AIR FORCE SPACE COMMAND

Volume 4, Number 4

HIGH FRONTIER

THE JOURNAL FOR SPACE & MISSILE PROFESSIONALS

INSIDE:

Reflections on the Integration of Black and White Space

Constructing a National Security Space Plan

Assuring Access to Space: The Partnership Continues

NATIONAL SECURITY SPACE COLLABORATION

Headquarters
Air Force
Space Command
Peterson Air Force Base, Colorado

Commander
General C. Robert Kehler

Vice Commander
Maj Gen Thomas F. Deppe

Director of Public Affairs
Col Dewey Ford

Creative Editor
Ms. Nadine Sage

High Frontier Staff

Lt Col Rusty Lorenz
Dr. Corvin Connolly
Dr. Rick Sturdevant
Mr. Masao Doi
Maj Audrey Pfingston
Maj Kirstin Reimann
Maj Frank Zane
MSgt Jennifer Thibault

Published by a private firm in no way connected with the US Air Force, under exclusive written contract with Air Force Space Command. This command funded Air Force journal is an authorized publication for members of the United States military Services. The views and opinions expressed in this journal are those of the authors alone and do not necessarily reflect those of the United States Department of Defense, the United States Air Force, or any other government agency.

Editorial content is edited, prepared, and provided by the *High Frontier* staff. All photographs are Air Force photographs unless otherwise indicated.

High Frontier, Air Force Space Command's space professional journal, is published quarterly. The journal provides a scholarly forum for professionals to exchange knowledge and ideas on space-related issues throughout the space community. The journal focuses primarily on Air Force and Department of Defense space programs; however, the *High Frontier* staff welcomes submissions from within the space community. Comments, inquiries, and article submissions should be sent to AFSPC.PAI@peterson.af.mil. They can also be mailed to:

AFSPC/PA
150 Vandenberg St. Ste 1105
Peterson AFB, CO 80914
Telephone: (719) 554-3731
Fax: (719) 554-6013

For more information on space professional development please visit:
http://www.afspc.af.mil

To subscribe:
Hard copy: nsage@colsa.com
Digital copy: http://www.af.mil/subscribe

Cover: Theme: National Security Space Collaboration

Back Cover: The National Reconnaissance Office satellite was successfully launched aboard a Titan IV-B rocket from Vandenberg AFB, California on 9 October 2001.

HIGH FRONTIER

The Journal for Space & Missile Professionals

August 2008 Volume 4, Number 4

Contents

Introduction

General C. Robert Kehler 2

Senior Leader Perspective

National Security Space Collaboration as a National Defense Imperative
Mr. Scott F. Large 3

Mission Assurance—A Key Part of Space Vehicle Launch Mission Success
Maj Gen Ellen M. Pawlikowski 6

Building an Integrated Intelligence Network: Challenges and Opportunities
Dr. Pete Rustan 10

Transforming National Space Security: Enabling DoD and Intelligence Community Defensive Space Control Collaboration
BG Jeffrey C. Horne 15

Reflections on the Integration of Black and White Space
Brig Gen Katherine E. Roberts 17

Senior Leader Profile

National Security Space – A Personal Perspective: An Interview with General Thomas S. Moorman Jr., USAF, Retired
Mr. George W. Bradley III and Dr. Rick Sturdevant 20

National Security Space Collaboration

Constructing a National Security Space Plan
Mr. Joseph D. Rouge 26

Assuring Access to Space: The Partnership Continues
Col John G. Stizza 29

Common Language, Common Culture: How the Space Community Must Change Language and Perspective to Achieve Cross-Domain Integration and Dominance
Lt Col Dana Flood 31

Rescuing Apollo: Building Consensus toward a National Strategy for Space
Maj Patrick A. Brown 35

Historical Perspective

Not Related to Reconnaissance in Any Way: An Interview with Dr. F. Robert Naka
Dr. Rick W. Sturdevant 39

Book Review

Twilight War: The Folly of US Space Dominance
Dr. Rick W. Sturdevant 46

Next Issue: ***Space Protection***

Introduction

General C. Robert Kehler
Commander, Air Force Space Command

"The major institutions of American national security were designed in a different era to meet different requirements. All of them must be transformed."

~ The National Security Strategy of the United States of America, September 2002

The Air Force Space Command (AFSPC) Mission is clear; deliver space and missile capabilities to America and its warfighting commands. As we look to the future, military space power elements must become more responsive to the warfighter, must remain assured under stressing conditions, must contribute decisively as an integral piece of the larger whole, and must be developed and wielded by space professionals who are recognized leaders in both the space domain and in joint warfighting operations. This quarter's *High Frontier* compiles perspectives on national security space collaboration illustrating the impacts, integration issues, and future challenges of our classified and unclassified space missions. Past and current senior leaders of the National Reconnaissance Office (NRO), the National Security Space Office (NSSO), and Strategic Studies, Directorate of Plans, Programs and Analyses, Headquarters (HQ) AFSPC offer their perspectives, share their personal experiences, and highlight some challenges as we look toward the future.

The first of five articles in the "Senior Leader Perspective," begins with Mr. Scott Large, director, NRO, as he elaborates on the evolving partnerships between the Department of Defense (DoD) and Intelligence Community (IC) and how these newly forged relationships help address America's most pressing national security challenges. Next, Maj Gen Ellen Pawlikowski, USAF, deputy director, NRO, provides her perspective on mission assurance as a key part of space vehicle launch mission success. Dr. Pete Rustan, director, Ground Enterprise Directorate, NRO, follows with an article on the challenges and opportunities facing the DoD and IC in building a fully integrated intelligence network. Fourth, BG Jeffrey Horne, USA, deputy director for Mission Support, NRO, offers his insight into transforming National Security Space to enable DoD and IC defensive space control collaboration. The Senior Leader Perspective concludes with Brig Gen Katherine Roberts, USAF, director, Signals Intelligence Systems Acquisition, NRO, providing her reflections on the integration of "black" and "white" space.

Transitioning to the "Senior Leader Profile," former AFSPC Commander, General Thomas Moorman Jr., USAF, retired, is in the spotlight as he is interviewed and provides his personal perspective on National Security Space.

Progressing through this quarter's volume, we provide four articles on National Security Space Collaboration. Mr. Joseph Rouge, director, NSSO, leads this section with a discussion on the construction of a National Security Space Plan. Col John Stizza, USAF, director, Office of Space Launch, NRO, summarizes the historical partnership between the Air Force and the NRO to leverage both organizations' strengths to create an unparalleled focus on mission success. He further emphasizes the decades of close coordination and relationships with another space launch partner—the National Aeronautics and Space Administration. Third, Lt Col Dana Flood, HQ AFSPC, deputy division chief of Intelligence Plans and Requirements, suggests a common Air Force language and common culture of viewing assets and missions to achieve cross-domain integration and dominance. The fourth and final article in the National Security Space Collaboration section is authored by Maj Patrick Brown, HQ AFSPC, chief of Strategic Studies, Directorate of Plans, Programs and Analyses. He highlights the importance of building a consensus for a national space strategy to provide the basis for future space plans, initiatives, and efforts to guide our actions in the years ahead.

In the "Historical Perspectives" section, we present an in depth interview with Dr. F. Robert Naka, former deputy director of the NRO (1969-1972) and former chief scientist of the Air Force (1975-1978). We round out this quarter's volume with a book review by Dr. Rick Sturdevant, entitled "Twilight War: The Folly of US Space Dominance."

Hopefully this issue spurs insightful discussions and I hope you are leveraging this magazine to expand your personal and professional horizons. As we look forward, there is no doubt the US will continue to be challenged in air, space, and cyberspace. Fittingly, the subject of our next issue is National Security Space Protection. As you form your opinions on space protection, I encourage you to think about the implications of a National Security Space Protection Program, how it impacts the tactical, operational, and strategic levels of war, to include national policy and how space protection contributes to deterrence.

General C. Robert "Bob" Kehler (BS, Education, Pennsylvania State University; MS, Public Administration, University of Oklahoma; MA, National Security and Strategic Studies, Naval War College, Newport, Rhode Island) is commander, Air Force Space Command (AFSPC), Peterson AFB, Colorado. He is responsible for the development, acquisition, and operation of the Air Force's space and missile systems. The general oversees a global network of satellite command and control, communications, missile warning and launch facilities, and ensures the combat readiness of America's intercontinental ballistic missile force. He leads more than 39,700 space professionals who provide combat forces and capabilities to North American Aerospace Defense Command and US Strategic Command (USSTRATCOM).

General Kehler has commanded at the squadron, group, and twice at the wing level, and has a broad range of operational and command tours in ICBM operations, space launch, space operations, missile warning, and space control. The general has served on the AFSPC Staff, Air Staff, and Joint Staff and served as the director of the National Security Space Office. Prior to assuming his current position, General Kehler was the deputy commander, USSTRATCOM, where he helped provide the president and secretary of defense with a broad range of strategic capabilities and options for the joint warfighter through several diverse mission areas, including space operations, integrated missile defense, computer network operations, and global strike.

National Security Space Collaboration as a National Defense Imperative

Mr. Scott F. Large
Director, National Reconnaissance Office
Chantilly, Virginia

In the late 1950s, President Dwight D. Eisenhower divided control of America's space program into three parts: National Aeronautics and Space Administration civil efforts; unclassified defense communications, navigation, and early warning programs; and classified Intelligence Community (IC) and Department of Defense (DoD) projects later incorporated into the National Reconnaissance Office (NRO).[1] In the 1960s, commercial interests joined America's space community with the launch of privately funded, produced, and managed for-profit communications satellites; commercial imaging satellites followed later. Although these four sectors (classified, unclassified, commercial, and civil) remain to this day, America's increasing reliance on space has largely removed the lines that have traditionally separated these distinct aspects of America's space community. Less than a decade into the twenty-first century, the interdependencies between them are clear, as well as the need to consider the parts of America's space program as a unified whole. The level of interconnectivity and interdependency has increased to the point where actions in one sector can conceivably affect all aspects of America's space enterprise. As a result, today America's concept of national security space no longer encompasses only classified and unclassified DoD and IC space systems; it includes all forms of space systems, as well as a growing use of foreign space capabilities.

American decision-makers and military users are as dependent on commercial and civil systems as they are on national NRO or Air Force systems. Capabilities for precise positioning, navigation, and timing, weather prediction, and global communications are the foundational applications for nearly every mission America's defense and intelligence communities undertake—supporting indications and warning, battle damage assessment, targeting, and operations planning and execution. The DoD-developed Global Positioning System (GPS) permits American and allied warfighters to determine their exact location in order to precisely target enemies on the battlefield and execute operations. Yet, GPS also helps farmers grow the food that feeds the population and assists industry in transporting materials that meet the nation's needs. Another DoD-developed space application, the Defense Meteorological Satellite Program, also supports military and non-military users with accurate life-saving weather predication data. Commercial imaging satellites are increasingly important supplements to the NRO's reconnaissance systems and have already made great contributions during crises, such as the 2005 Hurricane Katrina and 2007 California wildfire disasters, in which users required access to unclassified satellite imagery. In the information age, private global communications form the backbone of America's economic well-being. Additionally, these systems carry a large percentage of the nation's military data, critically augmenting America's military satellite communication architecture. This blending of commerce and defense data transmission demonstrates the commercial space sector's national importance. Although civil, commercial, classified, and unclassified space systems support different missions, each has unique capabilities that play vital roles in maintaining America's financial and military security.

Effectively leveraging the various parts of America's space program is a major challenge facing the national security space community. The DoD and IC recognized this emerging problem during the 1990-1991 Persian Gulf War. However, as the United States' dependence on space increases, the challenge of leveraging these systems' unique abilities will become more acute. The developmental and operational expense of space systems, and current budgetary pressures under which defense space finds itself, amplifies this challenge. The DoD and IC are integrating their architectures and collaborating to ensure the greatest amount of leveraging between both communities. National security space elements are jointly developing capabilities to fuse multi-discipline, multi-intelligence tasking with data from a broad spectrum of commercial, national, airborne and space-based sensor platforms. They are also creating interoperable computer networks that share information seamlessly, and new exploitation tools that increase the value of overhead-derived intelligence data.

The DoD and IC are also organizationally changing to apply the strengths of different agencies to some of America's most pressing national security challenges. After the 9/11 terrorist attacks, for example, combat support agencies, like the National Security Agency and National Geospatial-Intelligence Agency, embedded collection managers and analysts in major commands and deployed warfighter units, creating interactive users tools, to improve the delivery of timely intelligence to America's frontline defenders. Warfighters can leverage the global access and rapid retargeting of IC and DoD systems, the unique sources, methods, and fidelity of their data, and the timely processing and dissemination of information through mission partners. On the other hand, the IC can access the large workforce, launch, recovery, and computer infrastructures, acquisition experience, and warfighter perspective from the DoD.

One of the best examples of DoD and IC cooperation is the NRO's relationship with Air Force Space Command (AFSPC) and the Navy's Space Warfare elements. The NRO's relationship with the Air Force is one of its most enduring and valued partnerships, dating back to the NRO's founding on 6 September 1961 as a hybrid DoD/IC agency. In June 2006, the director, NRO (DNRO) and the Air Force chief of staff built on that relationship by signing an NRO-Air Force statement of intent to promote, clarify, and formalize NRO–Air Force cooperation in the areas of development, acquisition, and operation of national security space systems, and the development of space professionals. Under the agreement, the Air Force assigned a two-star general officer to serve as the deputy director, NRO (DDNRO), while the NRO detailed a senior one-star equivalent leader to AFSPC headquarters to serve as the deputy director, Air, Space, and Information Operations. The NRO and Air Force also created a Space Assignment Board, chaired by the DDNRO and vice commander, AFSPC, to oversee assignments of all Air Force credentialed space professionals, lieutenant colonel rank and below, including those at the NRO. To strengthen the relationship between the NRO Operations Center (NROC) and the US Strategic Command (USSTRATCOM) Joint Space Operations Center (JSpOC)—both 24/7 operated watches—USSTRATCOM commander, Joint Space Operations, gained the authority to initiate contingency response actions for all Air Force and NRO orbital assets in response to immediate space threats. The NRO and USSTRATCOM also agreed that the JSpOC and NROC would serve as each other's back-up facility and establish common emergency procedures. Lastly, the NRO and Air Force agreed to conduct lessons-learned reviews on the "long history of cooperation and interdependence between the Air Force, NRO, and industry for launching national security payloads."[2]

In the wake of the NRO-Air Force statement of intent, the NRO and AFSPC strengthened US space situational awareness and defensive space capabilities—an effort that gained great urgency after the widely publicized 11 January 2007 Chinese anti-satellite test. Space debris, natural phenomena, such as solar radiation and sunspots, accidents, and deliberate attacks by adversaries threaten America's on-orbit and ground-based space systems. Protection affects every aspect of America's space community due to the interconnectivity between civil, commercial, unclassified, and classified systems. This requires a holistic approach that leverages the strengths of America's entire space community.

Increased threats to America's space systems prompted the 31 March 2008 NRO and AFSPC creation of a joint Space Protection Program to provide "decision-makers with strategic recommendations on how best to protect [America's] space systems and stay ahead of the threat." General C. Robert Kehler, as the commander AFSPC, and I as the DNRO and the IC's space protection lead, are the Space Protection Program's director, and associate director, respectively. This program's mandate is to "preserve national security space efforts through an integrated strategy and to articulate vulnerabilities, assess threat impacts, identify options, and recommend solutions leading to comprehensive space protection capabilities."[3] In the past, *ad hoc* efforts had typically composed the nation's space protection strategy with inter-agency collaboration, generally limited to individual efforts as people rotated between assignments. General Kehler and I expect the current program to consolidate DoD, IC, and other stakeholder protection programs and requirements into a central national strategy. This senior level focus will better leverage different agencies' resources and maximize the national investment in space. The Space Protection Program will use IC threat assessments of US space adversaries to conduct engineering analysis and develop tactics, techniques, and procedures that mitigate dangers, and formalize procedures and processes that avoid duplicative efforts.

As part of their space situational awareness activities, the NRO and AFSPC also support the space surveillance network to detect, track, catalog, and identify approximately 8,000 baseball-sized or larger objects orbiting the Earth. These objects include active and inactive satellites, spent rockets, and other debris, as well as the Space Shuttle, International Space Station, and active US and foreign satellites. Maintaining a detailed catalog of orbiting objects, and their locations, is necessary to prevent on-orbit collisions and provides the US space community with vital space situational awareness. Established in 1975, this network consists of ground-based radar and optical sensors around the world, which currently transmit data to the JSpOC at Vandenberg AFB, California. The NRO also supports the Talon Spectrum Red Cloud program, an Air Force tactical exploitation of national capabilities program effort to load unique data directly into the catalog of orbiting space objects that the JSpOC maintains. Currently, the catalog only receives data from sensors that are officially part of the space surveillance network. The Talon Spectrum Red Cloud initiative will enable non-traditional sensor data to reach the space catalog, which will enhance America's space tracking capabilities and improve detailed space situational awareness.

The 2006 NRO-Air Force statement of intent emphasizes the importance of building and maintaining a highly qualified competent professional space cadre. Accomplishing this goal is a critical national mission, because America is currently facing a severe shortage of skilled engineers and scientists for present and future national security space programs. The US aerospace industry fell from 1.1 million employees in 1990, to 667,000 in 2000, and 584,000 in 2003, while need for aerospace professionals rose. This trend continues despite intense recruitment efforts. Moreover, the supply of engineers aged 30 to 40, who will become government and commercial aerospace managers within a decade, is about 30 to 45 percent below demand, raising alarms of a coming critical shortage of experienced supervisors. Compounding this problem is the fact that the average US aerospace engineer is nearly 60 years old, and approximately 27 percent of engineers are eligible for retirement.[4]

The acquisition reforms that the national security space community embraced in the mid-and late-1990s have exacerbated the aerospace workforce shortage. The NRO and other national security space organizations adopted acquisition practices, like Cost as an Independent Variable and Total System Performance Responsibility, which minimized government oversight and gave prime contractors significant decision-making authority. The government established system requirements for new acquisitions and left the contractors alone, believing that private industry best practices would produce systems "faster, better, cheaper." However, these acquisition practices produced procurement failures and hindered the professional development of a generation of program managers who were not given the opportunity to develop real-world experience because the contractors did the bulk of the work. In this environment, the national security space community was not a good customer; it failed to supervise prime contractors adequately, and was insufficiently involved in subcontractor oversight. Moreover, after the NRO's 1992 reorganization into functional Imagery Intelligence, Signals Intelligence, and Communications directorates, individuals who would have spent their entire careers at the NRO, instead rotated assignments between the NRO and their parent organizations in order to gain promotion, losing valuable space professional experience in the process. New overly complex acquisition processes diffused program execution responsibility and thus advanced space practitioners without the "scar tissue" necessary to manage large procurement activities successfully.

To address this growing workforce crisis, the NRO and AFSPC are matching space competencies to specific positions and establishing professional development regimens for space operators. Employees at the NRO follow parent service or agency requirements for training and certifications. While an NRO assignment does not postpone or eliminate a parent agency or service educational requirement, the NRO does provide its employees with supplemental training to meet unique NRO requirements, such as acquisition or systems engineering certifications, the parent agency or service does not provide. The NRO and AFSPC are collaborating to set common career standards and supervise the development of space professionals through the Space Assignment Advisory Board, established under the 2006 NRO-Air Force statement of intent. The board's overall objective is to strengthen oversight of the career development of all Air Force credentialed space professionals. It focuses on balancing the Air Force and NRO space professional staffing and experience levels to maintain the appropriate development and utilization of space professionals. Additionally, it helps sustain a sufficient pool of senior space leaders with operations and acquisitions experience at both the Air Force and NRO.

The NRO and AFSPC also support the National Space Security Institute (NSSI) in Colorado Springs. Officially activated in October 2004, the NSSI serves as the DoD's focal point for space education and training, complementing the Air University, Naval Postgraduate School, and Air Force Institute of Technology educational programs. It provides a broad cadre of space professionals with classified and unclassified instruction on America's on-orbit and ground-based space capabilities. The NSSI grew out of the Space Tactics School and the Space Operations School. The Space Tactics School, which existed from 1994 until the US Air Weapons School absorbed it in 1996, responded to lessons learned from the 1990-1991 Persian Gulf War that concluded campaign planners had not fully leveraged the nation's space capabilities. Established in 2001, the Space Operations School focused on broader space concepts and systems.

The NRO, AFSPC, and other space community organizations are also collaborating through the Space Industrial Base Council (SIBC), which the DNRO and DoD Executive Agency for Space co-chair, to maintain critical sources and services to build and sustain America's space systems. Representatives from major US government agencies with equities in America's space program compose the SIBC and analyze US and foreign markets and policies to ensure that America's civil, commercial, classified, and unclassified space communities have the resources to perform their missions. This is important because shortfalls in certain satellite components, or processes that make those components, may affect mission assurance efforts by adding unrealistic costs or time to reconstruct or find a substitute. The government needs to sustain critical suppliers, services, and processes regardless of acquisition programs in instances when the national space community is the only market.

With the support of Congress and mission partners, the NRO-AFSPC relationship is heading in the right direction to meet warfighter and IC needs. Crosscutting communications, fused multi-source data, accelerated information sharing between DoD and IC elements, and common service layers have expanded the value of NRO systems and created a more responsive organization able to confront America's most pressing national security challenges. Instead of the traditional INT-centric approach, the NRO, working with mission partners, is combining data from diverse sensors in new ways, refining products, streamlining delivery, and adding content value to provide analysts and warfighters with improved intelligence. This collaboration has already resulted in more focused, meaningful intelligence for decision-makers, analysts, and those in harms way.

Notes:

[1] R. Cargill Hall, "Sputnik, Eisenhower, and the Formation of the United States Space Program," *Quest: The History of Spaceflight Quarterly* 14, no. 4 (2007), 32-39; R. Cargill Hall, "The Eisenhower Administration and the Cold War: Framing American Astronautics to Serve National Security," *Prologue: Quarterly Journal of the National Archives,* 27 (Spring 1995), 59-72.

[2] Statement of Intent, Air Force-NRO Relationship, General T. Michael Moseley, USAF chief of staff, Donald M. Kerr, director, National Reconnaissance Office, 7 June 2006.

[3] Memorandum of Agreement, General C. Robert Kehler, USAF, commander, AFSCP and Scott F. Large, director, National Reconnaissance Office, SUBJ.: Establishment of the Space Protection Program, 31 March 2008.

[4] Patricia Maloney and Michael Leon, "The State of the National Security Space Workforce," *Crosslink* 8 (Spring 2007), 6.

Mr. Scott F. Large (BS, Engineering, University of Central Florida) became the sixteenth National Reconnaissance Office (NRO) director (DNRO) and was also appointed assistant to the secretary of the Air Force (Intelligence Space Technology) in October 2007.

Mr. Large joined the Central Intelligence Agency (CIA) in 1986 as a project management engineer in the Office of Development and Engineering developing advanced spacecraft payloads at the NRO. He held various senior development and systems engineering positions within the NRO's Imagery Systems Acquisition and Operations Directorate through 1996. Also during this time, he served one year as the executive assistant to the DNRO. In 1997, he became deputy director of the Future Imagery Architecture Program.

In 1998, Mr. Large was appointed the deputy chief for programs within the CIA Directorate of Operations' Technology Management Office. In this position, he helped administer a joint national program while assisting in the development of the program's strategic plan and program management process. In 2000, he was selected as director of the Clandestine Signals Intelligence Operations Group in the Office of Technical Collection within the CIA's Directorate of Science and Technology. While there, he led the development and execution of critical collection operations for the Intelligence Community. In September 2000, he became the deputy director of the Office of Technical Collection.

Mr. Large's last CIA assignment was as the associate deputy director for the Science and Technology Directorate, beginning in September 2001. He returned to the NRO to serve as director, Imagery Systems Acquisition and Operations Directorate, from July 2003 to November 2006. Mr. Large was the director, Source Operations and Management Directorate at the National Geospatial-Intelligence Agency until April 2007 when he again returned to the NRO to assume the position of NRO principal deputy director.

Mission Assurance—A Key Part of Space Vehicle Launch Mission Success

Maj Gen Ellen M. Pawlikowski, USAF
Deputy Director, National Reconnaissance Office
Chantilly, Virginia

Recent years have shown unprecedented levels of launch success for both Air Force and National Reconnaissance Office (NRO) missions. In order to achieve these results, many people and organizations have employed processes and worked in a disciplined and collaborative fashion to ensure every aspect of the mission has been examined, every scenario has been considered, and every risk has been understood, accepted, or mitigated before a multi-million dollar launch vehicle ignites, carrying a billion dollar payload. This collection of activities over the lifecycle of a space vehicle development program and through launch is called mission assurance.

Like in other national security space agencies, mission assurance is a key part of ensuring mission success for Air Force and NRO launches. All launches involve integrating the activities of one organization with another, whether those organizations are both internal to the Air Force or between the Air Force and the NRO. The mission assurance process allows the disparate organizations involved in the lifecycle of a program to speak in a common language with a common framework about different aspects of a mission. With mission assurance, program offices use a structured, disciplined, and layered verification process that requires rigorous analysis by subject-matter experts on every aspect of a mission to ensure all risks are known. Requiring programs to go through this process ensures that no rock is left unturned before launch. Mission assurance gives us the highest level of confidence to proceed with launch and ultimately ensures the best opportunity for mission success.

The Need for Strong Space Vehicle Mission Assurance Practices

In the late 1990s, the US launch industry suffered five major failures, including three Titan IV vehicles, losing Air Force and NRO payloads totaling over $3 billion. As a result of these failures, the president asked the secretary of defense to examine the failures and provide a report on the causes and corrective actions being taken to prevent their recurrence. The resulting Broad Area Review (BAR) of space launch, chaired by former US Air Force Chief of Staff, General Larry D. Welch, retired, was completed in November 1999. Three follow-up reviews were conducted through 2003.

The series of BAR reports were critical of existing mission assurance processes, as modified during a period of acquisition reform in the early 1990s. The BAR recommended changes to strengthen those processes by returning to earlier methods to prevent future failures. The BAR recommended incorporating several key features, such as clear accountability, strengthened systems engineering, process discipline, independent reviews, and government involvement in the mission assurance process.

