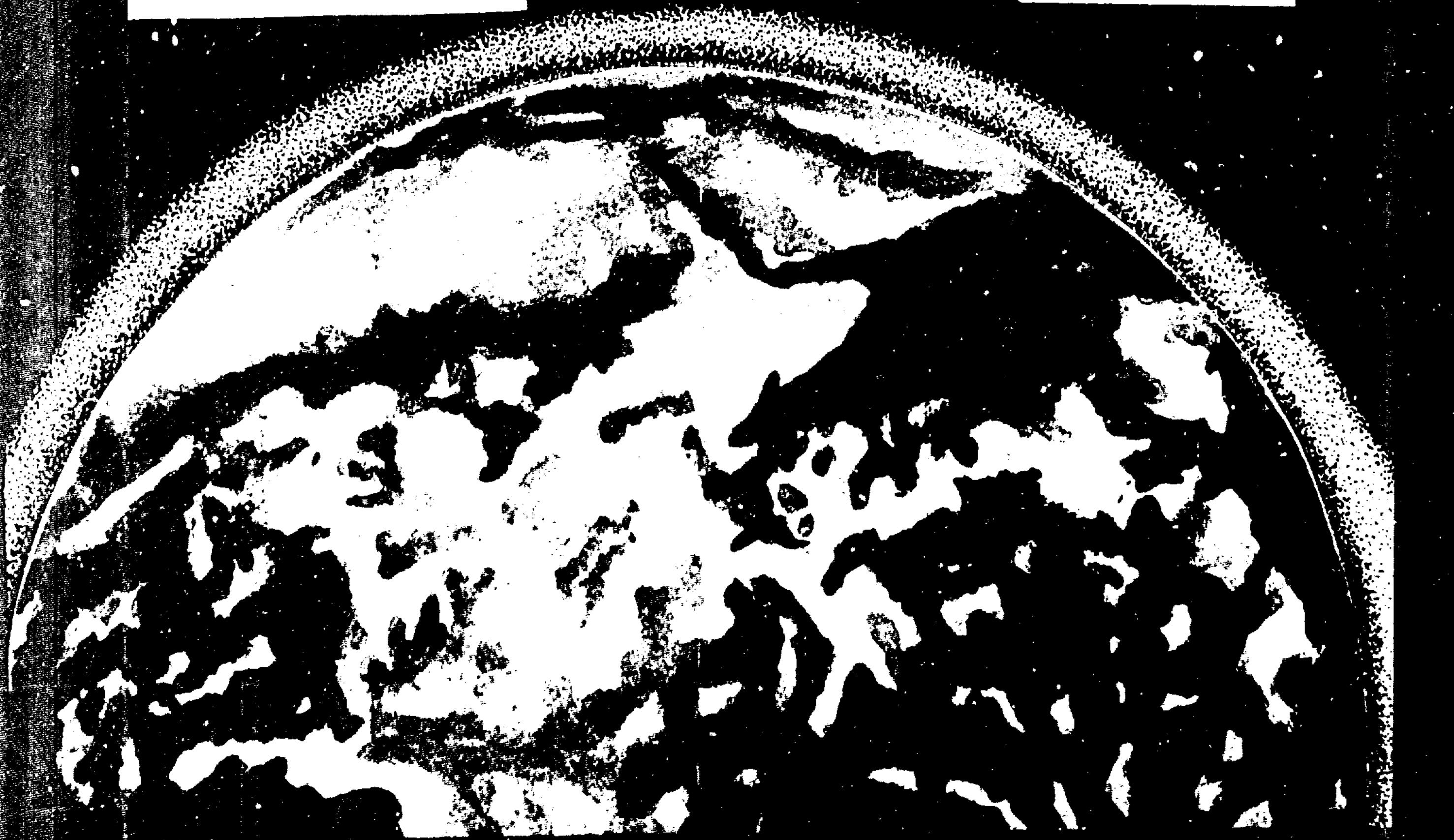
GLOBAL POWER THROUGH TACTICAL FLEXIBILITY

Rapid Deployable Space Units

Thomas A. Torgerson
Major, USAF



Research Report No. AU-ARI-93-6

Global Power Through Tactical Flexibility
Rapid Deployable Space Units

by

THOMAS A. TORGERSON
Major, USAF

ARI Command-Sponsored Research Fellow
Air Force Space Command

Air University Press
401 Chennault Circle
Maxwell Air Force Base, Alabama 36112-6428

June 1994

Disclaimer

This publication was produced in the Department of Defense school environment in the interest of academic freedom and the advancement of national defense-related concepts. The views expressed in this publication are those of the author and do not reflect the official policy or position of the Department of Defense or the United States government.

This publication has been reviewed by security and policy review authorities and is cleared for public release.

Whoever has the capability to control space will likewise possess the capability to exert control of the surface of the earth.

—Gen Thomas D. White, USAF
Chief of Staff, 29 November 1957

Contents

Illustrations

Foreword

The future success for deterring threats to US national security will depend to a significant degree upon the flexibility of US space systems. With the collapse of the Soviet Union, the greatest single threat to the US and Western ideals has disappeared. Unfortunately, the world isn't any safer considering growing regional nationalism, ethnicity, and religious zealousness. Future US military space systems will have to react to the growing regional threats throughout the world. Maj Thomas A. Torgerson's study provides a visionary approach for projecting the utility of space systems for a spectrum of applications. His study addresses the increasing ballistic missile and space lift threats the US will confront. He identifies specific applications for deployable space systems for each of the four space force functions: force enhancement, force application, space control, and space support. He examines manning, organizational structure, costs, and acquisition methods. Major Torgerson's study provides a fresh approach to apply space at the theater level to meet the challenges aerospace operators and planners will confront.

THOMAS S. MOORMAN, JR.,
Lieutenant General, USAF
Vice Commander
Air Force Space Command

About the Author

Maj Thomas A. Torgerson

Maj Thomas A. Torgerson was the Air Force Spac Command's research fellow at the Airpower Research Institute, Air University College for Aerospace Doctrine, Research, and Education (AUCADRE), Maxwell AFB, Alabama in 1992-93. He graduated from the University of Northern Colorado in 1978 with a bachelor of science degree in business administration and was commissioned a second lieutenant in the United Stated Air Force through the Reserve Officer Training Corps. He earned his master of arts degree in space systems management from Webster University in 1989.

Major Torgerson spent his first five years of active duty assigned to the 742d Strategic Missile Squadron and the 91st Strategic Missile Wing, Minot AFB, North Dakota. During this assignment, he served as a deputy missile combat crew commander, missile combat crew commander, and dual-qualified missile combat crew instructor in the Minuteman III Command Data Buffer System. In January 1983, Major Torgerson was selected for assignment to the North American Aerospace Defense Command and US Space Command headquarters, deputy chief of staff, Operations, Cheyenne Mountain AFB, Colorado. During this assignment, Major Torgerson served as a missile warning officer. From January 1986 to February 1987, he completed a remote tour as chief, Standardization/Evaluation for the 19th Surveillance Squadron, Pirinclik Air Station, Turkey. Upon his return from overseas, Major Torgerson was assigned the Command and Control Directorate, deputy chief of staff, Plans/Requirements, Headquarters Air Force Space Command, Peterson AFB, Colorado, and assumed the position of deputy division chief in 1988. During this assignment, he served as command manager for the Advanced HF Program, Offutt Processing and Correlation Center, United States Space Command Center Upgrade, and deputy chief, Command and Control Center Upgrades Development Office. In June 1990 Major Torgerson moved to Griffiss AFB, New York, where he became the director of Operations for the new 1st Space Surveillance Squadron.

Concurrent with his Airpower Research Institute fellowship, Major Torgerson attended Air Command and Staff College as a member of the class of 1993. Currently

he is assigned to the operations staff for space control, Headquarters Air Force Space Command. Major Torgerson; his wife, Diana; their daughter, Catherine; and their son, Steven, live in Colorado Springs, Colorado.

Preface

The collapse of the Soviet Union has fractured the single threat to the United States into diverse ill-defined global problems. The challenge to the United States is to maintain the flexibility to react to any new world threat. Rapid deployable space units (RDSU) can provide one means to project US power.

Aerospace power is global power and can no longer be thought of as acting only in the area extending above the land or seas to some point in the atmosphere. Like sea power, which once solely controlled the surface and depths of the seas, thus exerting an influence upon the land, aerospace power now controls the space environment and exerts its influence on the activities of the entire planet. No definite line divides the atmosphere and the space beyond. Our aerospace forces no longer depend upon the atmosphere to accomplish their missions. Air and space power components can now be considered a single entity: aerospace forces.

Aerospace forces today are comprised of long-range manned and unmanned aerial vehicles, ballistic missiles, space vehicles, satellites, and many means of detecting, intercepting, or destroying an opponent's forces. The compelling reason for the preeminence of aerospace power is that anyone who controls the aerospace arena can control the land and seas beneath.

At first glance aerospace weapons seem as though they must, as Bernard Brodie said of the atomic bomb, "change everything." Yet, a look at aerospace doctrine as it relates to current space systems, shows that although the systems may have changed, the guiding principles remain unchanged. Multitudes of examples show that new systems once were thought to have changed the face of warfare but did nothing of the kind. For example, during the late 1950s, the United States did away with guns on fighters because the Air Force was convinced air-to-air missiles had made such weapons obsolete. Well, we all know how obsolete guns were during the dogfights over North Vietnam a few years later. Even in nuclear war planning, the hoary old principles of economy of force, mass, maneuver, surprise, simplicity, and especially unity of command all play a vital role.

In this same fashion, we must not allow ourselves to be swept away by the new possibilities in the space component of aerospace power. The rapid deployable space unit concept applies most, if not all, of the principles of war in a single compact package. These principles include unity of command--aerospace defense under the control of a single commander; objective--operations which contribute to the aims of the theater commander; offensive--the theater commander retains the initiative; mass--aerospace defense forces can concentrate their effort; and simplicity--information flows directly from the RDSU to the theater commander. Air and space units are the components of aerospace power, just as airlift is a subcomponent of air power. Airlift doctrine is indistinguishable from bomber doctrine in terms of the "big picture." They both are air power doctrine components. In the same manner, space power doctrine is indistinguishable from air power doctrine--together they comprise the components of aerospace doctrine.

The day is dawning when an aerospace unit will be capable of destroying an opponent's air units. Detecting, tracking, intercepting, and destroying any aerospace vehicle, whether at its base or en route to its target, is no more or no less a vital component of the battle for command of the air than that carried out by today's fighters or bombers. This mission, whether it takes place within the atmosphere or in the exoatmosphere, is still the aerospace superiority mission and is the legitimate aerospace forces mission. As such, the basic principles of economy of force and unity of command apply, and the forces must be under the control of a single entity. The RDSU concept goes a long way towards achieving both unity of command and economy of force by placing all of the aerospace defense mission under a single command.

The expansion of aerospace power by the means of the rapid deployable space unit will further enhance the capability of our aerospace forces to impose limitations on our opponents by denying them the ability to exercise offensive power in the aerospace medium. The tactical flexibility our aerospace forces gain through these units will go far to ensure that our forces have the ability to project power anywhere on and above the globe.

The research for this report led me to realize that the RDSU concept is valid for the future, and is probably the most cost-effective means to maintain the needed flexibility to project global aerospace power against any threat through the next century.

Thomas A. Torgerson

THOMAS A. TORGERSON, Major, USAF
Research Fellow
Airpower Research Institute

Acknowledgments

My special thanks go to Gen Charles A. Horner and Lt Gen Thomas S. Moorman, Jr., of Air Force Space Command for providing me a balanced combination of guidance and freedom to pursue my approach to this study.

My deepest thanks to all the individuals who encouraged me to develop an idea into a realistic concept. Thanks for support and advice in undertaking this project go to a number of people. I would like to thank the greater Air University community at Maxwell AFB. A special thanks to Ms Emily Adams, my editor, whose patience, advice, and recommendations improved the report's quality, and Mr Terry Hawkins, my Air University Library researcher, whose energetic attitude and support were instrumental in obtaining essential documents and materials. Thanks go to the faculty and fellow students of 21st Student Squadron, Air Command and Staff College, whose support and encouragement helped me to balance both the course load and this report. And finally, thanks go to the members and my fellow command-sponsored research fellows of the Airpower Research Institute, whose support and assistance during hectic periods made this paper and my time at Maxwell AFB a worthwhile endeavor.

My gratitude goes to the following individuals for their support and inspiration for this project: Col Kenneth V. Walsh, Air War College, Air Force Space Command chair, whose assistance and debate was invaluable; Col Arnold M. Berry, chief, Space Control Division, Headquarters Air Force Space Command, for his support and guidance; and Maj Michael J. Petersen, aerospace warrior, whose sanity checks and debate helped me along the way.

