with AFPC and NASA through the AFSPC-NRO-NASA Partnership Council for more efficient uses of resources to field advance systems for theater CINC battlespace situational awareness requirements. This cooperation has already benefited the Discoverer II program, a space-based ground moving target indicator radar system.[91]

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[89] Ibid., 189.

[90] Dwayne A. Day, "Listening from Above: The First Signals Intelligence Satellite," *Spaceflight* 41, no. 8 (August 1999): 339-342.

[91] Keith R. Hall, "Presentation to the United States Senate Committee on Armed Services Subcommittee on Strategic Forces," downloaded from http://www.nro.odci.gov/speeches/sppo3-8.html, 11 May 2000, 8.

Military

The remaining national security missions comprise the military space sector. USSPACECOM was established in 1985 and added a bureaucratic layer that sometimes complicates organizational loyalties and military thinking about space.[92] The commander-in-chief of USSPACECOM is triple-hatted: he is also the commander of AFSPC and the North American Aerospace Defense Command. USSPACECOM is responsible for placing all DoD satellites into space, operating them, and providing support to unified commands with satellite communications, navigation information, and theater ballistic missile attack warning. He is also responsible for the nation's Intercontinental Ballistic Missile (ICBM) fleet.[93]

A functional combatant command, USSPACECOM is the single focal point for military space operations in the Unified Command Plan. Components include Army Space Command (ARSPACE), Naval Space Command (NAVSPACE), and Air Force Space Command AFSPACE). ARSPACE was established in 1988 and is responsible for integrating state-of-the-art space and national missile defense capabilities, operations, and expertise to deliver decisive combat power.[94] NAVSPACE was commissioned in 1983 and is responsible for providing essential information and capabilities to naval forces ashore and afloat.[95]

Although the Air Force is not the official custodian of USSPACECOM, AFSPACE comprises the largest segment: 90 percent of the personnel, 85 percent of the budget, 86

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[92] Hays et al., 12.

[93] Tamar A. Mehuron, "Space Almanac," *Air Force Magazine* 80, no. 8 (August 1997), 34.

[94] Army Space Command, "A Quick Look at U.S. Army Space Command," downloaded from http://www.spacecom.af.mil/usspace/army-fs.htm, 11 May 2000, 1.

[95] Naval Space Command, "Naval Space Command," downloaded from http://www.spacecom.af.mil/usspace/navspace.htm, 11 May 2000, 1.

percent of the assets, and 90 percent of the infrastructure.[96] AFSPACE makes space reliable for the warfighter by continuously improving the command's ability to provide support combat forces—assuring their access to space. In addition, the command's ICBM forces deter any adversary contemplating the use of weapons of mass destruction. AFSPACE has four primary mission areas: space forces support, space control, force enhancement, and force application.

AFSPACE supports these missions in variety of ways. Spacelift operations at the East and West Coast launch bases provide services, facilities, and range safety control for the conduct of DoD, NASA, and commercial launches. Satellite operators provide force-multiplying effects through command and control of all DoD satellites. Satellites provide essential in-theater secure communications, weather, navigation, and threat warning. Space warning monitors ballistic missile launches around the world to guard against a surprise attack on North America using ground-based radars and Defense Support Program satellites. Space surveillance radars provide vital information on the location of satellites and space debris for the nation and the world. The ICBM force plays a critical role in maintaining world peace and ensuring the nation's safety and security.[97]

Also looking for ways to reduce future launch costs, the Air Force envisions robust and responsive spacelift capabilities by 2025. The Evolved Expendable Launch Vehicle (EELV) will reduce the cost of launching by at least 25 percent over current Delta, Atlas,

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[96] Department of the Air Force, *The Aerospace Force: Defending America in the 21st Century…a white paper on aerospace integration* (Washington D.C.: Department of the Air Force, 2000), 5.

[97] Air Force Space Command, "Fact Sheet: Air Force Space Command," downloaded from http://www.af.mil/ news/factsheet/Air_Force_ Space_Command.html, 12 February 2000, 1-3.

and Titan launch systems.[98] The Air Force is also looking at buying launch services rather than the launchers themselves as it has done in the past.[99]

Space Capabilities

USSPACECOM's and AFSPC's vision for moving AWACS capabilities to space is dependent on the maturation of critical and enabling technologies. *Joint Vision 2010* is heavily dependent on aerospace power technological innovations to achieve information superiority and full spectrum dominance. But the Air Force cannot develop all the needed technologies by itself because funding remains the biggest challenge. Focusing on military specific research, it becomes imperative to exploit advancements in all sectors to meet this challenge.

Command and Control. The organizational structure of AFSPC and the NRO requires regional commanders to use space-based assets that they do not have operational or tactical control over. Established in 1982, AFSPC is an Air Force major command headquartered at Peterson Air Force Base (AFB), Colorado. AFSPC has two numbered air forces. 14th Air Force (AF) is located at Vandenberg AFB, California and provides space warfighting forces to support USSPACECOM and NORAD operational plans and missions. The commander of 14th AF is also the Air Force space (AFSPACE) component commander to USSPACECOM and has operational control (OPCON) over Air Force component forces to execute assigned missions.[100] The AFSPACE Aerospace Operations Center (AOC) monitors, plans, and executes space force missions to exploit space for

[98] United States Air Force, "Fact Sheet: Evolved Expendable Launch Vehicle," downloaded from http://www.laafb.af.mil/SMC/PA/Fact_Sheets/eelv_fs.htm, 11 May 2000, 1.
[99] USSPACECOM/AFSPC Legislative Update (13 January 2000), "EELV, SATCOM Face Adjustments," 4.
[100] 14th Air Force, "14th Air Force Organizations," downloaded from http://www.vafb.af.mil/organizations/ 14af/operations/operations.htm, 11 May 2000, 1-2.

USCINCSPACE and theater components worldwide. This AOC represents an in-place counterpart to the theater Air Operations Center and provides reachback space operations support to theater operations by fusing intelligence, combat planning, combat operations, and battle staff functions.[101]

14th AF has four wings that have tactical control (TACON) over the weapons systems assigned to it.[102] Two wings, the 30th Space Wing (SW) at Vandenberg AFB and 45th SW at Patrick AFB and Cape Canaveral Air Force Station on Florida's East Coast are responsible for range and launch operations.[103]

21st SW is located at Peterson AFB and operates a global network of missile warning sensors including tactical monitoring and attack assessment of sea-launched and ICBM attacks against the United States. They also operate the world's only global space surveillance network providing data on man-made objects in space.[104]

The last wing under 14th AF is the 50th SW located at Schriever AFB, Colorado and conducts satellite operations. Its space operators track and control the various weather, warning, communications, and navigation satellites. They also operate their payloads and disseminate data from them. With ground-based radars and deep space-looking optical sensors located at 25 different locales globally, the 50th SW ensures the various constellations provide continuous information to the warfighter.[105]

20th AF operates and maintains AFSPC's ICBM weapon systems in support of the United States Strategic Command war plans.[106] The 20th AF Missile Operations Center

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[101] *Strategic Master Plan*, Chapter 3.
[102] 14th Air Force, "14th Air Force Organizations," 3.
[103] Air Force Space Command, "14th Air Force" downloaded from http://spacecom.af.mil/hqafspc/library/facts/ site_desc.htm, 13 December 1999, 1.
[104] Ibid., 1.
[105] Ibid., 1.
[106] Air Force Space Command, "Fact Sheet: Air Force Space Command," 2.

provides the capability to command, control, and monitor all ICBM forces. It supports United States Transportation Command's operational control of all alert ICBM forces and provides non-alert ICBM forces for AFSPC.[107]

The NRO is a separate operating agency of the Department of Defense and is responsible for the operation of space surveillance and reconnaissance systems needed to support national security interests. The assistant secretary of the Air Force (space) is also the director of the NRO. The director of Central Intelligence establishes the NRO's collection priorities and requirements. Both the director and deputy director are normally civilians who serve at the discretion of the president, effectively shutting out decision-making by career military officers at the agency's highest level.[108]

Training. The military and intelligence space sectors do not have a specialty similar to an AWACS air battle manager (ABM). Space and missile operations (SMO) execute the AFSPC mission, which is primarily operation of military satellites. SMOs first attend the Officer Space Prerequisite Training course, formerly known as Undergraduate Space and Missile Training. This two-month course prepares officers for a career in space and missile operations. The curriculum is divided into six blocks of instruction: Space Program Overview, Space Fundamentals, Spacelift, Satellite Operations, Missile Operations, and Sensor Operations.[109] Of these six training blocks, the Optics and Sensors Fundamentals class in the Sensors Operations block had some similarity to the ABM's academic training on the principles of radar and electronic attack/electronic protect.