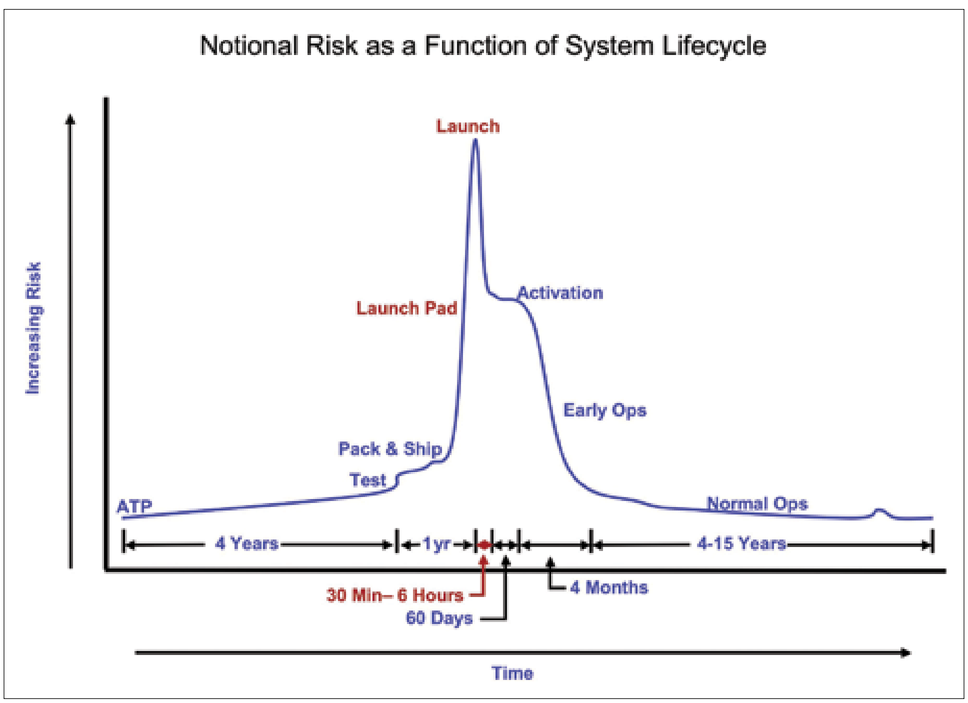


Figure 1. This notional chart shows that launch often is the greatest risk to any space system over its entire lifecycle.

Beyond the specific launch failures of the 1990s, mission assurance is a mandatory process that lays the foundation for successful launches. Each launch offers one—and only one—chance at mission success. There are no unconstrained post-launch orbital corrections, and there are no de-orbits of spacecraft to fix faulty wiring. There is no pre-launch flight testing; there is no second chance for success. We must ensure that every launch places a satellite in the correct orbit and that once there, the satellite performs flawlessly. Because of this, we continuously incorporate the lessons of the BAR into the Evolved Expendable Launch Vehicle program that provides the Delta IV and Atlas V space launch vehicles.

Defining Mission Assurance

Mission assurance is both a process and a culture that must be adhered to by all individuals involved with launch. As a process, mission assurance is an iterative, continuous, technical, and management activity employed over the entire lifecycle of a launch system to achieve confidence in mission success. Mission assurance includes a disciplined application of systems engineering, risk management, quality assurance, and program management principles. Mission assurance is performed by a partnership of both contractor and government, beginning at concept design and continuing through launch operations and post-flight analysis.

The launch mission assurance process consists of three primary elements. The first two, system design assurance and operational mission assurance, together demonstrate that the fully-integrated launch vehicle and its payload have been reviewed, all known technical issues have been assessed and resolved, residual launch risks have been satisfactorily assessed and accepted or mitigated, and confidence in launch mission success is acceptable. This process requires an in-depth review and validation of the launch system design, launch system manufacture and preparation, launch site processing, payload integration and mission design, and flight and ground hardware, software, and interfaces. These two elements result in a design certification and launch readiness verification.

Third, independent space vehicle mission assurance includes additional technical assessments of the system design to increase confidence that no issue has been missed or incorrectly dispositioned during the certification and verification processes. This process represents a third set of eyes to ensure the contractor and program office's technical and quality assurance processes have been adequately performed and all significant mission risks have been independently assessed.

Both the Air Force and NRO are doing this routinely and systematically. The Air Force, through the Space and Missile Systems Center (SMC), has its Independent Readiness Review Team. The NRO, through its Office of Space Launch, has its Mission Assurance Team. Both organizations perform mission assurance checks and readiness assessments as independent arms of their respective commanders.

Carrying out these structured and disciplined mission assurance processes is critical to mission success. But equally important is maintaining a culture of mission assurance. The way of doing the business of mission assurance requires strict attention to detail, rigorous analysis of issues, and a commitment to 100 percent mission success. Each individual must assume personal accountability and responsibilities both to perform successfully their part of the mission and to work collaboratively with others to ensure the process functions as a whole. This culture is revalidated periodically and passed along as experienced personnel depart and new individuals and teams step in. In addition, mission assurance is incorporated into various training classes and certification programs.

Though we have had an impressive string of successful launch performance in recent years, we must never become complacent with our successes. The culture of mission assurance requires recognition, acceptance, and continual awareness that each launch is unique and poses new and different integration challenges. While no two launches are the same, the process is. The mission assurance processes for the next launch must be carried out with the same rigor and focus as those for the last launch. We are only as good as our last launch.

Key Features of Space Vehicle Launch Mission Assurance

Procurement strategy. The first key feature of space vehicle launch mission assurance is the current "Buy 3" strategy for launch procurement that makes industry a full partner in the mission assurance process. Largely a result of the BAR, "Buy 3" expands upon and normalizes the mission assurance features that were added to earlier buy strategies. Unlike the "Buy 1" and "Buy 2" strategies, which were both for commercial fixed price contracts, "Buy 3" separates procurement into two components—one a fixed price and the other a cost-plus contract.

The fixed price portion of the contract is for the launch service—buying the hardware and touch labor associated with each individual launch, plus a mission success incentive. The cost-plus portion of the contract is to maintain launch capabilities for mission assurance—the workforce, facilities, and data sharing required to perform integration and launch, handle contingencies, and reach agreement—not just consensus—when issues arise. An award fee plan tied to this portion of the contract ensures that launch providers will maintain key mission assurance capabilities, irrespective of launch demands and timelines, and continue to perform quality work.

Unlike "Buy 1" and "Buy 2," with "Buy 3" mission assurance is no longer procured on an as-needed launch basis. Instead, industry has become a full partner in mission assurance because they are incentivized to maintain sound mission assurance capabilities across launches. This procurement strategy provides assured US access to space and ensures that launch vehicle providers maintain the infrastructure and expertise to deliver mission success.

Clear accountability. One of the key recommendations of the BAR was to de-fragment the accountability for spaceflight worthiness and launch. At the time the BAR was conducted, there was no single entity responsible for understanding and tracking the pedigree of a launch vehicle from design to delivery of a spacecraft on orbit.

Adopting the BAR recommendations, Air Force Space Command Instruction (AFSPCI) 10-1208, *Spacelift Operations,* and its lower level SMC Instruction 63-1201, assign overall responsibility to the commander of the SMC (SMC/CC) for delivering systems to orbit. These instructions implement Air Force Policy Directive 10-12, *Space,* Air Force Instruction (AFI) 10-1201, *Space Operations,* and AFI 10-1211, *Space Launch Operations*.

Together, these documents establish Air Force Space Command (AFSPC) roles and responsibilities relating to spacelift operations. The SMC/CC is responsible for certifying spaceflight worthiness approximately one to two weeks prior to launch. Concentrating this authority and accountability in the SMC/CC ensures that the certifying individual gains insight throughout the development of the satellite-launch vehicle system to make the certification with confidence.

Once that certification is made, equally important are clear roles and responsibilities between developers and launch operators in the final weeks before launch. AFSPCI 10-1208 and AFSPCI 21-202v2, *Missile Maintenance Management,* outline

Figure 2. The Aerospace Corporation has a long history of developing tools, models, data, analysis, and testing capabilities to support mission assurance for both the Air Force and National Reconnaissance Office.

the interdependent responsibilities of the developers and acquirers at SMC or NRO and the launch operators at the 14th Air Force. Clarifying how these two organizations interact up to and on the day of launch assigns clear responsibility and accountability to ensure that nothing is overlooked due to confusion over roles and responsibilities.

One key individual in the final weeks between certification and launch is the mission director. Once spaceflight worthiness certification is made, the mission director is responsible for ensuring that flight worthiness is maintained all the way through the remaining operations, including countdown and launch. The mission director, under SMC authority for Air Force payloads and NRO authority for NRO payloads, is the overall mission team lead in establishing the focus for mission assurance and mission success.

Continuity and independent verification. The Aerospace Corporation, a dedicated Federally Funded Research and Development Center supporting both SMC and NRO, plays a key organizational and technical role in providing mission assurance.

First, The Aerospace Corporation provides the critical role of technical continuity for SMC and NRO. Though active duty military personnel rotate frequently through launch and system program offices, Aerospace employees can remain with programs through most or all of a development cycle.

In addition, The Aerospace Corporation maintains a depth of independent technical capabilities to analyze potential issues and render assessments on spaceflight worthiness. The Aerospace Corporation has a long history of developing tools, models, data, analysis, and testing capabilities. These processes and tools have been validated many times over through The Aerospace Corporation's ongoing support of all major Air Force space programs. Aerospace facilities, employees, and processes together create a level of technical expertise that has, many times over, been called on to determine whether a particular issue will result in mission failure. This technical depth and excellence is a critical component to mission assurance and final launch certification.

Finally, the fact that the same Aerospace organization, personnel, and processes support both SMC and NRO ensures a bedrock foundation for those missions requiring partnership between SMC and NRO.

Review process. The final key feature of the space vehicle launch mission assurance process is the series of extensive reviews, both those leading to the spaceflight worthiness certification and go/no-go decision for launch and the post-flight data reviews conducted after launch.

The three major reviews preceding every launch are the Mission Readiness Review (MRR), Flight Readiness Review (FRR), and Launch Readiness Review (LRR). These critical reviews are in addition to the many reviews that the program office, contractors, and The Aerospace Corporation conduct throughout the design, development, and integration process.

The first critical review, the MRR, evaluates the flight hardware, launch and support facilities, range and orbital operations, and readiness and training of the operating personnel. The purpose is to determine whether all elements of the launch system are ready to accept the payload and proceed toward launch. Successful completion typically results in a "consent-to-ship" the payload to the launch site, five or six months prior to launch.

The second critical review, the FRR, focuses on launch vehicle, spacecraft, range and satellite control network readiness status; impacts from previous missions; open technical issues; and the launch mission assurance verification process. The purpose of the FRR is to ensure all stakeholders, including the system program office, launch program office, The Aerospace Corporation, prime contractors, and SMC/CC agree that the launch stack is spaceflight worthy and ready to begin final launch operations, one to two weeks before launch. The FRR results in the SMC/CC making the spaceflight worthiness certification based on the recommendation of the mission director and the senior representatives of the launch team.

The final critical review, the LRR, ensures that all elements of

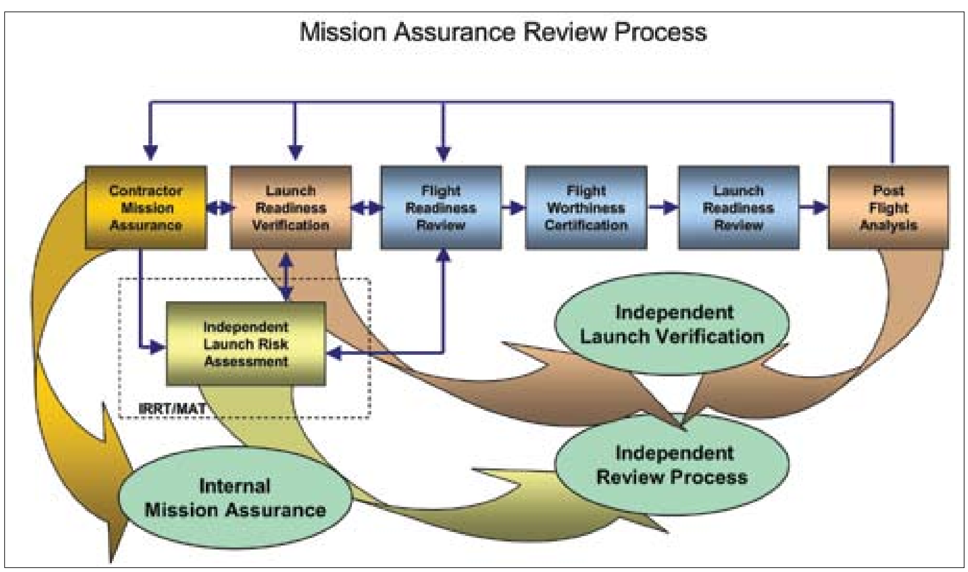


Figure 3. Pre- and post-flight reviews ensure checks and balances in the mission assurance process.

the launch system are operationally ready to support the launch. Typically conducted the day before launch, the LRR results in a final determination to enter the launch countdown. The spacelift commander (SLCC), as the launch decision authority under the direction of the commander of AFSPC, chairs the LRR and calls for the launch site, range safety, and range operations go/no-go determinations for launch. During day of launch operations, the SLCC makes the "clear to launch" statement following the mission director's final "go for launch" decision. This decision is based on the mission teams' assessment of the integrated launch vehicle and spacecraft stack.

Following launch, formal post-flight reviews are conducted by both The Aerospace Corporation and the launch vehicle provider for each mission. The post-flight analysis assesses any anomalies for a given flight, as well as any specified investigations in the event of a mission failure or mishap. Output products from each review, post-flight analysis, and lessons learned are assessed for impact on subsequent missions and the launch vehicle fleet as a whole. These reviews ensure that maximum value can be carried over from the lessons of one launch to the next.

This extensive and exhaustive review results in more than 2,000 individual items being certified before launch, as well as many more areas examined in the weeks and months following. This attention to detail, from the bottom up, across every aspect of the mission, and through several different individuals and teams, is a critical component of mission assurance.

Mission Assurance Works

There are many examples of how the rigorous mission assurance process has detected and corrected issues that would have caused launch failures if left uncorrected.

In one example, an engine bearing failed several acceptance test firings, raising concerns over its reliability. Technical experts at The Aerospace Corporation analyzed test data and bearing design, manufacture, and materials. They concluded that the probable cause of the failure was a change to a lower-strength material for the bearing. They also concluded that low pressure in the turbopump gearbox during the initial test firing of the engine contributed to the failures.

Based on these findings, new criteria were established for bearing acceptance and for the initial hot fire test run. Engines scheduled to fly were screened using these criteria, and where required, the bearing was changed. Additionally, the turbopump gearbox pressure requirement has become a standard screening criterion for Air Force engines and provides added engine reliability.

Detecting this issue during testing shows that the many reviews, tests, and certifications are critical for mission assurance. The ability to examine the issue and identify its root cause demonstrates the necessity of the technical expertise of The Aerospace Corporation and their partnership with the Air Force and NRO. Incorporating the findings of these analyses into the overall verification means the mission assurance process will forever remember this issue and ensure that the same conditions do not place future missions at risk.

Strengthening Launch Mission Assurance for the Future

A hallmark of mission assurance is striving for continuous improvement. Each mission and each launch teaches us one more thing about risk mitigation and technical excellence for spaceflight. Continuing the mission assurance process, consciously identifying successful and unsuccessful practices, and incorporating new developments will strengthen the mission success ratio.

As the space vehicle launch mission assurance process itself is improved, we also must share successful practices across our space enterprise. One existing example of this is the annual Mission Assurance Forum. This forum brings together stakeholders from industry and government across the space vehicle enterprise to describe and baseline current processes, share lessons learned, and disseminate best practices. Increased interactions between the Air Force, NRO, NASA, Missile Defense Agency, United Launch Alliance, prime contractors, and others result in increased cross-pollination and increased mission success for all types of US space assets.

Conclusion

In the almost decade since the costly failures of the late 1990s, SMC and the NRO have adopted a "back-to-basics" approach to mission assurance. This refocused mind-set has permeated the national security space community and is manifested in a culture of assuring each mission is flightready and flightworthy. From the SMC/CC down, each individual involved in contributing to the mission feels accountable for thoroughly resolving every issue and assuring 100 percent mission success.

These revitalized initiatives will increase the credibility of the space vehicle acquisition community, strengthen partnerships between the Air Force, NRO, and the other national security space agencies, and deliver the world's best space capabilities to our joint warfighters and the nation.

Maj Gen Ellen M. Pawlikowski (BS, Chemical Engineering, New Jersey Institute of Technology; PhD, Chemical Engineering, University of California at Berkeley) is the deputy director, National Reconnaissance Office, and commander, Air Force Space Command Element, Chantilly, Virginia. As deputy director, she assists the director and principal deputy director in the day-to-day direction of the NRO and also serves as the commander for Air Force civilian and uniformed personnel assigned to the organization.

Major General Pawlikowski has served in a variety of technical management, leadership, and staff positions in the Air Force. Previous assignments include vice commander, Space and Missile Systems Center, Los Angeles AFB, California, and commander, Military Satellite Communications Systems Wing, Space and Missile Systems Center, Los Angeles AFB, California. She was selected for promotion to major general in March 2008.

Senior Leader Perspective

Building an Integrated Intelligence Network: Challenges and Opportunities

Dr. Pete Rustan
Director, Ground Enterprise Directorate
National Reconnaissance Office
Chantilly, Virginia

Our adversaries, ranging from nation states to terrorist groups, take full advantage of information available on the internet and have deployed many networks to conduct their operations. In today's information technology (IT) world, we must fight their networks with an intelligence network much more powerful than anything available to them. People often state it takes a network to fight a network; but I contend it takes much more than that, it takes a more powerful and fully integrated network, with increased access, enhanced content, and reduced timelines. The National Reconnaissance Office's (NRO) vision is a fully integrated Department of Defense/Intelligence Community (DoD/IC) network, where information is virtual, assured, available on demand, and globally accessible to authorized users empowered with the tools and services necessary to generate tailored, timely, trusted, and actionable intelligence products. This architecture must operate as efficiently as the best commercial IT and knowledge service networks, and enable authorized users to receive, task, and query trusted information on-demand to improve the speed and execution of decisions from anywhere in the world. This article describes the challenges the NRO faces as we develop information products and services for use across the DoD and IC that ride on this powerful network with accurate and timely intelligence information on any problem of interest. Additionally, this article describes the tremendous opportunities available as we build this integrated intelligence network.

Over the past 48 years, the NRO has been known as the premier acquirer and operator of the nation's space reconnaissance capabilities. However, in today's world, the NRO also needs to work with our partners in the DoD and the IC to add more value to the data the NRO collects and provides to warfighters and intelligence analysts. While the NRO must maintain and continue to build on its expertise in system acquisition and operational excellence, it must also transform itself into a world class provider of information products and services. To start this transformation, the NRO must work with the National Geospatial Agency (NGA) and the National Security Agency (NSA) to build an integrated and scalable ground architecture capable of fusing overhead geospatial intelligence and signals intelligence with air and ground based collectors, as well as integrating other sources of information. This NRO, NGA, and NSA collaboration will provide new information products and services through an enhanced multi-intelligence (multi-INT) framework that is not possible using today's business model. In addition, we must build on our information assurance capabilities to securely share data with our mission partners and users. Our business should leverage the streamlined business practices used by the expanding commercial information technology/information services (IT/IS) industry, including the implementation of a service oriented architecture (SOA), migrating our infrastructure to commercial-like data centers, and capitalize on economies of scale by leveraging system commonality.

Challenges and Opportunities

Figure 1 illustrates some of the major challenges facing the community, and a rough estimate of the percentage of effort

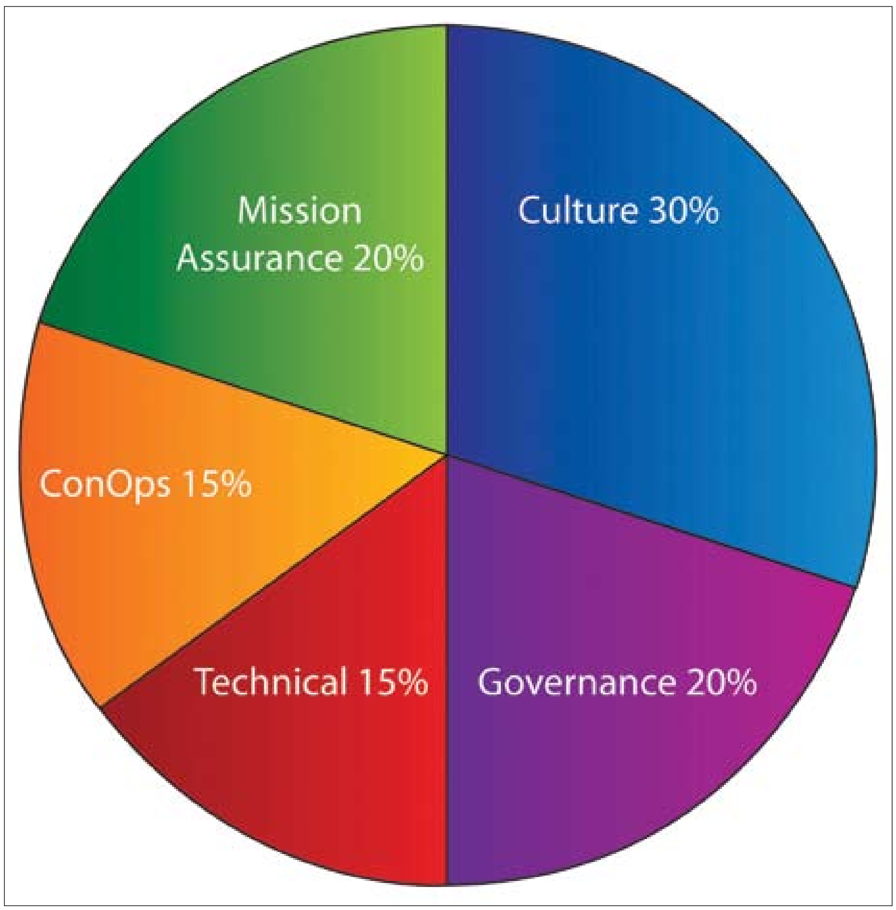


Figure 1. Challenges facing the Department of Defense/Intelligence Community in building a fully integrated intelligence network.

required for each category. Next, we will discuss these challenges and the potential opportunities available to solve these problems.

Cultural Challenge – 30 Percent

There are two aspects of the cultural challenge. The first deals with the need to adopt commercial business practices, the second relates to information sharing. Global geopolitical challenges, when coupled with the ever expanding capabilities of the commercial IT market, demand a completely new approach to solving present and future intelligence challenges. Unfortunately, the largest and most established government organizations offer the strongest resistance to change because they have become highly bureaucratic, generally following processes established prior to the advent of the internet. Human nature is such that people often get attached to existing procedures and do not change their approach, even when the problem or circumstances surrounding the initial conditions have changed significantly. There is also potential risk in change because one cannot predict the intended and unintended consequences of the new methods being proposed. As a result, our bureaucratic organizations have become very risk averse. We have established a multitude of processes that require inordinate amounts of time to execute (even for small tasks) and we have become unwilling to tolerate any changes.

The recapitalization cycle for successful IT businesses is measured in months, not years, and we must adopt their streamlined business practices into our acquisition strategies. A significant barrier is the amount of existing infrastructure that has been built up over many years. It would seem much easier to build a brand new system from scratch to achieve a given set of capabilities than to evolve a legacy system. Legacy systems generally have a number of unique and highly customized designs focused on solving very specific problems. They are difficult to modify and generally limit the government to a small group of contractors, or even a single contractor, who can perform the work required to make them interoperable. Unfortunately, the upfront costs associated with a "clean slate" approach are often too high in the near term, and the risk to existing operations threaten their approval even though their successful implementation would result in increased capabilities and long-term lower costs.

We must also embrace the open standards that are being widely accepted throughout the IT/IS industry to enable us to become more flexible and agile in our responses. Open standards give us access to a broader commercial industry base and should also reduce the overhead associated with test and integration as compared to traditional customized solutions. Finally, we must move away from one-of-a-kind, monolithic acquisitions that required years, if not decades, to build with no margin for error. The future of space acquisition must be based on larger constellations of smaller, cheaper platforms, that plug into modular ground systems (acquired separately from the satellites) using the latest commercial IT developments.

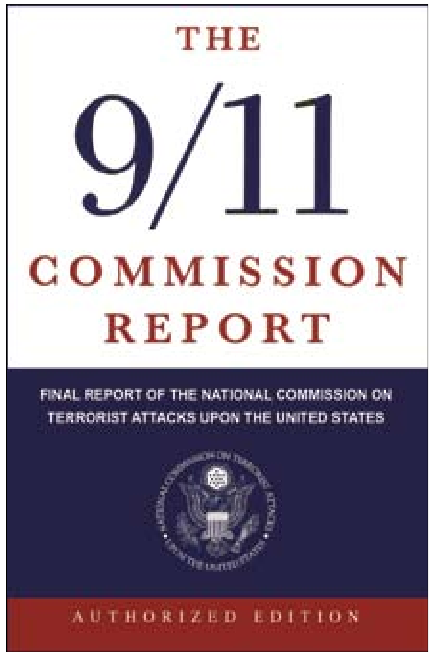


Figure 2. The 9/11 Commission Report.

Information sharing is another cultural change that must be addressed. The terrorist attacks on 11 September 2001 forced us to begin the process of breaking down cultural barriers within the DoD and the IC, and sparked the beginning of a fundamental transformation to meet the changing threat environment. The National Commission on Terrorist Attacks Upon the United States (9/11 Commission) proposed sweeping changes to the IC. The 108th Congress passed several of the proposals, referred to today as the Intelligence Reform and Terrorism Prevention Action of 2004, that were signed into law by President George W. Bush. In October 2005, the director of National Intelligence (DNI) published the nation's first National Intelligence Strategy (NIS). The strategy called for integrating domestic and foreign US intelligence and aimed at eliminating gaps in our understanding of threats to our national security, bringing more depth and accuracy to intelligence analysis, and ensuring US resources are used to define future capabilities as well as present results.