Finally, my deepest appreciation goes to the three special people who made the greatest contributions--my wife and best friend, Diana, whose love, support, and dedication to this effort is indescribable; and my children, Catherine and Steven, who understand the sacrifices the family makes for Dad's job and the Air Force. Thanks.

Chapter 1

Changing Threat

The recent changes in world events are mixed blessings. The collapse of the Soviet Union has removed the greatest single threat to the United States and has ended the cold war. Unfortunately, this collapse has generated new problems for the United States. These new challenges range from politically stable relationships with newly independent states, global free market economic reforms, and democratic reforms to the spread of weapons of mass destruction. The challenge may vary between political, economic, and military issues.[1] The US military must maintain the flexibility to react to any new world threat. Table 1 compares the changes in the threat to the US.

Since 1946 the focus of American strategic planning has been to deter and counter any Soviet threat. Strategic forces and attack warning systems met this threat. Ground- and space-based detection and tracking systems provide warning and attack assessment for the US prior to, during, and after a nuclear attack. Ground-based warning radar systems have evolved from a limited detection and tracking capability to a higher capacity and increased accuracy to detect, track, identify, and predict impact locations of intercontinental ballistic missiles (ICBM) and sea-launched ballistic missiles (SLBM).

Table 1

The Changing Threat

Old World	*New World*
Single (Soviet)	Diverse
Survival at Stake	Interests/Americans at Stake
Known	Unknown
Deterrable	Nondeterrable
Strategic Use of Nuclear Weapons	Terrorist Use of Nuclear Weapons
Overt	Covert
European-centered	Regional, Ill-defined
High Risk of Escalation	Low Risk of Escalation

Source: Rep Les Aspin, chairman, House Armed Services Committee, "National Security in the 1990s: Defining a New Basis for US Military Forces," address to the Atlantic Council of the United States, 6 January 1992.

The same is true for space-warning satellites. The integrated tactical warning and attack assessment (ITW/AA) command and control infrastructure has gone through similar changes to receive, process, and distribute warning and assessment data of a Soviet attack. These systems enhance the survivability of the United States and reduce the risk of nuclear war from any overt aggression by components of the former Soviet Union.

The evolution of the entire ITW/AA system is directly related to the nuclear strategies and increased weapons capabilities of the US and the former USSR. Changes to the US warning system reflect changes in the American nuclear strategy. When the US had a distinct advantage in nuclear weapons and delivery systems the strategy was mass retaliation. As the Soviets started closing the missile gap during the late 1960s and early 1970s, US strategy shifted to flexible response. Regardless of the rationale, the US knew who was the threat. Because of the breakup of the USSR, the US may not know who is the threat in the future.

The Unstable Threat

The August 1991 collapse of the Soviet Union marked the end of a bipolar superpower relationship between the US and the USSR. Today, the synergistic threat to Western ideals has dissipated, but the means to carry out an attack on the US remains intact. The weapons and delivery systems the USSR previously controlled are now controlled by independent sovereign republics of the former Soviet Union. Each of the new republics has established different economic, political, and military objectives. The 13 independent governments are in disarray because of economic, political, military, domestic, and ethnic problems. Their need for stability and growth may outweigh their need to maintain custody of their weapons, delivery systems, and the technology to build new weapons.

The death of Soviet communism now raises challenging questions for US political and military planners. First, how should the US maintain deterrence from a missile attack? Second, who actually controls the weapons of the former Soviet Union? Third, where is the location and what is the status of the Soviet delivery systems and warheads? These questions may go unanswered, but the US can develop a strategy to reduce the uncertainties of the answers.

The Future Threat

This study is meant to act as a catalyst for reevaluation of the roles, missions, and applications of space operations. Since the late 1950s, the majority of military space planning has focused on a single threat with associated system applications. The future threat for the US may come from any direction, and US strategy must be flexible to counter this unknown threat.

US military space strategy demonstrates the importance of space activities in all military operations. The recent conflict with a new adversary who had the technological means of developing, deploying, and launching weapon systems--not in a bipolar strategic context but in a conventional theater environment--demonstrates the demand for expansion of traditional space missions. The military success during Operation Desert Storm demonstrates the increasing role space operations will play in future military operations.[2]

The First Space War

Desert Storm premiered the use of space assets for ballistic missile warning and attack assessment, surveillance, reconnaissance, communications, navigation, weather, intelligence, and command and control operations. Creative applications of space systems designed to counter the traditional strategic Soviet threat met Central Command's (CENTCOM) tactical requirements.

The use of space assets in Desert Storm demonstrated that space is an active element in US military operations. Desert Storm opened the eyes of military planners around the world to the fact any future military success will require the use of space assets or products.

A new race is on to acquire access to space. The world military market is offering navigation, photo imagery, and even electronic intelligence collection systems. Regardless of economic standing, future adversaries will have either domestically developed space systems, systems acquired from the countries of the former USSR, or systems procured from the open world market. To maintain its technological and operational edge, the US military must consider, plan, and integrate space missions into all levels of military operations.

Flexible Space Strategy

Space and space-related assets need to be able to respond to joint operations at any point in the spectrum of conflict. The US should have an operational strategy incorporating the flexibility of space operations in the planning, programming, training, and operations for both Air Force and joint operations.[3]

This strategy must maintain a global strategic deterrence and defense against any nuclear attack, project a forward military presence, provide for a crisis response, and plan for a reconstitution of US military forces.[4] US strategy needs to be regionally focused and based on US global interests.[5] To counter any global or regional threat, space assets must be integrated into the full spectrum of strategy and provide the day-to-day forward presence for the United States. The technological capabilities of US space systems to monitor and react to a crisis will assist in maintaining regional stability anywhere in the world.

Space Functions

There are four function areas of space operations. These function areas are critical to the future success of US military operations at any level--strategic, operational, or tactical. Space operations have impacted both combat arms and combat support elements in all branches of the US military. The function areas focus on enhancing the effectiveness of military forces; providing freedom of access and operation in space; conducting force application missions against land, air, and sea targets; and conducting launch and on-orbit military satellite command and control and recovery of space vehicles. Since the functions overlap, space operations are broader than any one function.

Defining the functions will assist in understanding the integration of space operations into joint and combined military operations.[6] Table 2 shows the comparison of space force functions, space force capabilities, and military space operations.

Force enchanment: Activities conducted from space that improve operational effectiveness for military air, land, sea, and space forces in peace, crisis, and conflict. Force enhancement capabilities include communication, navigation, weather, reconnaissance, and surveillance.[7]

Force applications: Operations conducted from space against air, land, and sea targets. These capabilities could include space- and ground-based defense systems for ballistic missile defense.[8]

Space control: Military capabilities to assure freedom of access to space for friendly forces while limiting or denying enemy freedom of action when directed by the national command authorities (NCA). Space control capabilities include a worldwide space surveillance network, a means to inhibit or destroy enemy space systems, and the means to protect friendly space systems and negate an attack.[9]

Space support: Military capabilities to deploy and maintain military space systems. Space support capabilities include the infrastructure for launching and deploying orbiting space systems and controlling and maintaining on-orbit space systems, and spacecraft recovery.[10]

Rapid Deployable Space Units

To meet the challenge of the changing threat on a regional level, the military must integrate space operations functions with joint operations. The use of Scud missile systems by Iraqi military forces in Desert Storm demonstrates that the employment of missile and space technologies against regional targets are realistic elements of future conflicts.[11] Many countries have the potential to use space communication satellites for military purposes. For example, the Iraqis have legal access to Arabsat and Intelsat communication satellites.[12]

Table 2

Space Functions, Capabilities, and Operations

SPACE FORCE FUNCTIONS	SPACE FORCE CAPABILITIES *	MILITARY SPACE OPERATIONS
FORCE ENHANCEMENT	• COMMUNICATIONS • NAVIGATION/POSITIONING • INTELLIGENCE AND RECONNAISSANCE • ENVIRONMENTAL MONITORING • MAPPING, CHARTING, AND GEODESY • SURVEILLANCE/WARNING PROCESSING AND DISSEMINATION	SPACE COMBAT SUPPORT
FORCE APPLICATION	• BALLISTIC MISSILE DEFENSE • AEROSPACE DEFENSE • POWER PROJECTION	SPACE FIRE SUPPORT
SPACE CONTROL	• SPACE SURVEILLANCE • SATELLITE PROTECTION • SATELLITE NEGATION	COUNTERSPACE OPERATIONS
SPACE SUPPORT	• SATELLITE CONTROL • LAUNCH/RECOVERY • LOGISTICS	SPACE OPERATIONS MISSION SUPPORT

* Space force capabilities are mixed and matched to support military operations.

Source: Joint Pub 3-14, "Joint Doctrine: Tactics, Techniques, and Procedures (TTP) for Space Operations," final draft, 15 April 1992, III-5.

The US needs the deployable capability to detect and negate theater and strategic ballistic missiles, inhibit any adversarial satellite's capability or activity, and provide real-time space support to conventional theater forces. Rapid deployable space units (RDSU) can enhance the national strategy of crisis response. An RDSU is a self-contained, mobile, mission-specific, air-transportable unit. An RDSU can be as small as a three- or five-man team with portable equipment or as large as a squadron level force with self-contained operations shelters, vehicles, logistics equipment, and support equipment. The key to determining the size of the unit and the type of equipment of any RDSU will be based on the specific threat, mission objective, and operational requirements established by each combatant commander in chief (CINC) based upon the regional security objectives.

For example, RDSUs attached to the joint forces aerospace component commander (JFACC) can provide high speed communication links between a

CINC and his forces to counter a regional threat from hostile ballistic missiles.[13] One RDSU would establish links with warning satellites to detect and determine launch location of hostile missiles. A second RDSU would establish a radar warning fence around the CINC's defended area to provide a theater-level warning and tracking system. Both the satellite and ground radar warning and tracking elements could be connected with associated ground mobile or airborne defensive RDSUs. The defensive RDSUs would intercept and negate any enemy-launched missile at the earliest opportunity and location. All fielded RDSUs would be connected to an RDSU Mobile Command and Control System (MCCS). The MCCS would provide the command and control (C^2) link between the RDSUs and the JFACC. The MCCS also should maintain a link with the parent RDSU group, Air Force Space Command (AFSPACECOM), and United States Space Command (USSPACECOM) operations centers for additional operational support and taskings.

Providing real-time user-friendly weather, surveillance, and intelligence data to special operations teams on a foreign internal defense assistance mission is another example. A composite RDSU team could deploy with the special operations team to their main foreign operating location. Additionally, even though an RDSU's primary mission is associated with military operations, it could support natural disaster relief operations or temporarily replace an inoperable fixed satellite ground terminal.

Costs

Cost effectiveness is paramount. An RDSU must use current military or commercially available technology to add improvements as technology becomes available. The use of commercially available technology provides three distinct advantages to the war fighter. First, commercially available equipment employs state-of-the-art technology without incurring the developmental risk, costs, and long operational lead time associated with standard acquisition programs. Second, because the equipment can easily and cheaply be replaced, it eliminates the risk of losing a high-priced, one-of-a-kind system during a conflict. The third and most important advantage is the ability to field and operate multiple yet similar systems to support operational requirements specified by any combat CINC. These advantages provide the conduit for maintaining the newest technology and drastically reduce the problems associated with fielding technologically outdated, one-of-a-kind equipment with high development cost.

RDSU support requirements need to fit existing logistic infrastructures. Support experts and organizations are already in place and are using existing means to reduce or eliminate the up-front and life-cycle costs associated with new systems. Additionally, the logistic support infrastructure can support marrying commercial equipment with existing government-furnished equipment for RDSUs.

Rapid Deployable Space Unit Mission Focus

The following paragraphs define specific missions for RDSU operations and how these missions can meet the four space force functions. Later chapters discuss the specific RDSU missions, system concept, and implementation.

1. Ballistic missile warning and attack assessment. The RDSU must detect, track, and identify any ballistic missile--from short-range ballistic missiles to intercontinental ballistic missiles--and the associated warheads and fragments. The RDSU must be able to calculate predictable impact locations.

2. Ballistic missile defense (BMD). The RDSU must be able to interact with existing missile warning or space surveillance systems to track, identify, and intercept any threatening ballistic missile in a specific region. The RDSU weapons platform also must be able to intercept any threatening ballistic missile or interact with any air- or seaborne weapons platforms.

3. Space control. RDSU space control missions have two segments. The first segment is space surveillance. The RDSU must be able to track, identify, correlate, and catalog any earth-orbiting man-made object ranging from near-space to deep-space altitudes. RDSU surveillance systems should consist of active, passive, and electro-optical capabilities to provide cross-cover of space. This segment is essential to all military operations, especially combat forces.