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[107] *Strategic Master Plan*, Chapter 3.
[108] Burrows, 190.

Upon graduation, SMOs will specialize in one of five disciplines: space surveillance (surveillance of space), space warning (Defense Support Program), satellite command and control, spacelift, or ICBM force. Space surveillance and space warning officers are qualified in electronic, infrared, optical sensor operations; orbital analysis; and characteristics, tracking, ballistic missile trajectories, space surveillance, and space warning systems. Satellite command and control is concerned with launch systems and the on-orbit maintenance of satellites. Spacelift deals with spacecraft systems operations, booster and payload processing, range control and safety applications, and launch processing and solid or liquid rocket performance. The ICBM force is trained in missile combat crew procedures; fundamentals of electricity and electronics; and the principles of aerodynamics, missile guidance systems, power plants, and related components.[110] Of these five disciplines, only space surveillance and space warning had a few courses similar to ABM classes for air surveillance officer (ASO) and electronic combat officer (ECO) training, and none for senior directors (SD) or air weapons officers (AWO) whose core competency is controlling military aircraft in the employment of aerospace power.

A few highly qualified SMOs will attend the United States Air Force Weapons School Space Division course for six months. This intensive graduate-level space operations course produces graduates with the knowledge and skills necessary to provide expert advice on space related plans, applications, and issues at unified commands and numbered air forces. The graduate is the technical advisor to the respective commander on space system employment, friendly and adversary space capabilities and tactics

[109] Air Education and Training Command, "Officer Space Prerequisite Training Course Summary V3OQR13S1-000" (Vandenberg Air Force Base, California: 392d Training Squadron, draft copy, January 2000), 1-2.

matters, and air operations center operations. Interestingly, experience in satellite command and control, space surveillance, or space warning was deemed highly desirable.[111] The Space Division and ABM counterpart, the Command and Control Division, have a number of similar classes, but they are primarily about combat planning factors for employing the different aerospace assets and enemy threats.

NRO personnel are generally technical and scientific in training and experience. Some of the occupational specialties related to military operations are communications, intelligence, information management, remote sensing, satellite operations, and weather. These experts provide tailored intelligence-related data (surveillance from space). Representatives help regional commanders and warfighters integrate the complex NRO satellite and data capabilities into their doctrine, operations, and tactics.[112] Although much is still not known about the NRO, some of their courses may be similar to ABM academic training for the ASO and ECO, but not for SDs or AWOs who manage and control military aircraft in the air battle.

Communications. Current DoD satellite communications (SATCOM) provide military forces with near-global, high capacity voice, data, and video communications links. The present SATCOM architecture includes both military systems and DoD use of commercial services. SATCOM assets include ultra high frequency (UHF), super high frequency (SHF), and extremely high frequency (EHF) communications. Each band has

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[110] Air Force Personnel Center, "Space and Missile Operations (AFSC 13S)," downloaded from http://factstaff.uww.edu/afrotc/afsc13s.htm, 13 February 2000, 1-3.

[111] Air Combat Command, "USAF Weapons Instructor Course Syllabus—Space SPACEIDOZN" (Nellis Air Force Base, Nevada: USAF Weapons School, draft copy, January 2000), 9-10.

[112] National Reconnaissance Office, "The National Reconnaissance Office" (Washington D.C.: Department of Defense, pamphlet, 1999).

operational advantages and together they provide a robust and complementary SATCOM system.[113]

The Navy's UHF Follow-On (UFO) is the military's primary system for UHF SATCOM and carries the current Phase 2 of the Global Broadcast System (GBS). AFSPC transferred control of UFO satellites to the Navy in 1999.[114] UFO will replace the existing Fleet Satellite Communications (FLTSATCOM) and each satellite possesses 39 UHF channels, 70 percent more than FLTSATCOM.[115] GBS is a concept similar to direct broadcast television and will be an important step in providing warfighters a large volume of information.[116]

High priority communications between defense officials and the battlefield commanders is provided by the Defense Satellite Communications System (DSCS). It can also disseminate emergency action and force direction messages to nuclear capable forces.[117] AFSPC is responsible for these SHF communications satellites while the Defense Information Systems Agency (DISA) is responsible for network and payload control.

AFSPC also provides Milstar satellite control and communications management. Milstar provides highly robust, protected and secure EHF communications to strategic and tactical forces, as well as, the national command authority.[118] Each Milstar satellite

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[113] *Strategic Master Plan*, Chapter 3.
[114] Ibid., Chapter 3.
[115] Air Force Space Command, "Fact Sheet: Ultrahigh Frequency Follow-On Communications Satellite System," downloaded from http://www.spacecom.af.mil/hqafspc/library/facts/uhf.html, 11 May 2000, 1.
[116] United States Space Command, "The Future: New Systems, New Missions," downloaded from http://www.spacecom.af.mil/usspace/future.htm, 11 May 2000, 2.
[117] Air Force Space Command, "Fact Sheet: Defense Satellite Communications System," downloaded from http://www.spacecom.af.mil/hqafspc/library/facts/dscs.html, 11 May 2000, 1.
[118] *Strategic Master Plan*, Chapter 3.

acts like a switchboard in space directing traffic from one terminal to another anywhere on earth and can link with other Milstar satellites via crosslinks.[119]

As demand for SATCOM continues to grow, the *Long Range Plan* and *Strategic Master Plan* described how they will meet the challenge of bringing unprecedented volumes of information to the warfighter. By 2020, the *Long Range Plan* envisions a global defense information network accessible by any level of command through a local, automated systems for managing information called "battle manager." "Battle managers" consist of hardware, software, and databases that depend on the global grid for connectivity.[120]

By 2025, the *Strategic Master Plan* builds upon the *Long Range Plan*'s vision with a global, real-time situational awareness capability tailorable to commanders' needs. With the ability to rapidly retask space assets, satellite communications will be enhanced with multi-level security, virtually unlimited bandwidth, natural language interfaces, holographic displays, global knowledge banks, and artificial intelligence.[121]

There are two areas of concern for the ABM. First, most fighter-type aircraft do not have satellite voice communications capabilities and only a few have data-link systems. Second, neither the *Long Range Plan* nor *Strategic Master Plan* address a space-based Identification Friend-or-Foe/Selective Identification Feature capability.

Surveillance. As USSPACECOM seeks to implement its *Long Range Plan*, they are developing the concept of Integrated Focused Surveillance. They believe Integrated Focused Surveillance is the cornerstone of *Joint Vision 2010*'s concept of Global

[119] Air Force Space Command, "Fact Sheet: Milstar Satellite Communications System," downloaded from http://www.spacecom.af.mil/hqafspc/library/facts/milstar.html, 11 May 2000, 1.
[120] *Long Range Plan*, 80-82.
[121] *Strategic Master Plan*, Chapter 2.