Today, the military services and IC organizations do not work as a fully integrated entity and do not have effective mechanisms for making all data available to each other using standard formats. Many policy barriers still exist within the DoD and IC restricting the disclosure of classified information based on a "need to know" philosophy. These policies must migrate to a "responsibility to share" mindset to support the prosecution of a much more agile enemy and to allow us to take advantage of the information sharing technologies that we have become so familiar with on the Internet. From my perspective, the most important capability we must have to address present challenges is an integrated intelligence network. So far, our established culture has prevented the DoD and IC from building a unified network with the ability to deliver fused information products and services from various collectors directly to our user community.

Unfortunately, the largest and most established government organizations offer the strongest resistance to change because they have become highly bureaucratic, generally following processes established prior to the advent of the internet.

If we can address these cultural problems, we will deliver enhanced information products and services based on multiple collectors over an interoperable network to yield far greater intelligence. Users should be able to make improvements to existing intelligence products and create new ones with the knowledge that the available information is assured and secure. We should work with the users to build interactive tools and services, accessible through common interfaces, to tailor multi-INT information to meet their specific needs. Each system and information stream produced by the DoD and IC should become a data feed accessible by authorized users.

Governance Challenge – 20 Percent

DoD and IC agencies are tied to their functional managerial roles that were established by policies written when we faced a different enemy and when we did not have access to the information technologies available today. These organizations will have to shed outdated roles to create a virtual enterprise. Breaking existing functional relationships are difficult without strong leadership and direct guidance from the president and the National Security Council. To break the governance barriers, new sets of governing rules will have to be provided.

To improve mission performance, expand information sharing, and reduce the cost of ownership, the IC and the DoD have created the Integrated Intelligence Architecture Leadership Board (IIALB). The IIALB provides a forum to jointly evaluate and structure solutions to network interoperability problems. A DoD-IC Joint Technical Board (JTB), reporting to the IIALB, manages and coordinates solutions to the identified and prioritized interoperability needs. The JTB applies a business model to determine the optimal level of federated versus unified execution as well as the resulting and appropriate governance model. The IIALB governance body should provide effective management to ensure every piece of information is discoverable and accessible in real-time.

Mission Assurance Challenge – 20 Percent

Users must know that the data has not been altered, modified, or tampered with in any way and that the information provided is from a trusted source. Making security transparent to the customers, without system performance degradation and complexity, is an enormous challenge but vital to delivering trusted information to the users. Integrating security mechanisms into the integrated ground architecture and providing them as a service will preclude providers from having to develop and implement unique solutions. A cohesive and deliberate approach to security and mission assurance is fundamental to addressing the customers' needs.

Technical Challenge – 15 Percent

Intelligence analysts, warfighters, policymakers, and other decision makers require on-demand access to information products and services with assured content. Our objectives, milestones, and performance metrics are all designed to fulfill that fundamental need in the community. That need applies to a wide range of intelligence problems, including but not limited to:

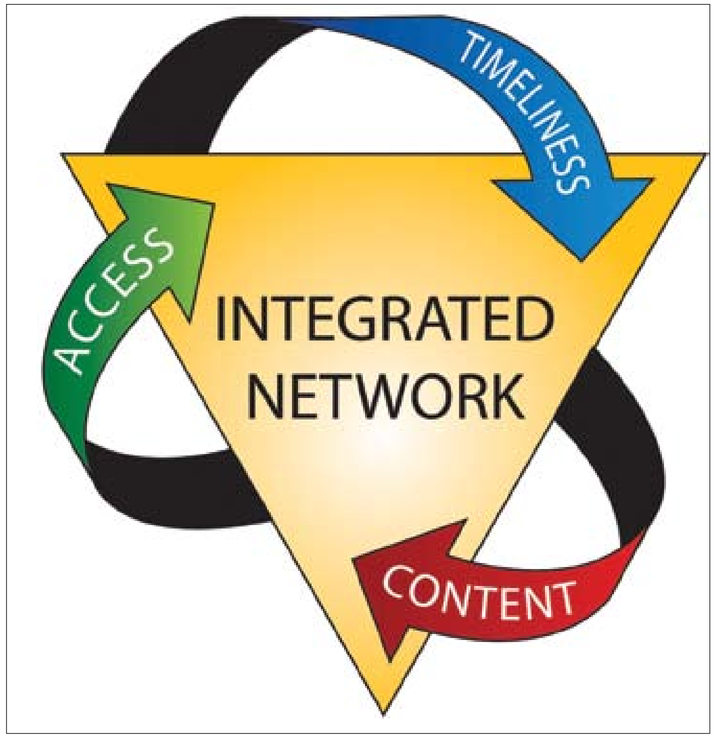


Figure 3. Improvement Focus Areas.

- monitoring weapons of mass destruction
- countering the threat of improvised explosive devices
- global war on terror
- combat search and rescue support
- high value target location and tracking
- drug interdiction and ship tracking
- missile launch detection
- weapon and space system performance characterization
- strategic indications and warning

Our technical challenge is to ACT (access, content, timeliness) by building an integrated and interoperable DoD/IC network, providing expanded access, enhanced content, and reduced timeliness:

Access. Users, regardless of their role, require relevant data and information to be readily available. Common, user-friendly interfaces that simplify their ability to produce, discover, acquire, understand, and use intelligence, regardless of its data sources or types, are critical to operational success. Our approach is to work with our partners to post all information products and services at the earliest point of consumability instead of only delivering those information products and services to individuals that request the information.

Content. Users will always demand continuously improving information content, from both new and existing information products and services. Improved performance characteristics such as better geolocation, improved product quality, and data fusion across all collection platforms are central to our intelligence needs. Analysts must also be able to combine real-time information with information collected in the past to determine strategic and tactical changes.

Timeliness. Users demand the information they need, when they need it, and have little patience for delays resulting from disparate systems and dissemination mechanisms. While the specific requirements for different user groups vary, a war fighter's decision timeline may be dramatically shorter than an analyst tracking a strategic threat. The bottom line is that users need their information on their timelines.

To make ACT a reality we must integrate our ground infrastructure. The mission processing, mission management, and command and control areas have to be optimized to ensure that every new or existing operational system complies with a common set of standards to facilitate multi-mission tasking and data integration. Where necessary, we will migrate legacy systems to new common standards. We will take advantage of commonalities in existing systems and systems in development to eliminate redundancy and maximize interoperability. We will no longer build customized ground systems tailored to specific spacecraft; instead, we will acquire ground systems as an enterprise using the best available commercial technologies for future systems.

We must enable dissemination of data to our forces in the field to the "last tactical mile." This will require a two pronged approach where we continuously enhance the speed and capacity of the networks while investigating data format changes that allow data streaming in real-time over low bandwidth communications.

Overcoming these technical challenges will enable a fundamental shift in how intelligence is collected, processed, disseminated, and exploited. It will require a complete transformation of our ground architecture, without the disruption of current operations, and the development of new, multi-INT information products and services. Fortunately, there are no technical miracles needed to fulfill these needs.

Concept of Operations Challenge – 15 Percent

Our end state will be an IC enterprise that operates as efficiently as the best commercial IT and knowledge service companies, enabling authorized users to receive, task, and query trusted information on-demand to improve the speed and execution of decisions from anywhere in the world. Our intelligence network must be designed to anticipate mission needs for information by making the complete spectrum of sources of information seamlessly fused and available to the users. Our concept of operations will encourage new collaboration opportunities with improved analytic practices. It will operate like the best commercial IT networks, using common standards and cost-effective enterprise-wide IT services. It will provide users with common administrative and operational services accessible through a common desktop operating across multiple security levels based on the user's credentials.

Implementing the Vision

Figure 4 shows five key enablers to implementing this vision: SOA, Distributed Common Ground System-IC (DCGS-IC), network consolidation, data centers, and economies of scale. The adoption of SOA is one of the largest trends in commercial markets today. SOAs foster innovation and agile development by focusing on the service provided and not on the specific implementation behind the service. This enables service managers to modify a service to enhance the user's experience without changing the fundamental service provided. The implementation of SOA is directly tied to the use of open standards that enable us to evolve away from customized solutions and foster greater access to information than ever before.

DCGS-IC is a collaborative SOA effort to share data, information, intelligence, and services across the IC in a net-centric manner consistent with the emerging DoD DCGS and Joint Intelligence Operations Command (JIOC) enterprises. It is designed to meet the community requirement for information at the earliest point of consumability, ensuring the unique data and services provided by the NRO are interoperable, discoverable, accessible, and usable by the DoD and IC. Our desired network should leverage the large DoD investment in developing the architecture, standards, documentation, and tools for the defense industrial base. The attributes we are striving to achieve with our implementation are:

- common core services and infrastructure

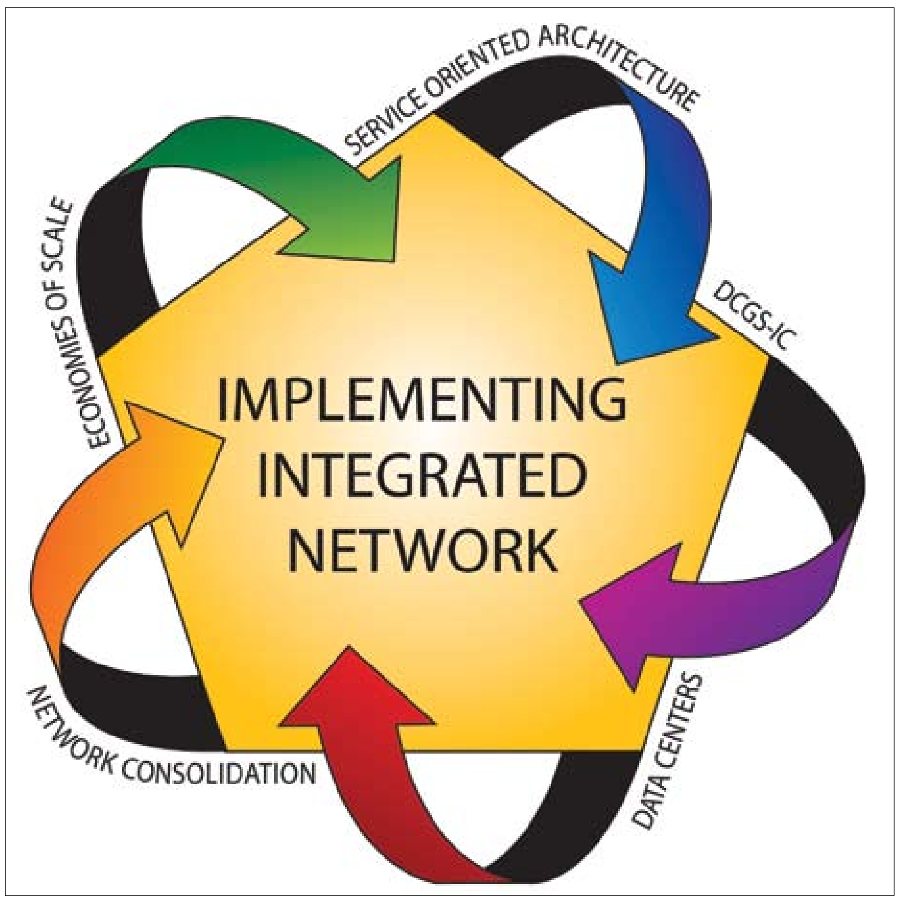


Figure 4. Five Key Enablers for Implementing the Vision.

… we can leverage economies of scale by developing integrated mission management, mission processing, and command and control. We should no longer build a specific ground system for each spacecraft, but build a basic, common architecture for new systems to "plug into" with minimum customization.

- re-use of services
- single query access to multiple intelligence sources
- delivery of unique, net-enabled value added IC services
- ubiquitous, common-standard visualization interface
- discoverable data and services
- global situational awareness
- rapid acquisition and transition of new capabilities
- use of "live/real" data for testing

Network consolidation is essential to the success of our SOA efforts. It is also in line with DNI and the chairman, Joint Chiefs of Staffs' strategic guidance to establish a single information environment across the community. We are engaging with the DNI chief information officer and our mission partners to enable community collaboration across a peered federation of DoD and IC enterprise frameworks. There are two essential steps. First, NRO, NGA, and NSA should work together as one entity operating on one network. Then, all available intelligence, whether from the DoD intelligence organizations or the IC, should be integrated into the same network.

A growing trend in the commercial IT market is the use of data centers. Data centers provide extraordinary opportunity for integration of mission data and applications, effective tipping and cueing, multi-INT data fusion, and hardware and software cost savings by capitalizing on mission commonality. Data centers can also provide a common repository for mission data archiving. By merging our data into master data repositories across agencies, we can ensure the pedigree of our data and provide our customers with a flexible platform capable of meeting their needs.

Finally, we can leverage economies of scale by developing integrated mission management, mission processing, and command and control. We should no longer build a specific ground system for each spacecraft, but build a basic, common architecture for new systems to "plug into" with minimum customization. Depending on the model being used, one can demonstrate that between 50 percent and 80 percent of the mission management, mission processing, and command and control are the same regardless of the specific spacecraft mission. Consolidating these functions using data centers and operating the spacecraft using SOA should provide economies of scale.

Summary

This article describes the capabilities that could be available to the DoD and IC if we build an integrated interoperable intelligence network. It addresses challenges and opportunities, including culture, governance, mission assurance, technical, and concept of operations. It also presents the next steps required to achieve this vision. That is, accelerating the development of SOA, DCGS-IC, network consolidation, data centers, and benefiting from economies of scale to achieve the best value proposition.

The author encourages collaborative developments between the various IC agencies and the DoD to build information products and services based on data collected from multi-INT sensors. We must proceed with a sense of urgency since today's problems cannot be addressed effectively unless these information products and services are made available on an integrated and interoperable intelligence network that is more powerful than anything available to the enemy. To prevent future attacks on the US and our allies, we must take immediate action to build this kind of integrated intelligence network.

Dr. Pete Rustan (BSEE and MSEE, Illinois Institute of Technology, Chicago; PhD, Electrical Engineering, University of Florida) is the first director, Ground Enterprise Directorate (D/GED), National Reconnaissance Office (NRO), after serving as the NRO's director of Advanced Systems and Technology for over four years.

Dr. Rustan served a 26 year career in the United States Air Force, where he distinguished himself in the management of seven spacecraft development programs that used advanced technologies and implemented the "faster, cheaper, and better" approach to acquiring space systems. He was the mission manager for the Clementine spacecraft, which mapped the surface of the moon and obtained more than 1.8 million images using 11 spectral bands. The construction and testing of the Clementine mission took just 22 months from concept to launch and cost only $80 million. The Clementine mission demonstrated for the first time that a fairly sophisticated spacecraft with six cameras could be built on a shortened schedule. Of scientific note, Clementine's radar returns strongly suggested the presence of ice on the moon's South Pole.

During his last tour of duty in the military, which was coincidentally at the NRO, Dr. Rustan promoted and demonstrated that NRO mission objectives could be met by building a constellation of smaller and cheaper systems. Dr. Rustan remains an advocate for rapid prototyping and selecting the best value proposition that addresses our intelligence needs.

Dr. Rustan has received many national and international awards, including the Aviation Week and Space Technology Laureate and Hall of Fame, the Disney Discovery Award for Technological Innovation, the National Space Club Astronautics Engineer Award, the NASA Outstanding Leadership Medal, and was featured by *Space News* in their Top 100 in Space 1989–2004.

Transforming National Space Security: Enabling DoD and Intelligence Community Defensive Space Control Collaboration

BG Jeffrey C. Horne, USA
Deputy Director for Mission Support
National Reconnaissance Office
Chantilly, Virginia

Today's national security environment is characterized by rapidly evolving and fleeting intelligence targets in an increasingly challenging operational environment. As you would imagine, the Department of Defense (DoD) and Intelligence Community (IC) are working to counter these rapidly changing threats and continuously assess methodologies, tools, and procedures. Ultimately, we must provide timely, value added, target quality information to our toughest customers—our warriors, leaders, and analytic support customers. DoD and IC space assets, working in concert with airborne and ground systems, are vital components of the overall collection architecture that provides the nation global situational awareness, intelligence, surveillance, and reconnaissance (ISR), targeting information, and critical strategic indications and warning. America's combined space architecture gives national policymakers and military leaders, analysts, and operators timely and responsive access to denied areas, unparalleled collection capabilities, and precision data at little risk to human life. The DoD, IC, and increasingly, commercial overhead collection systems, further provide critical enabling capabilities when operating in concert with a wide realm of intelligence partners.

Responding to operational challenges and constrained budgets, DoD and IC space operations communities are transforming the way they deploy and operate in space, fuse the information that transits space-based platforms, and protect America's space architecture. That architecture not only consists of DoD, IC, and commercial industry operated orbital assets, but also includes a broad and increasingly networked array of communications, ground processing, and dissemination systems. This architecture promotes operational flexibility, but creates many critical interdependencies vulnerable to threats from America's adversaries. The successful Chinese anti-satellite test in January 2007 demonstrated that lesson to the national security space community. This watershed event reminded us that space can no longer be seen as a sanctuary, and that the nation's space-based capabilities support more than military and intelligence operations, but also commercial, scientific, and global communications as well. It also highlighted the need to accelerate joint efforts to improve shared situational awareness, cross-train DoD and IC space operators, and jointly develop new tools, analytic techniques, and operating procedures to protect America's space-based systems. One tangible sign that the DoD and IC communities are moving in this direction is the growing relationship between the National Reconnaissance Office (NRO) National Reconnaissance Operations Center (NROC) and the US Strategic Command (USSTRATCOM) Joint Space Operations Center (JSpOC).

In late 2006, senior DoD and IC leaders signaled their intent to integrate their respective space capabilities to enhance our overall capabilities and provide enhanced situational awareness activities. Dr. Donald M. Kerr, director NRO (DNRO); and General James Cartwright, commander, USSTRATCOM, signed a memorandum-of-agreement "dual-hatting" the NRO deputy director for Mission Support (DDMS) as the deputy commander (DCDR) of STRATCOM's Joint Functional Component Command for Space (JFCC-SPACE). The agreement states, "due to the critical importance of the JFCC-SPACE mission, it is essential that this organization be functionally connected with the NRO." Dr. Kerr and General Cartwright further defined the relationship in a March 2007 agreement that formalized the "dual-hat" role.

Today, I am privileged to support Lt Gen William L. Shelton and the DNRO as we accomplish our joint Space Mission sets. Specific task include:

- Serve as the senior military advisor to the director of the NRO for Operational Matters and ensure our operational support to DOD, IC, and other customers meets their operational needs.
- Ensure that NRO activities provide effective program and technical interface and optimize support to the DoD, the IC, and other agencies as directed.
- Maintain the program interface and operational support activities within the NRO, and among the defense agencies, the military departments, the services, the combatant commands, the IC, and other organizations as directed.
- Recommend processes and procedures yielding common space situational awareness, rapid assessment of events affecting space systems and operations, and if required, synchronizing responses to these events between the DoD and NRO space activities and supporting components.
- Ensure a coordinated approach to identifying/fielding capabilities and advocating for resources to support warfighting needs for space and ISR, and assist in providing space capabilities to the combatant commanders and the IC.

A March 2008 instruction from DNRO Scott F. Large gave us further responsibility for creating and maintaining NRO integrating operations and assured processes for defensive counter-space operations, flight safety issues, NRO contingency exercises, USSTRATCOM JFCC-SPACE operations, and space situational awareness operations. My dual oversight of these functions should better enable continuity of operations across the IC and DoD joint space operations environment.

We presently have multiple components that conduct space protection and situational awareness activities: the NROC, JSpOC, Wings, and Operations Centers. The NROC, originally created in response to the September 11th terrorist attacks, has evolved into a capability that provides enterprise system status and awareness, not only to the NRO leadership, but also to mission partners, combatant commanders, IC partners, and other US government agencies. The NROC conducts survivability assessments, flight safety operations, and applies IC threat reporting to support defensive space control. It also provides us with critical support as the NRO focal point for special access programs in support of NROC mission elements. Under the Unified Command Plan, the JFCC-SPACE is the USSTRATCOM element responsible for planning and conducting DoD space operations. In this role, the JSpOC undertakes space force enhancement, space control, on-orbit operations, and force application of DoD space assets. Successful accomplishment of these missions hinges on USSTRATCOM's ability to understand and remain constantly aware of both the terrestrial and space threat environments in much the same way as the NRO leadership requires situational awareness of IC space assets.

In the last several months, we have made significant strides to further the relationships, not only between DDMS and JFCC-SPACE, but also between the NRO and USSTRATCOM. Since late 2006, the two organizations have undertaken several activities to improve information sharing and create mutual backup capabilities. Today we jointly certify watch officers, install tool suites in each other's facilities, exchange representatives to their respective locations to facilitate daily communications, and conduct exercises to reinforce roles and responsibilities.

The recent shoot down of a disabled US intelligence satellite highlighted the improved relationship between the NRO and USSTRATCOM, and pointed the way forward to further improving their mutual capabilities. During Operation Burnt Frost, the two organizations collaborated in America's "first-ever" attempt to use a missile to intercept a satellite in its final days before atmospheric reentry. Both organizations leveraged their relationships with other IC and DoD agencies, as well as their intimate knowledge of their own organization's abilities to resolve the situation. This event highlighted the fact that while neither organization has full knowledge of, or access to, all of America's resources, when linked virtually, they can bring a formidable complement of assets to bear on the toughest national security problems. Together, the NROC and JSpOC are the hub of an unprecedented collaboration of more than two dozen DoD, IC, and federal organizations. The overall experience, planning abilities, dedication, and hard work from operations centers on opposite sides of the country resulted in a successful worldwide effort to prevent the loss of human life that could have resulted from the uncontrolled reentry of a satellite containing unspent toxic fuel.

Operation Burnt Frost and various exercises have given us the opportunity to improve DoD and IC space protection capabilities and reaffirm our commitment to these national security priorities. In particular, the DoD and IC space communities need to significantly improve their respective Space Situational Awareness capabilities. We need better tools and technological capabilities to track space objects, a more robust analytic cadre trained and equipped with improved processing and modeling and simulation tools, enhanced ability to share real-time status of both DoD and IC space assets, and better concept of operations and tactics, techniques, and procedures to support rapid decision-making. We also require the means to communicate transparently with foreign mission partners, the broader international community, and even the media as appropriate.

As the two communities work together to craft a joint space protection strategy and build and equip our communities to better support each other, the DDMS/DCDR JFCC-SPACE dual-hat relationship and the corresponding work of the NROC and JSpOC reflect important first steps in this shared responsibility to protect the nation's vital space interests.

The author wishes to acknowledge the following for contributing to the article: Mr. Rob Fountain (Associate Deputy Director for Mission Support), Lt Col Gary Melusen, Maj Jake Middleton, Mr. Fred Davenport, and the entire JFCC Space and NRO team for their amazing efforts to support.

BG Jeffrey C. Horne (BS, Business Administration, Ohio State; MS, Information Systems Management, United States Naval Postgraduate School; MSST, Security and Strategic Studies, US Army War College) is currently deputy commander, Joint Functional Component Command for Space, US Strategic Command and is the deputy director for Mission Support, National Reconnaissance Office.

Brigadier General Horne has served in the US Strategic Command and the National Reconnaissance Office since April 2007. From January 2006 to December 2007, he served in Iraq under Operation Iraqi Freedom as effects coordinator, Multi-National Corps-Iraq. From July 2004 to January 2006, he was deputy commanding general for operations, United States Army Space and Missile Defense Command/United States Army Forces Strategic Command, Peterson AFB, Colorado. He also worked on the National Missile Defense Program as training and doctrine command systems manager, United States Army Space and Missile Defense Command, Arlington, Virginia, from June 2000 to June 2004.

Senior Leader Perspective

Reflections on the Integration of Black and White Space

Brig Gen Katherine E. Roberts, USAF
Director, Signals Intelligence Systems Acquisition
National Reconnaissance Office
Chantilly, Virginia

The integration of black and white space has been the "holy grail" of the Department of Defense (DoD) practically from the inception of the space age. Since the watershed event that was Desert Storm, "Washington has devoted so much attention to fixing that problem that other vital uses for satellite data have sometimes been shortchanged."[1] However, the conditions that led to the black/white framework no longer exist, which could lead one to the conclusion that the black/white frame of reference has become increasingly irrelevant. In fact, I assert it is worse than irrelevant; it is an impediment to progress.

Background

Historically, the concept of black and white space has been defined by the interplay between the fear of another Pearl Harbor and the fear of expansionist communism. Two imperatives formed the foundation upon which the concept was built. The first imperative was to prevent strategic surprise. The second imperative was to establish and maintain the military capability to defeat a nuclear armed peer adversary. However, the implementation of the concept depended upon which imperative took precedence. The editors of the book *Eye in the Sky: The CORONA Story* described the lessons from Pearl Harbor and the fear of nuclear war thusly:

> For many in the military, the lesson meant to be prepared for all contingencies. The natural inclination for military leaders was to plan for the worst-case scenario [nuclear war] … For many in the Intelligence Community [IC], even within the intelligence branches of the US military, Pearl Harbor was a warning of the dangers of not knowing what America's potential adversaries were planning and capable of doing …[2]

The two implementations came to be identified by their classification levels. The systems supporting the new discipline of "strategic reconnaissance," which was focused on preventing nuclear war and strategic surprise, were highly classified and therefore called "black." The more tactically and operationally oriented systems such as those oriented towards bomb damage assessment were called "white." The two implementations also had different technical needs. On the one hand, the systems identified as strategic had to provide details on potential adversaries' strengths, weaknesses, and preparations for war; data latencies on the order of days to weeks were tolerable in most cases. On the other hand, the systems identified as tactical were much more focused on perishable data where speed took precedence. Because, "Eisenhower was concerned with preventing nuclear war, not waging it,"[3] the first space capability, CORONA, was focused on strategic reconnaissance, that is, it was "black."

Historically the concept of black and white space has been defined by the interplay between the fear of another Pearl Harbor and the fear of expansionist communism.

KH-4A (Key Hole) of "Corona" family with 2 descent capsules.