The second segment of space control, counterspace operations (CSO), has three types of missions. Defensive CSOs are nonlethal actions taken by US space forces to confuse, disrupt, or deceive an enemy's satellite systems and to prevent the enemy from exploiting US and friendly space systems. Offensive CSOs are lethal and nonlethal actions taken by space operations forces to negate an enemy's ability to conduct space operations. Jamming the satellite's up or down links and antisatellite systems are examples of the range of offensive CSO capabilities. Counter CSOs are lethal and nonlethal actions taken by US space forces to counter the enemy's offensive CSOs or negate the enemy's defensive CSOs. RDSU CSO negation needs to physically disable or temporarily impair any satellite or satellite system.[14]

4. Space support. This feature includes integrated satellite control and maintenance for on-orbit operations of military warning, weather, navigation, communications, and national space systems.

5. Command and control. Command and control isn't a specified function of space operation; however, it is a key operation. The link between the RDSUs, the CINC, and the continental United States-based support is an essential element of any RDSU operation. An additional function of the RDSU command and control element is coordinating such support activities as providing navigation, weather, and surveillance/warning information and supplying space reconnaissance terminal equipment, mission and support data, and lines of communications to the tasked forces.

The final area of discussion is the RDSU system concept strategy. This discussion focuses on the operational concept and configuration of RDSU organizations. The system concept examines the RDSU organization structure, personnel, RDSU element configuration, locations for home basing, and an implementation strategy.

The use of space as a medium of military operations has moved from the pages of science fiction to reality.[15] Space operations will be a part of future military operations. The involvement may be indirect, through surveillance and navigation support, or direct by deploying ballistic missile defense or CSO systems. Having space forces actively participate in operations at any level is a means to meet US national security objectives. The new world holds true to Carl von Clausewitz's principle, "war [military operations] is politics by other means."[16] Inversely, if peacetime military operations deter aggression, then political objectives are obtained.

Notes

1. Joint Chiefs of Staff, *The National Military Strategy* (Washington, D.C.: Government Printing Office, January 1991), 1.
2. Lt Cols Michael A. Hamel and Michael L. Wolfert, "Space Strategy and the New World Order," White Paper, AFSPACECOM/XPX, April 1992, 1.
3. Dennis M. Drew and Donald M. Snow, *Making Strategy: An Introduction to National Security Processes and Problems* (Maxwell AFB, Ala.: Air University Press, 1988), 19.
4. The President of the United States, *National Security Strategy of the United States* (Washington, D.C.: Government Printing Office, January 1993), 14–15.
5. Hamel and Wolfert, 2.
6. Joint Pub 3-14, "Joint Doctrine: Tactics, Techniques, and Procedures (TTP) for Space Operations," final draft, 15 April 1992, III-3.
7. Ibid., I-5.
8. Ibid.
9. Ibid., I-16.
10. Ibid.
11. Andrew Wilson, ed. *Space Directory,* 8th ed. (Alexandria, Va.: Jane's Information Group, Inc., 1992), 65. On 5 December 1989 the Iraqis launched a Tamouz 1 satellite booster. The Iraqis claim the test was a success. Their technology is based on Scud technology with an Iraqi-developed second and third stage. Further evidence suggests that Brazil would supply the first satellite payload and that China, France, and the former Soviet Union would provide direct or indirect technical support.
12. Larry Van Horn, *Communication Satellites,* 3d ed. (Brasstown, N.C.: Grove Enterprise, 1987), 59; Mark Long, *World Satellite Almanac,* 2d ed. (Indianapolis, Ind.: Howard W. Sams and Co., 1987), 58.
13. The use of "joint forces aerospace component commander" vice "joint forces air component commander" is a more accurate description of the control function of aerospace operations in joint US military operations.
14. Joint Pub 3-14, III-17.
15. Ibid., II-1.
16. Carl von Clausewitz, *On War,* ed. and trans. by Michael Howard and Peter Paret (Princeton, N.J.: Princeton University Press, 1976), 87.

Chapter 2

Ballistic Missile Warning and Defense

This chapter discusses existing space-based and ground-based warning and attack assessment systems and sensor capabilities tailored for a Soviet threat and upgrades and modifications to those systems. President George Bush directed the Strategic Defense Initiative Organization (SDIO) to establish protection from limited ballistic missile strikes from any location against the US, American forces and citizens overseas, and friends and allies.[1] This move is the result of the growing number of countries who have obtained ballistic missile weapons technology and the willingness to use it in armed conflicts. The outcome of the presidential direction was the establishment of Global Protection Against Limited Strikes (GPALS). Finally, the chapter examines possible application of RDSUs for both warning and defense against a limited missile attack.

Current Warning and Attack Assessment System

The US has tailored its tactical missile warning and attack assessment capabilities towards detecting and tracking ballistic missiles. The traditional cold war system divides missile launches into either threat or nonthreat categories. The threat determination is based upon the national security interests of the United States. When a missile launch from the Asian landmass or ocean occurs, the US considers it threatening if its direction is towards the continental United States, Alaska, Hawaii, Southern Canada, or western European North Atlantic Treaty Organization (NATO) countries or until the launch is determined to be space related.[2]

The ITW/AA system has the capability to determine the launch and impact locations of any short-, medium-, or long-range land- or sea-launched ballistic missile. The two methods the US has for detecting and tracking missile launches are warning satellites and fixed ground-based radar systems.

The warning satellite system, called the Defense Support Program (DSP), consists of geostationary satellites with three ground entry stations. The ground entry stations process warning data provided by the satellite and transmit the information to the Cheyenne Mountain Complex (CMC), located near Colorado Springs, Colorado, for threat processing, event correlation, and validation. Within minutes of the validation by the CMC crews, the commander in chief, United States Space Command (USCINCSPACE) assesses the event and directs the release of the event assessment information to national users, other command centers, and CINCs.

Currently, the front line ground-based warning radar systems are phased array (PA) type radars.[3] The radar sites provide launch and impact locations and the respective times to the CMC and national users. CMC crews use this data to verify and correlate launches detected by the satellite system. This verification provides dual phenomenology or confirmation of the launch by two or more separate warning systems. Dual phenomenology provides the human factor in eliminating the possibilities of false attacks caused by equipment malfunctions, human errors, or environment anomalies.

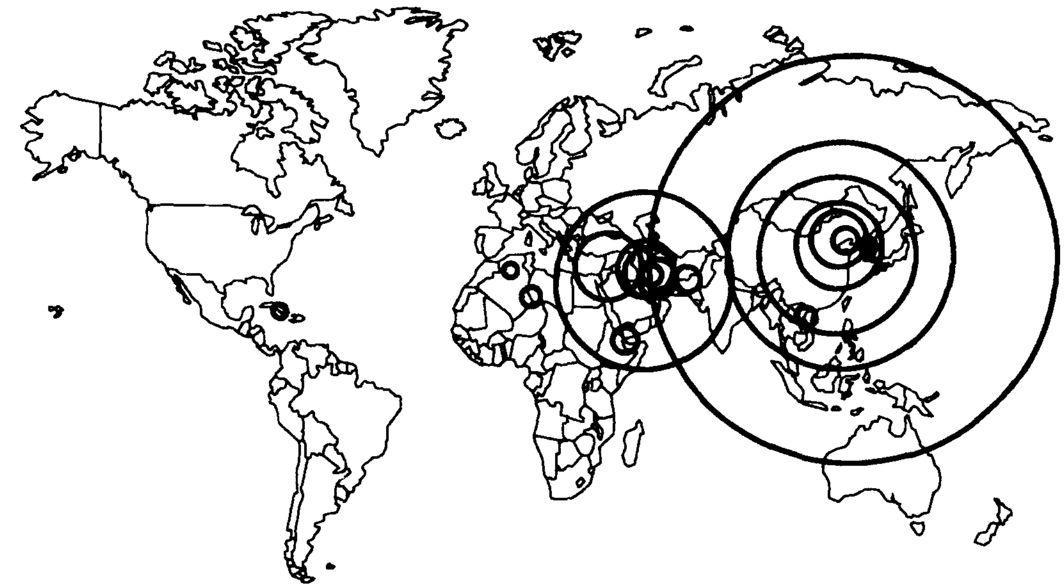
Both warning systems focus on a Soviet threat from ICBMs launched from the Soviet land mass, intermediate range ballistic missiles (IRBM) from western USSR or eastern Europe and SLBMs. This warning and assessment system has been a decisive element in maintaining deterrence against ballistic missile attack.

The advancement in weapons development and deployment of land- and sea-launched ballistic missiles by the Soviets has slowly reduced the effectiveness of the warning system through the use of multiple independently targeted reentry vehicles on both ICBMs and SLBMs. Soviet actions have caused the US to evaluate the effectiveness of the ITW/AA system to maintain deterrence against an increased warhead threat.

Flexibility is a major key for future ballistic missile warning, detection, and assessment. *For space-based satellite warning,* the United States is developing a new generation DSP satellite with an operational laser cross-link capability. This cross-linking will allow data to be relayed between satellites and then transmit to a ground station out of view of the detecting satellite.[4] The advantage of this upgrade is twofold. The first advantage provides system survivability because the data links have multiple paths to the warning centers. Having multiple paths reduces the risk of loss of launch detection if a ground station is incapacitated from attack, accidents, or natural disasters. The second advantage provides for a global data path for receipt of launch detection data without being dependent on the location of the ground entry stations.

New World Threat

During the 1980s the world witnessed the use of ballistic missiles by Iraq, Iran, and Libya. Their use of ballistic missiles gave birth to the second ballistic missile arms race. Some countries realized that the ownership of ballistic missile systems brought them prestige and a tool to threaten not just their adjacent neighbors but countries far beyond their borders with a capability to deliver conventional, chemical, biological, or nuclear warheads. The list of developing countries with missile and/or space programs is growing. Figure 1



WEST

CUBA

AFRICA/MIDDLE EAST

AFGHANISTAN, ALGERIA, EGYPT, IRAN, IRAQ, ISRAEL, KUWAIT, LIBYA, SYRIA, YEMEN, SAUDI ARABIA

ASIA

CHINA, NORTH KOREA, SOUTH KOREA, VIETNAM

Note: Range circles are notional and do not depict actual coverage.

Source: Information taken from Strategic Defense Initiative Organization, *Briefing on the Refocused Strategic Defense Initiative* (Washington, D.C., 12 February 1991); Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 35; and Ducan Lennox, ed., *Jane's Strategic Weapons Systems* (Alexandria, Va.: Jane's Information Group, Inc., 1992), issues 9, 10, and 11.

Figure 1. Current Third World Ballistic Missile Capabilities

depicts the current growth of third world countries with an operational ballistic missile capability.

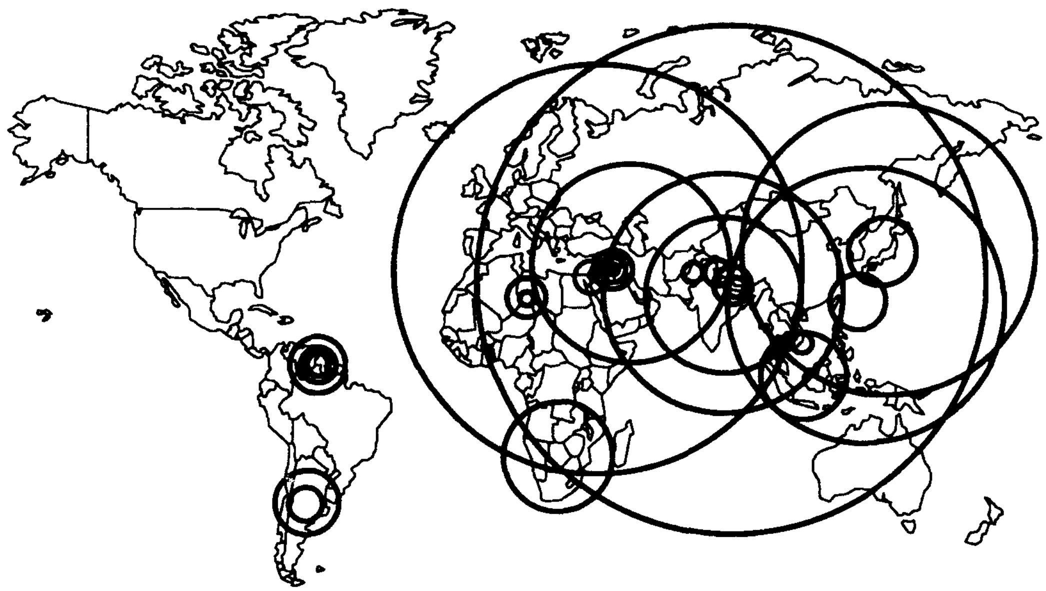
These countries, with the exception of Israel and South Korea, have Soviet or Chinese-derived missile technology. The Israeli missile program is based upon a combination of US Lance technology and in-country development.[5] A few countries have joined Israel to develop ballistic missiles for either weapons or space lift capabilities. Alliances seem to be based upon political, economic, or military relationships.[6]

The acceleration of the arms race seems to center in the Middle East because countries there are accelerating their acquisition of missile technology or whole systems. The former Soviet Union and China have been the major suppliers of ballistic missiles, training, logistics, and support for third world countries.