Engagement. It is a system that provides on-demand, continual surveillance of high interest targets to support missile defense and force application for all commanders. High interest targets will probably include key fixed, moving, buried, and relocatable targets, as well as ballistic and cruise missiles. This will lead to families of systems that provide different space-based capabilities similar to AWACS for missile and air defense and Joint Surveillance Target Attack Radar System (JSTARS) for mobile and fixed targets. These systems will be fully integrated with comparable theater air- and surface-based systems.[122]

Although many people in the Air Force believe the AWACS surveillance function could be done from space, the space community currently does not have a space-based air moving target indicator (AMTI) radar capability. Initially, the Air Force's Scientific Advisory Board's *Space Roadmap for the 21st Century Aerospace Force* believed a non-stealthy space-based AMTI radar was possible by the year 2012 with technology push, otherwise by 2020.[123] Unfortunately, the recently released *Strategic Master Plan* stated their investment analysis indicates that current space-based AMTI concepts are too costly for their already aggressive plan. The Air Force may not be able to develop all the needed technologies by itself and has, therefore, pushed the availability of this capability to beyond 2025.[124]

The Discoverer II is a space-based ground moving target indicator (GMTI) program designed to complement the high demand/low density asset JSTARS. Originally projected to be operational by 2012, Discoverer II was a financial alternative to JSTARS because the Air Force would never be able to afford enough of the expensive, yet

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[122] *Long Range Plan*, 52.
[123] John T. Correll, "A Roadmap for Space," *Air Force Magazine* 82, no. 3 (March 1999): 22.

effective command and control aircraft.[125] A space-based GMTI radar would expand battlefield awareness and use JSTARS to fill in the gaps. However, the latest *Strategic Master Plan* stated the Discoverer II program was too expensive for AFSPC to develop on its own and sought a joint effort with other organizations like the Ballistic Missile Defense Organization and/or the other services. Consequently, the operational capability of this system has been pushed back to the far term, sometime after 2014.[126] Discoverer II is seen as a breeding ground for future capabilities, such as the recent breakthroughs in microminiaturization that could be the key to making a space-based radar system deployable and affordable.[127] One senior military official said "Once you have solved the power problem [faced by Discoverer II] and worked the antenna technology, then in 5-10 years you are probably looking at doing successful air surveillance."[128]

Air surveillance from space is a more complex technical problem than GMTI. The speed and vertical movement of airborne targets creates problems that cannot be solved by traditional doppler radar techniques.[129] GMTI's once a minute continuous update of slower moving tanks and trucks would not meet the requirements for an AMTI radar.[130] Physics dictates that the more demanding AMTI must have higher revisit rates, a larger radar aperture, and massive power source to detect fighter aircraft or cruise missiles.[131]

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[124] *Strategic Master Plan*, Chapter 6, Chapter 7.

[125] Michael Dorsey, "Funding Cut Threatens Space Project," *U.S. Air F*orce *ONLINE News*, downloaded from http://www.af.mil/newspaper/v1_n24/v1_n24_s2.htm, 15 February 2000, 1.

[126] *Strategic Master Plan*, Chapter 6.

[127] USSPACECOM/AFSPC Legislative Update (10 April 2000), "AFSPC Requirements Chief: Space-Based Radar Must Conduct Flight Demo," 2.

[128] Robert Wall and David A. Fulghum, "New Satellite Designs Tackle Many Missions," *Aviation Week & Space Technology* 152, no. 19 (8 May 2000): 26.

[129] Wall and Fulghum, 26.

[130] Roger G. DeKok and Bob Preston, "Acquisition of Space Power for the New Millennium," in Peter L. Hays, et al., eds. *Spacepower for a New Millennium: Space and U.S. National Security* (New York: McGraw-Hill, forthcoming), 31, 33.

[131] David A. Fulghum, "Space Beckons Future AWACS," *Aviation Week & Space Technology* 149, no. 12 (21 September 1998): 62.

The larger aperture and massive power source is due to AMTI's much lower wavelength.[132] One Boeing official said “The three-dimensional aspect [of AMTI] creates much more complicated problems for computer analyses,” particularly when attempted from thousands of miles in space.[133] To get the quality required for tracking, space-based radars must be at relatively low altitudes to get global coverage and a great number of them must be in orbit.[134] Like GMTI, the best view of targets is from cheap ($100 million or less), low flying satellites. However, there is a tradeoff between gaps in coverage or the expense of building a huge constellation to give constant coverage everywhere. Interestingly, the *Strategic Master Plan* describes how future space-based ISR systems would provide initial global, real-time situational awareness and airborne surveillance systems would provide follow-on enhancement capabilities. Affordable spacelift would open up the use of space for things not currently feasible or anticipated.

Unmanned Aerial Vehicles (UAV) may provide part of the solution, but they also have technical problems to solve. To duplicate the large AWACS radar, a UAV would have to have much more on-board power available than is currently available. The E-3 has four engines to provide power for its long-range surveillance radar and cool the electronics. The largest UAV today is Global Hawk and it only has one engine.[135]

Electronic Intelligence

The AWACS Electronic Support Measure (ESM) capability for theater-level situational awareness could be supported from space based on capabilities developed since the GRAB mission in 1960. Unfortunately, the cloak of secrecy that still surrounds

[132] DeKok and Preston, 33.
[133] Fulghum, 62.
[134] Moorman, 19.

the NRO only allows for speculation. A second GRAB system apparently entered service in 1963 and operated until 1967.[136] It has been speculated the Navy Research Laboratory later launched numerous other signals intelligence satellites in 1976. In addition to looking for land-based radars, these new satellites serve naval interest searching for ships at sea and using multiple satellites to overcome the difficulty of precisely locating the radar emitter.[137] Until programs are declassified, the true space-based capabilities of the NRO will remain only with those who "have a need to know."

Mission Flexibility/Versatility. Although the AWACS "all-under-one-roof" concept does not physically apply to the space community, the goal is a seamless operation of space assets for the future. Space assets are divided among the various space organizations, and secrecy could complicate coordination efforts. Assuming the space community develops the required satellite constellations to duplicate AWACS systems, Air Combat Command's ABMs may have to coordinate with AFSPC for space-based AMTI radar and secure communications support, the secretive NRO for electronic signals support, and possibly commercial space for backup unsecure voice and/or data-link communications support. The question is how responsive will this coordination be in a dynamic environment where missions can change during execution? Both the *Long Range Plan* and *Strategic Master Plan* envision on-demand execution of satellite operations functions and the ability to rapidly retask space assets.

Global Presence. Space provides a vantage point where no point on Earth is denied to a sensor system. A space-based AWACS capability that provided continuous global presence 24 hours a day/7 days a week could have far greater diplomatic and deterrent

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[135] Fulghum, 63.
[136] Day, 345.

affects. In the past, spy satellites played an important role in maintaining détente during the Cold War.[138] The threat that someone was watching from above and could expose treaty violations was a real deterrent.

This could also be the case with space-based surveillance, reconnaissance, and communications systems. Space-based systems could duplicate this capability by quickly sending electronic messages to potential adversaries whenever a violation is observed, similar to what the United States did with the Soviet Union during the Cuban Missile Crisis. When the Soviets denied deploying intermediate-range ballistic missiles and medium-range ballistic missiles, the United States showed them reconnaissance photos of them in Cuba.