The Impetus for Change

People began to focus on integrating the two implementations as it became clear the data was agnostic; it could be used to address either strategic or tactical questions as long as one understood its limitations such as accuracy or availability. Other key factors also played a part in the movement to integrate "black" and "white" space. Among them were technology, which began to address the data latency issue; the concept of maneuver warfare, which moved to the forefront of Army doctrine; and the push by the Soviets to build and sell increasingly accurate long range surface-to-air missiles. In response to these opportunities and pressures, the Intelligence Community (IC) and the DoD established programs such as the Tactical Exploitation of National Capabilities to bridge the divide between "black" and "white" capabilities. The galvanizing events that added a sense of urgency to the "black/white" integration efforts were Operations Desert Shield and Desert Storm. During that time General Norman Schwarzkopf complained frequently about his inability to get "national," that is, "black," space support in a timely manner at a classification level he and his forces, both US and coalition, could use. As if to emphasize the point some imagery had to be disseminated to military forces in-theater using couriers and airplanes.[4]

This is not to say the two imperatives have changed. Preventing strategic surprise is still of the highest priority as is be-

Cpl Edward Chin, from New York, of the 3rd Battalion, 4th Marines Regiment, places a US flag on the face of Iraqi President Saddam Hussein's statue before tearing it down in downtown Baghdad, 9 April 2003.

ing able to wage and win the nation's wars. What has changed is our understanding of what information is strategic and what information is tactical. The driver behind this shift is the global telecommunication revolution.

"Can You Hear Me Now?"[5]

In the past, the length of time and the expense of transmitting information were key factors in delineating the boundary between strategic and tactical information. The value of strategic information had to endure beyond the time required to assemble and deliver it to the national leaders. In addition, it had to be sufficiently important to warrant the cost of delivering it to them. The dawn of the electronic age saw the first dramatic reduction in the time required to deliver information, but the actual delivery was still expensive. For example, in 1914 the cost of cable rates per word from New York City to Japan was $1.33 (then year dollars) per word.[6] Today with the advent of the World Wide Web we have the start of a true global grid that encompasses both land line and over-the-air broadcast. Not only is communication nearly instantaneous, but it is also inexpensive. The cost per word to everywhere on the grid, let alone anywhere on the grid, is infinitesimally small. Where now is the boundary between strategic and tactical information?

The boundary is now defined solely by the purpose for which the information is used. The previous filters of time and treasure have been completely removed. Today one person's tactical information or action is another's strategic information or action. The magnitude of this change was illustrated early in Operation Iraqi Freedom when a young US soldier, during the tearing down of a large statue of Saddam Hussein, threw an American flag over the face of the Saddam Hussein statue. Sensing the reaction of the crowd of Iraqi citizens, he quickly replaced the American flag with an Iraqi flag. The crowd then cheered wildly. The entire sequence of events took only a few minutes. In the past it would have been neither noteworthy nor newsworthy, lost to history except perhaps as part of someone's memoirs, but this is the age of global communications. The sequence of events was caught on video and broadcast on the Web, CNN, Al Jezeera, and many other media outlets. The global reaction was swift and the impact lasting. While most of us would have considered the act tactical in nature, the Jihadists and others considered it strategic. The images of the US soldier placing an American flag over the face of the Saddam Hussein statue are among many replayed thousands of times a day on Jihadist Web sites as part of their strategic Information Operation campaign.

So in effect, the revolution in global communications has rendered the discussion of "black" and "white," that is, strategic and tactical, space integration moot. Time and treasure are no longer factors; therefore, space systems should no longer be typecast as strategic or tactical. The data these systems provide feeds the information set that informs the nation's decision-makers at all levels. That said, however, the impact of the global telecommunications revolution is broader than just shifting the discussion relative to the integration of "black" and "white" space. The concept of integration as it has been understood until now is no longer valid because it implies there are two separate implementations that can and should be brought together. Such a concept impedes progress because the boundaries implied by the phrasing of an idea often constrain the discussions of potential solutions.

A Glimpse of the Future

The removal of the previously accepted understandings of strategic and tactical has put us in a time of transition. We need to implement an architecture that is a single structure, one that provides data to all users and meets "the needs of the disparate national security users—both military and civilian."[7] In this context the term "national security user" is not restricted to the traditional IC and the DoD, but rather is meant in its broadest

… the revolution in global communications has rendered the discussion of "black" and "white," that is, strategic and tactical, space integration moot. Time and treasure are no longer factors; therefore, space systems should no longer be typecast as strategic or tactical.

The information itself is agnostic: how we put the puzzle pieces together is what builds credible strategic and tactical context. To this end the question of integrating "black," that is, strategic systems and capabilities, with "white," that is, tactical systems and capabilities, is no longer the correct one.

connotation with regards to all elements of national power as applied to the national security framework of assure, dissuade, deter, and defeat. Although there are clearly limits, overall, to cite a commonly heard statement, "the need to know has been replaced by the need to share."

The current approach to achieving the goal of providing data using the "need to share" philosophy is the net-centric approach. The DoD defines net-centric as cited below:

> … net-centricity is the realization of a networked environment, including infrastructure, systems, processes, and people, that enables a completely different approach to warfighting … by securely interconnecting people and systems independent of time and location, supports a substantially improved military situational awareness, … and dramatically shortened decision cycles. Users are empowered to better protect assets; more effectively exploit information; more efficiently use resources; and create extended, collaborative communities to focus on the mission.[8]

From a US government perspective the definition would be modified to reflect the achievement of national goals vice just warfighting goals and a broader situational awareness not just military situational awareness. While we have started on a path to provide data and information in such a manner, we as a nation have a long way to go, but go we must. Short of the unraveling of civilization, the global telecommunications revolution is here to stay. What opportunities the move to net-centric will present is a matter open for debate. Even the most wild-eyed zealot can only imagine a tiny part of the change the move will enable. Each satellite bus, each payload, could be a node on the net which would consume, as well as generate, information. Each would be an active participant in the machine to machine processing chain. How, where, and by whom or what value is added to information will change as will the definition of "value" itself.

Summary

The nation's civilian and military leaders need information across the spectrum of peace through war. The information itself is agnostic: how we put the puzzle pieces together is what builds credible strategic and tactical context. To this end the question of integrating "black," that is, strategic systems and capabilities, with "white," that is, tactical systems and capabilities, is no longer the correct one. It has been overcome by the global telecommunications revolution. As we move to a net-centric implementation, the issue will shift from integration to the issue of value added. We are indeed in a time of transition. It is up to us to move out and shape the future.

Notes:

[1] Philip Taubman, *SECRET EMPIRE: Eisenhower, the CIA, and the Hidden Story of America's Space Espionage* (New York, NY: Simon & Schuster, 2003), 364.

[2] Dwayne A. Day, John M. Logsdon, and Brian Latell, *Eye in the Sky: The Story of the CORONA Spy Satellites* (Washington, DC: Smithsonian Institution Press, 1998), 2-3.

[3] Ibid, 33.

[4] Bob Preston and John Baker, "Space Challenges," *Strategic Appraisal: United States Air and Space Power in the 21st Century,* ed. Zalmay Khalilzad and Jeremy Shaprio (Santa Monica, CA: RAND, 2002), 155.

[5] Television advertising slogan used by Verizon beginning in about 2005.

[6] Innovator's Dilemma Albert A. Hopkins and A. Russell Bond, *Scientific American Reference Book of 1914* (New York, NY: Munn & Co., Inc, 1914), http://books.google.com (accessed 30 May 2008).

[7] Robbin Laird, "The NRO and the USAF: Integration in Search of Purpose," Space News Business Report, 5 September 2006, http://www.space.com/spacenews/archive06/LairdOpEd_0904.html (accessed 16 May 2008).

[8] Department of Defense, *Net-Centric Data Strategy* (Washington, DC: Department of Defense Chief Information Officer, 9 May 2003), 1.

Brig Gen Katherine E. Roberts (BA, Physics, Indiana University; MS, Space Technology, Johns Hopkins University) is director, Signals Intelligence (SIGINT) Systems Acquisition, National Reconnaissance Office, Chantilly, Virginia. She is responsible for the development, acquisition, and deployment of multi-billion dollar space and C3I systems needed to satisfy military, intelligence community, and civil needs. Her multiservice and multiagency organization's advanced SIGINT systems are used as force multipliers by national and DoD policymakers, providing direct satellite reconnaissance and intelligence products to unified combatant commanders and deployed warfighters.

General Roberts entered the Air Force as a distinguished graduate of ROTC at Indiana University in 1977. Her career has spanned a wide variety of space operations, acquisitions, and staff assignments. She has served as a manned spaceflight engineer, program manager of a major acquisition program, major command and unified command staff, Joint Staff, and Office of the Secretary of Defense.

General Roberts has been the vice director of operations at US Space Command and the vice director for space operations at US Strategic Command during the execution of Operation Iraqi Freedom. General Roberts has also served as the commander, Command and Control, Intelligence, Surveillance, and Reconnaissance Systems Wing at Hanscom AFB, Massachusetts. Prior to assuming her current position, she was the special assistant to the deputy director, National Reconnaissance Office, Chantilly, Virginia.

National Security Space – A Personal Perspective: An Interview with General Thomas S. Moorman Jr., USAF, Retired

Mr. George W. Bradley III
Command Historian
Headquarters Air Force Space Command
Office of History
Peterson AFB, Colorado

Dr. Rick W. Sturdevant
Deputy Command Historian
Headquarters Air Force Space Command
Office of History
Peterson AFB, Colorado

The following interview by George W. Bradley III and Dr. Rick W. Sturdevant with General Thomas S. Moorman Jr., USAF, retired, occurred as a series of email exchanges during June 2008. General Moorman retired in August 1997 after having served as Air Force vice chief of staff from 1994 to 1997. The general has served in a variety of intelligence and reconnaissance related positions within the United States and worldwide. While stationed at Peterson AFB, Colorado, in 1982, he became deeply involved in the planning and organizing for the establishment of Air Force Space Command (AFSPC). During his Pentagon tour in 1987, he provided program management direction for development and procurement of Air Force surveillance, communications, navigation and weather satellites, space launch vehicles, anti-satellite weapons, ground-based and airborne strategic radars, and communications and command centers. He additionally represented the Air Force in the Strategic Defense Initiative (SDI) program and was authorized to accept SDI program execution responsibilities on behalf of the Air Force. As commander and vice commander of AFSPC, General Moorman was responsible for operating military space systems, ground-based radars and missile warning satellites, the nation's space launch centers at Cape Canaveral AFS, Florida, and Vandenberg AFB, California, the worldwide network of space surveillance radars, as well as maintaining the intercontinental ballistic missile force. Over his career he has headed a number of blue ribbon panels on issues of significance to Air Force space and has had the unique opportunity to observe and interact with the national security space sector. This interview is a brief summary of his observations on national security space. His comments are his own and do not necessarily reflect the position of AFSPC or the US Air Force.[1]


General Thomas S. Moorman Jr., USAF, Retired.

INTERVIEW

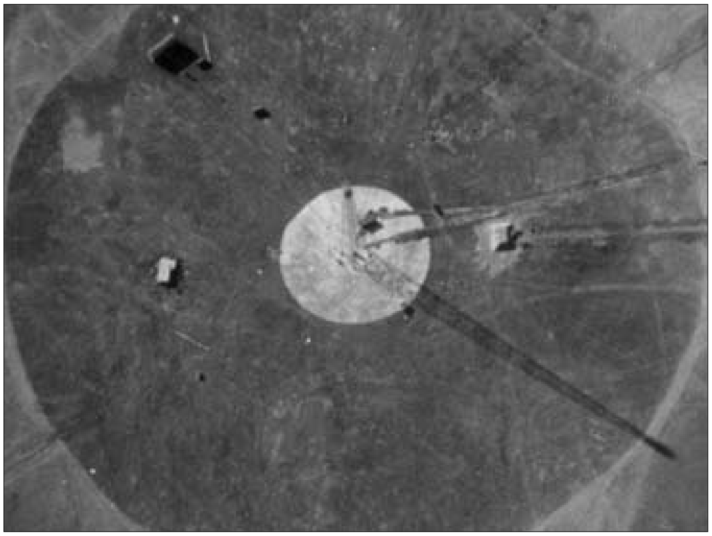
Bradley/Sturdevant: General Moorman, when and how did you become involved with national security space?

Moorman: First, let me define national security space. The term is conventionally used to include both the military and intelligence space sectors. As it turns out, I have been involved in national security space since 1964. While I was not actually working on a space program at that time; nevertheless, I was a customer of the Corona program during the height of the Cold War.

Let me explain. My first assignment in the Air Force was as an intelligence officer—a photo interpreter—in a Strategic Air Command (SAC) B-47 bomb wing in Kansas. Our bomb wing was responsible for plans to strike several hundred targets in the Soviet Union. For each of these targets, a combat mission folder was created. These combat mission folders included charts, which were often based upon World War II-era reconnaissance of the Soviet Union.

Corona, the first photoreconnaissance system, had a phenomenal impact on our knowledge of the USSR. For example, it produced intelligence that debunked the so-called missile gap. Corona also produced more imagery of the Soviet Union in one mission than had been acquired in all other imagery collection programs, such as the U2. As a result, the nation's mapping and charting production capability in the early sixties was swamped with imagery and, thus, could not keep up with demand. In an attempt to keep up with the need to rapidly update our charts, a decision was made to clear one intelligence officer in each of the SAC wings. After each Corona mission, that intelligence officer went on temporary duty to one of several photointerpretation centers. There, the officer was assigned a team of enlisted interpreters whose job was to manually update each wing's target materials; that is, hand draw the changes that were revealed in the imagery and revise the predicted radar returns.

Well, I was one of those intelligence officers. To this day, I do not know why I was selected, but this opportunity to exploit Corona imagery fundamentally changed my life. I became fascinated with reconnais-



Corona satellite imagery of Lop Nor atomic test site, China, 8 December 1966.

sance, the technical capabilities of the sensors and the exploitation of product. After tours with the SR-71 wing and with tactical and reconnaissance units in Southeast Asia and Germany, I was assigned to an NRO unit in 1970. Thereafter, I would be directly involved in national security space for the remainder of my career—some 27 more years.

Bradley/Sturdevant: From your perspective, how and why did national security space evolve from that time to the present?

Moorman: This is a broad-ranging question covering over 40 years, so I will try to just hit the high spots.

In the very early days of the nation's space activities, these two communities were, by policy and practice, separate and distinct. The intelligence sector was executed by the NRO and, as such, was a covert program for almost 30 years. The NRO brought together the existing CIA, Air Force, and Navy satellite reconnaissance programs. The preponderance of the military space program was managed by the Air Force and, over time, functions performed by space systems have grown to include weather, warning, precision navigation, timing, and communications. Other functions include launch, satellite command and control (C2), and space control and space surveillance systems.

Early on, it was decided to dual-hat a senior civilian (most often the under secretary of the Air Force) as the director of the National Reconnaissance Office (DNRO). The reason for this organizational construct was that the National Reconnaissance Office (NRO) was dependent upon the Air Force for launch, satellite C2, capsule recovery, certain logistics support, and of course, highly talented, technical people. The dual-hatting arrangement ensured that the NRO would enjoy a high priority for this support within the Air Force.

The evolution of national security space can be generally characterized by individual decades. The decade of the 60s saw the initial fielding of space capabilities. In the 70s, the next generation of systems with dramatically improved capabilities were developed. The 80s can be described as both the decade of space organization as well as a period of ever-increasing space support to crises and contingencies. With respect to space organization, we saw the establishment of the various space commands: AFSPC (1982), the Naval Space Command (1983), the Unified Space Command (1985) and the Army Space Command (1988). Basically, these commands were created to "operationalize" space and to improve space support to warfighters. In addition to the organizational flux during the 80s, there were several contingency operations, which saw the ever-increasing use of, and evolving dependence on, space systems.

The decade of the 90s began with Desert Shield/Desert Storm. I will not dwell on space support in this conflict as I will discuss the first desert war in a subsequent question. Suffice it to say, this was the first conflict wherein the full complement of military and NRO space systems were brought to bear on the fight. The contributions of space to rapidly achieving our objectives in Iraq is a well-known story. Suffice it to say that Desert Storm was a great learning experience.

Today we continue to be engaged in Iraq and in Afghanistan. In contrast to Desert Storm, where space came of age and the warfighters began to realize the criticality of space force enhancement capabilities, today, in Operations Iraqi Freedom and Enduring Freedom, space is now integrated into the ground, air, and maritime operations in support of the joint fight.

Bradley/Sturdevant: What were the major challenges confronting national security space from the 1970s to the 1990s and how successfully did both black and white space meet those challenges?

Moorman: The question is very broad and, hence, I will only summarize a few key challenges. The subject matter is also very closely related to the previous question.

Let me say at the outset that the challenges for black and white space were generally similar. During the 70s and 80s, both the military and intelligence programs were dealing with a customer base which was gradually expanding. In the case of white space, the use and awareness of the value of space systems steadily increased from its modest beginnings in Vietnam, where the Defense Meteorological Satellite Program (DMSP) satellite and the first-generation Defense Satellite Communications System (DSCS) satellite were first employed. The military use of space systems gradually increased throughout the 80s in support of a number of contingency operations: Urgent Fury - Grenada (1983); Eldorado Canyon - Libya (1986); Earnest Will -Persian Gulf Minesweeping (1988); and Just Cause - Panama (1989). By and large, however, the employment of space capabilities in support of these engagements was ad hoc, because other than communication satellites, space was rarely part of the planning cycle.

The growth in use of black space systems during this period was understandably more gradual due to the classification of the systems and policy direction and orientation. Quite frankly, very few military operators had any appreciation of the capabilities of satellite reconnaissance systems. Moreover, the orientation of the intelligence space sector had been, almost exclusively strategically focused with a small, but very senior customer set (e.g., national decision makers).

In addition to the challenges represented by classification and policy orientation, the NRO in the early days also had certain technology limitations, which affected responsiveness. Said a different way, the state of technology in the 60s and early 70s was such that the systems provided superb support to deliberate planning in support of the nuclear warplan or the Single Integrated Operational Plan, order of battle analysis and arms control, but was not sufficiently timely for tactical operations. In the mid 70s, we began to see dramatic improvements in technology which offered the potential for extraordinary support to warfighting. Because of this potential, Congress in 1978 established the Tactical Exploitation of National Capabilities Program (TENCAP) and directed each service to create TENCAP offices to add emphasis to exploiting and developing applications for output from satellite reconnaissance.

I think it is also important, in both a historical sense and in light of recent events, to say something about the prevailing space threat. In the 1970s and 1980s, we were very concerned about the Soviet antisatellite (ASAT) weapon system. The Soviets had developed a co-orbital system that threatened our low altitude systems. After a hiatus of several years, the Soviets resumed testing of their system in 1976 as I recall. This set in motion a series of policy actions by the Ford and Carter administrations, which directed the initiation of an ASAT program (an F-15 with a miniature homing vehicle) and a series of measures to improve satellite survivability. Much could be said on this subject, but suffice to say that with our growing dependence on space systems, we worried a lot about the Soviet space threat.

On 13 September 1985, an F-15 launched an ASM-135A anti-satellite weapon that intercepted and destroyed a Solwind satellite.

So in the late 70s and early 80s, the Air Force initiated a series of studies on how best to organize and manage space systems to deal with the growing dependency, the need to integrate space into military operations and the need to provide sharper operational focus and advocacy for this increasingly critical mission area. The culmination of these studies was the creation of AFSPC in September 1982. As I mentioned, in relatively short order, the other services created their respective space commands and a unified command was also created for the joint employment of space.

I would [be] remiss if I didn't mention two events which I believe had a profound effect on the NRO. The first was the fall of the Berlin Wall and the dissolution of the Soviet Union. The other event was Desert Storm.

Keeping track of the Soviet Union had been a primary focus of the NRO since its inception in 1960. With the demise of the USSR in 1991, the unambiguous priority for the nation's satellite reconnaissance program began to change and, over time, the security restrictions and sensitivity were eased. In addition, certain streamlined management prerogatives began to erode. These trends presented significant challenges for the NRO leadership in the 90s and continue to this day.

The impact of Desert Storm on both joint warfighting and on the services' understanding and planning for space capabilities is well known. The impact of this conflict on the NRO and the Intelligence Community (IC) that supports space reconnaissance is perhaps not as well known, but I believe is every bit as profound. Simply stated, like white space, virtually the entire complement of NRO capabilities were brought to bear in the desert war. Thus, large numbers of commanders and warfighters were exposed to these heretofore unknown capabilities. With this exposure, the military now understandably wanted not only more and broader dissemination of the space reconnaissance product, but it also wanted a greater say in the requirements for new systems. Meeting those demands continues to be a major challenge today.

Bradley/Sturdevant: Although there is some disagreement on whether Desert Storm can be termed "The First Space War," it was certainly the first conflict in which space assets played a major role. Were on-scene commanders afforded timely access to information from NRO assets? If not, what do you believe caused the disconnect?

Moorman: The IC and the NRO gave the highest priority to satisfying warfighters' needs during Desert Storm. Accordingly, an unprecedented volume of data and intelligence products from NRO assets were provided to the theater. Nevertheless, I think the degree to which on-scene commanders were satisfied is a mixed bag for several reasons.

First, while some deployed senior folks at headquarters like in Riyadh, Saudi Arabia, were aware of these capabilities, most commanders at lower echelons (e.g., division and wing) were not. Even if the warfighter in the field had some understanding, in all likelihood they had not trained with the products, and there is always a reluctance to use new and unfamiliar systems, especially in wartime.

There was also the question of dissemination of the data to lower echelons. As I recall, the communications bandwidth was not available and even if it were, units did not have equipment to receive and use the information.

The lack of awareness and associated training programs, the lack of bandwidth, and the need to develop and field equipment to receive and exploit products were key lessons learned from Desert Storm for the IC, the NRO, and the military services. These lessons have driven significant investment since about 1992.

Bradley/Sturdevant: From your perspective as a senior space officer, including vice commander and commander of AFSPC during the 80s and 90s, how much collaboration existed between the NRO and AFSPC, between black and white space?

Moorman: First of all, let me provide some personal background to put this question into context. From 1970 to 1979, I served in various capacities within the NRO. These assignments gave me sensitivity and understanding of NRO culture and capabilities. I also had developed very close relationships with a large number of NRO people. In addition, during my four years on the NRO staff in the plans and policy business, I had the good fortune to be the NRO representative on a series of space organizational studies. I was also the interface to the white Air Force on a number of support agreements and programmatic issues. Thus, when I was initially assigned to Colorado Springs in 1981, I had some understanding of black/white space interfaces and the need for improved collaboration.

My first job in Colorado Springs was running the space operations business in Cheyenne Mountain. This included managing the Space Defense Operations Center (SPADOC), which was tasked to assess operational threats and to provide warning data of threats to US space systems. Recall that the Soviet Union was actively testing their ASAT system and, in response, the Air Force was developing the F-15 ASAT. I think we in the SPADOC had a very good relationship with various satellite owner-operators at that time, and I think our relationship with the NRO was especially close. Therefore, I would judge that during the early 80s our collaboration with the NRO on space defense-related planning and operations, while fairly basic, was extensive.

New facilities for the Space Defense Operations Center (SPADOC) inside Cheyenne Mountain opened in March 1982.

A little later in my career, I had the privilege of serving as the director of the NRO staff under Mr. Pete Aldridge, the DNRO. During this time, there was significant interaction with AFSPC. Two specific examples come to mind. As I mentioned earlier, the Air Force supported the NRO by providing satellite command and control (C2) services. This support has been provided since the very beginnings of the national security space business. In 1987, the satellite C2 capability, then known as the Satellite Control Network (SCN), transferred to Space Command. Supporting the NRO was a high priority for the SCN, and assuring a smooth transition required considerable coordination.

The *Challenger* accident also occurred during this time, as well as two Titan launch failures. As a result, the national space community was in extremis as we had no access to space launch for our most critical payloads. Consequently, the highest priority issue was developing and executing a launch recovery plan. Ultimately, our major launch systems, as I recall, were down for 31 months. At any rate, developing the recovery plan required close cooperation between the NRO and the Air Staff, the white space acquisition community and AFSPC.

I became commander of AFSPC in late March 1990, and one of my first priorities was to transition launch responsibilities from Air Force Systems Command. Similar to SCN support, the Air Force provides launch services to the NRO. Accordingly, it was critical that the NRO was comfortable that the command would continue to provide the quality support and emphasis mission success. AFSPC worked closely with the NRO to provide that support.

When General Charles A. Horner became the commander of AFSPC in late June 1992, he brought with him experience as the air component commander during Desert Storm. He had a strong belief that the Air Force was deficient in integrating and applying space systems in modern warfighting, especially NRO capabilities. Hence, he argued strongly for the creation of a space warfare center to develop new applications for space systems and to train operators on how to use space systems. This center was created initially at Falcon AFB, Colorado (later renamed Schriever AFB) in November 1993, and one of its major objectives was to work with the NRO's military support office, the Deputy Director of Military Support (DDMS).

I would be remiss if I didn't mention another area of collaboration, and that area is people. Over the last 25 years, there has been an extensive exchange of people between the white and black space communities, which I think has contributed immeasurably to improving the quality of collaboration and the understanding between the two communities. I guess I am one of those folks who spent my formative space years in the NRO, then was assigned to white space. The list of senior people who have been part of this exchange is lengthy but includes folks like Lt Gen Mike Hamel, Lt Gen Tom Sheridan, Maj Gen Jimmy Morrell, Maj Gen Jim Armour, Maj Gen Mitch Mitchell, Brig Gen Rick Larned, Brig Gen Tom Scanlan, Mr. Bill Maikish and, more recently, Brig Gen Ed Bolton, Brig Gen Kathy Roberts, and Mr. Doug Lovero. I have undoubtedly left some folks out and, for that, I apologize.