China has been supplying ballistic missiles and technology to any country having the resources to purchase them. For example, since 1986 China has been supplying Saudi Arabia with CSS-2 or DF-3A IRBMs that have an estimated range of between 2,800 and 3,500 kilometers. The following countries have Chinese-supplied missile systems ranging from surface-to-air missiles to short-range ballistic missiles (SRBM) to IRBMs: Afghanistan, Albania, Bangladesh, Burma, Cambodia, Chile, Egypt, Iran, Iraq, North Korea, Pakistan, Saudi Arabia, Syria, and Thailand.[7]

The list of countries that have acquired ballistic missile systems from the former USSR is even larger. During the cold war era the Soviets were willing to provide their systems to any country willing to buy them or held an ideology aligned with the Soviets.

By the end of the century, over 24 third world countries could have operational missile systems.[8] Figure 2 shows the increasing number of countries that may acquire ballistic missiles in the near future.



WEST	AFRICA/MIDDLE EAST		ASIA	
ARGENTINA	EGYPT	IRAN	NORTH KOREA	SOUTH KOREA
BRAZIL	IRAQ	ISRAEL	TAIWAN	INDIA
	LIBYA	SOUTH AFRICA	INDONESIA	

Note: Range circles are notional and do not depict actual coverage.

Source: Information taken from Strategic Defense Initiative Organization, *Briefing on the Refocused Strategic Defense Initiative* (Washington, D.C., 12 February 1991); Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 35; and Ducan Lennox, ed., *Jane's Strategic Weapons Systems* (Alexandria, Va.: Jane's Information Group, Inc., 1992), issues 9, 10, and 11.

Figure 2. Possible Additions to Third World Ballistic Missile Countries

Since the technology is similar for either a ballistic missile capability or a space-launch capability, one program can accelerate the advancement of the other. The threat is not the establishment of the vehicle programs but the intent of the deployment. With the changing world environment, the threat of a ballistic missile attack to the CONUS, US allies, or US regional interests is increasing. The recent sales of Soviet weapon technologies by the former Soviets, China, and North Korea to Iran and other politically volatile countries stress the need for theater-level warning. The weapons technology sales seem to be based upon the need for hard currencies by these countries rather than ideology. The US technological edge in the use of space may well be at risk in the near future.

The uncontrollable ballistic missile threat may keep the world on the edge of armed conflict for years to come. Considering the intimidation factor, owning operational ballistic missiles provides a cost-effective threat for third world countries or even national organizations. In 1990 Libya, Iraq, and the Palestine Liberation Front (headed by Muammar al-Qaddafi, Saddam Hussein, and Abul Abbas, respectively) each openly expressed the fact that they want ICBMs to use to threaten American cities.[9] The desire to obtain ballistic missiles or space systems isn't exclusive to hostile Middle Eastern Islamic countries or organizations. As noted in table 3, since the 1980s, the development race has reached global proportions.

Table 3

Emerging Ballistic Missile and Space Lift Threats

COUNTRY	SYSTEM	TYPE	ORIGIN	STATUS	RANGE (NM)[a]	WEAPON PROGRAM[b]
AFGHANISTAN	SCUD B	BM	USSR	OPR	165	
ALGERIA	FROG 7	BM	USSR	OPR	40	NUC
	SS-21	BM	USSR	OPR	40	
ARGENTINA[c]	ALACRAN	BM	ARGENTINA	DEV	110	NUC/BIO/CHM
	CONDOR I	BM	ARGENTINA	DEV	60	
	CONDOR II	BM	ARGENTINA/EGYPT/IRAQ/ W. EUROPEAN CONSORTIUM	DEV	600	
BRAZIL	MB/EE-150	BM	BRAZIL	DEV	80	NUC/BIO/CHM
	SS-300	BM	BRAZIL	DEV	165	
	MB/EE-350	BM	BRAZIL	DEV	190	
	SS-1000	BM	BRAZIL	DEV	540	
	MB/EE-600	BM	BRAZIL	PLN	325	
	VLS	SLV	BRAZIL	DEV	3,720	
	SONDA III	SR	BRAZIL	OPR	50	
	SONDA IV	SR	BRAZIL	OPR	370	
CHINA	M-11	BM	CHINA	OPR	90	NUC/BIO/CHM
	M-9	BM	CHINA	OPR	325	
	M-18	BM	CHINA	DEV	550	
	CSS-1	BM	CHINA	OPR	650	
	CSS-2	BM	CHINA	OPR	1,620	
	CSS-3	BM	CHINA	OPR	3,800	
	CSS-4	BM	CHINA	OPR	6,000	
	CSS-X-5	BM	CHINA	DEV	1,350	
	CZ-1	SLV	CHINA	OPR	(CSS-3)	
	CZ-2	SLV	CHINA	OPR	(CSS-4)	
	CZ-3	SLV	CHINA	OPR	(CZ-2 DERIVATIVE)	
	CZ-4	SLV	CHINA	OPR	(CZ-3 DERIVATIVE)	

Table 3—continued

COUNTRY	SYSTEM	TYPE	ORIGIN	STATUS	RANGE (NM)[a]	WEAPON PROGRAM[b]
CUBA	FROG 4	BM	USSR	OPR	30	
	FROG 7	BM	USSR	OPR	40	
EGYPT	FROG 5	BM	USSR	OPR	30	BIO/CHM
	FROG 7	BM	USSR	OPR	40	
	SAKR 80	BM	EGYPT/IRAQ/N. KOREA	OPR	50	
	SCUD B	BM	USSR	OPR	165	
	IMP SCUD B	BM	EGYPT/N. KOREA	DEV	370	
INDIA	PRITHVI	BM	INDIA	TST	150	NUC/CHM
	AGNI[d]	BM	INDIA	TST	160	
	SLV-3	SLV	US/INDIA	OPR	740	
	AUG SLV-3	SLV	INDIA	DEV	2,480	
	POLAR SLV	SLV	INDIA	PLN	4,960	
	GEO SLV	SLV	INDIA	PLN	8,680	
	CENTAURE	SR	INDIA	OPR	30	
	ROHINI	SR	INDIA	OPR	80	
INDONESIA	UNNAMED	SLV	INDONESIA	PLN	960	CHM
	RX-250	SR	INDONESIA	DEV	60	
IRAN	OGHAB	BM	IRAN/N. KOREA	OPR	25	NUC/BIO/CHM
	SHANHIN 2	BM	IRAN	OPR	40	
	NAZEAT	BM	IRAN	OPR	70	
	SCUD B	BM	USSR OR N. KOREA	OPR	165	
	NODONG 1	BM	NORTH KOREA	OPR	300	
	TONDAR 68	BM	IRAN/CHINA	DEV	550	
IRAQ[e]	FROG 7	BM	USSR	OPR	40	NUC/BIO/CHM
	SCUD B	BM	USSR	OPR	165	
	FAW 70	BM	IRAQ	OPR	40	
	FAW 150	BM	IRAQ	OPR	81	
	FAW 200	BM	IRAQ	OPR	110	
	AL-HUSSEIN	BM	IRAQ	OPR	350	
	AL-ABBAS	BM	IRAQ/USSR, N. KOREA, GERMANY, BRAZIL, ARGENTINA, CHINA, OR EGYPT	DEV	560	
	AL AABED	BM	IRAQ/USSR, N. KOREA, GERMANY, BRAZIL, ARGENTINA, CHINA, OR EGYPT	DEV	1,100	
	TAMMUZI	BM	IRAQ	TST	1,240	
	LAYTH	BM	IRAQ	DEV	60	
	NISSAN	BM	IRAQ	DEV	70	
	KASSIR	BM	IRAQ	DEV	90	
	BARAQ	BM	IRAQ	DEV	160	
	FAHD	BM	IRAQ	DEV	310	
	CONDOR II	BM	ARGENTINA	DEV	600	
	AL-ABID	SLV	IRAQ	TST	3,720	
ISRAEL	LANCE	BM	US	OPR	80	NUC/BIO/CHM
	JERICHO I	BM	ISRAEL	OPR	310	
	JERICHO II	BM	ISRAEL/SOUTH AFRICA	OPR	930	
	SHAVIT	SLV	ISRAEL	OPR	4,650	
KUWAIT	FROG 7	BM	USSR	OPR	40	
LIBYA	FROG 7	BM	USSR	OPR	40	NUC/BIO/CHM

Table 3—continued

COUNTRY	SYSTEM	TYPE	ORIGIN	STATUS	RANGE (NM)[a]	WEAPON PROGRAM[b]
LIBYA						NUC/BIO/CHM
	SS-21	BM		OPR	40	
	SCUD B	BM	USSR	OPR	165	
	OTRAG	BM	USSR	DEV	190	
	AL FATAH (ITTISALT)	BM	GERMAN DESIGN GERMAN DESIGN	DEV	430	
NORTH KOREA						
	FROG 5	BM	USSR	OPR	30	
	FROG 7	BM	USSR	OPR	40	
	SCUD B	BM	USSR	OPR	165	
	NODONG 1 (IMP SCUD B)	BM	NORTH KOREA	OPR	370	
	NODONG 2	BM	NORTH KOREA	DEV	550	
PAKISTAN						
	HAFT I	BM	PAKISTAN/CHINA AND GERMANY	TST	45	
	HAFT II	BM	PAKISTAN/CHINA AND GERMANY	TST	165	
	HAFT III	BM	PAKISTAN	DEV	325	
	UNNAMED	SLV	PAKISTAN	PLN	740	
	SHAHPAR	SR	PAKISTAN/FRANCE	OPR	70	
	SUPARCO	SR	PAKISTAN	OPR	250	
SAUDI ARABIA						
	DF-3A (CSS-2)	BM	CHINA	OPR	1,670	
SOUTH AFRICA						NUC/BIO/CHM
	ARNITON (JERICHO II)	BM	SOUTH AFRICA/ISRAEL	TST	820	
	UNNAMED	SLV	SOUTH AFRICA WITH ASSISTANCE FROM FRANCE, GERMANY, ISRAEL, AND TAIWAN	PLN	UNKNOWN	
SOUTH KOREA						NUC/BIO/CHM
	HONEST JOHN	BM	US	OPR	20	
	NHK-1	BM	SOUTH KOREA/US	OPR	135	
	UNNAMED	SLV	SOUTH KOREA	PLN	2,480	
SYRIA						BIO/CHM
	FROG 7	BM	USSR	OPR	40	
	SS-21	BM	USSR	OPR	40	
	SCUD B	BM	USSR	OPR	165	
	NODONG 1	BM	NORTH KOREA	OPR	300	
TAIWAN						NUC/BIO/CHM
	GREEN BEE	BM	TAIWAN	OPR	70	
	SKY HORSE	BM	TAIWAN	DEV	620	
	UNNAMED	SLV	TAIWAN	DEV	UNKNOWN	
VIETNAM						CHM
	SCUD B	BM	USSR	OPR	165	
YEMEN						
	FROG 7	BM	USSR	OPR	40	
	SS-21	BM	USSR	OPR	40	
	SCUD B	BM	USSR	OPR	165	

Legend: BM-Ballistic Missile, SLV-Space Lift Vehicle, SR-Sounding Rocket; OPR-Operational, DEV-Development, TST-Testing, PLN-Planned; NUC-Nuclear, BIO-Biological, CHM-Chemical; GEO-Geosynchronous, AUG-Augmented, IMP-Improved

Notes:

[a]Range figures for space lift vehicles are estimates of how far the SLVs could tarvel if they were converted for ballistic missile surface-to-surface launches.

[b]Countries with ballistic missiles do not necessarily have active nuclear, biological, or chemical weapons, but the potential exists for developing and deploying weapons of mass destruction.

Table 3—continued

Notes:

[c]Argentina and Brazil both have long-standing nuclear programs, but at the end of 1990 they signed a bilateral agreement banning the production of nuclear weapons, the testing of nuclear explosives inside thier territories, and the manufacture of nuclear-capable missiles.

[d]This missile system was developed from space lift boosters. The Agni ballistic missile is based on the solid-propellant first and fourth stages of the SLV-3, and the second stage is similar to the liquid-propulsion system of the Prithvi SLV.

[e]*Information for Iraq reflects capabilities prior to Desert Storm. Known Iraqi missile and chemical, biological, and nuclear storage and manufacturing or research facilities were destroyed.*

Source: Information taken from Amb Henry Cooper, director, Strategic Defense Initiative Organization, and Hon Stephen Hadley, assistant secretary of defense, International Security Policy, *Briefing On the Refocused Strategic Defense Initiative* (Washington, D.C., 12 February 1991); Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 38-45; *The Emerging Ballistic Missile Threat To The United States, Report of the Proliferations Study Team* (Washington, D.C.: Government Printing Office, February 1993), 3, 11; Duncan Lennox, ed., *Jane's Strategic Weapon Systems* (Alexandria, Va.: Jane's Information Group, Inc., 1992), issues 9, 10, and 11; and "Argentina, Brazil Ban A-Weapons," *Washington Post*, 29 November 1990, A48.