Conclusion

To help understand some of the issues with moving AWACS capabilities to space, this chapter identified current and future space capabilities. USSPACECOM's *Long Range Plan* and AFSPC's *Strategic Master Plan* provided a basis for identifying current space-based systems and what is planned for the future. From these two documents, space-based assets could duplicate AWACS capabilities in the categories of communications, electronic intelligence, and global presence. In the area of command and control, USSPACECOM would retain combatant command authority of space-based systems, whereas geographic combatant commanders would be given control of AWACS in their area of responsibility. Duplicating AWACS mission flexibility/versatility from space may be difficult with security issues potentially complicating coordination with the

[137] Ibid., 345.
[138] Hays et al., 3.

various space organizations, but coordinating operational employment procedures could alleviate this concern. Although AFSPC's *Strategic Master Plan* does not foresee a space-based AMTI radar constellation until after 2025, unforeseeable innovations in technology could change this forecast. Finally, ABM and SMO training are so different that coordination between these two communities is required to properly migrate and integrate AWACS capabilities to space. With this in mind, the next chapter will discuss some of the issues regarding the movement of AWACS to space and correct some of the misperceptions of those in the ABM and SMO career fields.

Chapter 4

What are the Issues?

> *There is no limit to what a man can accomplish if he does not care who gets the credit for it.*
>
> —Frank B. Rowlutt

Introduction

Having presented the present and future capabilities of both AWACS and the space community, what is the future role of airborne systems? This chapter will discuss some of the issues in each category identified by the C4ISR framework, followed by some comments on the misperceptions of those in the air battle manager and space and missile operations career fields.

Command and Control

For the geographic unified combatant commander, there is a difference in command authority over AWACS versus space-based systems. When AWACS deploys to a contingency, the combatant commander is given combatant command (COCOM) over that resource. The theater commander will normally give operational control (OPCON) and tactical control (TACON) of the E-3 to the joint forces air component commander (JFACC). AWACS executes the JFACC's air tasking order and the air battle manager (ABM) directs military aircraft in managing the air war. The AWACS mission crew is optimizing their systems constantly in response to changing environments (terrain, atmospherics, target type, range) and/or mission taskings.

Desert Storm provided an opportunity for United States Space Command (USSPACECOM) to enlarge the role of space. Determining who would control future space-based moving target indicator radars was a step in this direction. In 1998, Air Force Space Command (AFSPC) and Air Combat Command co-authored the "Concept of Operations for the Space-Based Moving Target Indicator (SBMTI) System." This document describes how this system should be employed. The commander of USSPACECOM will maintain COCOM of this system, while the Air Force component commander of USSPACECOM (COMAFSPACE) will have OPCON. COMAFSPACE, who is also commander of 14th Air Force, will normally delegate TACON through the wing or group to the SBMTI Payload Control Center. COMAFSPACE and the Payload Control Center may set up direct liaison authority relationships with SBMTI users, for example, the JFACC/Joint Aerospace Operations Center and (JAOC) and the Aerospace Operations Center (AOC). Within a joint force, the JFACC/JAOC performs SBMTI operations planning and the AOC performs SBMTI operations execution and dynamic tasking.[139] Therefore, the ABM would mission plan SBMTI support with the JOAC and coordinate mission requirement changes during execution with the AOC versus manipulating the AWACS radar.

This difference in command and control structure can be seamless if properly coordinated. The concept of using data from geographically separated radars is not new. ABMs in ground-based air defense squadrons have defended the United States' air

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[139] Hugh W. Youmans and Eric T. Kouba, "Concept of Operations for Space-Based Moving Target Indicators" (Peterson Air Force Base, Colorado: United States Space Command, 2 February 1998), 11-12.

sovereignty using data from radar sites hundreds of miles away for decades. The Air Force and Federal Aviation Administration share these radars for military and civilian air traffic control. ABMs assigned to the Southeast Air Defense Sector at Tyndall Air Force Base, Florida provides air surveillance and protection for the entire southeastern United States. ABMs direct military aircraft against unknown aircraft penetrating sovereign airspace and during training missions anywhere along 3,000 mile of coastline from North Carolina to Texas.[140] Letters of agreements describe how these joint surveillance system radars are operated during peacetime through war.

Despite not being given control of satellites, geographic combatant commanders and ABMs have used space-based systems in the past successfully. More than 30 military and commercial satellites were used for intelligence gathering during the Gulf War.[141] These satellites provided valuable information to the warfighter and were a force multiplier in defeating the enemy overwhelmingly. ABMs onboard AWACS coordinate the use of satellite communications for every mission with no problems.

This affinity for control can be a problem, but the commander of USSPACECOM maintaining COCOM of its satellites has merit. What happens when a space-based system simultaneously supports more than one geographic combatant commander? This is similar to the commander of Transportation Command retaining COCOM of its strategic airlift assets when physically landing in different areas of responsibility in support of combatant commanders.

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[140] Southeast Air Defense Sector. "Southeast Air Defense Sector," downloaded from http://www.fljack.ang.af.mil/HQ/seads.htm, 11 May 2000, 1.

[141] Peter Anson and Dennis Cummings, "The First Space War: The Contributions of Satellites to the Gulf War," in Alan D. Campen ed., *The First Information War: The Story of Communications, Computers and Intelligence Systems in the Persian Gulf War* (Fairfax, Virginia: AFCEA International Press, 1992), 127.

Training. Since the space community does not have personnel similar to ABMs, do they intend to pursue this core competency when moving AWACS capabilities to space? There is nothing in the *Long Range Plan*, "Concept of Operations for the Space-Based Moving Target Indicator System," or AFSPC's and Aerospace Command and Control, Intelligence, Surveillance, and Reconnaissance Center's (AC2ISRC) "Space-Based Moving Target Indicator System Roadmap" that indicates any desire by AFSPC to be responsible for executing the air battle management mission. This is also the case for the National Reconnaissance Office (NRO). In fact, all of these documents emphasize how air-, surface-, and space-based sensors will augment each other to help the warfighter execute the mission. The concept of operations specifically states "Battle managers could be located on airborne platforms or in some type of operation center."[142] This would imply ABMs on AWACS, Joint Surveillance and Target Attack Radar System (JSTARS), and Airborne Battlefield Command and Control Center (ABCCC), or in ground units such as the AOCs and Modular Control Element. The space community wants to develop and provide space-based satellites that will provide force multiplier support.

If the space community does not seek the air battle management mission, why is there some confusion concerning the future of ABMs? This misunderstanding may be due to the *Long Range Plan*'s use of the term "battle managers." Although some space battle managers (SBM) and ABMs interact with radar scopes, there is a fundamental difference in core competency. SBMs are focused on managing space assets, whereas, ABMs are concerned with executing and managing the air war.

[142] Youmans and Kouba, 6.

The *Long Range Plan* describes USSPACECOM "battle managers" as local, automated systems for managing information. They consist of hardware, software, and databases that depend on the global grid for connectivity. This battle management system receives, processes, correlates, and distributes information reliably, unambiguously, and rapidly. This system will automatically cue systems; fuse information from air-, surface-, and space-based systems; and distribute tailored information to various users in real or near-real time. In addition to providing a common operating picture, battle managers will also provide the status of forces, planning tools, decision aids, and execution paths needed to control space. The battle manager will also support a dynamic modeling and simulation capability to support rigorous training, testing, and exercising of joint operations.[143] But does this imply automation will replace the human element, in this case the air battle manager?

Once again, the *Long Range Plan* describes how USSPACECOM's battle management system will support decision makers at the commander-in-chief, component (i.e. air-, land-, and space battle managers), and joint task force levels. Although computer technology has grown exponentially, no computer program can incorporate every scenario possible. Therefore, it would be safe to assume that the ABM would use the space's battle management system in executing the AWACS mission.