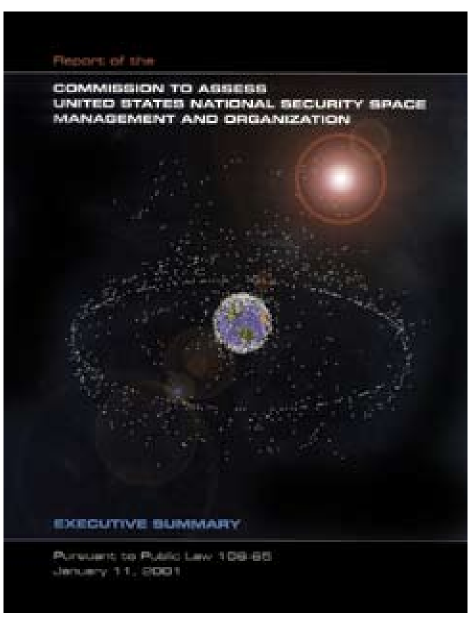
Bradley/Sturdevant: With the improvements in the use of "black" space assets in Operation Enduring Freedom and Operation Iraqi Freedom, could you describe the general level of support commanders in the area of responsibility received from national assets during these conflicts?

Moorman: I am not comfortable in commenting as I do not have firsthand experience in Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF). I think this is a question better posed to folks like Lt Gen Shelton, the 14 AF Commander, or people who served as the director of space forces (DIRSPACEFOR), such as Maj Gen Dick Webber and Brig Gen Larry James. I am told, however, that the level of support has been excellent and that support to OEF and OIF enjoys a very high priority in the tasking of National Systems. Moreover, I think, the in-theater DIRSPACEFOR and the NRO's DDMS are working hard to improve the support in any way they can.

Bradley/Sturdevant: Do you think the current organizational distribution of responsibilities for national security space is appropriate? If not, what changes would you recommend and why?

Moorman: Several years ago, I had the privilege of serving on the congressionally-directed Space Commission chaired by Mr. Don Rumsfeld. The commission made a number of recommendations on the organization and management of national security space. I continue to support those recommendations, and I believe the commission's concerns regarding the vulnerabilities of our space systems is even more significant today than it was when the commission report was published in 2001.

In addition to the threat, I think that dual-hatting the under secretary of the Air Force as also the DNRO is the right way to go; I believe we should return to that construct. I also support the creation of a major force program for space (MFP 12). I think it would be a useful tool to provide better visibility to manage space programs and to ensure a more coherent military space program. It would also provide a great mechanism to synchronize the acquisition of satellites, their associated launchers, and terminals. I understand that Congress has [recently] directed that an MFP 12 be created.



Cover of 2001 Space Commission Report, Executive Summary Volume.

One of the inexorable trends is that all four of the sectors that constitute the national space program (military, intelligence, civil, and commercial) are growing more interdependent with each passing year. Despite this convergence, there is no national interagency forum to oversee the implementation of national space policy and to coordinate and frame cross-agency space—related issues such as launch, remote sensing, precision navigation, and testing. Additionally, an interagency forum could help develop national positions on space matters being considered in international [circles]. The Rumsfeld Space Commission recommended that this group be established and created under the National Security Council structure. I believe we still need an interagency group for space.

As a sidebar, it should be noted that an independent assessment panel on National Security Space Management and Organization—a Space Commission II—has been underway for several months now. It is an eminently qualified group under the chairmanship of Mr. Tom Young, former chief operating officer of Martin Marietta and former director of the Goddard Spaceflight Center. They are due to report their findings in the near future.

Bradley/Sturdevant: What do you envision as the biggest challenges for national security space during the next 25 years, and how well poised is the space community to meet those challenges?

Moorman: First, I am not sure my crystal ball is all that clear. One thing for sure is that I am not comfortable in looking out 25 years. How about I briefly take a crack at a ten-year horizon?

The second general comment I would make is there is no shortage of future challenges for national security space. Here is a list in no particular order.

The Threat. The Chinese ASAT test of January 2007 has reminded us of our vulnerability to attack. This rapid and unambiguous kinetic intercept of one of their own weather satellites underscores vulnerabilities. There are also a host of other potential threats in this timeframe which will challenge our space situational awareness and warning capabilities. We have examined this problem for decades and done literally hundreds of studies but, unfortunately, have not made enough progress to deal with the threats. With our dependencies, space systems are inviting asymmetrical targets. The challenge is to free up the resources to take action across all components of the space control mission—space situational awareness, space protection and space negation. At the same time, we need to energize our best minds in crafting space deterrence theory and doctrine to go along with real capability.

Responsiveness. Improving responsiveness is one of the holy grails of the space business. It seems like an eternal quest. Nevertheless, a characteristic of modern warfare is the extraordinary compression of time, which places difficult demands on space capabilities. In addition, the nature of the threat and the rapidity of events mean that there is a requirement for certain capabilities to be launched and checked out perhaps in hours versus months. The Defense Department has a program to work this challenge called Operationally Responsive Space (ORS). I am not sure what the answer or the answers are, but I do believe today's and tomorrow's technologists, acquirers, operators, and users have to adopt a responsiveness mindset.

Improving Space Acquisition. The past decade has been a bad period for both black and white space acquisition. I think we are making progress in overcoming our problems by adopting a back-to-basics approach, which emphasizes the blocking and tackling of space acquisition and program management. In addition, I think we are improving cost estimating and are attempting to budget to a higher probability of success. Space acquisition—I think this area will always require close attention, as the consequences of cost growth, schedule slips, and not meeting performance goals not only directly affect our national security but, also, undermine the confidence of those who oversee our performance.

People. Ensuring that the national security space community can continue to attract, develop, and retain high-quality people has to be on any list of national security space challenges. This is a generational problem. Our experience base, especially the space acquisition area, has eroded over the past 15 years, and it will probably take at least that long to correct. I believe that virtually everything is possible with experienced and motivated people. In the absence of these people, technical and operational problems are enormously more difficult.

Interdependence. This is a catch-all term that covers several challenges. I have already addressed the interdependence of the space sectors and why we need a White House level inter-agency group to deal with this convergence.

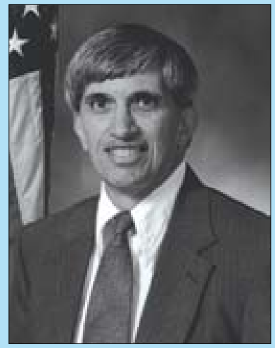
However, there is another dimension to this issue, and that is the blurring of the distinctions between black and white space, national and tactical needs, and the surveillance and reconnaissance mission area. Because we have not totally come to grips with the implications of these trends, the national security space community is having difficulty coalescing on the requirements and roles and missions for certain new capabilities, such as space radar. This inability to reach consensus on new multi-role systems has created a stalemate, which in a fiscally constrained environment is a prescription for inaction. Here I am not carrying the brief for any specific system, only pointing out a daunting challenge.

Industrial Base. I think this is a challenge that is well understood, and I am heartened by recent actions within the administration to work the impact of export controls on the industrial base. That being said, I think a major challenge will be not necessarily the health of the large primes but the viability of the second and third tier contractors who, by and large, are the source of a large percentage of the innovation in national security space. Another basic challenge is to create the processes and databases to permit the government to oversee and, in some cases, actually manage the industrial base. The effects of globalization and the trend to employ more offshore suppliers compound this challenge.

Bradley/Sturdevant: Thank you General Moorman.

Notes:

[1] Career summary, official biography, General Thomas S. Moorman Jr., USAF, Air Force Link, http://www.af.mil/bios.



Mr. George W. Bradley III (BA, History, Canisius College, Buffalo, New York; MA, American Military History, Ohio State University, Columbus, Ohio) is command historian, Headquarters Air Force Space Command, Peterson AFB, Colorado, a position he assumed in 1992. He began his federal career in 1979 when he joined the Department of Defense as a civil service employee and has served as an Air Force historian in various positions for over 25 years. He is the author of *From Missile Base to Gold Watch: An Illustrated History of the Aerospace Guidance and Metrology Center and Newark Air Force Station*. In addition, he has penned a number of articles in professional journals, presented numerous papers at professional meetings and symposia, been a contributing author to various published works on Air Force history, and served as senior editor for several books on Air Force space history.

Dr. Rick W. Sturdevant (BA, History, University of Northern Iowa; MA, History, University of Northern Iowa; PhD, University of California, Santa Barbara) is deputy command historian, Headquarters Air Force Space Command (HQ AFSPC), Peterson AFB, Colorado. He joined the Air Force History and Museums Program in April 1984 as chief historian, Airlift Information Systems Division, Scott AFB, Illinois, and moved one year later to the Chidlaw Building near downtown Colorado Springs as chief historian, Space Communications Division (SPCD). When SPCD was inactivated in 1991, he moved to the HQ AFSPC history office and became deputy command historian in 1999.

An acknowledged expert in the field of military space history, Dr. Sturdevant appears frequently as a guest lecturer on space history topics and is author or co-author of chapters or essays in *Beyond the Ionosphere: Fifty Years of Satellite Communication* (1997); *Organizing for the Use of Space: Historical Perspectives on a Persistent Issue* (1995); *Golden Legacy, Boundless Future: Essays on the United States Air Force and the Rise of Aerospace Power* (2000); *Air Warfare: An International Encyclopedia* (2002); *To Reach the High Frontier: A History of US Launch Vehicles* (2002); *The Limitless Sky: Air Force Science and Technology Contributions to the Nation* (2004); *Encyclopedia of 20th-Century Technology* (2005); *Societal Impact of Space Flight* (2007); and *Harnessing the Heavens: National Defense through Space* (2008). His articles or book reviews have appeared in such journals as *Space Times*, *Journal of the British Interplanetary Society*, *Air & Space/Smithsonian*, *Quest: The History of Spaceflight Quarterly*, *Air Power History*, *High Frontier: The Journal for Space & Missile Professionals*, and *Journal of the West*. He sits on the editorial board of *Quest* and on the staff of *High Frontier*.

Dr. Sturdevant is an active member of the American Institute of Aeronautics and Astronautics (AIAA), American Astronautical Society (AAS), British Interplanetary Society (BIS), and Society for the History of Technology (SHOT). His professional honors include the Air Force Exemplary Civilian Service Award (1995-1999), the AAS President's Recognition Award (2005), and election as an AAS Fellow (2007).

Constructing a National Security Space Plan

Mr. Joseph D. Rouge, SES
Director
National Security Space Office
Washington, DC

Space-based capabilities and services enhance the national power of the United States and pervade every aspect of our American way of life.

Space assets allow us to use cellular phones, pagers, and ATMs. Satellites provide us weather information before our morning commute, and families across the country enjoy sporting events in high-definition signals transmitted through satellites. Most of America's imports and exports are carried via commercial shipping, which navigate the ocean with a global positioning system (GPS) signal from space.

Likewise, space systems provide crucial support to military operations. Space-based systems for weather, navigation, missile warning, reconnaissance, and communications have become so critical that one cannot fathom going to war without them. The message is clear: the need for space superiority is on par with the need for air, land, and sea superiority.

Make no mistake—our country's space dependence will deepen as *transformation* and *network-centric warfare* heighten the importance of rapid collection and dissemination of information. This will be felt at all levels, right down to the individual warrior. In the civilian world, losing a space asset could mean losing advanced warning for a hurricane; for our military, it could also mean the difference between life and death.

It was said by former Secretary of the Air Force Dr. James G. Roche that a space capability is like oxygen—if you have it, it is taken for granted. If you do not have it, it is the only thing you want.

A Need for Collaboration

The national security space community (NSSC), which consists of all services and components of Department of Defense (DoD) and the Intelligence Community (IC), face numerous challenges that warrant a clear and immediate change in defense strategy, planning, and acquisition. For space, this change must result in focused prioritized strategies that deliver the capabilities needed by our warfighters and our policy decision makers. Additionally, there must be collaboration throughout the NSSC planning efforts to ensure alignment with guidance from sources such as:

- National Security Presidential Directives
- Presidential Decision Memorandums
- Quadrennial Defense Review
- Guidance for Development of the Force
- Guidance for Employment of the Force

There must also be coordination with capability portfolio managers and programmers to ensure we execute sound space acquisition practices. We must also establish standards for budgeting, cost estimating and executable programming.

NSSP as a Collaborative Tool

DoD Directive 5101.2 assigned space planning to the DoD Executive Agent (EA) for Space—a responsibility currently held by the secretary of the Air Force. The chief product of this planning is captured in the National Security Space Plan (NSSP). The NSSP is based on annually updated space plans and architectures of DoD components, and serves as the mechanism by which the DoD EA for Space articulates results of coordinated space planning capabilities for the next program objective memorandum (POM). The main intent of the NSSP is to provide the NSSC with accurate information and structured recommendations regarding planning, programming, budgeting, acquisition, and execution of national security space (NSS) capabilities.

The NSSP outlines space capabilities in response to guidance and as prescribed in architectures, enabling force providers and system developers to deliver these capabilities in a resource-constrained, strategically-responsive fashion. The result: establish an NSSC baseline for *where we are, where we want to go, and how to get there*.

A Capabilities-Based Plan

The NSSP provides an integrated view of space capability through national, intelligence, and military policies, strategies, and approved architectures. The core capabilities are:

- ***Environmental monitoring.*** Observing, collecting, analyzing, and forecasting environments ranging from the sun's surface to just below the surface of the Earth's land and water masses.
- ***Industrial base.*** The space industrial base (SIB) includes all industries that support NSS acquisition programs.
- ***Intelligence, surveillance, and reconnaissance.*** Space-based systems and sources of intelligence designed to find, watch, collect data, and provide it as useful and timely information. Includes collection, information and data management, communication and distribution, analysis and decision support.
- ***Missile warning and attack assessment (including nuclear detonation).*** Capability for detection and characterization of ballistic missile launches and nuclear detonation. Can also provide detection, tracking, discrimination, and handover capabilities for missile defense.
- ***Position, navigation, and timing (PNT).*** PNT is generating and using signals to enable determination of precise location, movement, and time. Precise PNT information, predominately provide today by GPS, is integral to military and intelligence operations, as well as broad components of the nation's economic infrastructure.
- ***Science and technology (S&T).*** Space S&T addresses applied research and advanced technology development activities.
- ***Satellite Communications (SATCOM).*** Provides capability for global sharing of secure and non-secure data, voice, and video communications for national, strategic, tactical,

civil, and coalition users. SATCOM provides a seamless end-to-end space-based communications "system of systems" and is an integral element of the global information grid.

- ***Satellite operations.*** Satellite control and mission data handling processes and infrastructure necessary for telemetry, tracking, and command of satellite vehicles.
- ***Space access.*** Deliver, maneuver, and recover payloads to and from space in a responsive, reliable, flexible manner. Space access guarantees assured access to space in peace, crisis, and through the spectrum of conflict.
- ***Space control (includes space command and control [C2]).*** Space control operations encompass space situational awareness, protection, negation, prevention, and C2 of space assets. This is the foundation for all space activities and requires robust space surveillance and reconnaissance.
- ***Space force application.*** Prompt global strike, from or through space, against land, sea, and air targets by non-nuclear weapons.

For each of these core space capabilities, the NSSP outlines major categories of analysis and evaluation. These categories recommend:

- future desired states
- capabilities roadmaps
- minimum assured capabilities
- risk factors
- recommended actions for next fiscal year (FY)

The last category, "recommended actions for next FY," captures the DoD EA for Space influence into the space capability investment in the FY10-15 POM. The actions are organized into three sub-categories: reduce risk, maintain capability, and studies and analysis. These prioritized recommendations reflect national and military policies, as well as DoD POM guidance.

Who Does the NSSP Support?

Recommendations contained in the NSSP are designed to influence the prioritization and funding of capabilities through the POM process (figure 1). It supports the Office of the Secretary of Defense (OSD) and Office of the Director, National Intelligence

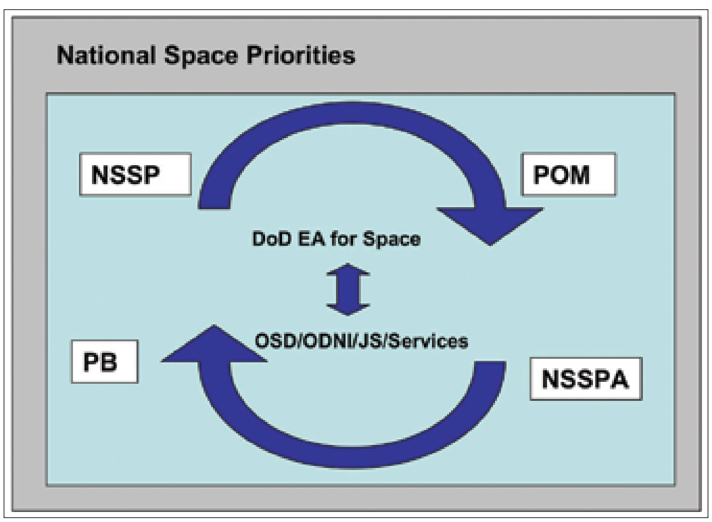


Figure 1. NSSP Relationships.

(DNI) in presidential budget decisions. The intended audience is the DoD component and agency programmers, along with their key decision-makers. It conveys to them space-specific capabilities, priorities, and actions required to comply with guidance and validated capability architectures.

Space Planning Considerations

As previously mentioned, preparation of the NSSP includes alignment to the national military strategy, Quadrennial Defense Review, National Space Presidential Directive-49, Guidance for Development of the Force (GDF), and other guidance documents. Additional considerations in the planning process include maintaining continuity of service (functional availability), protection of those capabilities, integration, and optimizing of the entire virtual Major Force Program (vMFP) portfolio, and investment of new capabilities to include S&T.

The NSSP captures what is contained in programs of record for the vMFP for space. However, there are components outside the vMFP that will utilize space capabilities that cannot be ignored. For instance, end-to-end capabilities found in the GPS may require consideration of subsystems outside the vMFP. The procurement of a GPS receiver for our ground forces is not necessarily contained in the vMFP. The NSSC as a whole is intended to deliver space effects in support of the warfighter and policy decision maker. To do this the NSSC must consider the timing, fielding, availability, and interoperability of the satellite, ground control equipment and receiver equipment for our services which may include handheld receivers, GPS-aided munitions, ships, fighting vehicle, and so forth.

Stakeholders Vital to Success

No plan can be formulated without involvement by key members from the NSSC. The vetting process used for the NSSP surfaces space priorities and acknowledges differences with other DoD and IC investments. Rigorous analysis leads to the identification of capability gaps and risk areas that require attention in POM deliberations. The objective is to provide proper situational awareness to senior leadership that include: (1) *where* and *why* space priorities are different, and the impacts to other space-dependent capabilities, (2) the cost associated with changing space priorities, and (3) risk assessment.

In order to engage the community, the DoD EA for Space has established a formal three-tier enterprise vetting construct (EVC) (figure 2) that includes O-6, 2-star, and 4-star level engagement. The EVC process occurs as needed throughout the year. Each level is co-chaired by a senior leader from the DoD, the DoD EA for Space, and DNI offices. The NSSP collaborative process also uses integrated product teams for each core capability area. Stakeholder membership includes participation of subject matter experts from all NSS organizations.

The Space Program Review Committee (SPRC) meets at the O-6/GS-15 level and is the first of three vetting levels designed to assist the DoD EA for Space. The SPRC ensures that significant alternative views are expressed to the 2-star board and recommends the best mix of programs to achieve NSS needs.

The Space Enterprise Board (SEB) meets at the 2-Star GO/Flag/SES level. It includes space champions, component programmers, and selected senior representatives as subject mat-

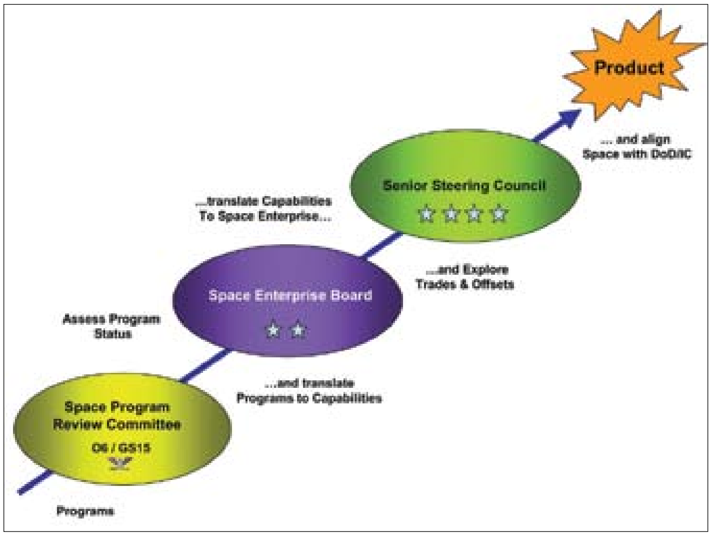


Figure 2. Enterprise Vetting Construct.

ter experts. The SEB is chaired by the National Security Space Office (NSSO) director. It vets and prioritizes proposals received from the SPRC and identifies issues and recommends strategies and solutions to the next higher EVC body—the SSC.

The Space Steering Council (SSC) meets at the 4-star GO/Flag/SES level and is the top EVC level designed to assist the DoD EA for Space. It is chaired by the DoD EA for Space. It considers proposals from the SEB. It informs 3-star programmers and the Deputies Advisory Working Group, and it approves secretary of defense (SECDEF) and DNI reports. It establishes and advocates priorities within SECDEF, DNI, and Congress. It ensures the space enterprise is properly aligned with national enterprise and introduces strategic issues for deliberations.

Space Enablers

The NSSP takes into consideration the enabling functions of our space enterprise, and recognizes how S&T investments, industrial base concerns, and space cadre strides can positively influence the success of our efforts in space.

S&T provides the foundation upon which space capabilities are built. Each NSSP core capability area balances the S&T needs with the current efforts, and then considers recommended areas to reduce risk or maintain capability. The resulting recommendations help the S&T community focus its efforts on those areas most important to the warfighter and the acquisition community.

All the planning, architectures, and capabilities would be lost if it were not for a robust cadre of space professionals. Through forward thinking leadership, we have increased the scope of DoD personnel identified as space professionals—those with a direct role in space missions. Through the use of improved management methodologies and increased professional development opportunities, we are able to better educate, train, and provide experience for our space cadre.

Just as personnel are a crucial element for success in space, a healthy space industrial base workforce must be one of our top priorities. The Space Industrial Base Council (SIBC), which is co-chaired by the DoD EA for Space and the director of the NRO, assembles key stakeholders from government and industry, and coordinates actions on industrial base issues. Along with addressing critical industrial base capabilities, the SIBC maintains focus on the health of US companies and how they are balancing competitiveness and security concerns.

Future Outlook

The NSSP is the DoD EA's input to documents such as the GDF, Global Environment Facility council documents, and other like documents, to express the space domain's priorities to meet broader NSSC needs. It reflects a continuous, repeatable process that informs decision makers and guides planning and programming actions. It provides general direction for the DoD and IC to steer their NSS budgeting processes, and provides information to OSD and DNI for use in reviewing the components' POM submissions.

Advancing our nation's space-related capabilities continues to be a key factor in maintaining our competitive advantage in space. The NSSP is critical to ensuring this effort—consequently, it must not be taken for granted. To be effective, the NSSP must not become stagnant. The NSS community must continue to engage in consistent and recurring review processes to ensure our nation maintains an asymmetric advantage in space.

Conclusion

The NSSO developed the NSSP to provide unity of effort across space and integrate space systems with the other domains. It represents a continuous process that informs decision makers and guides DoD planning and budgeting efforts. Finally, the NSSP assures space capabilities for our warfighters and other key users in a contested domain.

Mr. Joseph D. Rouge (BS, Aerospace Engineering, University of Southern California; MS, Aerospace Engineering, University of Southern California; MS, Business Administration, Auburn University) is the director, National Security Space Office (NSSO), the Pentagon, Washington, DC. He is responsible for leading a multiagency unit tasked to create unity of effort across all of National Security Space. Specifically, the NSSO is responsible for promoting synergy and integrating interagency space policy, strategy, acquisition, launch, planning programming, and technology development.

Mr. Rouge came on active duty in September 1974, serving in a variety of positions involving space surveillance systems, Strategic Defense Initiative Programs, and systems engineering and program integration. He has served on the faculty of the Industrial College of the Armed Forces, at the Air Force Inspection Agency and on the staff at Headquarters US Air Force.

Mr. Rouge was a research fellow at the Airpower Research Institute, located at Air University's Center for Aerospace Doctrine and Education, where he authored a book on national military space strategy. He was also a research fellow at the Industrial College of the Armed Forces, authoring a book on national security strategy. Mr. Rouge is also a joint specialty officer. He retired in June 2004 as chief of NSSO's Integration Division, and he has also served as associate director.

Assuring Access to Space: The Partnership Continues

Col John G. Stizza, USAF
Director, Office of Space Launch
National Reconnaissance Office
Chantilly, Virginia

A History of Partnership

In the November 2006 edition of *High Frontier,* the National Reconnaissance Office (NRO), Office of Space Launch (OSL) authored an article titled "The Power of Partnership—Assuring Access to Space." That article described the decades old collaboration between the Air Force and the NRO that enabled the US to place critical national security satellites safely, efficiently, and accurately into space. This partnership has allowed the Air Force and the NRO to leverage both organizations' strengths without duplication and create an unparalleled focus on mission success. This partnership continues to be strong today. For instance, the NRO funds half of The Aerospace Corporation Federally Funded Research and Development Center technical resources used by the Space and Missile Systems Center Launch and Range Systems Wing. This commitment benefits both the Air Force and the NRO, and ensures that we can bring the appropriate amount of The Aerospace Corporation expertise to bear for launch system analysis. The Air Force-NRO relationship has worked exceptionally well since the late 1990s following three Titan IV failures in 1998 and 1999. Since then, the Air Force and NRO working together have launched 42 consecutive missions successfully, including the last of the legacy Atlas IIAS, Atlas IIIB, and Titan IV systems. The success of this partnership continues into the evolved expendable launch vehicle (EELV) era with all 13 Air Force and NRO Delta IV and Atlas V missions launched successfully to date. The Air Force and NRO continue to strengthen their partnership by bringing to bear the unique capabilities of each organization.

Figure 1. NROL-24 ready for launch at Space Launch Complex-41, Cape Canaveral AFS, Florida, December 2007.

The remainder of this article will address the NRO's "other" space launch partner—the National Aeronautics and Space Administration (NASA). Indeed, the Air Force, NRO, and NASA have been working together to access space since the late 1970s when the Space Shuttle was designated the primary means of deploying US government payloads into space. Exceptionally close coordination was the order of the day as Air Force, NRO, and NASA personnel worked together in planning the integration and deployment of very complex spacecraft. This spirit of cooperation has remained strong even after the transition back to expendable launch vehicles following the loss of space shuttle *Challenger* in 1986.