Any country with the capability to develop ballistic missiles also has the capability to develop weapons of mass destruction (WMD). The nondiscriminating destruction caused by nuclear, chemical, or biological weapons provides additional factors when characterizing the increasing threat (table 4).

Table 4

Proliferation of Ballistic Missiles to Weapons of Mass Destruction

Ballistic Missiles	*Weapons of Mass Destruction*
• 15 or more third world countries now have ballistic missiles	• 4 third world countries with missile programs either have or are near to having nuclear weapons
• 7 third world countries will be capable of indigenous ballistic missiles by the year 2000	• 7 or more countries probably have offensive biological or chemical weapons programs
• 24 or more third world countries will probably have ballistic missiles with ranges up to 1,620 nm by the year 2000	• 8 third world countries with missile programs could have or will have nuclear weapons or programs by the year 2000
• 3 or more third world countries may have ballistic missiles with ranges up to 3,000 nm by the year 2000	• 30 third world countries will probably have offensive chemical weapons by the year 2000

Source: Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 33; and *The Emerging Ballistic Missile Threat to the United States, Report of the Proliferations Study Team* (Washington, D.C.: Government Printing Office, February 1993), 3, 7.

US Response to the Threat

President Bush directed the Strategic Defense Initiative Organization to develop the means for the US to respond to the increasing ballistic missile and weapons of mass destruction threat. Previously, President Ronald Reagan tasked the SDIO to develop the technology for the possible deployment of defensive systems for the US. The new focus is to deploy a system to protect the US, US forces overseas, and friends and allies from accidental or unauthorized limited ballistic missile attacks.[10] The refocused program is named Global Protection Against Limited Strikes. GPALS protects the Continental United States (CONUS) and overseas US interests against a limited attack rather than a Soviet mass raid attack.

The objective of the GPALS program is near-term deployment of such theater missile defense (TMD) systems as the Patriot air defense system used in the Persian Gulf.[11] The modified Patriot system proved that a localized antiballistic missile (ABM) system is feasible based on existing technology.

A TMD system has two near-term goals. First, it should protect US forces deployed to support a friendly nation's forces or a multinational force (e.g., Desert Storm coalition forces in Saudi Arabia).[12] Second, the program enhances the cooperative development and deployment of a TMD system by allies. Such cooperative TMD programs as the joint US and Israeli Arrow system can allow systems of other countries to be interoperable with US systems. The reduced duplication of system architectures, exchange of program information, advances in technology, and cost can make TMD systems affordable for many countries.[13]

The GPALS pursuit for a theater missile defense system is based upon such current Strategic Defense Initiative (SDI) programs or existing systems as the Patriot defense system. Each service is pursing the possibility of fielding TMD systems to cover their respective areas of responsibilities based upon the modification of existing systems.[14]

Threat Strategy

The Missile Defense Act of 1991 directs all DOD organizations to have the capability of defending against ballistic missile attacks. This act calls for two plans--deployment of both a theater missile defense system and a Limited Defense System (LDS) to protect the US from any ballistic missile attack.

The director of the Strategic Defense Initiative Organization controls the focus of the program. Each service will continue to evaluate existing systems and Strategic Defense Initiative efforts. The SDIO will provide the direction for accelerating ballistic missile defense programs and for any necessary realignment of program funding.

These plans use technology in existing US military weapon systems and call for modifying the systems to defeat a theater missile attack. This plan also exploits the research and developments of the SDI programs and blends these advancements with existing systems. This approach is both feasible and cost effective, because it will enable the US to provide protection for its military forces, allies, and friends against any theater ballistic missile attacks.

Another part of this strategy fields a LDS by using both space- and ground-based defensive systems to protect the United States. This plan builds on TMD systems and incorporates technology developed through the SDIO. This approach is a building block concept from both a technological and a funding standpoint.

The deployment of TMD systems has a few near-term advantages for the US. First, these systems provide a deterrence from ballistic missile attacks. Second, this deployment should slow down the proliferation of ballistic missiles. If TMD systems are deployed globally, then the psychological threat of using ballistic missiles will be diminished.

The LDS would have a real impact on the citizens of the US as demonstrated by the Scud attacks on the Israeli population by Iraqi forces during the Gulf War. The number of Israeli deaths related to the Scud attacks was over 200 people.[15] When a third world country threatens the United States with the use of ballistic missiles, the citizens of the US will demand both the capability to defend the US against such an attack and the capability to preempt the attack.

Each service has different capabilities and requirements for both TMD and LDS. The Army has the Patriot and the HAWK/TPS-59 surveillance sensor and weapon system. The Navy has the AEGIS weapon system. The Air Force has ground- and space-based sensor systems and the integrated tactical warning and attack assessment system. Each of these systems has specific abilities to counter specific threats, but if these systems are modified and integrated then they could provide a feasible near-term TMD system.

Each system, as it stands today, will not meet the intent of the MDA. For example, the Patriot in its current configuration isn't the panacea news reporters in the Gulf War made it out to be. First, the objective of the Patriot system is the air defense of a specifically defined area, such as an air base. Second, the Patriot system is intended to identify, track, and interdict attacking jet-powered cruise missiles and aircraft, not rocket-powered ballistic missiles. Third, the use of the Patriot system in the role of a ballistic missile defense system was a creative application against a new threat. This is not intended to downplay the significant role the Patriot systems and crews had during Desert Shield and Desert Storm but to point out that the Patriot system is not the miracle weapon for ballistic missile defense. It didn't prevent the loss of lives and property damage. Additionally, the Patriot was at times defeated by a low-tech weapon--the Scud missile.[16]

Current weapon systems are capable of meeting their original purpose. All the systems are either large, requiring heavy strategic lift, either by air or sea; are integrated into a ship, which limits their littoral utility; or are stationary and have a fixed surveillance area planned to counter the old Soviet threat. These systems may not meet the requirements of an RDSU ballistic missile warning and defense system.

Rapid Deployable Space Units for Theater Ballistic Missile Warning and Defense

RDSUs can complement TMD. To be effective, RDSUs must be flexible, mobile, and simple, and have the ability to escalate weapon systems based on a changing threat, and a streamlined organizational structure.

RDSUs must be able to change their mission. This change could be accomplished through the integration of existing equipment or software. For example, Central Command (CENTCOM) may have a peace-keeping mission, while Pacific Command (PACOM) may have a theater defense requirement. CENTCOM needs an RDSU that can provide warning of ballistic missile launches--the capability to detect, track, and identify the launch type and location of missiles and the ability to disseminate data on the launch and impact locations for warning alerts. PACOM's requirements start with the same warning capabilities as CENTCOM but add the requirement to engage incoming missiles. The RDSU tasked to each command may have the same or completely different equipment depending on the requirement, threat, and location.

RDSU ballistic missile warning and defense systems need to be mobile and have the ability to adapt to any geographical location. An example is a call for a ballistic missile defense RDSU to be deployed in the mountainous regions of Central America or to the Caucasus Mountains of the Commonwealth of Independent States (CIS). A Patriot-like system may not be practical because of the lift and movement requirements and problems encountered with the terrain. To deploy to mountainous regions, the RDSU must partition into small packages that can be either lifted by helicopter or C-130 aircraft then transported on the ground by a minimum number of light all-terrain vehicles. Again, the situation and location of the need for the RDSU will determine its mobility requirements.

An RDSU needs to be simple for two reasons. The first requirement is that the technology be current and that the equipment be compatible with the equipment used by allies and friendly coalition partners. This is important for the GPALS program and to facilitate technology exchange and integration with allied forces. The second requirement is to keep the cost of operations and logistic support within an acceptable range. This factor will influence decision makers to either commit or not commit a specific RDSU. The cost of an RDSU must not be so high that a decision maker will hesitate to deploy the RDSU because of fear of loss of the unit. Simplicity is important in all phases from development of the units to planning by the unified staffs.

The ability to escalate or increase the capabilities of a missile warning and defense RDSU is paramount. This ability is an element of preplanning that is tailored for each theater and drives the equipment acquisition and the organizational structure of the parent RDSU group. Future budgeting requirements will demand the evaluation of the threat against the cost to counter the threat. The second element for escalation of missile warning and defense RDSUs is how and who will operate and support the RDSU equipment. For example, AFSPACECOM could be tasked to deploy a missile warning and defense RDSU for a peace-keeping mission. If the peace between the hostile forces breaks down and the US joins a coalition force to deter a possible attack, then the previous TMD threat may have increased to a level that would require additional RDSUs.

Streamlining the RDSU organizational group would provide a quick reaction capability. The theater commander's staff would have a dedicated organization to call for immediate support for theater ballistic missile warning and defense. An example would be the establishment of dedicated ballistic missile weapon systems like the Patriot-Arrow assigned to AFSPACECOM. These systems would complement AFSPACECOM's direct space planning support to theater commanders by forward space support of in-theater teams.[17]

Summary

As the sole remaining global superpower, the United States has a responsibility to advocate for a slowdown in global ballistic missile development and deployment. In addition, the US must watch the ever-expanding group of countries with a nuclear, biological, or chemical weapons capability.

The technology exists today for missile warning and defense systems for the US and also our allies and friends. The redirection of the SDIO towards the development of missile defense systems provides protection of the US and deterrence to hostile countries, individuals, or organizations. Having RDSUs capable of responding to any location or threat and based upon simple technology with the ability to escalate the warning and defense capability holds a viable solution for the future.

Notes

1. President George Bush, "Address Before a Joint Session of the Congress On the State of the Union, 29 January 1991," *Weekly Compilation of Presidential Documents* 27, no. 5 (4 February 1991): 94.

2. The North American Aerospace Defense Command (NORAD) is the combined American and Canadian military command for the defense of North America.

3. The 12th Missile Warning Squadron, Clear AFB, Alaska, operates a traditional mechanical tracking radar and a fixed beam detection radar.

4. Maj Gen Robert R. Rankine, Jr., "The US Military Is not Lost in Space," in *Building a Consensus toward Space: Proceedings of the Air War College 1988 Space Issues Symposium* (Maxwell AFB, Ala.: Air University Press, 1990), 51.

5. Ibid., 42.

6. Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 38–42.

7. R. Bates Gill, "Curbing Beijing's Arms Sales," Orbis, Summer 1992, 398–403; John M. Goshko and Don Oberdorfer, "Chinese Sell Saudis Missiles Capable of Covering Mideast," *Washington Post,* 18 March 1988, sec. A1.

8. Payne, 32.

9. Ibid., 31.

10. Amb Henry Cooper, director, Strategic Defense Initiative Organization, and Hon Stephen Hadley, assistant secretary of defense, International Security Policy, *Briefing on the Refocused Strategic Defense Initiative* (Washington, D.C., 12 February 1991), 13.

11. Ibid., 15.

12. Department of Defense, *Report to Congress: Plan for Deployment of Theater and National Ballistic Missile Defenses* (Washington, D.C.: Government Printing Office, June 1992), 19.

13. Cooper and Hadley, 16 and 29.

14. DOD, *Report to Congress*, 15.

15. Payne, 49.

16. Theodore A. Postol, *Lessons for SDI from the Gulf War Patriot Experience: A Technical Perspective, Testimony Before the House Armed Services Committee, 16 April 1991* (Cambridge, Mass.: Massachusetts Institute of Technology, 1991), 1, 4.

17. Air Force Space Command (AFSPACECOM/DOX), *Concept of Operations for Forward Space Support In Theater (FSST) Team*, 1 February 1993, 1.

Chapter 3

Space Control

This chapter focuses on the current fixed surveillance sensor capabilities of the United States. It examines the three mediums of space surveillance--active, passive, and electro-optical (EO)--and their applications and deficiencies.

The chapter looks at lethal and nonlethal counterspace missions in support of national security or combat operations. It concludes with a discussion of the advantages of mobile surveillance systems and looks at how both fixed and mobile systems support the function of space control for both defensive and offensive counterspace operations.

Why Space Control?

President Dwight D. Eisenhower's Open Skies doctrine set the stage for US space policy. The fear of a nuclear surprise attack on the United States by the USSR drove the US to acquire reconnaissance information on the activities of the Soviet military. The Eisenhower administration saw the benefit of launching satellites for scientific and military purposes as a means of obtaining information. President Eisenhower's proposal for the concept of freedom of space for all nations for satellite overflight of sovereign countries is analogous to freedom of the high seas.

The Soviets rejected Eisenhower's Open Skies doctrine as a means for both countries to reduce the fear of a surprise attack through the use of both aerial and orbital space systems.[1] Ironically, the Soviets validated the Open Skies doctrine and the concept of freedom of space by launching Sputnik I over international borders without provoking international protests.[2] The Soviet's Sputniks and American Explorer and Vanguard launches set the stage for the claim to ownership of military space systems by any country with a space launch capability. The Open Skies doctrine provides the US access and use of space while at the same time allowing the overflight of foreign satellites above the United States. The US established the Space Surveillance Network to monitor the orbits of satellites.