Communications

Although the space community envisions a robust global defense information network providing real-time situational awareness accessible by any level of command, there are two concerns for the ABM. First, the vast majority of fighter aircraft are not

[143] United States Space Command, *Long Range Plan: Implementing USSPACECOM Vision for 2020*

equipped with satellite voice radios. The next generation fighter, the Lockheed Martin F-22 Raptor, is not programmed for satellite voice communications, but will have a satellite data-link capability with the Joint Tactical Information Distribution System.[144] When data-links are inoperable, the ABM can use voice transmissions to "paint the air picture" and build situational awareness for the pilot. Will line of sight voice radios always be possible? If not, what happens when data-links become inoperable and the fighter's target is now under friendly control or is actually innocent civilians?

Second, no space document addresses the issue of developing a space-based Identification Friend-or-Foe/Selective Identification Feature (IFF/SIF) system. As stated earlier, the ABM relies quite heavily on this capability to distinguish friendly from enemy aircraft and help prevent fratricide. Air traffic control may be interested in such a system for flight safety reasons. Civilian and military transponders help identify airplanes by assigned numerical codes and provide the most accurate method for determining aircraft altitude. A space-based IFF/SIF could be expanded to include global positioning system position, heading, and speed.[145]

Surveillance

Although "surveillance from space" offers a tremendous potential, funding a constellation of air moving target indicator (AMTI) radars is an issue. The less complex Discoverer II space-based ground moving target indicator radar (GMTI) program was nearly cancelled due to costs. Congressional critics of the Discover II want a program

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(Peterson Air Force Base, Colorado: United States Space Command, 1998), 82, 21-22.

[144] Matthew H. Molloy, "US Military Aircraft for Sale: Crafting a High-Tech Air Export Policy" (Maxwell Air Force Base, Alabama: School of Advanced Airpower Studies Thesis, draft copy, 2000), 22.

[145] Kim Corcoran, "Higher Eyes in the Sky: The Feasibility of Moving AWACS and JSTARS Functions into Space" (Maxwell Air Force Base, Alabama: School for Advanced Airpower Studies Thesis, 1998), 70.

less than the projected $700 million one-year, two satellite demonstration. Even senior Pentagon officials are not ready to commit Discoverer II to an operational configuration for global coverage. One senior Pentagon official noted "You can afford 24 satellites at $100 a [spacecraft], but not at $250 million."[146] The cost for a 24-satellite, global constellation is too high and buying fewer satellites would provide only intermittent coverage. Some experts believe a space-based GMTI radar constellation with continuous global coverage is well beyond the scope of Department of Defense experience.[147]

To estimate the cost for acquiring a space-based AMTI radar constellation, experts have used Teledesic's "Internet-in-the-sky" network as a model.[148] Teledesic is a private company that is building a broadband space-based network for worldwide, "fiber-like" telecommunications services. Using a constellation of 288 low earth orbit satellites, plus spares, this system would support high quality voice communications, video conferencing, interactive multimedia, and computer networking. This network is designed to support millions of simultaneous users with access speeds more than 2,000 times faster than today's standard analog systems. The estimated cost for design, production, and deployment of the network is about nine billion dollars, the approximate value of the current AWACS fleet.[149] With lifespans of about 10 years, satellites would have to be replaced gradually. Add another billion or two for infrastructure and the constellation issues become quite important.[150] Consequently, the *Strategic Master Plan* stated a desire to include a space-based AMTI capability, but investment analysis

[146] David A. Fulghum and Robert Wall, "Discoverer-2 Goals: Spying, Arms Targeting," *Aviation Week & Space Technology* 152, no. 19 (8 May 2000): 28.

[147] Roger G. DeKok and Bob Preston, "Acquisition of Space Power for the New Millennium," in Peter L. Hays, et al., eds. *Spacepower for a New Millennium: Space and U.S. National Security* (New York: McGraw-Hill, forthcoming), 32.

[148] Ibid., 34.

[149] Teledesic, "About Teledesic," downloaded from http://www.teledesic.com, 7 May 2000, 1-2.

demonstrated these concepts are too costly for this plan.[151] AFSPC's and the National Aeronautics and Space Administration's (NASA) visions for robust, responsive, and affordable spacelift capabilities by 2025 will reduce some of these costs.

One alternative is the Air Force testing of "bistatic" radars—separate transmitters and receivers, with receivers closer to the target. If it is not technologically feasible for radar returns to travel back into space to be processed by a satellite, what about smaller satellites that only scan the skies with radar information that is received or relayed by AWACS, unmanned air vehicles, or other aircraft close to the targets? Northrop Grumman wants to demonstrate that a secondary platform can receive or relay radar images of airspace generated by an AWACS radar. A significant amount of radar "pings" generated by AWACS are lost because the targets are too far away for the radar signals to return to the source. Stand-alone space-based AMTI radars have this same problem. Bistatic works by moving the receiver or relay closer to the target. Therefore, if a secondary platform could receive or relay these "lost" pings, satellites could illuminate a significantly larger area of airspace.[152] If successful, this could mean smaller and less expensive AMTI satellites due to reduced capabilities requirements and weight.

Some planners believe bistatic radars may be the key to finding stealth aircraft and missiles, and defeating electronic jamming. A secondary platform, such as an unmanned aerial vehicle (UAV), fitted with a passive radar receiver and located behind enemy lines could pick up radar signals that were deflected above or to the sides of stealthy aircraft

[150] DeKok and Preston, 34.

[151] Air Force Space Command, *Strategic Master Plan for FY02 and Beyond* (9 February 2000), downloaded from http://www.spacecom.af.mil/hqafspc/library/AFSPCPAOffice/2000smp.htm, 11 May 2000, Chapter 6.

[152] Bryan Bender, "USAF Studies Capability of AWACS in Space," *Jane's Defence Weekly* 33, no. 5 (2 February 2000): 10-11.

and missiles.[153] This same principle would apply to electronic jammers preventing radar returns from travelling back to its source.[154] In both cases, the secondary platform could relay the position of the stealth aircraft and missile or electronic jammer to an AWACS if it could not receive the information itself.

Another concept being examined by the Air Force is TechSat. This concept would use 16 small inflatable radar satellites that would launch as small, flat pancake structures. Once in orbit, each TechSat would inflate into a cylinder shape with down-facing radar antennas. The key is to develop a spacecraft with receivers and processors to detect its own radar returns, as well as, bistatic communications with other TechSats to share data and target processing. The idea is that a cluster of these simple spacecraft would function as one larger, more powerful space-based radar satellite.[155]

Although never specifically mentioned in any space documents, the *Concept of Operations for the Space-Based Moving Target Indicator System* implies maritime surveillance would be possible.[156] The list of potential targets includes warships, military support, commercial, and certain private vessels. This AWACS capability has been used in support of the president of the United States' war on drugs in the Atlantic, Caribbean, and Pacific waters.

Electronic Intelligence

For national security reasons, the NRO will probably retain control of electronic intelligence satellites, which may lead to some growing pains for the ABM. Upon

[153] David A. Fulghum, "Radar Upgrades Pay Off in Alaska," *Aviation Week & Space Technology* 149, no. 12 (21 September 1998): 61.
[154] Bender, 44-47.
[155] Craig Covault, "USAF Shifts Technology for New Future in Space," *Aviation Week & Space Technology* 149, no. 7 (17 August 1998): 44-47.
[156] Youmans and Kouba, 9.

request, the NRO provides electronic intelligence data to warfighters. Although geographic combatant commanders prefer to control airborne electronic intelligence assets, not enough of these platforms exist to meet the demand. One of these airborne assets is the United States Navy's EP-3E. This platform's primary mission is to detect and report tactically significant communications and radar signals to the warfighter. Unable to meet worldwide commitments, the Navy needs $209 million for four additional aircraft to fully satisfy mission requirements.[157]

The Air Force thought enough of this capability that the Electronic Support Measure system comprised a significant portion of the one billion dollar Block 30/35 modification to the AWACS fleet.[158] A new ABM specialist was also added to the mission crew, the electronic combat officer (ECO). The ECO can dynamically optimize this system based on mission requirements and provides electronic intelligence support for locating emitters, threat warning, and maintaining situational awareness in executing the AWACS mission.