Perhaps nowhere was this cooperation more evident than in the launch campaign for NRO Launch-24 (NROL-24) in December 2007 at Cape Canaveral Air Force Station, Florida. NROL-24 was scheduled to launch from Space Launch Complex-41 (SLC-41) on 10 December and the Air Force and NRO took all the steps required to meet that date. Also progressing toward launch during this time was Space Shuttle *Atlantis* carrying the European Space Agency's Columbus Laboratory, the first European component to be delivered to the International Space Station (ISS), a critical milestone in completing the ISS and one that NASA and the European space community had awaited for over a decade. *Atlantis'* earliest opportunity to launch was 6 December and, due to ISS power and temperature issues related to the ISS orbit, *Atlantis'* launch window was to close on 13 December. When it became apparent that these two missions might conflict, the NRO director and NASA administrator mutually agreed that *Atlantis* should have the eastern range priority through the end of the shuttle's launch window, even if this delayed the launch of NROL-24 by several days. Even so, NRO and Air Force Space Command's 45th Space Wing launch crews continued progressing to a 10 December launch, staying poised in case the shuttle experienced a delay. The plan for NROL-24 was to reach maximum readiness, and stay "in the tube" until *Atlantis* either launched or was scrubbed. This minimized the downtime between launches and maximized NROL-24's probability of launching before the holidays.

In preparing for the 6 December shuttle launch, NASA engineers discovered a problem with low-level hydrogen fuel sensors, delaying the launch until at least 8 December—two days prior to the scheduled NROL-24 launch. Coordination among NRO, NASA, and the 45th Space Wing kept both on track. Should NASA engineers determine to stand down *Atlantis,* the Air Force and NRO would be notified immediately and all efforts would be refocused on launching NROL-24. *Atlantis* was again delayed from 8 December to 9 December, making a 10 December launch of NROL-24 seem almost impossible given the necessity to reconfigure the eastern range from the shuttle to the Atlas V. On 9 December, as NASA was once again attempting to launch *Atlantis,* the three mission partners leaned forward to go as far as

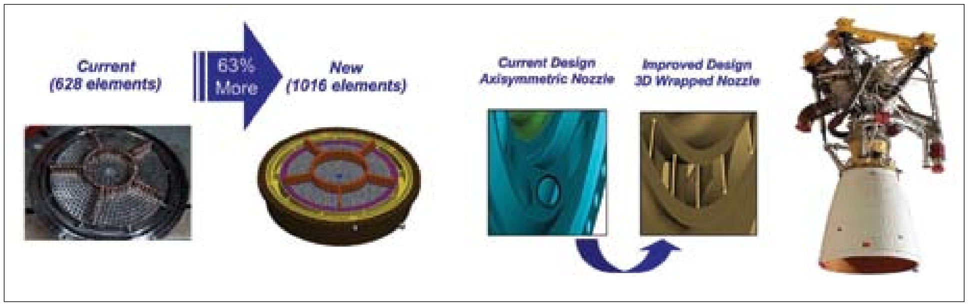


Figure 2. The Delta IV RS-68 main engine upgrade. Data from the NRO-funded upgrade will be shared with the Air Force and NASA.

possible to keep the NROL-24 launch on track for 10 December, should NASA scrub on 9 December, but without precluding another *Atlantis* attempt on 10 December.

At approximately 0930 Eastern Standard Time (EST) on 9 December, NASA made the decision to postpone the *Atlantis* launch to January 2008, due to continuing unresolved issues with the fuel sensors, and immediately notified the Air Force and the NRO. Because of the exceptionally close coordination among NRO, NASA, the 45th Operations Group, and United Launch Alliance—the EELV launch service provider—an all-out effort was initiated to attempt a launch of NROL-24 in about 32 hours. One critical element of this extremely aggressive plan was preparing to roll NROL-24 from the Vertical Integration Facility (VIF) to SLC-41 as soon as possible in the event of an *Atlantis* scrub. Within 45 minutes of NASA's decision to stand down the shuttle, the Atlas V carrying the NROL-24 payload left the VIF and rolled to SLC-41. Due to pre-coordination, the eastern range reconfiguration was accomplished in one-third the normal time. Remaining procedures leading to launch day proceeded smoothly, albeit urgently.

At 1705 EST on 10 December, all the hard work and cooperation was rewarded with a flawless launch at the opening of the window. This extraordinary achievement would not have been possible without the exceptionally close coordination, planning, dedication, and true teamwork that can only come from a strong trusting relationship among mission partners.

Another significant example of partnership and shared mission goals is the Delta IV heavy lift upgrade program currently underway. NRO mission requirements demanded more performance than the Delta IV heavy lift vehicle (HLV) currently provides. The main effort focuses on upgrading the Delta IV's main engine, the RS-68, to a more powerful RS-68A. The NRO partnered with the Air Force and NASA to evaluate a plan forward to achieve the necessary performance improvements. These partners determined that there were benefits for all three organizations. The NRO would attain the performance it required. The Air Force (as the EELV program manager) would have the option to make the RS-68A a Delta IV fleet-wide upgrade for all common booster cores, potentially avoiding the cost of using solid rocket strap-on boosters for some future Delta IV missions. NASA would receive all RS-68A program data to enable it to develop another variant—the RS-68B. NASA plans to use five RS-68B engines in the next generation Ares V heavy lift launch vehicle that will serve as the primary means for delivering large-scale equipment to space—from the lunar landing craft and materials for establishing a lunar base—and replenishing food, water, and other staples needed to extend human presence beyond Earth orbit.

To accomplish this upgrade, the Air Force, NRO, and NASA executed a tripartite agreement to exchange information. This will enable the NRO Delta IV HLV upgrade program to meet its goals and provide a more robust capability for delivering payloads to Earth orbit and beyond.

Conclusion

Assured access to space is critical for US national security. Whether providing a precision navigation capability, conducting reconnaissance activities, or pushing the edge of our scientific knowledge, space plays a critical role that cannot be replaced. The Air Force, NRO, and NASA have partnered for decades to safely, efficiently, and reliably provide the gateway to space for the nation.

That partnership continues.

Col John G. Stizza (BS, US Air Force Academy [USAFA]) is director, Office of Space Launch at the National Reconnaissance Office (NRO), Chantilly, Virginia. He is responsible for successful delivery of every NRO satellite on orbit, on time.

After graduation from the USAFA in 1983, Colonel Stizza's first assignment was Wright-Patterson AFB, Ohio, as an F-16 flight simulator systems engineer. He was responsible for designing, testing, and delivering flight trainers to US and allied Air Forces around the globe. In 1988, he was assigned to the western Space and Missile Center, Vandenberg AFB, California, supporting classified payload integration to ground support launch facilities. In 1991, he became the lead systems engineer for Space Launch Complex 40, overseeing the demolition and rebuild of the $450 million launch complex to accommodate the nation's largest expendable booster, the Titan IV. In 1993, he transferred to the 45th Space Wing, Cape Canaveral AS, Florida, where he completed tours as a Titan IV launch controller, Delta II maintenance officer and 45th Space Wing chief of standardization and evaluation. During this time, he was a certified crew member on four Titan IV launches and nine Delta II launches. In 1997, Colonel Stizza moved to NRO Headquarters (HQ), in the Office of Space Launch, acquiring launch services for NRO systems. He then moved to the NRO Office of Legislative Liaison where he provided the interface between the US Congress and NRO programs, eventually assuming the role of deputy director, legislative liaison. Colonel Stizza then assumed command of the NRO Operations Squadron, Schriever AFB, Colorado, in December 2000. His unit provided telemetry acquisition and relay for all NRO launches and all evolved expendable launch vehicle (EELV) launches for Air Force Space Command (AFSPC). They also executed 175+ daily NRO satellite contacts in support of intelligence gathering operations worldwide. He then moved to the staff at HQ AFSPC managing efforts to maintain the nation's launch ranges and satellite control networks while also managing procurement of the next-generation launch vehicle—EELV. In 2005, Colonel Stizza returned to the NRO at Los Angeles AFB, California, where he took on duties as the deputy director for the Office of Space Launch.

Common Language, Common Culture:

How the Space Community Must Change Language and Perspective to Achieve Cross-Domain Integration and Dominance

Lt Col Dana Flood, USAF
Deputy Division Chief
Intelligence Plans and Requirements
Headquarters Air Force Space Command
Peterson AFB, Colorado

For the Air Force to achieve cross-domain dominance, it must first achieve cross-domain integration. The black and white space communities must speak the same language as the rest of the joint force in order to properly integrate.

In the quarter-century of its existence, AFSPC has, like all large organizations, evolved over time to develop its own language, jargon, and terminology. Unfortunately, by either accident, function, or design, AFSPC was largely a separate entity from the rest of the Air Force. Thus, like an isolated culture on a remote island, AFSPC's language developed to a point that it became a separate dialect, sometimes incomprehensible to the parent Air Force culture.

In the present and future era of declining budgets, need for cross-domain integration, and a lower margin for error, this must stop. The space community should change the way it culturally views both its assets and missions in order to properly integrate with the rest of the Air Force and the joint fight. Specifically, AFSPC should lead the way by unequivocally declare that overhead non-imaging infrared (ONIR) assets are intelligence, surveillance, and reconnaissance (ISR) platforms, and should reexamine the utility of phrases like "space effects" and "space situational awareness" (SSA).

These recommendations may seem like heresy to the bulk of the *High Frontier* audience, but they are necessary. The era in which stovepipes and intentionally crafted independent fiefdoms is long since over. AFSPC has an excellent opportunity to lead the charge across the breadth of the defense and intelligence communities and change the way all operators of ONIR platforms and users of ONIR data view these systems.

Out of the Black: ONIR is ISR

Ironically, for years, the Air Force and joint community were better served in the ISR arena by black space assets operated by outside organizations than by white space ISR assets operated by AFSPC. Indeed, it has been historically difficult for the command to even admit that ONIR assets are ISR platforms. Achieving warfighting success demands solid efforts by the space community to better integrate white ISR to the broader Air Force and joint ISR enterprise.[1] Fortunately, this task is achievable.

The first step towards integration with the rest of the Air Force is to a share a lexicon—a common language. As AFSPC Commander General C. Robert Kehler has said and written on numerous occasions, if 95 percent of the Air Force speaks the universal language of joint warfighting, and five percent of the Air Force speaks the arcane language of space operations, then one of those communities has to change.[2]

Consider, for the sake of argument, the space community's ONIR systems. The language the community uses confusing at best and misleading at worst. In any event, the lack of clarity impedes coordination and cooperation in contributing to the joint fight.

The Defense Support Program (DSP) and Space-Based Infrared System (SBIRS) satellites are AFSPC's current ONIR platforms.[3] The current AFSPC mission briefing, which is frequently given to distinguished visitors, flatly describes DSP as an "early warning" asset, and characterizes SBIRS as a "missile warning" satellite. To go into more detail, according to the AFSPC SBIRS fact sheet, the satellite "contributes to" four missions: missile warning, missile defense, technical intelligence (TI), and battlespace characterization.[4] The problem is that the satellite itself doesn't actually do any of these things. Rather, it simply does surveillance and reconnaissance—space and intelligence professionals inside and outside of the space community use its data to do those four missions. Though this is a subtle distinction, it is an important one.

Starting from the bottom, "battlespace characterization" is a meaningless term. The phrase does not appear in Joint Publication (JP) 1-02 (the Department of Defense (DoD) Dictionary of Military and Associated Terms), nor is it even defined within Air Force doctrine. As of the date of this writing, the official Air Force fact sheet for SBIRS still lists "battlespace characterization" as a mission, but some newer documents within AFSPC swap this phrase with battlespace awareness (BA). This is a positive step, but it is still both incomplete and misleading to the rest of the force.

BA, as defined in JP 1-02, is, "Knowledge and understanding of the operational area's environment, factors, and conditions, to include the status of friendly and adversary forces, neutrals and noncombatants, weather and terrain, that enables timely, relevant, comprehensive, and accurate assessments, in order to successfully apply combat power, protect the force, and/or complete the mission." BA is an end-state, a product of ISR; it is not a mission in and of itself.

Likewise, SBIRS is said to perform TI. This is not the case. TI, as described and defined in the JP 1-02, is a product that is developed by the combination and analysis of information from multiple sources. SBIRS is a series of sensors that use ISR to collect data that is valuable to the process of crafting TI, but it does not "do" TI in and of itself.

The BA and TI functions of SBIRS are analogous to the mission of the E-3 Airborne Warning and Control System (AWACS). The AWACS radar performs surveillance; the battle managers onboard turn that into actionable offensive counter-air (OCA) or defensive counter-air (DCA) tactical control, the end product of which is air superiority. But doctrinally, nobody says AWACS nor the fighters they control are conducting "air superiority" missions; rather, they are described as performing OCA or DCA. SBIRS should be thought of in the same fashion.

One can make a similar argument about the missile warning and missile defense roles of SBIRS and DSP. Throughout AFSPC, and indeed, throughout the defense community, most people consider these assets to be "missile defense satellites." In truth, they are not. As General Kehler said (admittedly in a moderately different context), "the hardware doesn't perform the mission, the people do."[5] In essence, the Second Space Warning Squadron (2 SWS) uses ONIR data from SBIRS and DSP, in conjunction with predictive intelligence to perform missile warning/missile defense. Indeed, one could look at missile warning as a subset of ISR. This neither minimizes nor invalidates the role that ONIR can play within the four mission areas, but it clarifies a situation that is confusing to the Air Force and thus inhibits cross-domain integration.

AFSPC should clearly define SBIRS as an ISR asset. AFSPC has taken steps in this direction, but it should be unequivocal and stated at all levels of the organization. Lest readers question whether SBIRS is an ISR asset, and thus consider this article to be going "off the reservation," consider the following: General Kehler has already said that SBIRS is ISR. In his March 2008 testimony before the Senate Armed Services Committee, his prepared text had three paragraphs under the heading "Intelligence, Surveillance, and Reconnaissance." Each of those paragraphs discussed a different aspect of SBIRS.[6] Furthermore, the recent reorganization of HQ AFSPC staff put ONIR firmly in the lane of A5F (the command lead for ISR matters). If SBIRS is not ISR, why is it managed by the ISR office and briefed to Congress under the ISR rubric?

So at the top level, it seems clear that SBIRS is acknowledged to provide ISR effects, but at the action officer level, the command needs to be more clear and go all the way down the line within and outside of AFSPC.[7] Doing so does not minimize the importance of the 2 SWS, nor does it prevent them from conducting their warning mission. This data can flow to multiple users and be used to develop a wide variety of intelligence products with absolutely no degradation to the 2 SWS mission; indeed, they would not even know anyone else was receiving the data.

Some are inclined to resist this designation, based on an outmoded paradigm that views intelligence and operations as separate functions with separate funding lines. This is not the case. Intelligence, as General T. Michael Mosely noted, *is* operations. Nor are there any Title 10/Title 50 concerns. All military services fund, field and operate ISR assets, and those assets can function in any domain.

There are advantages to be gained from the designation. First, using a clear and consistent descriptor helps the Air Force and the joint world understand what ONIR assets are and helps provide a mental framework for how they can be used. The warfighter already understands what can be gained from black space; changing our vocabulary helps propagate knowledge of what can be gained from white space as well.

Second, defining these assets as ISR sensors bolsters the AFSPC argument for augmented architectures. The Air Force Intelligence, Surveillance and Reconnaissance Agency (AFISRA) is devoted to connecting all major commands (MAJCOMs) and air operations centers (AOCs) to the Distributed Common Ground System (DCGS). By pointing out to AFISRA that AFSPC ISR assets collect terabytes of data that is largely not exploited in real time, the command makes the case that DCGS should be extended to space command sooner rather than later.[8]

AFISRA, like virtually every other Air Force organization, is air-centric. Give them an excuse to ignore AFSPC and they will do it. They are neither malicious nor incompetent; but they are accustomed to focusing on airborne collection and processing, and unless they are spoken to in a common language, they are unlikely to come out of their domain and budgetary comfort zones, particularly given their severe constraints in both funding and manpower.

Third, AFSPC should embrace the concept of a universal tasking of its ISR assets. Although, under the cold war mindset, there was a logical reason at the time for establishing the existing stovepiped system, that time is long past. The Air Force and AFSPC cannot afford to continue to support disparate tasking and dissemination systems for what have been traditionally and erroneously artificially categorized as strategic and tactical collectors. As the Air Force ISR concept of operations (CONOPS) (in MAJCOM draft) says, "The Air Force must gain every possible efficiency from all available sensors—human, surface, cyber, air (including strike and mobility aircraft), and space. ISR must be executed through a single integrated process that tasks or cooperatively exploits the capabilities of all platforms and sensors and that is flexible enough to cover the entire range of military operations."

In this, there is a gap to be bridged both in terms of architecture and in culture. Within AFSPC, some contend that the Intelligence Community (IC) and SBIRS already "share a joint tasking and planning process."[9] Although this may be the view within the space community, that perspective is quite different in the field. Interviews with two officers who have served as collection managers at the Combined Air and Space Operations Center in Southwest Asia showed a different story. "We tried the entire deployment, but never cracked that nut," said Capt Ryan O'Neal of efforts to task and acquire ONIR data through standard channels.[10]

It will be neither cheap nor quick to transition SBIRS tasking to the same collection management process used to task black space and other assets by the rest of the DoD and IC, but it will be necessary. It is certainly possible to build tasking and collection management systems, but it would be easier to simply tie into existing architectures. Certainly, some tactics, techniques and procedures must be ironed out, and AFSPC and US Strategic Command must have assurances that these assets will always be able to provide key ISR data for missile warning/defense. These problems are not insurmountable, and the gain—bringing more ISR data derived from white space to the warfighter—could be immeasurable. The time to act is now, when SBIRS, with its new robust taskable capabilities is still in its infancy and the Missile Defense Agency's Space Tracking and Surveillance System, with comparable capabilities, has yet to be launched.

Indeed, AFSPC can and should work to encourage owners of other ONIR assets outside of this MAJCOM all fall under the same umbrella of tasking and dissemination. This will enable space professionals to contribute to a positive cultural shift throughout the defense and intelligence communities.

What is a "Space Effect?" The Rise of Domain-Neutral Language

Just as there are gains to be made in clearly defining ONIR assets as ISR platforms, there is also work to be done in rethinking what AFSPC means when the words "space effect" or "SSA" are used. The term "space effect" is omnipresent. For example, virtually every *High Frontier* published in the last three years has had at least one article that discusses "space effects." But what does this phrase mean, how is it used, and does it add to or detract from AFSPC's ability to achieve cross-domain integration?

Although in most cases, these effects involve space assets, it's not necessarily useful nor doctrinal to refer to them as "space effects." Indeed, there is no doctrinal definition for what constitutes a "space effect," so let us instead examine the literature and see what develops.

At least three articles refer to ISR imagery from orbital assets as a space effect.[11] Regardless whether it comes from national systems or commercial platoforms, overhead imagery is considered by these authors to be a "space effect." Another article notes that the Joint Space Operations Center (JSpOC) is the "single point of contact for requesting space effects."[12] It would logically follow (given that the authors of most of these articles are general officers), that the JSpOC should be the arbiter of all overhead imagery requirements.

This, clearly, is not the AFSPC position. Casual readers, however, could be forgiven from thinking that it was the command's opinion, however. Indeed, it would be a logical conclusion of an argument that began with an illogical premise: that anything involving space should be viewed as a "space effect." Nobody in the Air Force looks at a C-130 sortie as an "air effect." We would not dream of calling the ISR provided by a Predator as an "air effect." And one can search in vain for a reference to tactical air navigation as either an "air effect" or "surface effect." Yet navigation, communications and ISR involving AFSPC assets are routinely called "space effects."

The rise of domain-neutral doctrine and concepts, fortunately, provides an alternate means of envisioning this issue. AFSPC can look to the existing Air Force CONOPS documents and core competencies as a guideline. In contemporary Air Force language, effects are only rarely defined by their domains (air, space, and cyberspace superiority are the exceptions).

Indeed, some AFSPC assets are already viewed in this domain-neutral fashion. The Space Lift capability resides within the Global Mobility CONOPS,[13] for example, and ICBM operations are in the Global Strike CONOPS.[14] This model better defines those capabilities and effects that AFSPC brings to the fight. For example, rather than calling ONIR a space effect, call it ISR. Rather than calling what the Wideband Global System provides a space effect, call it a communications effect.

This would provide precision and accuracy of language that is lacking in the current amorphous verbiage that is "space effect." In turn, this elegance of language makes it easier to integrate AFSPC with the rest of the Air Force and joint force, and simplifies the ability to plan for and produce appropriate effects. In short, the term "space effects" as currently written is imprecise and an invitation to misunderstanding. Killing the term improves rather than hurts the command's ability to achieve cross-domain integration.

By the same token, the space community should carefully consider the definition and utility of the term "SSA." After many years of conflicting service-level definitions, a joint definition is now in the works in the draft Joint Publication 3-14, *Space Operations*. Currently, the draft definition is, "The requisite current and predictive knowledge of the space environment and the operational environment upon which space operations depend—including physical, virtual, and human domains—as well as all factors, activities, and events of friendly and adversary space forces across the spectrum of conflict."[15]

This is a largely adequate definition, and it's a positive step to finally standardize the term in the joint arena. But is it complete? As it stands in the draft, SSA is set out to be a completely separate mission area. In reality, it's simply a different window dressing on an existing doctrinal concept—BA. Recall that the first clause of the BA definition is, "Knowledge and understanding of the operational area's environment, factors, and conditions, to include the status of friendly and adversary forces, neutrals and noncombatants, weather and terrain …"

Is it possible to look at those two definitions and conclude that they are utterly separate? Not remotely. Rather, one should look at this draft definition of SSA for what it is: a subset of BA.

True, there are a great many dollars attached to program elements with the "SSA" tag, but labeling SSA as a subset of BA does not jeopardize those funding streams. It can, in fact, have the opposite effect. By clearly spelling out the role of SSA within the broader mission set of BA, AFSPC may have the opportunity to levy greater requirements against the Air Force, DoD, and National IC vis-à-vis threats to space operations. This could, in turn, lead to greater funding and greater integration of SSA efforts. The Air Force as a whole, sadly, does not fully understand space operations and requirements. This change would allow space professionals to use common language to make the case for a bigger slice of the budgetary pie.

Words Matter

The arguments outlined above may seem eye-gougingly painful. Doctrinal discussions at first blush seem irrelevant to many. But the more discerning reader should understand the implications. We are faced with two competing courses of action. We can continue to talk the talk of cross-domain integration, while steadfastly holding to outmoded definitions that inhibit achieving our stated goal. Alternately, we can take concrete steps to achieve that integration. These steps require changes in mindset and lexicon as much as they require improved architectures.

The prospect of making these semantic changes is frightening or heretical to many. But there is no reason to fear. General Mosley and General Kehler have given us all a charge to achieve cross-domain integration, and the steps outlined above will take us down the path of implementing his vision. Doing a better job of integrating white space capabilities into the broader fight is quite possible—and it is far easier to achieve cross-domain dominance (and the cross-domain integration which is its prerequisite) if everyone in the Air Force embraces a common language and common culture.

Notes:

[1] On the flip side, the air-centric Air Force must also devote greater emphasis on providing intelligence products to help ensure space superiority. This issue is largely beyond the scope of this article, but efforts are ongoing behind the scenes to meet this goal.

[2] Lt Gen C. Robert Kehler, USAF, address to AFA National Symposium on Space, 17 November 2006. There have been significant improvements in recent years, particularly via the 1996 introduction of a Space Division at the USAF Weapons School, and the integration of sharp space professionals within Air and Space Operations Centers (AOCs) worldwide. But there is still a long way to go both in the area of space professionals understanding air operations and (to an even greater extent) air-centric personnel understanding space operations.

[3] These arguments about the nature of SBIRS and DSP are also applicable to ONIR platforms managed by other organizations. Indeed, the somewhat vague acronym "ONIR" originated outside of AFSPC, and use of the term was rightly resisted by AFSPC for years. Use of this acronym to describe the sensors in question contributes to confusion about the use and capability of the platforms. The author calls SBIRS a "current" program based on having systems on orbit; this is an admittedly somewhat loose designation inasmuch as the system is not at present fully operational.

[4] Space-Based Infrared (SBIRS), fact sheet, Air Force Space Command Public Affairs, 1 June 2008, http://www.afspc.af.mil/library/factsheets/factsheet.asp?id=3675.

[5] Corey Dahl, "Space mission will become more important, says AFSPC commander," [sic], *Space Observer,* 3 April 2008, 11.

[6] General C. Robert Kehler, USAF, Statement of General C. Robert Kehler, commander, Air Force Space Command before the Senate Armed Services Committee, Strategic Forces Subcommittee, United States Senate, 4 March 2008, 16.

[7] Some contend that SBIRS has "for years been considered an ISR asset" within AFSPC. But current AFSPC publications, briefings and fact sheets belie this notion. SBIRS clearly is ISR (a fact that is understood by some individuals throughout AFSPC), but the institutional culture of the command has yet to embrace that fact.

[8] This is not to say that ONIR data from Air Force and other organizations is not exploited. But although there is some use of real-time use of ONIR, the majority of the exploitation happens days or weeks after an IR event is detected. For some uses (such as TI), this is fine, but DCGS will help enable a far more robust role in what is currently known as the battlespace characterization/awareness mission set.

[9] Maj Robert Kittell, USAF, HQ AFSPC A5F, email received 18 June 2008.

[10] Capt Ryan O'Neal, USAF, 603 AOC/ISRD, personal interview, 18 June 2008. Interviews with several collection managers were conducted on 18 June in response to the Kittell email. Captain O'Neal's quotation is representative of all comments.

[11] Eric Miller et al., "Small Satellite Multi-Mission Command and Control for Maximum Effect," *High Frontier* 3, no 1 (November 2006): 58-64; Lt Gen Gary North, Col John Riordan, "The Role of Space in Military Operations: Integrating and Synchronizing Space in Today's Fight," *High Frontier* 4, no 2 (February 2008): 3-7; and General T. Michael Moseley, "Dominating the High Frontier: The Cornerstone of Global Vigilance, Global Reach, and Global Power," *High Frontier* 3, no 4 (August 2007): 6-7.