The need to maintain a surveillance system capable of detecting, tracking, and identifying man-made orbiting objects became apparent with the growing use of space by the US and other countries. The surveillance system produces a real-time stellar map of man-made objects orbiting the earth. This system can detect the movement and breakup of satellites. The system also considers whether the changes in a satellite's movement are threatening to the US or allies.

National Security Directive (NSD) 30, *National Space Policy,* 2 November 1989, details the importance of space to US national security. NSD 30 focuses on the use of space to strengthen national security and establishes principles governing space activities for military space operations.[3] The *National Space Policy* provides specific guidance for military space operations for national security:

> The United States will conduct those activities in space that are necessary to national defense. Space activities will contribute to national security objectives by (1) deterring, or if necessary, defending against enemy attack; (2) assuring that forces of hostile nations cannot prevent our own use of space; (3) negating, if necessary, hostile space systems; and (4) enhance operations of United States and Allied forces.[4]

The *National Space Policy* further defines and directs implementation of four actions for space control:

> 1. The DOD will develop, operate, and maintain enduring space systems to ensure its freedom of action in space. This requires an integrated combination of antisatellite, survivability, and surveillance capabilities.
>
> 2. Antisatellite (ASAT) Capability. The United States will develop and deploy a comprehensive capability with programs as required and with initial operations capability at the earliest possible date.
>
> 3. DOD space programs will pursue a survivability enhancement program with long-term planning for future requirements. The DOD must provide for the survivability of selected, critical national security space assets (including associated terrestrial components) to a degree commensurate with the value and utility of the support they provide to national-level decision functions, and military operational forces across the spectrum of conflict.
>
> 4. The United States will develop and maintain an integrated attack warning, notification, verification, and contingency reaction capability which can effectively detect and react to threats to United States space systems.[5]

The establishment of a robust operational space control infrastructure is the primary task for space operations organizations. An analogy can be drawn between the need for space control and the need for air superiority. When the US needs to establish air superiority over a specific location, US air forces inhibit or destroy an enemy's capabilities at a time and place of its choosing.[6] A country can attain space control in the same manner except the country doesn't need to gain control of any adversary air space. The advantage of space control over air superiority is that space control can provide the quickest means to target an enemy's vital centers of gravity without putting pilots and aircraft in harm's way. Space control provides the means of denying an enemy vital information--thus causing friction and increasing the fog of war.

Space control is a valuable asset at any level of the conflict. In wartime, space control can deny any enemy the benefits of weather, navigation, surveillance or warning, reconnaissance, and multispectral imagery data, as well as degrading his capabilities to effectively conduct air, land, and sea operations. In peacetime, space control provides a level of deterrence and insurance for terrestrial operations by US forces, allies, and friends. The potential threat of the US denying a country access to space or knowing the US will not stand by while attempts are made to deny the US access or use of space is the stabilizing factor of space control.

Space control consists of three elements: surveillance, protection, and negation. Surveillance systems provide the capability to detect, track, and identify orbiting objects and indicate whether the object is a possible threat. Satellite protection ensures friendly space systems are safe to operate while under attack. Space control negation consists of defensive and offense space operations. Defensive operations can range from confusing or deceiving an enemy about the reliability of his space systems to direct actions against an enemy's ability to deny the use of space by friendly forces. Offensive space control operations use either lethal or nonlethal weapons against an enemy to deny him access or use of his space systems.

The selection of lethal or nonlethal weapons will impact users of orbiting space systems. ASAT capabilities include all weapon, technology, and techniques that can be used to disable, damage, or destroy an on-orbit satellite system (table 5).[7] Deploying a US ASAT system to interdict an enemy's ASAT system is an example of using a lethal space control weapon. A major drawback of lethal weapons is that they leave debris in orbit. This debris creates a hazardous area in space for a undetermined period of time and sends small fragments speeding in multiple directions, possibly on intercept paths with other satellites. The use of a destructive lethal space weapon will inhibit not only enemy but also friendly access to space.

Table 5

Antisatellite Systems

Dedicated	*Implied*
• Electronic countermeasures	• Modified
• Ground-based, directed-energy weapons	• Modified ICBMs
• Direct attack (nuclear, conventional, impact)	
• Co-orbital	
• Direct ascent	
• Space-based mines*	

*This means provides the most effective threat for a low-intensity capability.

Source: Adapted from Steven R. Peterson, *Space Control and the Role of Antisatellite Weapons* (Maxwell AFB, Ala.: Air University Press, 1991), 37.

The use of nonlethal space weapons provides the greatest flexibility for negating an enemy's space systems. The options could range from destroying ground control stations, jamming an enemy's up-link frequencies, to targeting the specific sensor package on the satellite.[8]

The use of space by other countries and international organizations has steadily increased over the past 30 years. The need to establish and maintain control of space at any time or global location is fundamental in meeting US national security objectives.

New World Threat

In the past the US focused on the USSR for threats to space systems. While the US focused on Soviet activities, other countries made rapid gains in the ability to launch satellites into space. The two areas the US has not monitored closely enough are developing countries space and missile programs and the transfer of missile technologies to emerging countries. An example of an emerging space program is Iraq's 1989 test of the Al-Abid space launch vehicle.[9] This launch vehicle is based upon Soviet Scud B technology.

The second area lacking US attention has been the transfer of technology between countries either by sales or assistance. Examples of this transfer are the sale of Soviet liquid-fueled rocket motors to India, Soviet assistance to China, and China's assistance to such lesser developed countries as North Korea.[10] Also, when the Soviet Union disintegrated, technology and personnel quickly spread among the independent republics of the CIS. The desire of a country to possess an ASAT system may not be based on political objectives, but may be driven by economic shortfalls. Future mercenaries will hold advanced technical degrees and wear white lab coats. To fuel the economies of their respective republics, scientists and technicians will be available to the highest bidders.

The ever-growing number of space lift vehicle (SLV) programs will continue to fog the source of threats to US space systems. The future ASAT threat will proliferate proportionally with the number of countries with space launch capabilities (table 6).

The growing number of space users has changed the direction of possible threats from bipolar to multipolar. Some countries may not use space for peaceful purposes. The current objective for certain emerging countries is the development of their own observation or imagery sensoring satellites. During the Gulf War, the United Nations (UN) imposed a data information embargo against Iraq for having purchased data from France and Russia. Since the end of the Gulf War, three emerging countries began or have planned to develop observation or sensoring satellites. This development may or may not be the result of a UN embargo on the transfer or sale of satellite imagery from France and Russia during the Gulf War, but it's clear that a number of countries will still have access to the same type of information that was available under the old Soviet regime.[11] A future number of space users will be willing to attack US, allied, or friendly countries' satellite systems, not out of specific national objectives, but as a regional show of force. The US must be ready and willing to deter this form of space piracy.

Table 6

Ballistic Missile Space Launch Vehicle Capabilities

COUNTRY	OPERATIONAL ICBM	OPERATIONAL SLV	SLV IN DEVELOPMENT OR PLANNED
BELORUSSIA	SS-25		
BRAZIL			VLS
CHINA	DF-4 DF-5	CZ-1D CZ-2C CZ-2E CZ-3 CZ-4A	CZ-3A
FRANCE		ARIANE 4	ARIANE 5
INDIA		SLV-3 ASLV	PSLV GSLV
INDONESIA			SLV (UNNAMED)
IRAQ			AL-ABID
ISRAEL		SHAVIT	
JAPAN		M-3SII H-1	M-5 H-II
KAZAKHSTAN	SS-18		
PAKISTAN			SLV (UNNAMED)
RUSSIA	SS-11 M2/M3 SS-13 SS-17 SS-18 M4/M5 SS-19 M3 SS-24 SS-25	SL-3 SL-4 SL-6 SL-8 SL-11 SL-12 SL-13 SL-14 SL-16 SL-17 ENERGIYA SL-17 BURIAN	SS-19 SLV SAWFLY (SS-N-8)
SOUTH AFRICA			SLV (UNNAMED)
SOUTH KOREA			SLV (UNNAMED)
TAIWAN	SS-24		SLV (UNNAMED)
UKRAINE	SS-19	SL-16 SL-7 SL-8 SL-14	SPACE CLIPPER (SS-24) SS-18K

Source: Adapted from *The Emerging Ballistic Missile Threat to the United States, Report of the Proliferation Study Team* (Washington, D.C.: Government Printing Office, February 1993), 3; and Keith B. Payne, *Missile Defense in the 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview Press, 1991), 38-44.

Today's Space Surveillance Network

The US Space Surveillance Network (SSN) consists of a worldwide sensor system consisting of dedicated, collateral, and contributing sensor systems (fig. 3). The sensors of the SSN monitor the near-, medium-, and deep-space

Legend:

Active Radar Sites

B	Shemya AFB	2
C	Clear AFS	2
D	Beale AFB	2
F	Eldorado AFS	2
G	Eglin AFB	1
H	Robins AFB	2
I	NAVSPASUR[a]	1
J	Cape Cod AFS	2
K	Millstone & Haystack	3
M	Cavalier AFS	2
N	Thule AFB	2
O	Antigua	3
P	Ascension	3
R	RAF Fylingdales	2
U	Pirinclik AS, Turkey	1
Z	Kwajalein	3

Passive RF Sites

L	Griffiss AFB	1
Q	Edzell Army Air Field, UK	1
S	RAF Feltwell, UK	1
T	San Vito AS, Italy	1
W	Osan AB, South Korea	1
Y	Misawa AB, Japan	1

Electro-optical Sites

A	MOTIF[b]	Maui, Hawaii	1
	AMOS[c]	Maui, Hawaii	2
E	Socorro, New Mexico		1
V	Diego Garica		1
X	Taegu, South Korea		1

1- DEDICATED SENSOR 2- COLLATERAL SENSOR 3- CONTRIBUTING SENSOR

▲- SPACE SURVEILLANCE CENTER ▼- ALTERNATE SPACE SURVEILLANCE CENTER

Notes:
[a]NAVSPASUR—Naval Space Surveillance System
[b]MOTIF— Maui Optical Tracking and Identification Facility
[c]AMOS—Air Force Maui Optical Station

Figure 3. US Space Surveillance Network

environment around the earth. The sensors receive their individual taskings from the Space Surveillance Center (SSC) in Cheyenne Mountain to track or search for orbiting objects of interest. The SSC is responsible for maintaining and cataloging all orbiting man-made objects in space. The SSC tasks the SSN sensors to monitor and process the data collected and report their findings via data links to the SSC. When orbits of interest change, the information is passed on to the Space Defense Operations Center (SPADOC) for analysis of possible threat actions against US or friendly satellite systems. The information collected by the SSN and processed by the SSC is critical, especially when changes in a satellite's orbit may put other satellites in harm's way.

A satellite may be harmful to other satellites especially if it breaks up. After a breakup, instead of a controllable single satellite, there is a mass of uncontrollable small objects. Each object has the lethality of a small projectile. When this happens SPADOC sends out warning notifications to the owners and operators of threatened satellites to take any possible action to maneuver away from the danger.

SPADOC implements the same procedures when a satellite is deliberately maneuvered to intercept another satellite. The ultimate objective of the SSN is to monitor, track, and alert the SSC of anomaly in the orbits of man-made objects.

The surveillance system has three types of tracking systems--active radar systems, passive radio frequency (RF) systems, and electro-optical systems. Each of the sensor systems provides unique information on orbiting objects. The different SSN sensors enhance the space control capability of the US by providing the flexibility to monitor and predict actions in space which may affect US national security objectives.

Active Sensors

Active radar sensors track all types of objects, such as active satellites, rocket bodies, and debris. They can determine movement of objects day or night and in all types of weather. There are two types of active sensors--mechanical and phased array. Each type has specific advantages for space surveillance.

Mechanical radar provide the best data on small objects because they have a focused beam of radar against the object in track. The data provides a highly accurate definition of the object's physical characteristics. Unfortunately because of the tight radar pattern, mechanical radars take longer to scan and detect objects. This type of search and tracking is analogous to using a high-powered flashlight to find a single person in a stadium instead of using an array of flood lights to accomplish the same task.

Phased array radars can track individual objects, or track multiple objects simultaneously. A additional advantage of phased array radars is their ability to project their radar in specific patterns to optimize detecting objects of interest in specific orbits. A prime example is the tracking of multiple objects from a satellite breakup. This tracking allows for a "quick look" of the orbit of the debris to predict changes in the orbit of each object. In the simplest definition, the active radars are the eyes of the surveillance network.

Passive Sensors

Passive RF sensors detect, track, and discriminate active emitting satellites. These sensors can scan the space environment more quickly than radar systems and provide the fastest means to identify a specific satellite or to determine the operational status or changes in the orbit of a satellite. Passive sensors can provide the quickest means to track and monitor new foreign launches, because they are able to detect the telemetry signal while the payload is still in its initial launch orbit.