Although more is known about the NRO today, how much information would be made available to ABMs and those involved in executing the air tasking order? ABMs need to train the way they are going to fight and electronic intelligence support is a critical component. A space-based electronic intelligence system that complements air- and surface-based assets can also reduce the number of personnel put in harms way to gain information about the enemy. Although the NRO declassified the GRAB program recently, it was a capability used in the 1960s and more than likely only those who have a

[157] Peter J. Skibitski, "Navy Says Four More Special Mission Planes Needed to Meet Demands," *Inside the Navy* (17 April 2000): 1.

[158] Donald M. Gricol, Sencom Corporation/Operations Analyst with 552d Air Control Wing/Requirements, telephone interview by author, 19 May 2000.

"need to know" are aware of follow-on systems, assuming they do exist. If ABMs are to use space-based sensors in the future, security and operational issues between ABMs those who control electronic intelligence satellites must be resolved.

Mission Flexibility/Versatility

One perception of military commanders is "if I don't own it, I can't count on it." Commanders instinctively prefer to control C4ISR assets and are likely to favor building indigenous systems such as UAVs until a process is developed to ensure the reliability of national systems."[159] But UAVs have a limited capability compared to the large sensors carried on AWACS. This may help explain why regional commanders are quick to request AWACS at the first sign of trouble. Once deployed, this "all-under-one-roof" force multiplier is under their combatant command and helps them find and monitor the enemy.

Interestingly, the *Concept of Operations for the Space-Based Moving Target Indicator System* states "Manned aerial systems are among the most mobile and responsive RSTA [reconnaissance, surveillance, and target acquisition] assets available, capable of carrying out critical missions and gathering vital information in NRT [near real time]. Manned systems can often respond to changing conditions and modify missions while in progress."[160] AWACS can project combat support and/or surveillance functions into a theater within 24 hours after notification.[161] Combined with other E-3s, it can provide theater-wide air coverage over Iraq, or maritime surveillance during counterdrug missions, or provide air traffic control in support of contingencies such as

[159] Thomas G. Behling and Kenneth McGruther, "Satellite Reconnaissance of the Future," *Joint Forces Quarterly* 18 (Spring 1998): 28-29.
[160] Youmans and Kouba, 17.

Haiti. AWACS' organic systems can provide autonomous or semi-autonomous operations when data-links are severed with higher echelons of command and control. Unlike satellites, AWACS aircrews are trained to react to real-time situations and can retrograde away from threats and return when the threat has subsided.

Decades of bureaucracy and secrecy within the space community contributed to some of the military's attitudes towards space support. To paraphrase one Army commander, "begging for coverage is not acceptable."[162] Until the Gulf War, Air Force aviators and the space community lived and worked in almost separate worlds.[163] Part of this can be attributed to the concealment of the NRO until 1992. Integration between the military and space community has improved, but how difficult will it be to coordinate mission requirements and/or mission changes during execution? Some RAND officials believe the Air Force may be going too far with plans for off-board sensing due to the inflexibility of operating intelligence satellites.[164] This coordination process will be further complicated if there are agencies that still do not officially exist and/or lots of organizations are involved. Whatever organization(s) inherit the different space-based systems, the establishment of a standing committee to develop, coordinate, and resolve employment issues with users is a must.

Global Presence

The issue is whether or not continuous global coverage by space-based systems will be required. Today's surface-based systems do not provide worldwide coverage, and

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[161] Thomas W. Nine, "The Future of USAF Airborne Warning & Control: A Conceptual Approach" (Maxwell Air Force Base, Alabama: Air Command and Staff College Research Report, 1999), 21.

[162] Behling and McGruther, 28.

[163] Benjamin S. Lambeth, "The Synergy of Air and Space," *Airpower Journal* 12, no. 2 (Summer 1998): 4.

"intelligence satellites and airborne platforms provide only localized and generally discontinuous sensing, often impeded by weather, terrain, and hostile countermeasures."[165] The *Long Range Plan* and *Strategic Master Plan* discussed global partnerships with civil and commercial sectors as one means to help develop space capabilities and reduce costs. In the case of space-based radars, a satellite constellation similar to Teledesic to provide continuous AMTI coverage worldwide is around $12 billion.[166] A global space-based AMTI radar system could have prevented the mid-air collision of a United States Air Force C-141 and German Air Force C-130 west of Africa in 1997. Would the international community be interested in sharing some of the costs in developing and maintaining such a system for flight safety?[167]

When technology permits space-based systems to duplicate AWACS-type capabilities globally, what will become of air- and surface-based systems? These systems will continue to complement each other and provide a redundancy capability. Unless a "break rate" of zero can be guaranteed, some satellites will fail to reach orbit or malfunction. Future space transportation, such as NASA's Orbit Transfer Vehicle, will be able to service, repair, and reposition some of these space assets.[168] Because space-based systems fly predictable orbits, what happens when a satellite is rendered useless by future enemy threats—hostile satellites; air-, surface- and space-based directed energy weapons; ICBMs; or nuclear weapons? Where surface-based assets are unable to cover areas of interest, an airborne platform can quickly deploy to fill the gaps in coverage.

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[164] Washington Outlook, "Creating a Dependency," *Aviation Week & Space Technology* 140, no. 17 (25 April 1994): 17.

[165] Air Force Scientific Advisory Board, cited by John T. Correll, "A Roadmap for Space," *Air Force Magazine* 82, no. 3 (March 1999): 23.

[166] DeKok and Preston, 34.

[167] Kim Corcoran, 69.

[168] *Strategic Master Plan*, Chapter 6.

Therefore, a manned and/or unmanned airborne AWACS-type asset will continue to exist in some capacity. The data fusion center for coordinating all these different systems inputs and disseminating this information to the warfighter is the Aerospace Operations Center—a ground-based AWACS system perfectly matched for future ABMs. Does this mean a less than complete global coverage may be acceptable provided there are enough air- and surface-based assets to complement space-based systems? Congress and the military are debating this very question.

ABM and SMO Misperceptions

There are a number of misperceptions about AWACS and AFSPC that perpetuate a cultural barrier between these two communities. One that has been repeated time and time again, even by general officers, is that AWACS will not have a job in the future. Based on what has been presented in this thesis, it becomes quite apparent that space-based systems will not be able to duplicate all the different AWACS capabilities by the year 2025. Future threats to space make an integrated system with air-, surface-, and space-based systems complementing each other more plausible and with a built-in redundancy to fill in the gaps in coverage. If surface-based systems cannot fill in the gaps by space-based systems, then an airborne asset, either manned or unmanned, can quickly deploy to his void in coverage. That is not to say, as technology develops, ABMs will not become more dependent on space-based systems to execute the air battle management mission. Comments that advocate the demise of E-3 AWACS only create animosity between the two communities and a feeling of despair by ABMs who believe they are “riding a dead horse”—no future, no promotions, and no career.