[12] Lt Gen C. Robert Kehler, USAF, "Enhancing Joint Space Operations," *High Frontier* 3, no 1 (November 2006): 56.

[13] Headquarters Air Mobility Command, *Global Mobility CONOPS*, version 6.0, 6 October 2006, 2.

[14] Headquarters Air Combat Command, *Global Strike CONOPS*, 27 December 2006, 5.

[15] Joint Publication 3-14, *Space Operations,* first draft, January 2008, GL 11.

Lt Col Dana Flood (BA, History, University of Portland; MS, Strategic Intelligence, Joint Military Intelligence College; MA, National Security Studies, College of Naval Warfare) is the deputy division chief for Intelligence Plans and Requirements, Air Force Space Command (AFSPC), Peterson AFB, Colorado.

Colonel Flood's previous staff assignments including HAF Long Range Plans (XPXP), the Joint Single Integrated Air Picture Office, and the office of Warfighting Integration. His operational assignments include 30 months in the CENTCOM AOR, having worked at both squadron and AOC level; he also has served a year in the 36th Fighter Squadron (Osan AB, Korea) and three years at the 509th OSS (Whiteman AFB, Missouri).

Colonel Flood is a weapons officer and former instructor at the United States Air Force Weapons School. He has previously authored a master's thesis on the effect of fluctuating GPS dilution of precision on combat performance of GPS-assisted weapons.

Rescuing Apollo: Building Consensus toward a National Strategy for Space

Maj Patrick A. Brown, USAF
Chief of Strategic Studies
Directorate of Plans, Programs and Analyses
Headquarters Air Force Space Command
Peterson AFB, Colorado

"Now it is time to take longer strides—time for a great new American enterprise—time for this nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on earth.

… I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish."

~ President John F. Kennedy

More than ever, the US recognizes the crucial importance of spacepower for national security, including the requirement for a national strategy for space. This country's national security demands focus on the development and exploitation of space capabilities to protect and defend our homeland, friends, allies, and global interests. As a consequence, that recognition and demand has brought forth a resurgence of national security and political interest in space. And this renewed interest highlights the imperative to build a national consensus, essential in establishing national space strategies capable of driving the imagination and direction of US space programs now and into the future—a goal reminiscent of President John F. Kennedy's vision.

Today, space continues to be "intimately tied to the reality and perceptions of America's global leadership."[1] Just as Project Apollo embodied President Kennedy's bold challenge and our country's motivation and support, leaders today are asking: can the US recapture the imagination of the nation and, in effect, rally competing agendas toward the central goal of exploiting space for the purpose of national security, economic development and scientific achievement? Not only does the US require innovative space capabilities, but it requires goal-oriented space programs to inspire new technologies, scientific research, and "a reinvigorated space program [that] stimulates professional education in science, technology, engineering, and mathematics—critical to the long-term competitiveness and national security of the US."[2]

The theme and focus of this quarter's *High Frontier,* National Security Space Collaboration, is timely. More than seven years after the publishing of the Space Commission, and almost 40 years since the US first landed men on the Moon; an undercurrent of uncertainty exists concerning the advancement and identification of space priorities for development, execution, and resource allocation. For that reason, and considering the theme of this *High Frontier,* a review of the current development status of national space strategies and the strategic foundation of a prospective national strategy for space provides an appropriate starting point for this quarter's journal.

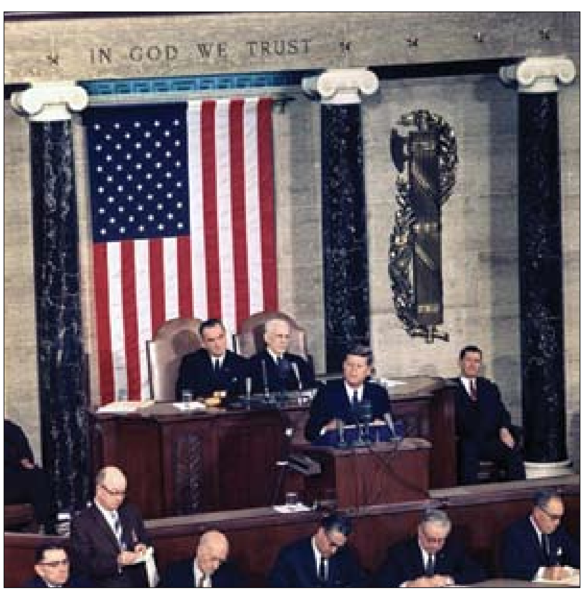


Figure 1. President John F. Kennedy calls for a mission to send man to the moon during a joint session of Congress on 25 May 1961.

Charting a Destination toward a National Strategy for Space

The US has made significant progress on space policy, strategy, training, and organization. However, in order to maintain the decisive advantage spacepower provides, particularly for its military, intelligence, civil organizations, and partnership with the commercial sector and industrial base, the US requires a comprehensive strategy. This strategy will provide the basis for future space plans, initiatives and efforts, and to serve as a guide for future actions in concert with those stated in the 31 August 2006, National Security Presidential Directive-49, hereafter referred to as the National Space Policy.

To date, several roadmaps for individual mission areas and capabilities from disparate space organizations have emerged, but a national space strategy has not been issued. The non-issuance has not been for a lack of leadership or desire.

National Strategy for Space

A national space strategy should recognize this nation's diverse and dispersed national security challeng-

Figure 2. The 363 ft tall Apollo 11 space vehicle is launched from Pad A, Launch Complex 39, Kennedy Space Center, at 9:37 a.m., 16 July 1969. Apollo 11 is the first US lunar landing mission.

es, civil and industry objectives, and international goals. Globalization and the emergence of violent and persistent non-state actors in the post-Cold War era requires timely intelligence and rapid decision making capabilities, which US and allied space capabilities greatly enhance. Retaining this decisive advantage is becoming increasingly important and difficult, and as such, should be the guiding focus of a national space strategy. Without the proper stewardship of space and a national consensus on ends, ways and means to sustain that advantage, the US risks losing its space edge.

As a nation, the US must find a method for unity of effort it is necessary for progress and future support to the warfighter, human space flight, national economic development, and protection of sovereign US space assets. If space is indeed an enabler of the American way of war, and the American way of war is the path to continued success and existence of the US, this strategy should directly address this challenge.

As such, this article outlines six themes of a prospective national space strategy: authority and responsibility to include linkages to higher-level guidance and lower-level implementation plans and enterprise architectures; enable unhindered space operations and freedom of action/access; develop space partnerships and dependencies; improve planning, development and technological solutions; leadership and professional development; and a strategic investment approach.

Authority and Responsibility

A national space strategy should expand on the definitions in the National Space Policy and chart responsibilities in those areas where military and intelligence organizations overlap with civil, commercial, and international space. It should provide seamless linkages between the space strategy and higher-level guidance and lower-level implementation documents.

For example, the National Space Policy establishes as a goal: "Enable unhindered US operations in and through space to defend our interests there." A National Defense Strategy end is to: secure strategic access and retain global freedom of action. And a prospective national space strategy, in direct correlation to the above guidance, would outline the imperative goal of ensuring access to space and freedom of action in space. Furthermore, this strategy must be in concert with national security space implementation plans and space control concepts of operations. In some cases, these plans and concepts are already established and functional. A sound strategy should only change these if they require significant redirection.

Enable Unhindered Space Operations and Freedom of Action/Access

This strategy should outline the imperative goal of enabling unhindered US operations in and through space and ensure space capabilities are available to further US national security by ensuring access to space and freedom of action in space. To achieve this goal, the US must continue to pursue access capabilities and design, develop, field, and operate a set of robust

Figure 3. This view of the Earth rising over the moon's horizon was taken from the Apollo 11 spacecraft. The lunar terrain pictured is in the area of Smuth's Sea on the nearside. Coordinates of the center of the terrain are 85 degrees east longitude and three degrees north latitude.

The US must adopt a balanced approach to planning, designing, fielding, and employing new space capabilities. Such an approach will require a prioritized national security space plan and assessment with increased investment in systems engineering and integrated solutions that capture the complementary advantages and dependencies of space and non-space systems.

assured space control capabilities; chief among these being comprehensive space situational awareness. The end state is delivery of responsive, assured, and decisive space power that meets user needs and addresses unique warfighter, intelligence apparatus, and economic challenges the US will face to sustain its decisive asymmetric advantage. In doing so, this strategy will dictate other strategies for protection, survivability, human capital investment, architecture approaches, and so on.

Develop Space Partnerships and Dependencies

This strategy must account for existing national strategies for military operations, the intelligence community, and for leveraging civil, commercial, and foreign capabilities. The intent is to provide a common goal and vision to enable viable, long term national strategic contributions among all space partners. A common vision will also enable national security space plans, mission area and capability roadmaps, and enterprise architectures. This strategy emphasis must be on delivering integrated effects and on producing space capabilities that support and ally with friends, while deterring adversaries. Further, it must fully integrate civil, commercial, and international space activities that support national security issues. The strategy must be global in perspective, but still allow for local execution, while driving the development of more responsive and integrated survivable, flexible, and agile systems and capabilities that together will meet the needs and challenges identified above. Moreover, this strategy should advance national security through international cooperation with foreign (allied) nations and/or consortia on space activities that are of mutual benefit by increasing and strengthening partnerships. The US' international partners have become even more essential to our future security environment in space. This strategy should lay a path for further cooperation and expand on the direction already set forth in the National Space Policy.

Improve Planning, Development, and Technological Solutions

The US must adopt a balanced approach to planning, designing, fielding, and employing new space capabilities. Such an approach will require a prioritized national security space plan and assessment with increased investment in systems engineering and integrated solutions which capture the complementary advantages and dependencies of space and non-space systems. To further this objective, the US must integrate space enterprises wherever possible, continue to align space capabilities throughout national security endeavors, and fully incorporate the contributions of civil, commercial, and international space activities to national security. Further, this strategy must enable a robust science and technology base supporting national security by producing innovative solutions.

Technological and industrial dominance have been a prevailing theme in many of our national successes over the past century. As witnessed with the Apollo program and many others that followed, the strategy of using focused technological and industrial capabilities has proved very successful. The US must maintain its technological edge and the means to nurture innovative approaches to enable employment of spacepower for the goals of this strategy.

To create and improve innovative solutions the US must invest in skilled and dedicated people, nurture leading-edge science and technology, and sustain a healthy industrial base. This effort requires investment in transformational capabilities, as well as partnerships with civil agencies, industry, and academia to form a national science and technology program. These efforts, fueled by sufficient investment to encourage innovation and preserve US leadership in critical space-related technologies, would serve to bolster areas of research where the US lead is diminishing. By providing innovative new means, concepts, processes, and capabilities through targeted investment, partnerships, and leadership, the US will sustain an asymmetric advantage in space.

Space Leadership and Professional Development

By building a cadre of space professionals, the US will ensure it has the personnel and leaders to acquire, operate, and employ the space systems that provide a decisive asymmetric advantage in space. Making an early and sustained investment in standardized education, training, and space career opportunities will ensure the space cadre is ready to lead and teach future generations of space professionals. Further, professional development requires direct leadership involvement. The price of education, aside from the cost, is the absence of personnel from the day-to-day tasks, sometimes as long as six months, as in the case of the Space Weapons Officer Instructor Course at Nellis AFB, Nevada.

Strategic Investment Approach

A national strategy for space must provide the foundation for investment in space capabilities, balanced against investments in other transformational capabilities and industrial base considerations required to execute the National Space Policy and National Defense Strategy. While this strategy should not prioritize investments into specific programs since prioritization should be relegated to specific mission areas or capability road-

Figure 4. The prime crew for the first manned Apollo space flight was named at a Manned Spacecraft Center (MSC) press conference on 21 March 1966. Left to right, are Astronauts Roger B. Chaffee, Edward H. White II, and Virgil Grissom . At the very end of the table is Dr. Robert R. Gilruth, MSC director, who made the announcement.

maps, implementation plans, and architectures at the service level, the strategy should provide a comprehensive guide to resource allocation in accordance with objective-based goals.

Charting a Way Forward

The Apollo 1 astronauts, Virgil Grissom, Edward H. White II, and Roger B. Chaffee, paid the ultimate sacrifice for progress in space. The lessons learned from these events did then, and should today, urge our nation toward maximizing the US' development and exploitation of space. By recognizing and overcoming barriers to progress, the US will set a course for the advancement, development, and execution of space for decades to come.

As witnessed with the Apollo program, future success will occur at the intersection of policy, strategy, leadership, industrial ability, investment, and people. In the Apollo program, leaders recognized that not only was the US seeking international prestige in going to the Moon, but they believed the program would yield great scientific and technological return on investment and "accelerate and integrate national space efforts, incorporating both scientific and commercial components."[3]

In this new century, US policy makers and military leaders look to the national security space team to provide space capabilities competently, efficiently, and seamlessly. The US must apply innovative thinking to exploit the inherent advantages of the space medium and enhance space capabilities to help solve the security challenges we are faced with today and in the future. A national space strategy and its objectives is needed to provide the basis for future space plans, initiatives and efforts, and to guide our actions in the years ahead. Achievement of these strategic objectives will ensure the US' ability to sustain spacepower as a decisive asymmetric advantage into the 21st century.

Notes:

[1] Eric Sterner, "More than the Moon," *The Washington Times,* 11 April 2008, http://www.washingtontimes.com/article/20080411/EDITORIAL/190619503/1013/EDITORIAL.

[2] Ibid.

[3] Project Apollo: A Retrospective Analysis, NASA, http://history.nasa.gov/Apollomon/Apollo.html.

Maj Patrick A. Brown (BBA Management, Midwestern State University; MS, Administration, Central Michigan University; MMOAS) is the chief of Strategic Studies, Directorate of Plans, Programs and Analyses, HQ AFSPC, Peterson AFB, Colorado. He is responsible for providing the AFSPC commander with a comprehensive range of strategic options and independent assessments to enable strategic recommendation and decisions. He is also the command focal point for interactions with the chief of staff of the Air Force's Strategic Studies Group (CHECKMATE). Major Brown was commissioned from Air Force Officer Training School in 1993. His career includes assignments as a missile combat crew commander at Minot AFB, North Dakota, a missile combat crew initial qualifications instructor and training flight commander at Vandenberg AFB, California, the sole space advisor, planner, and chief of Special Technical Operations (STO) for 9th Air Force/US Central Command Air Forces commander at Shaw AFB, South Carolina, the assistant director of operations for the USAF Weapons School's space squadron at Nellis AFB, Nevada. He has deployed numerous times to theater combined air and space operations centers to include positions in strategy and STO during Operation Iraqi Freedom's Major Combat Operations from February to April 2003, the primary Afghanistan air strategy planner for Operation Enduring Freedom from December 2003 to March 2004, and other deployments where he performed duties as lead space weapons officer, space strategist, STO chief, and deputy director of space forces in support of major theater exercises. Major Brown is a resident graduate of the Squadron Officer School, Air Force Weapons School, and Air Command and Staff College.

Not Related to Reconnaissance in Any Way: An Interview with Dr. F. Robert Naka

Dr. Rick W. Sturdevant
Deputy Command Historian
Headquarters Air Force Space Command
Office of History
Peterson AFB, Colorado

Typical DEW Line Site.

Dr. Rick W. Sturdevant interviewed Dr. F. Robert "Bob" Naka, former deputy director of the NRO (DDNRO) (1969-1972) and chief scientist of the Air Force (1975-1978), via e-mail during April-June 2008. Born in California to Japanese immigrant parents, Bob Naka was imprisoned at Manzanar Relocation Center, California in 1942. Fortunately, through the efforts of the National Japanese American Student Relocation Council, supported by the American Friends Service Committee (Quakers), he gained release to begin attending college in February 1943. After graduating from the University of Missouri–Columbia with an electrical engineering degree in 1945, he completed a master's degree in the same field at the University of Minnesota and a doctorate at Harvard University.

INTERVIEW

Sturdevant: Please describe the circumstances that led to your employment at Massachusetts Institute of Technology (MIT) Lincoln Laboratory after receiving a doctorate in electron optics from Harvard in 1951.

Naka: I became acquainted with professors at MIT and management at General Electric (GE) through an inquiry about establishing a chapter of the American Institute of Electrical Engineers at the Harvard Graduate School of Engineering, where I was working on my doctorate. I pointed out that the chapter was more suited for undergraduates, but Harvard did not award a degree in engineering to them. As for graduate students, I pointed out that there were too few of them to start a chapter and besides, they were much busier with their research than undergraduates would have been with their studies, so it did not seem feasible to try. That seemed to satisfy them, and that formed a basis for my becoming better acquainted with them. The GE managers invited me to the annual "Jamboruption," and I also took a business trip with the professor, Prof. Eugene Boehne. He used to telephone me to suggest a joke to start a speech he had to give. I would provide him with one after I determined whether the audience was men only or mixed. As I neared completion of my doctorate, Professor Boehne suggested that I should consider working at MIT on a new project that was starting, and he set up an interview with Prof. Albert G. Hill. I was attracted to the idea even though I interviewed with other organizations that were offering more salary. So, I started with Project Lincoln, before it became Lincoln Laboratory, on 1 June 1951.

Dr. F. Robert "Bob" Naka.

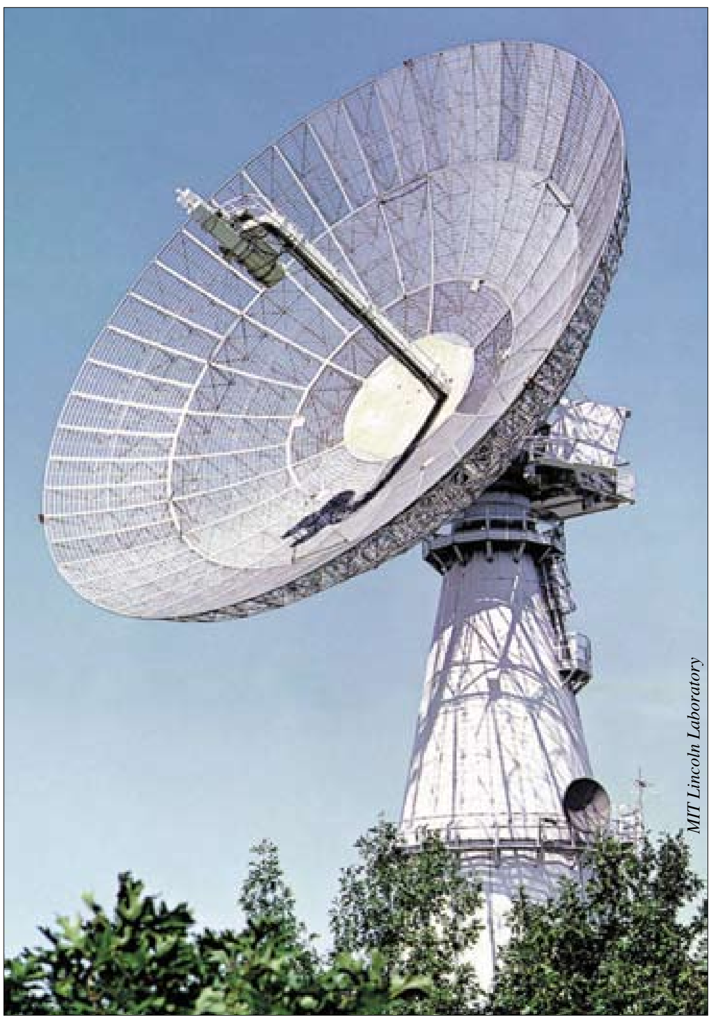
Sturdevant: What was your contribution to the design of the Distant Early Warning (DEW) Line?

Naka: I began work on Project Lincoln with the Presentation Group, a group of engineers and psychologists who were charged with investigating the relationship of man and machines, in this case the detection of radar signals by people as the radar signal detectors. I wrote a paper on this in the *Lincoln Laboratory Technical Journal*. Since my wife was a clinical psychologist, I found the activity fascinating. We examined eye-hand signal detection coordination and ear signal detection. Curiously, we found that the responses were essentially identical. We then tried to apply these ideas to the DEW Line, where there were to be only 10 personnel per site to do all the work. That meant that the radar signal detection personnel had to be able to do other tasks while being radar signal detectors. We first settled on an audible signal, but decided it would need some type of electronic backup in case the human became too involved in other tasks, even though the backup might be inferior to the human detector. So we invented the first automatic analog radar signal detector. A comparison test with the human ear and the electronic device showed that they were equal.

Sturdevant: Why were you selected to work on U-2 development, and what did you contribute?

Naka: This is a question that is more properly asked of Dr. Marshall Holloway, then director of MIT Lincoln Laboratory. Prior to that time I had worked on the DEW Line Radars (plural) and the Ballistic Missile Early Warning Radars. I was instrumental in the design of the Millstone Hill Radar. All during this time I had been given photographs of foreign radar antennas and asked to describe what the radar characteristics might be. I had been appointed in February 1956 as group leader of Group 42, Heavy Radars, to concentrate on the development of heavy air defense radars. So, it might have been natural to have been selected as one of three men to work on the U-2. The other two men were Dr. Franklin A. Rodgers and Mr. Thomas C. Bazemore.

SR-71 Blackbird.



Millstone Hill Radar, ca. 1958.

I contributed to the program by first determining what the radar cross-section of the U-2 was. Then I contributed to the design of the radar cross-section reduction material. As it turned out, I also applied the "solution" to the first aircraft to be equipped. I developed the theory of what electromagnetic principles had been exploited and went on to experiment with other related phenomena.

Currently, I am writing a classified treatise on this.

Sturdevant: How did your joining The MITRE Corporation in 1959 come about? When and how did you become MITRE's chief scientist?

Naka: In the spring of 1959, Mr. Robert "Bob" Everett, then vice president of The MITRE Corporation, approached me to join MITRE because it was set up to work on Air Defense without having a research laboratory capability; he asked me to form a laboratory. I was very reluctant to engage in that endeavor because of the existence of Lincoln Laboratory, which could perform that function. Bob Everett felt otherwise, that MITRE needed an internal capability. I turned the offer down twice, but on the third time he approached me (after having discussed the matter with other candidates) I accepted. At one time I was running a quarter of the company, called the Applied Science Laboratories, which included a number of departments: radar, communications, data processing, and so forth.

Some time after Dr. John McLucas became MITRE's president, he asked me to become chief scientist and I agreed to do so. My tenure did not last very long, because I was soon at the Pentagon with him with the covert title of DDNRO and the overt title, Deputy Under Secretary of the Air Force for Space Systems, a title that was created for me so that my move to the Pentagon would appear to be legitimate. Otherwise, I would have just disappeared.

Sturdevant: For your work on Project Oxcart, which evolved into the SR-71 Blackbird, you became known as a pioneer of stealth technology. Can you elaborate on this subject?

Naka: In the spring of 1961, Mr. Herbert "Herb" Miller of the Central Intelligence Agency (CIA), with whom we had worked on the U-2 Program, came to me and said he had a problem. The people working on the radar cross-section reduction of the U-2 follow-on had walked off the job. After I said I couldn't believe that, he said I had to take a leave-of-absence from MITRE and solve the problem. I told Bob Everett that a problem had developed that seemed to require my help and I would look into it before deciding what to do. So, I went west with Herb Miller. He had told me that I would need to make the airplane "disappear" to impress the workers. I told him that I could do that, but the solution might not be aerodynamically satisfactory. He asked me to proceed, and I did that at the experimental site.

Upon returning to MITRE from the trip, I asked Bob Everett for a leave-of-absence and told my family that we would need to spend the summer and some of the fall in Las Vegas, Nevada. After some work, I determined why the men had become frustrated enough to walk off the job. I then produced the better material that eventually was manufactured for Oxcart.


Lockheed Martin

Technicians prepare first SBIRS geosynchronous satellite for the environmental test phase at facilities in Sunnyvale, California, 19 March 2008.

Sturdevant: In his autobiographical book *Reflections of a Technocrat: Managing Defense, Air, and Space Programs During the Cold War* (2006), John McLucas said he didn't get to know you as well as he would have liked while he was president of MITRE in the 1960s, because you were "out in the West Coast leading an important project to improve the surveillance of objects in space." When and how did you first become involved with space-related activities?

Naka: "Surveillance of Objects in Space in the 1970s" was the name of the study that I kicked off in January 1968. I was director of the study, appointed by General James Ferguson, commander of Air Force Systems Command (AFSC) and Lt Gen "Saylor" Agan, commander of the Air Defense Command (ADC). The deputy study director was Col Charles Minihan, who had commanded the anti-satellite program at Johnston Island. I was supported by personnel from The Aerospace Corporation, RAND Corporation, and The MITRE Corporation. Our point of contact at AFSC was Maj Gen Glenn Kent and at ADC was Maj Gen Michael Ingelido.

The study included an ICBM and rocket launch detector we called the high-altitude surveillance platform (HASP), and an earth-satellite and ICBM penetrator-and-decoy tracker called the low-altitude surveillance platform. We know them today as Space-Based Infrared System (SBIRS) High and SBIRS Low. There were various incarnations in between. We compared the capabilities of these space assets against air- and ground-based sensors. We concluded that the space-based systems were the most cost-effective systems inspite of the high initial cost and provided worldwide coverage. The aircraft-based sensor systems, having lower initial cost, would have high recurring costs and have limited coverage. The ground-based systems with the lowest initial costs would have severe limited coverage.

After a mid-term status briefing, General Agan renamed the ADC, the Aerospace Defense Command.

Air Force Maj Bill Craig did the work on the ICBM terminal-defense phase that rounded out the study.

At that time Lt Gen John O'Neill was the commander of the Space and Missile Systems Organization. He asked me in June, before the study was complete, to brief his Advisory Group, chaired by Dr. Edward Teller. I understood that he was tough on briefers, so I traveled to Lawrence Livermore Laboratory where he was director and met with his deputy on how to brief Dr. Teller. He said it was simple, "Just use chalk on a blackboard!" I told him that would be difficult to do with this material, but he said that the importance would be that it would take me so long to draw the curves and label the important points that Dr. Teller would be able to follow the discussion, which was very important. He would follow the discussion and not get lost, as when vugraphs were rapidly flipped by.