In the same manner as new launches, the passive sensors can determine the change of location a satellite has in reference to the earth. This function is critical for satellites in geosynchronous orbits where optimal locations in reference to the position over the equator are limited.

The operating principle is the same as searching through a radio band to find a specific station. The disadvantage is that passive RF sensors can track only objects with active emitters. When a satellite is turned off, passive sensors are deaf to the orbit of the satellite. Passive sensors are the ears of the Space Surveillance Network.

Electro-Optical Sensors

Electro-optical sensors use computer controlled and enhanced optical-telescopes to detect, track, and identify orbiting objects. The sensor is similar to astronomical telescopes. These sensors observe both starlight and the light reflected from orbiting objects. The sensor's computers remove the starlight from the field of view, leaving just the reflective images of orbiting objects.

Early in the space shuttle program, an electro-optical sensor in Hawaii was tasked to determine if any of the critical heat resistance tiles fell off the shuttle during the launch. Within minutes of the overhead pass, the sensor's operators accomplished a visual inspection of the shuttle's underside, then they passed the information to shuttle engineers for evaluation. The sensor's actions were critical in determining the risk to the shuttle and crew upon reentry. In the role of space control, electro-optical sensors can evaluate and record the physical characteristics of possible co-orbital antisatellite platforms.

Geographical location is essential to the performance of electro-optical sensors. Electro-optical sensors are limited to nighttime operation from locations free from both light and atmospheric pollution with clear evening skies.

Drawbacks for Tomorrow

Four concerns may affect the Space Surveillance Network. The first is the location of existing sensor sites which focus on maximizing warning and space surveillance coverage from the Soviet missile threat. The second concern is the rapidly expanding space and missile programs of countries. The third concern is the cost of operating fixed overseas locations. The fourth concern is the changes in political relationships between the US and countries hosting permanent fixed sensors. Each concern influences the effectiveness of the United States to project space control.

Space surveillance sensors in their current locations have coverage gaps for orbits originating from locations other than the major global space launch centers. A real possibility exists for a space launch to occur and initially be detected by a space-based ballistic missile warning system. The existing Space Surveillance Network configuration will take time to detect, track, collect, and catalog the orbital characteristics of the object. The sooner the SSN tracks an object, the quicker it can identify the object's orbit and determine the intentions of the satellite owners. This development is critical for future access and use of space by the US, allies, and friendly countries.

The increasing number of players in the missile and space club creates an ever-increasing gap of coverage for space launches. The Convention of Registration Treaty of 1974 and the Outer Space Treaty of 1967 task the United States to maintain the spacetrack catalog of man-made objects in orbit around the earth.[12] Unfortunately a country or organization can report the launch to the UN after the space launch has occurred, specifically, "when practicable."[13] When practicable is not defined, the Outer Space Treaty, Article IX obligates a country to consult with other countries if their actions could cause harmful interference. The treaty doesn't specifically define harmful interference, and if a country raises the issue of harm or interference to its satellites, then the country planning the launch doesn't have to consult with the other country.[14] In 1987 and 1988 the Soviet Union failed to notify the US of possible interference to the Solar Maximum Mission (Solar Max) satellite. The Soviets placed two radar ocean reconnaissance satellites (RORSAT) for testing of two high-powered, 10-kilowatt, thermionic nuclear power supply systems at altitudes above Solar Max. The RORSATs' power supply systems caused interference to Solar Max. This example shows how countries ignore Article IX.[15] If a country or organization launches an object with the intent to deny other countries the use or access to space, then that country or organization jeopardizes the national security of the United States and others.

The decreasing military budget and the increasing cost of operating fixed overseas space surveillance sites is a concern to military planners. Cost concerns are in two areas--contractor operations of many of the surveillance sensors and the increasing costs imposed by countries for the right to operate a surveillance sensor in their country. An example of imposed costs is associating the country's inflation rate with labor costs the US pays to native workers. The costing method was driving the yearly cost of operating the FPS-79 surveillance radar in Turkey to increase not by thousands of dollars, but by tens of thousands.

The fourth concern is related to the political cost of operating overseas sites. If a country demands more money than the US wants to pay, or the political climate in the host country changes, the US may shut down and remove the sensor system. The withdrawal of the US military from the Republic of Philippines is an example of a host country demanding more payment than the facility is worth. Also, the political changes in Turkey caused the Air Force to shut down the Pirinclik site from 27 July 1975 to 26 October 1978.[16]

Rapid Deployable Space Units for Space Control

In the future, RDSUs can be valuable for space control. Mobile sensor systems can aid the US to anticipate and respond to threats to space operations. Deployable space surveillance units provide the means to counter the drawbacks of the existing SSN. Mobile surveillance systems can fill the gaps in the existing global surveillance coverage. The RDSUs can support friendly countries as well as the UN in establishing a tailored space surveillance network for any launch location.

Mobile systems would not have the same cost and political climate considerations as fixed sensor locations. These self-contained systems can deploy to a location using an agreement from the host country similar to aircraft landing rights. Since the operations and maintenance costs of an overseas location for mobile units are less than for a fixed site, this solution provides a great cost savings.

In peacetime, RDSUs can provide more accurate data than a fixed ground station on orbiting objects in a path of an uncontrolled reentry. The deployment of RDSUs to locations directly under the paths of these objects can provide the data needed to predict the impact locations. As more countries gain the ability to launch systems into space, the odds increase for a disaster from the breakup debris to life and property.

Examples of uncontrolled reentries range from Skylab to a nuclear power supply from a Soviet satellite. On 11 July 1979, National Aeronautics and Space Administration (NASA) mission controllers commanded the Skylab space station to prevent the uncontrolled reentry over North America. Their actions delayed the reentry by 30 minutes so Skylab would break up over the south Atlantic Ocean and the southern Indian Ocean. Skylab debris as large as a one-half ton six-foot cylinder were found throughout western Australia.[17]

Uncontrolled reentry problems have plagued the Soviet's RORSATs. Specific concerns focus on the RORSAT's nuclear power supply system. Between 1978 and 1988 the Soviets had three uncontrolled reentries of RORSATs. In January 1978 Kosmos 954 scattered radioactive debris over a large remote area of northern Canada. It wasn't until 8 June 1988, after losing control of the third RORSAT, that the Soviets announced that Kosmos 954 (1978), Kosmos 1402 (1983), and Kosmos 1900 carried nuclear reactors fueled by 31.1 kg of U^{235}. Fortunately, the fail-safe features of Kosmos 1402 and Kosmos 1900 ejected the nuclear fuel core into a high orbit. Global concern over Kosmos 1900 lasted four months (i.e., until the reactor's fail-safe system was activated). During this time sensors continued to track Kosmos 1900 to predict a worst case impact area for the nuclear debris. The means to track and predict future uncontrolled deorbits is vital.[18]

Active and Passive Sensors

Active radar sensors needed the capabilities of both phased array and mechanical radars. The specific data need by either the SSC or SPADOC determines the radar's fence. If an organization requires both a large number of objects and refined data on specific objects, then the Air Force could deploy both active and passive RDSUs. As with ballistic missile warning RDSUs, the space control RDSUs need to be cost effective and optimize operational effectiveness by matching appropriate technology to the mission.

Passive RDSUs should be able to detect any satellite frequency band. This capability provides the flexibility for orbital data requirements from any satellite or satellite constellation. RDSU's need the capability to detect RF emissions from satellites in low, medium, and high earth orbits. RDSUs provide the greatest flexibility and coverage at a cost less than operating fixed locations.

RDSUs can be tailored to meet specific mission requirements. An example is the deployment of both an active radar RDSU and a passive RF RDSU to a friendly country to detect and track possible hostile satellite systems. Having both active and passive RDSU sensors at a specific location increases operational effectiveness for surveillance taskings and provides a single command and control point for the SSC and SPADOC. In this scenario, active and passive sensors provide a better performance than an electro-optical RDSU. Environmental factors are the greatest drawback to establishing EO RDSUs.

Future Rapid Deployable Space Units for Negation and Protection

RDSUs are the most valuable assets the US could use to maintain a peaceful use of space. The US must remember that other countries and foreign organizations have the technological means and the desire to gain a military, political, or economic advantage. The United States needs to establish a flexible and responsive system for space control. Using RDSUs for negation and protection provides a deterrence umbrella to all countries and organizations. The ultimate objective of space control is to deter any actions intended to deny or prevent the US from operating in space.

Inhibiting US space operations is a topic of foreign space experts. In October 1992 Russian Major General Yuri Gusev, deputy commander of space forces in the Russian Ministry of Defense, stated that Russia could maneuver the Mir space station to capture another satellite.[19] This statement may have been made because of the fear of the US negating CIS or Russian satellite systems. Specifically, the capture of a spy satellite concerned the Soviets, since the US has used the space shuttle to retrieve and return orbiting satellites.[20]

Summary

In the future space control will be vital to ensure that the US has free use and access to space. The success of future terrestrial military operations will depend on the ability of the US to operate in space. Within the next 20 years, the reliance on orbiting space systems will increase for a host of countries.

The US has established a highly reliable surveillance network to track and monitor satellites and other objects. This network was based upon the cold war need to monitor the space activities of the Soviet Union. With the transfer of technology and the growing number of countries racing to own the capability of launching systems into space, the need to track their launches and satellite systems will be critical to the future operations of US-owned space systems. RDSUs can provide a cost-effective means to complement the existing fixed world-wide space surveillance network. RDSUs can meet the future needs of the US without having the same economic and political liabilities as the fixed surveillance sites.

Notes

1. During this period, the US routinely flew the high altitude U-2 reconnaissance aircraft over the Soviet Union to provide information on Soviet military activities. This routine provided the catalyst for establishing the principle of freedom of space in international law for future military satellites. The U-2 flights went unchallenged by the Soviets, except through diplomatic channels, until the downing of Francis Gary Powers by the Soviets on 1 May 1960.
2. R. Cargill Hall, "The Origins of U.S. Space Policy: Eisenhower, Open Skies, and Freedom of Space" (Paper presented to the World Space Congress, Washington, D.C., 3 September 1992), 27.
3. Joint Pub 3-14, "Joint Doctrine: Tactics, Techniques, and Procedures (TTP) for Space Operations," final draft, 15 April 1992, I-7 through I-9.
4. The President of the United States, *National Space Policy* (Washington, D.C.: Government Printing Office, 2 November 1989), 3.
5. Ibid., 10.
6. AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force*, vol. 1, March 1992, 6.
7. Steven R. Petersen, *Space Control and the Role of Antisatellite Weapons* (Maxwell AFB, Ala.: Air University Press, 1991), 37.
8. Joint Pub 3-14, III-16 through III-17.
9. "Iraqis Announce Test of a Rocket," *New York Times*, 8 December 1989, A9.
10. *The Emerging Ballistic Missile Threat to the United States, Report of the Proliferations Study Team* (Washington, D.C.: Government Printing Office, February 1993), 2.
11. Ibid., 5.
12. *Space Handbook*, ed. Lt Col Curtis D. Cochran, Lt Col Dennis M. Gorman, and Maj Joseph D. Dumoulin (Maxwell AFB, Ala.: Air University Press, 1985), 15-3.
13. Petersen, 90.
14. *Space Handbook*, 15-2; Petersen, 96.
15. Nicholas L. Johnson, *The Soviet Year in Space: 1988* (Colorado Springs, Colo.: Teledyne Brown Engineering, 1989), 78.
16. *Aerospace Defense: A Chronology of Key Elements, 1945–90* (Petersen AFB, Colo.: AF-SPACECOM History Office, October 1991), 46, 49.
17. Kenneth Gatland, *The Illustrated Encyclopedia of Space Technology: Comprehensive History of Space Exploration* (New York: Harmony Books, 1981), 181.

18. Ibid., 78, 90; Johnson, 76, 77.

19. Vincent Kiernan, "Russian Space General: Mir Could Grab Satellites," *Space News*, 19–25 October 1992, 11.

20. Ibid.

Chapter 4

Space Combat Support Enhancements And Space Operations Mission Support

This chapter discusses space combat support enhancements and space operations support functions. It focuses on the support space systems provide to terrestrial forces and on direct mission support to on-orbit space systems.

The RDSU concept further refines, streamlines, and simplifies space combat support to the war fighters through the continuum of conflict. Operational support missions can benefit from RDSUs because of the flexibility and survivability mobile space units offer.

Today's Enhancements to Air, Land, and Sea Forces

Today, space combat support forces can provide equipment, capabilities, and more importantly information to bolster the combatant commander's objectives. The information the commander and his combat forces have acquired about the enemy, the terrain, and the enemy's capabilities provide the essential answers to identifying the enemy's centers of gravity.