To the unknowing ABM, this fear of "riding a dead horse" may seem justified given the Air Force 's desire to move C4ISR capabilities to space, USSPACECOM's quest to expand its role, and the vocal desire by some in AFSPC for a separate space force. Again, this perception is unfounded when looking at the facts. The Air Force does want to move C4ISR capabilities to space, but to complement air- and surface-based assets. USSPACECOM wants to expand its warfighter role by controlling future space-based capabilities, which is the current policy for military satellites. No space document advocates USSPACECOM and AFSPC developing an ABM core competency. Instead, space documents describe how ABMs at ground stations, such as the Aerospace Operations Center, can use space-based and unmanned systems to manage the air battle. These same documents also describe ABMs on AWACS and JSTARS enhancing their situational awareness with space-based assets. For the time being, those pushing for a separate space force are in the minority and have yet to find their "Billy Mitchell."

ABMs have struggled for recognition and survival for decades. Formerly called air weapons controllers, this career field has existed for over 50 years, but their first general officer was not selected until 1999. Col C. Thomas Hill's 1984 Air War College Research Report "Rating the Air Weapons Controller (AWC) AFSC 17XX Career Field" addressed the manning problem of attracting and retaining qualified AWCs in AWACS. He identified seven factors impacting AWACS AWC manning: individuals must volunteer for flying, high temporary duty rate, enhanced hazardous duty incentive pay (pseudo flight pay) was less than "rated" flight pay, AWCs not allowed to command an

AWACS flying squadron, shortage of authorizations worldwide, fluctuating number of qualified personnel, and non-flying command billets increased promotion rates.[169]

In 1987, Maj Thomas H. Buchanan's Research Fellow Report described how many AWCs felt like second-class citizens in the pilot-oriented Air Force. This fueled some misconceptions, as well as, efforts by both sides to reduce some of the tensions between these two communities. Interestingly, this report also discussed the need for AWCs to broaden their expertise as "battle managers" and outlined a proposal for a battle management course.[170]

Flying alongside pilots and navigators executing the AWACS, JSTARS, and ABCCC missions, ABMs in flying billets were finally "aeronautically rated" on 1 October 1999. ABMs can now become wing, operations group, and squadron commanders of flying organizations where ABMs are part of the aircrew. Ironically, United States naval flight officers performing this same ABM function on E-2 Hawkeyes have enjoyed the benefits of being "rated" for decades.

But does this new ABM "aeronautical rating" pose a threat to the space community? Has the ABM moved ahead of the SMO into what Lt Col Thomas C. Walker describes as the "core elite" class of rated Combat Air Force members?[171] Can an ABM now command USSPACECOM or AFSPC? Under current Air Force policy, this seems highly unlikely since ABMs are not qualified in space systems. But what happens if a "rated" ABM qualifies in one of the five space and missile disciplines? Better yet, what

[169] C. Thomas Hill, "Rating the Air Weapons Controller (AWC) AFSC 17XX Career Field" (Maxwell Air Force Base, Alabama: Air War College Research Paper, 1984), 5-7.

[170] Thomas H. Buchanan, "The Tactical Air Control System: Its Evolution and Its Need for Battle Managers" (Maxwell Air Force Base, Alabama: Air University Press, 1987), 66-67, 69-77, 83-84.

[171] Thomas C. Walker, "Implementing Aerospace Integration: The Quest for Aerospace Culture" (Maxwell Air Force Base, Alabama: Air War College Research Report, draft copy, 2000), 14-15.

happens if a SMO earns an "aeronautical rating" by qualifying as an ABM on AWACS or JSTARS? Can this "rated" SMO become the commander of USSPACECOM or AFSPC? Air Force history highlights why an airman should be responsible for employing airpower. Should this concept carryover to space? There is precedent; Air Force Material Command is commanded by General George T. Babbit, who is a logistician and not a pilot.[172]

Despite a shorter existence than ABMs, SMOs have produced their own general officers for some time. The Air Force promotes one space officer at a time to brigadier general, although recently they have been predominantly missilers, which is a source of tension for space officers.[173] Sometimes referred to as the "first space war," Desert Storm provided an opportunity to enlarge the role of space. Gen Thomas S. Moorman, Jr., a reconnaissance intelligence officer who transitioned to space, commanded AFSPC from 1990 to 1992 and later became the vice chief of staff of the Air Force in 1994.[174] Gen Lester L. Lyles is the current vice chief of staff of the Air Force and is from the space launch community.[175] But since its creation in 1985, USSPACECOM has been commanded by a pilot in an effort to bring the space and flying communities closer together.[176] Seeking to expand their role, AFSPC developed the Space Tactics School that evolved into the United States Air Force Weapons School's Space Division, started the Space Warfare Center which also houses the Space Battlelab, and is developing an Air Force Institute of Technology (AFIT) sponsored Master's Degree program in

[172] United States Air Force, "Biography: General George T. Babbit," downloaded from http://www.af.mil/news/ biographies/babbit_gt.html, 12 February 2000, 1.
[173] Bob Smith, "The Challenge of Space Power," *Airpower Journal* 13, no. 1 (Spring 1999): 33.
[174] United States Air Force, "Biography: General Thomas S. Moorman, Jr.," downloaded from http://www.spacecom.af.mil/hqafspc/history/moorman_ts.htm, 12 February 2000, 1.
[175] United States Air Force, "General Lester L. Lyles Biography," downloaded from http://www.af.mil/news/ biography/lyles_ll.html, 12 February 2000, 1.

Aerospace and Information Operations. Graduates of this AFIT program will be assigned to advanced academic degree billets within and outside the command.[177]

The future for ABMs and SMOs is promising and full of new opportunities. With this in mind, both communities need to understand the facts and start working together to resolve current and future interoperability issues which can win wars and save lives. Neither AFSPC nor the NRO plan to "home grow" or assimilate ABMs. USSPACECOM's *Long Range Plan* uses the term "space battle managers" to describe SMOs managing space assets in the future. Although the article "Space Power and the Revolution in Military Affairs" recommends space develop operational and tactical thinking, there is no reference for the AFSPC to acquire an ABM core competency.[178] The NRO is not in the business of managing a theater-level air war by directing military aircraft against enemy targets, they are in the business of providing reconnaissance data to decision-makers and warfighters. USSPACECOM's concept of integrated focus surveillance, which is supported by AFSPC's *Strategic Master Plan*, advocates a mix of airborne, surface, and space systems to support the warfighter in fulfilling national strategies.

Conclusion

This chapter addressed some of the issues concerning the movement of AWACS capabilities to space. In the category of command and control, the geographic combatant

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[176] Lambeth, 6.

[177] AFSPC/CC Monthly Message (March 2000), "Aerospace Officer Development Initiatives," 1.

[178] Colin S. Gray and John B. Sheldon, "Space Power and the Revolution in Military Affairs: A Glass Half Full?" *Airpower Journal* 13, no. 3 (Fall 1999): 28.

commander enjoys combatant command of AWACS when in theater, but this will not be the case for space-based systems for justifiable reasons. Although USSPACECOM is eager to control space-based assets that duplicate AWACS systems, AFSPC does not seek an ABM core competency to execute the AWACS mission from space. Future satellite communications capabilities will be robust, but the space community has not expressed a desire or need for a space-based IFF/SIF capability, a critical component for the ABM to manage the air war. Future fighter aircraft, such as the F-22, are not programmed for satellite voice communications, but the technology exists to add this capability in the future if required. Unless funding dramatically increases, a space-based air moving target indicator radar system will not be possible until after 2025, about the time economically feasible spacelift is available. The details of integrating NRO's electronic intelligence support for ABM situational awareness will need to be coordinated to ensure the seamless operation of this essential capability. This coordination also applies to the different space organizations that control the various space-based systems, because real-time changes for mission requirements in a dynamic environment is a fact in warfare. With a better understanding of the complexities of continuous global coverage from space, would a less demanding capability with gaps filled by airborne platforms serve the nation better? The military will always have a backup system and a manned or unmanned airborne capability will continue to exist. Finally, both military and civilian professionals need to understand the facts to help tear down the cultural barriers that permeate between the ABM and space community. The final chapter will assess the value of the C4ISR framework and offer some recommendations for the continued integration of ABMs and the space community.