I did just that. I kept stopping and asking if there were any questions. He usually had none. When I briefed the part on HASP, I said that we would have data passed between the three deployed satellites using 60 GHz microwave technology. Dr. Teller said that he would use lasers. I replied, "Dr. Teller, this is 1968. I know I can do this with microwaves, but more work is required for lasers because of the power requirement and pointing accuracy." He accepted that statement.

He also suggested that the Air Force liked to fly airplanes. They would like to accomplish this mission with aircraft. I pointed out the recurring cost of continuous, limited North American continental coverage compared to worldwide satellite-borne coverage. He seemed satisfied with my answer.

When I briefed the terminal-defense phase, I pointed out that the important point was that calculations could be made, based on a set of assumptions. When a member of the audience questioned my assumptions, Dr. Teller stopped the questioner and said, "Not only are Dr. Naka's assumptions good ones, but they are the best there are." He became my friend right then and there—he was a supporter for years later. I can elaborate further, but I will leave it here.

I would say in retrospect that it was one of the most complete studies ever done. I have chaired many studies so I can say that with conviction.

Sturdevant: When Dr. McLucas became NRO director in 1969, he brought you on as his deputy. What were the most significant challenges you faced during your service as DDNRO (1969-1972)? What were your most noteworthy accomplishments, at least of an unclassified nature?

Naka: For now, let me say there are many facets to my service at the NRO and I almost don't know where to start. Years later, while having dinner with John McLucas, we both said that our time at the NRO was the most satisfying activity of our careers.

Dr. McLucas left MITRE to become the Under Secretary of the Air Force about the beginning of March 1969. At his farewell party I said to him to call on us if he needed some kind of help. He knew that I had convened a committee to advise David Israel, who was then the deputy at the Defense Systems Program Group in the Pentagon, on personnel-detecting radars. On St. Patrick's Day, only two weeks later, John telephoned me and asked me to come to his office. When I arrived two days later, he said, much to my surprise, "When can you move down?" After sizing up the situation, I accepted his proposal and took the job.

The NRO was then a small group of very talented people with a huge budget. I had an immediate staff of about 30 people, including then Brig Gen Lew Allen, director of the staff. There were probably a total of 300 people in program offices in nearby Virginia, Washington, DC, and in Los Angeles, California, and at various ground stations reporting to me. Some sites were jointly manned with National Security Agency (NSA) personnel.

I noted that there were only two general-officer slots at the NRO and many O-6s, and colonels and Navy captains retired after their service. With the help of Brig Gen Lew Allen, then the director of my NRO staff, I devised a future NRO officer position assignment scheme to enhance their opportunities to be promoted to O-7. Lew thought my ideas were splendid and that no one had ever done that before. I was able to move Lew to major general, Col [David] Bradburn to major general, Col [Henry] Stelling to major general, and Navy Capt [Robert] Geiger to rear admiral. In addition, I advised Col Robert "Rosie" Rosenberg how to be promoted to brigadier general. He made major general on his own.

U-2 Spy Plane.

The NRO was a completely vertically integrated organization from research, development, to acquisition, launch, and operations. It not only had satellite operations, but had two U-2 aircraft squadrons reporting to me. I began my tour with an extensive mostly continental US, but also worldwide, travel program to see all aspects of the organization and to attend as many program reviews and operations as were possible.

My predecessor DDNRO James "Jim" Reber, was of considerable help. He not only filled me in on the issues facing the NRO but also had his secretary, Maxine Christmas, remain in the Pentagon as my secretary. Since she knew all the "nooks and crannys" of the establishments, she turned out to be a great asset and, in my experience, the best secretary I ever had helping me.

The first thing I did was to notice that the Air Force general and NRO director of the staff preceding Brig Gen Lew Allen had the larger office compared to that of DDNRO Jim Reber. I asked John McLucas what would happen if I switched offices so that the general would have the smaller one. He said, "Go ahead and do that." In addition, after I was on the job for about six months, John McLucas and I agreed that I would run the NRO on a daily basis and he would deal with the Congress and outside groups. That is, he would be Mr. Outside and I would be Mr. Inside, much as Defense Secretary Mel Laird and his Deputy Dave Packard were doing. As things turned out, I did much of the outside work also. For example, I regularly attended meetings of the United States Intelligence Board (USIB) chaired by the director of Central Intelligence, and I often briefed the president's Foreign Intelligence Advisory Board and the Arms Control and Disarmament Committee.

Management: Somehow I got into the management issues, so I will continue. At the time I arrived, the director of the Office of Special Programs was John Crowley, a very kindly and capable gentleman. His deputy was John McMahon, who later became director of the CIA. John Crowley, I learned later was very interested in becoming DDNRO when John McLucas arrived. McLucas however chose me because, as I later learned, he knew I ran a rather theoretical group at MITRE, had good management capabilities, and he could trust me. John Crowley was very gracious in accepting his disappointment, I later learned, and was a very helpful partner. McLucas required the concurrence of Dick Helms, the director of Central Intelligence, who readily approved. McLucas didn't know at that time that Dick Helms already knew me, because he had been the deputy director of the U-2 Program under Dick Bissell.

One of the issues that Jim Reber, my predecessor, had told me about was that there was still great animosity between the Air Force Program A and CIA Reconnaissance Programs. One day, when I was with John Crowley at a program review at Lockheed Missiles and Space Company, I ran into Brig Gen William "Bill" King, then director of Secretary of the Air Force Special Projects or in classified terms, director of Program A of the NRO. I said I didn't know he was in the building, otherwise I wish he could be at the meeting to which I was going. He gave an excuse that he was scheduled so heavily he couldn't change his itinerary. After the meeting was over I asked John Crowley why Bill King was not at the meeting, after all he had responsibility for a good part of the program. John answered they never invited those people. Later that day I took John Crowley aside and said to him, "What happened about the meeting attendees didn't make sense to me. I would like you to invite General King to all meetings of this type, no alternates, and will ask him to do the same thing toward you." John replied, "That makes sense to me. I'll do it." That simple act brought about a good deal of healing and working together, that I called constructive competition. Of course, in later years after I left the NRO, those tensions would build up again.

After John Crowley retired, he was replaced by Harold Brownman. On one of my visits to his office he said he learned that Program A was developing a competitive space satellite antenna at a company that was different from the company working with him. He asked me to stop that program. I refused, saying that friendly competition was a healthy activity. It was a good thing I did that because ultimately the technology being pursued by Brownman's contractor didn't work and was replaced by the one from Program A.

My relationship with John McLucas, director of the NRO (DNRO) and my immediate boss, was very close. I kept him fully informed of actions such as the two above. In exchange, he defended me at every turn, even though he received complaints about the actions I was taking. An oddity was that the Air Force secretariat began to realize that I could get answers to questions from John that others could not. They said, "Dr. McLucas doesn't answer questions, he only asks them." They would come to me to determine what John's opinions were on a number of subjects. I generally told them that if I could find out casually, I would, but the issues were out of my purview.

I attended many breakfast meetings with Mel Laird and Dave Packard when John McLucas was out of town. NSA Director VADM Noel Gaylor and Defense Intelligence Agency Director Lt Gen Donald "Don" Bennett attended those meetings. Although I gave reports of satellite operations, the big concern at those meetings was the Vietnam War and how to get out.

One issue that I tackled started at the USIB meeting. I sat to the immediate left of Dick Helms, who sat at the head. His deputy, who was a Marine general, sat opposite of me. On my left was assistant secretary of state for intelligence and on his left was Vice Admiral Gaylor. I felt that a certain satellite should have its surveillance point changed because there could be more valuable data collected from a different location. Noel agreed with me, but the deputy chiefs of staffs of the services disagreed and wanted the aim point left the way it was. I was surprised that Dick Helms had asked them, because I thought that the opinion of Lt Gen Donald Bennett, DIA director, was all that was needed. Noel Gaylor made an impassioned plea that the group was assuming that the current satellite would last forever and that the next satellite would be launched successfully, when neither of these opinions was completely true. What happened was the worst, the current satellite began to fail and the next launch failed.

I felt there was danger that the program could be cancelled, so I organized an argument not only about the value of the program but also what could be collected if the satellite's aim point were elsewhere. I had the NRO staff brief a subcommittee, and then a committee of the intelligence committee that generated requirements. My staff would not let me brief these groups, saying that I was in too strong a position. The next step then would be the NRO Executive Committee (ExCom). I had been briefing John McLucas of these activities up to this point, and now I said it was up to him to make the presentation to the NRO ExCom. He said he couldn't do that because he might lose and he couldn't afford that. I never found out why he felt that way, but then I said, "I think you said it was alright if I made the presentation." He told me to proceed, and I did. The ExCom approved my presentation, and the program continued. The result was a great success, to the point that an NSA program director told me later that the US government owed me a debt of gratitude for my insight!

Technical: Two of the management issues above were a mixture of technical issues that I resolved by a management procedure. The following are more technical issues:

As soon as I agreed to become DDNRO, John McLucas asked me to chair a committee in April 1969 to make an estimate of the first launch date of a much delayed development program for a new satellite system and what we should consider to be success. I conducted such a review and made my recommendations to the ExCom. The predicted launch date was missed slightly, but the success was better than anticipated.

With the new satellite operating, I visited Air Weather Service (AWS) at Offutt AFB, Nebraska. There, after taking a short course on becoming a photointerpreter, I looked into their operations. I observed that if I were to have an additional computer installed I might be able to improve operations of the new satellite. So, I set up a cost-benefit analysis to show the value of another computer at the AWS. At that time the purchase of computers was controlled by the controller of the Air Force. I had my staff prepare a report based on the analysis and sent it to the controller with a letter of transmittal signed by me. He approved the purchase, but kidded me about it at a lunch in the

Secretary's Mess a few days later. I also became a hero at the AWS.

Research I started in 1970 led to another program that necessitated training photointerpreters to handle a new product. As for the research experiment itself, I went to Dave Packard (John McLucas knew in advance what I was up to) to find an area of "ground truth" that would be acceptable. He said I should pick a remote place with plenty of data. I suggested Cuba, which he immediately embraced. However, we would need White House concurrence that he said he felt he could obtain. One day, he told me he had failed to obtain concurrence, so I should continue and keep him informed. I do not recall what location I selected.

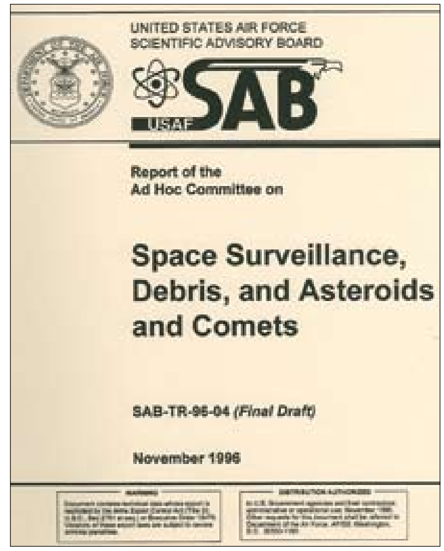
I enlisted the help of Col Frank Hartley, director of Program D and the U-2 wing at Davis Monthan AFB, Arizona.

The photointerpreters issued an unenthusiastic report, much to my disgust, because I had prepared them for the experiment. I postulated that the problem was that humans are accustomed to polychromatic forward scatter, whereas we were presenting them with monochromatic backscatter. I suggested that we prepare an area with targets, with an overlay taken from several angles to simulate a condition of forward scatter. I transferred the responsibility for the project to Program A. The new program manager was Col Paul Kaminsky, who did a number of clever things to proceed. The upshot of my idea turned out to be correct for the wrong reason. It turned out that there was a favorable look angle that permitted the viewer to sort one type of target from another.

I chaired many technical committees during and after my service at the NRO. One of these had to do with the changing use of the electromagnetic spectrum. This was somehow called "The Naka Panel" and we made a number of recommendations on foreign instrumentation signals for a new satellite system. This fact is noted in the citation of my portrait hanging in the hallway of the current NRO building at Westfields, Virginia, a suburb of Washington, DC.

Security: Security was very tight. For example, shortly after I was appointed DDNRO I was visited by Clarence "Kelly" Johnson, with whom I had worked closely on the U-2 and Oxcart. He gave me autographed photographs of the U-2 and SR-71 that I asked to be mounted on my office wall. Security stepped in and explained to me that they wished I would not do that because I was not to be related to reconnaissance in any way.

Brian O'Brien, chair of the NASA Space Program Advisory Council, invited me to be a member of his council. After gaining approval of John McLucas, Dick Helms, and Dave Packard, I became a member. During one of the council's deliberations, Brian proposed a weather satellite with about three-mile resolution, adequate for weather predictions and larger than the standard set by the NRO. I naturally provided my support, but was very careful to avoid discussion of resolution, which was not only a sticky point, but something I supposedly knew nothing about. I was very mindful of the security restrictions under which I was laboring.


UNITED STATES AIR FORCE
SCIENTIFIC ADVISORY BOARD
USAF SAB
Report of the
Ad Hoc Committee on
Space Surveillance, Debris, and Asteroids and Comets
SAB-TR-96-04 *(Final Draft)*
November 1996

Bob Naka chaired the USAF Scientific Advisory Board's Ad Hoc Committee on Space Surveillance, Debris, and Asteroids and Comets

Sturdevant: Over the years, you have served on numerous industrial, scientific, and government advisory boards, including the NASA Space Program Advisory Council and the US Air Force Scientific Advisory Board (AF-SAB). To what extent are you still involved with advising on space-related issues and systems?

Naka: I am not now active in the AF-SAB, but I would like to note here two space studies that I chaired. The first was a summer study on "Space Based Radar" that was a thorough study of tracking of aircraft from a constellation of earth-satellite-based radars. We considered not only the space-based radar system, but also all other-based radar systems. In addition, two of us, Dr. John Allen and I, studied the capability of the radar system on stealth aircraft. Then Secretary of the Air Force Dr. Donald Rice was a proponent of the system.

I also chaired a committee on Space Surveillance, Debris, and Asteroids and Comets a number of years ago.

In the last few years I have been involved in two activities that involved space. The first is on GPS that I will cover in the next question. The second is a set of committees and a symposium with the US Army Space and Missile Defense Command, Redstone Arsenal, Huntsville, Alabama. At first this involved Army space directly, but recently evolved to advising the Missile and Space Intelligence Center director.

Sturdevant: What is your advisory role related to the Global Positioning System?

Naka: I am one of the original members asked some 10 or 11 years ago initially to review the GPS III Operations Requirements Document. It became apparent that the Air Force was planning to produce GPS I, followed by GPS II Replacement and GPS II Follow-On satellites as then programmed and to put all the improvements including anti-jam capability into GPS III. The GPS-IRT (Independent Review Team) pointed out that with the satellites lasting a long time in orbit, the improved satellites with war fighting capability would take too long to be operational. Rather, it would make sense not only to begin to insert improvements into the satellites in the production line for GPS IIR and GPS IIF, but also to recycle satellites that had already been produced and were sitting in storage waiting to be launched. Reluctantly, the Air Force followed our recommendations.

The value of the GPS-IRT is that we spin off committees that study issues in depth, then provide solutions to the commander of Air Force Space Command and to the director of the GPS Joint Program Office. The solutions do not necessarily need to be implemented, but they represent solutions indicating a way to proceed. I have chaired two such committees.

Sturdevant: Since you have been involved over many years in the worlds of both "black" and "white" national security space, how would you describe their respective evolutionary paths? To what extent have those paths merged or diverged? From your perspective, has their merger or divergence been positive or negative?

Naka: The main value of a "black" program is that the team is allowed to work on the project without continually having to brief some groups in the funding line of authority. The latter causes the program office to require a set of people to prepare and do the briefings, hindering the work at hand.

Another value is that the program is often structured to have continuity of personnel, with the same program manager (sometimes succeeded by his deputy) leading the effort from research and development to acquisition to launch and then to operations. This is more likely to be true in a civilian environment, but it is often true with a military officer as the program manager. In a "white" program, the program manager is rotated frequently so that the details of history are lost, leading to very inefficient management.

Generally speaking, I have observed that the canonic form of "black" program is in jeopardy of disappearing.

Sturdevant: What would you recommend for strengthening the overall enterprise of national security space in the near-term? Do you have any suggestions for long-term changes in national security space activities?

Naka: I haven't been a close observer of the NRO for a good 10 years or so. In that time the control of the NRO seems no longer in the hands of the NRO managers. Rather, somehow it appears to me to be in the hands of the congressional staff, persons who have authority, but without responsibility. Assuming my observation is true, we should at every turn try to reverse the situation and return to the "golden years of the NRO" when I was deputy director and, with the concurrence of the DNRO Dr. John McLucas, ran the daily activities of the NRO for the continuum from research to operations.

For additional information about Dr. F. Robert Naka, readers should consult the following sources:

1. Teressa Tignor Gilbreth, "Military Intelligence: Pioneer of Classified Stealth Technology Was Once Classified an Enemy," *Mizzou Engineer* 5, 1 (Fall 2006):16-19, http://engineering.missouri.edu/alumni/magazine/EngrMagazine06.pdf.

2. Dr. John L. McLucas with Kenneth J. Alnwick and Lawrence R. Benson, *Reflections of a Technocrat: Managing Defense, Air, and Space Programs during the Cold War* (Maxwell AFB, Alabama: Air University Press, 2006).

3. F. Robert Naka and William W. Ward, "Distant Early Warning Line Radars: The Quest for Automatic Signal Detection," *Lincoln Laboratory Journal* 12, 2 (2000):181-204, http://www.ll.mit.edu/publications/journal/pdf/vol12_no2/12_2distantearly.pdf.

4. F. Robert Naka, "National Reconnaissance Office," in Hans Mark et al., eds., *Encyclopedia of Space Science and Technology*, 2 vols. (New York: John Wiley and Sons, 2003).

Dr. Rick W. Sturdevant (BA, History, University of Northern Iowa; MA, History, University of Northern Iowa; PhD, University of California, Santa Barbara) is deputy command historian, Headquarters Air Force Space Command (HQ AFSPC), Peterson AFB, Colorado. He joined the Air Force History and Museums Program in April 1984 as chief historian, Airlift Information Systems Division, Scott AFB, Illinois, and moved one year later to the Chidlaw Building near downtown Colorado Springs as chief historian, Space Communications Division (SPCD). When SPCD was inactivated in 1991, he moved to the HQ AFSPC history office and became deputy command historian in 1999.

An acknowledged expert in the field of military space history, Dr. Sturdevant appears frequently as a guest lecturer on space history topics and is author or co-author of chapters or essays in *Beyond the Ionosphere: Fifty Years of Satellite Communication* (1997); *Organizing for the Use of Space: Historical Perspectives on a Persistent Issue* (1995); *Golden Legacy, Boundless Future: Essays on the United States Air Force and the Rise of Aerospace Power* (2000); *Air Warfare: An International Encyclopedia* (2002); *To Reach the High Frontier: A History of US Launch Vehicles* (2002); *The Limitless Sky: Air Force Science and Technology Contributions to the Nation* (2004); *Encyclopedia of 20th-Century Technology* (2005); *Societal Impact of Space Flight* (2007); and *Harnessing the Heavens: National Defense through Space* (2008). His articles or book reviews have appeared in such journals as *Space Times*, *Journal of the British Interplanetary Society*, *Air & Space/Smithsonian*, *Quest: The History of Spaceflight Quarterly*, *Air Power History*, *High Frontier: The Journal for Space & Missile Professionals*, and *Journal of the West*. He sits on the editorial board of *Quest* and on the staff of *High Frontier*.

Dr. Sturdevant is an active member of the American Institute of Aeronautics and Astronautics (AIAA), American Astronautical Society (AAS), British Interplanetary Society (BIS), and Society for the History of Technology (SHOT). His professional honors include the Air Force Exemplary Civilian Service Award (1995-1999), the AAS President's Recognition Award (2005), and election as an AAS Fellow (2007).

Book Review

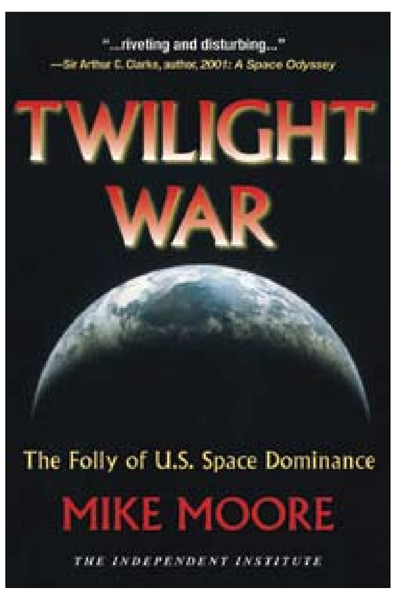
Twilight War: The Folly of US Space Dominance

Twilight War: The Folly of US Space Dominance. By Mike Moore. Oakland, California: The Independent Institute, 2008. Appendices. Notes. Index. Pp. xxiv, 392. $24.95 Hardcover ISBN: 1598130188.

The issue of US space dominance, otherwise referred to as space superiority, space supremacy, or space control, has a long history but has become more heated in recent years. Even before the Soviet Union launched the world's first artificial satellite in October 1957, space experts such as Dr. Wernher von Braun and General Bernard Schriever publicly advocated military efforts to establish and maintain US control of outer space. President Dwight Eisenhower, however, pronounced a policy based on two fundamental principles—freedom of space, and space for peaceful purposes. In February 1958, Air Force Chief of Staff General Thomas White reasoned that US possession of at least the "capability to control space" would ensure the success of Eisenhower's space policy and would benefit peace-loving people everywhere, just as peaceful nations' capability to control the seas in times past had profited people around the globe. Over the next half century, as the number of space-faring nations grew and dependence on space-based systems for both military and civil purposes increased, military pragmatists increasingly perceived space weaponization, whether for better or worse, as inevitable.

As one might expect, based on the subtitle of *Twilight War*, author Mike Moore disagrees vigorously with "political hawks" and "space warriors" who campaign stridently for urgent development and deployment of space weapons to ensure US space dominance. In a narrative analysis heavily oriented toward policy and values, with less attention to technology, he finds fault with the notion that unilateral US military actions in space will guarantee national security. Moore claims such unilateralism almost certainly guarantees conflict and, potentially, a new cold war featuring a costly, destabilizing arms race in space.

Virtually all nations, except the US and Israel, have called repeatedly for negotiation of a new treaty—somewhat awkwardly labeled Prevention of an Arms Race in Outer Space (PAROS)—to secure space more comprehensively as a weapons-free sanctuary, according to Moore. He finds it unfortunate that US policymakers have eschewed collective judgments in favor of an "American Monroe Doctrine for space." Regardless of official pronouncements about a unique US role in preserving space for peaceful purposes, however, all nations remain legally free to place weapons in space as long as they do not violate terms of the 1967 Outer Space Treaty.



Far from naïve about the probability that other nations might attempt to exploit space for their own military advantage, Moore favors controlling or countering such attempts through collective arrangements. Admitting the difficulties associated with negotiating and, subsequently, verifying compliance with a PAROS treaty, he points to "confidence-building measures," particularly "rules of the road" or a "code of conduct for space" as worthwhile first steps toward committing nations to avoid actions that might provoke or injure others. Hopefully, such a course would short-circuit the dynamic that presently appears to be driving space-faring nations toward weaponizing space. It might culminate eventually in a hardheaded, fully verifiable treaty banning all space weapons and incorporating sufficiently tough, specific sanctions against violators. Moore expresses far more optimism about prospects for a new treaty banning space-based weapons than did Brookings Institution realist Michael O'Hanlon in *Neither Star Wars Nor Sanctuary: Constraining the Military Uses of Space* (2004).

Drawing lessons from ancient, European, and American history, along with insights from arms-control experts like Thomas Graham, Jr., and Keith Hansen, authors of *Spy Satellites and Other Intelligence Technologies That Changed History* (2007), Mike Moore's *Twilight War* concludes with a different warning than Donald Rumsfeld's 2001 Space Commission report, which expressed fear of a "space Pearl Harbor." Moore warns that notions of exceptionalism and unilateralism put us at "war with our own values." The "American hubris regarding space," he believes, could lead to squandering our strength and mocking our virtues as a body politic. Rather than leaving it to elected officials, Moore believes it imperative for "We, the people," in whom our Constitution vests ultimate sovereignty, to debate actively and intensely before deciding whether unilateral dominance of outer space is in our best interest.

According to Moore, "We, the people," should refuse to accept the oft-repeated idea that space must inevitably become an arena for military conflict simply because that is what happened to land, sea, and air. The concept of inevitability implies an inability to make choices whose impact could change significantly the course of events. But, we have the power to choose between unilateral and collective actions; whether we choose to exercise that power is another matter. For the author of *Twilight War*, the choice is clear: the US ought to pursue a collective agreement among all space-faring nations to ban space weapons. He asserts unequivocally that a comprehensive ban on space weapons and collective enforcement of space for peaceful purposes would pose less risk for everyone concerned than would US unilateralism. When someone with as contradictory a stance as Everett Dolman, author of *Astropolitik: Classical Geopolitics in the Space Age* (2001), praises *Twilight War* as "an excellent and thorough work," anyone interested in the issue of space security should take notice.

Reviewed by Dr. Rick W. Sturdevant, deputy command historian, HQ Air Force Space Command.

We are interested in what you think of the ***High Frontier*** Journal, and request your feedback. We want to make this a useful product to each and every one of you, as we move forward to professionally develop Air Force Space Command's space and missile workforce and stimulate thought across the broader National Space Enterprise. Please send your comments, inquiries, and article submissions to: HQ AFSPC/PA, High Frontier Journal, 150 Vandenberg St, Ste 1105, Peterson AFB, CO 80914-4020, Telephone: (719) 554-3731, Fax: (719) 554-6013, Email: afspc.pai@peterson.af.mil, To subscribe: hard copy, nsage@colsa.com or digital copy, http://www.af.mil/subscribe.

U.S. AIR FORCE

AIR FORCE SPACE COMMAND

AFSPC/PA
150 Vandenberg St.
Ste 1105
Peterson AFB, CO 80914
Telephone: (719) 554-3731
Fax: (719) 554-6013

For more information on space professional development visit:
www.peterson.af.mil/spacepro

Air & Space Power Journal:
www.airpower.maxwell.af.mil/airchronicles/apje.html