Chapter 5

Conclusion and Recommendations

> *The United States Air Force is moving forward into the 21st century as a seamless, integrated aerospace force. The Air Force is committed to continue the integration of air and space. We have made great strides in many areas but we need to go further. Integration is a journey, not a destination.*
>
> —General Michael E. Ryan, 1999
> USAF Chief of Staff

Introduction

This final chapter assesses whether or not this study achieved the desired results of highlighting some of the important issues regarding the movement of airborne C4ISR capabilities to space, as well as, help to promote a better understanding of the air battle manager and space and missile operations career fields. Then, this chapter proposes some recommendations to help continue the integration of warfighters of the 21st century aerospace force.

Conclusion

One Air Force official said it best, "We're never going to be in a situation where we can get it all into space, there will always be some sort of mix."[179] This research

[179] David A. Fulghum, "Space Beckons Future AWACS," *Aviation Week & Space Technology* 149, no. 12 (21 September 1998): 62.

addressed a need to help understand the complexities of moving airborne C4ISR assets to space. This paper offered a C4ISR framework to help identify categories that may highlight some of the important issues by answering the question “Why is this particular airborne C4ISR asset valuable to decision-makers and warfighters?” Using AWACS as a case study, it is hoped a better understanding of the air battle manager (ABM) and space and missile operations (SMO) career fields helps correct some misperceptions about these two warfighters.

The C4ISR framework identified seven categories that highlighted a number of important issues relevant to moving AWACS capabilities to space. First, geographic combatant commanders will have to get accustomed to *using* space-based capabilities and not having combatant command authority over these systems. This makes it imperative that a well-documented command and control process is in place to coordinate the seamless employment of these different space assets.

Second, there are no current plans to have the human element that makes AWACS such a valuable asset operate from space, but ABMs may have to use space-based assets to accomplish the air battle management mission. The AWACS air battle manager is trained to be the focal point that fuses all the different sensor data inputs and disseminates this information to decision-makers and warfighters. Air Force Space Command (AFSPC) does not seek this ABM core competency, but wants to control the space-based assets. Then ABMs and AFSPC need to understand and coordinate future requirements in order to execute their respective warfighter missions.

Third, satellite communications is one of space's many strengths and offers decision-makers and warfighters a wide spectrum of capabilities to receive and disseminate information. If the goal is to move all of the AWACS capabilities to space, then a plan for acquiring a space-based Identification Friend-or-Foe/Selective Identification Feature system needs to be included. Without this capability, the ABM loses a critical component in executing the air battle management mission.

Fourth, a space-based air moving target indicator radar is the "long pole in the tent" for moving AWACS capabilities to space. Not only are there technological issues to overcome with radar aperture and power, but the costs associated with maintaining a constellation the size of Teledesic's "Internet in the sky" network must be considered. Unless increased funding for this project is forthcoming, this capability will not become feasible until after 2025. Will the E-3 Sentry AWACS be obsolete by then? What tradeoffs will have to be made to develop or delay this capability from space?

Fifth, coordinating electronic intelligence support from the National Reconnaissance Office could pose some problem for the ABM and those executing the air tasking order. Warfighters want to train the way they are going to fight and resolving employment issues will need to be accomplished. Electronic intelligence support is another critical component for the ABM to execute the air battle management mission. AFSPC and the National Reconnaissance Office (NRO) partnership is one step in the right direction, but what other "black world" capabilities are known by only those who have a "need to know?"

Sixth, responsiveness to dynamic changes in mission tasking or threats is a concern for geographic combatant commanders. AWACS multi-role mission and "all under one roof" sensor capabilities provides mission flexibility/versatility, which is one of the tenets of aerospace power. Having to coordinate with the different space organizations for space-based systems support is not the warfighters' idea of responsiveness—"begging for coverage is not acceptable." This coordination process could become complicated if there are organizations who do not "officially" exist but control satellites that duplicate AWACS capabilities.

Finally, there is the issue of continuous global presence. This is a very expensive proposition in a time of budget constraints. Given that air- and surface-based systems will continue to exist, would a less demanding worldwide capability be acceptable to civilian and military leadership? Aerospace operations centers would use space-based AWACS capabilities that provided near-continuous coverage worldwide and deploy the E-3 to fill the gaps in coverage or, if required, enhance contingency operations. This reduction in AWACS operations and personnel tempo supports the Expeditionary Aerospace Force concept.

Based on the number of issues derived from these seven categories, the C4ISR framework did accomplish its goal of highlighting some important issues in moving airborne C4ISR capabilities, in this case AWACS, to space. Therefore, the C4ISR framework does have merit and could help identify important issues with moving other airborne C4ISR capabilities to space. Solving these issues is beyond the scope of this framework and paper.

Next, did these issues help promote a better understanding of the ABM and SMO career fields? Each issue dealt with AWACS capabilities used by the ABM to execute the air battle management mission. Discussing the ABM formal training programs helped understand their core competency and how they use the different sensors to execute their mission. Likewise, each issue discussed space capabilities and how different the SMO formal training program is compared to the ABM. Although the primary focus was moving AWACS capabilities to space, these issues did help understand what each warfighter brings to the fight.

Finally, did these issues help correct some of the misperceptions about ABMs and SMOs? Once again the evidence points to the affirmative. Flushing out the facts, such as United States Space Command's (USSPACECOM) use of the term "battle manager," as well as, understanding AFSPC's desire to control satellites and not acquire the ABM core competency helped set the record straight for ABMs and SMOs.

Recommendations

In light of this research's findings, the author would like to offer some recommendations to help the integration of the aerospace force for the 21st century. If information superiority is the enabler of full spectrum dominance, then funding for future systems must be forthcoming for the United States to maintain superiority. As the military commander's quest for more real-time information about the enemy increases, the capability to provide this information must be developed. All those involved with C4ISR capabilities need to work together in charting a path that exploits the ultimate high ground—space—because the evolution of aerospace power cannot occur in isolation.

If the Air Force believes only an airman knows how to effectively employ airpower, then someone qualified in space operations would know how to effectively employ space power and be given the opportunity to command USSPACECOM or AFSPC. Gen George T. Babbit is not a pilot, but a logistician by trade and commander of Air Force

Material Command.[180] This step would help to build the bonds of a unified aerospace force.

Air Force literature and professional military education need to educate others on how the various air force specialties contribute to the accomplishment of the service's mission. Too many times the focus is on technology, equipment, and the "shooter," when it is the combined efforts of many individuals, to include the ABM and SMO, which make the mission a success. The Air Force individuals pictured on the front and back covers of *The Aerospace Force: Defending America in the 21st Century* are all pilots.

Finally, develop a program where ABMs and SMOs can interact with each other in developing, integrating, and employing present and future C4ISR capabilities. This includes assigning ABMs to USSPACECOM, AFSPC, and the National Reconnaissance Office. This will help foster a better understanding between these communities and reduce the misperceptions about these warfighters of the 21st century aerospace force.

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[180] United States Air Force, "Fact Sheet: General George T. Babbit," downloaded from http://www.af.mil/news/ biographies/babbit_gt.html, 12 February 2000, 1.

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