Space combat support is rapidly becoming an essential element in the planning and execution of operations by air, land, sea, and space forces. After the commander has given directions, established plans, and assembled hi-tech forces, the major barrier left to confront is the "fog of war."[1] To clear the fog of war, the commander can rely on space combat support to provide a wide variety of force enhancement services. This support will not eliminate the problem, but will provide the means to reduce internal and external frictions for the commander.

The support provided to the military command is informational. Receiving and sending information at all levels is vital to military forces. The key is knowing what is happening, where the players are located, changes in the situation, and generally what the enemy is thinking, saying, and doing. The following discussion of five mission functions provides a baseline of capabilities to combatant commanders.

Navigation/Positioning

The newest capability provided to military forces is the ability to know within meters where you are in relation to other units and the enemy. The capability for individual units to know their current position, anywhere on the globe, is essential to any commander. The ability to navigate in unmapped regions increases flexibility, surprise, and maneuver.

The coalition forces execution of the "Hail Mary" maneuver in the uncharted western desert during the Gulf War provided a great element of surprise. The Iraqis were caught totally off guard by the fact that the coalition forces were moving in an area of the desert where even they don't go because they can't navigate and get lost.[2] The space navigation/positioning capability has proven its worth and is increasingly useful for air, land, and sea movements.

Communications

Communications is the key for effective command and control. Today, combatant commanders need the capability to communicate at all distances.

The Gulf War demonstrated the value of communication satellites for the United States and Saudi Arabia. The use of intratheater satellite communications was even more important for coalition forces due to a lack of host country communications support for a military force of over 500,000 personnel. The reliability and utility of satellite communications outstripped the availability of ground terminals for US forces. The beyond-the-line-of-sight capability of satellite communications provides a real-time global communications system. This provides the national command authorities with a positive control capability to all military forces for a near-global coverage.[3]

Weather/Environmental

Weather data and forecasting is an essential element of the success or failure of any military operation. Satellite systems have provided this information for over 25 years. Weather or environmental data can determine when to execute a mission, what equipment is required, and which weapon to use. Satellite weather data has been used since the Vietnam War to plan missions and adapt military operations to environmental conditions.

Environmental data on the movement of smoke gathered from the Kuwaiti oil well fires was essential for air operations during the Gulf War. Environmental data helped environmental engineers and scientists in measuring the effects of the deliberate spillage of crude oil into the Persian Gulf by Iraq. In Somalia the use of weather and environmental data is crucial to evaluating the effects of the draught and civil war on the Somalian population. Information provided by weather/environmental satellites enables the combatant commander to plan and execute operations throughout the total continuum of conflict.

Intelligence and Surveillance

Intelligence and surveillance data of the earth provides the quickest means to effectively discern the enemy's intentions and strengths and then remove the element of surprise. It reduces uncertainty for US, allied, or friendly forces and improves effectiveness. This capability provides combat forces with another means to observe, warn, and react.[4] The elements of surprise and shock were taken away from the Iraqis by the constant monitoring of systems capable of detecting, tracking, and warning coalition forces of the Scud launches.

Mapping, Charting, and Geodesy

Satellite systems are critical in providing the most accurate information to update charts and maps. Data collected by satellites with global coverage is essential to the mapping, charting, and geodesy production.

Satellite systems can provide supplemental updates for US military forces on rural and urban status (e.g., new roads or buildings) as well as geographical changes (e.g., new reservoirs or changes in rivers) in any location.[5] This capability gave US forces up-to-date charts of Somalia prior to their deployment.[6] The updated charts and Global Positioning System (GPS) receivers provided the means for US forces to move within Somalia and maintain an updated status of population centers.

Today's Space Operations Mission Support

The space combat support provided to a combatant commander is only as good as the capabilities and capacity of space operations mission support. The effectiveness of the information to the combat forces depends on the status and configuration of the satellite systems. To provide global coverage, the different satellite constellations require constant operational management.

Satellite control is monitoring a satellite's status once it has been launched. This function is performed for the life of the satellite and consists of three primary functions: monitoring the telemetry, tracking, and commanding the satellite (TT&C). Regardless of the mission or satellite type, all satellites require TT&C. The level of TT&C attention is dictated by the mission and configuration of the individual satellite and/or constellation. A worldwide network of satellite control facilities (SCF) and remote tracking stations (RTS) accomplish TT&C for all satellites.

Remote tracking stations perform satellite control tracking and transmit and receive data from the satellite. The tracking function locates a satellite at a specific time and location in relation to the look angles of the ground station as the satellite moves in and out of the field of view. Tracking data consists of specific information unique to each satellite. Data collected by the RTS is used to calculate the satellite's time (first time of view), azimuth (direction), elevation (height), range (distance), and range rate (speed). Tracking data optimizes when, where, and for how long a ground station can send and receive data from a satellite.

Telemetry data consists of information on the health and status of the satellite and the mission-related payload. The satellite's health data consists of the satellite's temperature, power system voltage, pressure of control-fuel propellant, and the status of mechanical and electrical equipment. Mission-related payload status is information-specific to the mission. An example for a communication satellite is antenna position, transponder frequency, active and inactive status for transponders, or power levels for the transponders.

Commanding is the third element of TT&C. Commanding is done by a satellite mission control complex (MCC). MCC maintains the health of the satellite and the mission payload. It receives commanding directions and mission data for the mission payload and sends them to the users. It also forwards commands to the satellite via the RTSs for such functions as maneuvering, activating and deactivating sensors, or calibrating equipment. The MCCs generate two types of commands for the RTSs. The first is a real-time command MCCs use when the satellite is directly in the view of an RTS to monitor the immediate results of the order. The second type of command is stored and activates stored programs when the satellite is not in direct view of an RTS. An example is activating sensors or transponders when the satellite is over a specific location on the globe.[7]

Growing Reliance and Dependencies

The demand for information has been a driving force for the increasing use and reliance on space systems by the military. The utility, flexibility, and types of information have caused a surge in requirements of space systems by all users. The increased use of space systems also has created a dependency on the fixed infrastructure for controlling space systems. As the requirements increased, services and governmental organizations fielded one-of-a-kind systems. Along with the benefits associated with each system, uniqueness has caused limitations. These limitations should generate a cause for concern. Concerns range from the life cycle costs associated with each system to the liability associated with the TT&C, to maintenance, training, and logistics for each system.

The weakest link in the system is the uniqueness of the satellite control network. The need for multiple terminals, antennas, and space has created duplication of manpower, equipment, logistics, training, and maintenance. As satellite systems have evolved, the necessity to support the satellites has created fixed, limited use (satellite system-specific), and highly vulnerable RTS locations. The present network configuration lends itself to possible attacks, host county problems for those sites located overseas, and the limited period of view for low earth orbit (LEO) and medium earth orbit (MEO) satellites.

Rapid Deployable Space Units for Force Enhancement and Space Support

The use of RDSUs for force enhancement and satellite support provides a single focal point for space support for combat commanders, a flexible system to respond to situational needs, a streamlined system for acquisition, and standardization for operations.

Instead of multiple mission-specific ground support units, RDSUs can provide a single-point unit for all theater support to combat forces. Establishing an integrated capability to provide multiple support services to the combat forces from a single AFSPACECOM RDSU can accomplish this. An important goal for any commander is reduction or elimination of uncertainty. The establishment of space combat support RDSUs dedicated to the requirements of the CINCs and available to the on-site forces will act as a force multiplier. The RDSU will have a composite package of capabilities designed to support the needs and requirements of the CINCs. RDSU configuration can meet the specific needs of the situation. For example, if a commander has a need for weather, imagery, and communications support, a single RDSU can provide this support by using a portable terminal to receive and process the data for dissemination to the meteorologists, intelligence officers, and mission planners. This approach provides a single point of contact to the commander and his staff for space combat support services. If the need is for enhanced navigation and positional information, the same RDSU can include or later add navigational equipment to support the specific needs.

The RDSU concept provides a method for streamlining the acquisition process of the ground equipment. Establishing a single space group or wing to meet worldwide requirements for navigation/positioning, communications, weather/environmental, intelligence and surveillance, mapping, charting, and geodesy services provides a single funnel for space support needs at both the operational and acquisition stages of a system. This approach eliminates duplication in requirements and in the number of acquisition organizations and program cost because a single acquisition office will handle acquisitions and a single organization will be responsible for operations. This approach benefits all organizations and services because a requirement by a single organization may be a valid requirement for other organizations.

Using RDSUs for satellite control can counter the liabilities of the current fixed, satellite-specific equipment and provide satellite coverage if a fixed station is disabled or destroyed. Weather events can affect the operation of fixed-ground tracking stations. For seven days, Typhoon Omar caused the Guam RTS to shut down both wide-band and narrow-band operations. An

RDSU could have assumed the mission for the Guam RTS with minimal loss of network support while the RTS personnel were working to recover from the outage.

Using an RDSU can counter the loss of an RTS due to political conflicts. For example, the communist government of the Seychelles could be overthrown. The new government may demand the removal of foreign activities from the island. The closure of the Mahe RTS in the Seychelles would limit the effectiveness of the satellite control network.

Satellite control RDSUs also provide further flexibility for the satellite control network. They provide additional windows of opportunity for TT&C to LEO and MEO satellites.

The design of RDSUs can reduce the problems associated with training, operations standardization, and manning for space combat support and satellite control functions. The recent and continuing reduction of personnel and budget forces us to accomplish today's and tomorrow's missions cheaper, smarter, and with fewer people. The cost savings derived by establishing RDSUs for space support enhancement and satellite control activities to supplement MCCs and RTSs come from the consolidation of personnel and mission capabilities. The personnel who operate ground terminals for weather data can operate the same equipment to receive intelligence and surveillance data. Using the same equipment and personnel will reduce the costs associated with operating multiple systems.

Military Activities

RDSUs are useful to any US military mission. US special forces can benefit from a space combat support RDSU for foreign internal defense (FID) missions. An RDSU at a special forces FID location can provide the US advisors and host country forces with a technological informational edge over an enemy.

Again, the RDSU needs to have flexibility to meet the user's needs. An RDSU provides a combatant commander and his staff with the flexibility to meet the ever-present challenge of uncertainty.

Peacetime Activities

In peacetime, RDSUs can assist in humanitarian relief activities after earthquakes, hurricanes, tornadoes, or floods. An RDSU can provide critical communications and environmental support (e.g., radioactive debris contamination) for coordinating relief activities. Another application of RDSUs is space support for friendly foreign governments. With the move towards using military forces in the role of peacekeepers, and peacemakers, combat space support enhancements to military forces in problem areas like Somalia will benefit American, Coalition, and United Nations forces by providing global space power.

The peacetime use of RDSUs for satellite control has two distinct benefits. First, they can provide flexibility to the global fixed-satellite control network by providing the means to maintain TT&C to satellites without the liabilities associated with the fixed-ground stations. The second benefit has long-term gains. It provides the way for the United States to assist emerging countries in establishing a means for TT&C. Within 20 years, the importance of responsive TT&C stations will multiply, since every satellite requires TT&C, and the number of satellites will grow proportionally with the number of space-launch-capable countries.

Summary

Desert Shield and Desert Storm established the baseline for future space combat support to combatant commanders. Space support capabilities provided the means to burn off some of the fog produced by the Iraqi leadership and military. Future conflicts will demand more information to offset the fog of war because the world has seen and is convinced that the products and services provided by space combat support enhancements will be a decisive factor in any conflict.

To ensure that the means are available to provide support from space-based systems, a flexible method to operate the space system is needed. Satellite control RDSUs enhance the capability of the US and provide a level of survivability through mobility. The redundancy and expanded capability of RDSUs for satellite control adds fog and friction to any adversary who has the intent of disabling US and friendly space system capability by attacking stations of the satellite control network.

Notes

1. Joint Pub 1, *Joint Warfare of the US Armed Forces,* 11 November 1991, 4.
2. U.S. News & World Report, *Triumph without Victory: The Unreported History of the Persian Gulf War* (New York: Random House, Inc., 1992), 334.
3. Joint Pub 1, IV-3.
4. Joint Pub 3-14, "Joint Doctrine: Tactics, Techniques, and Procedures (TTP) for Space Operations," final draft, 15 April 1992, III-9.
5. Joint Pub 1, IV-3.
6. "Space Commands Support Troops Restoring Hope," *Space Watch,* United States Space Foundation 10, no. 2 (February 1993): 10.
7. Joint Pub 3-14, IV-42; and *Space Handbook,* ed. Lt Col Curtis D. Cochran, Lt Col Dennis M. Gorman, and Maj Joseph D. Dumoulin (Maxwell AFB, Ala.: Air University Press, 1985), 5–21.

Chapter 5

Rapid Deployable Space Unit System Concept and Implementation

The previous chapters discuss the changing threat and different missions RDSUs can perform. This chapter considers the infrastructure to develop and employ an RDSU system. It covers organizing and equipping, specific functional mission elements, organizational manning, peacetime locations, and command and control, and identifies an implementation strategy.

The RDSU concept focuses on two areas. The first is the consolidation of DOD mission equipment to support the RDSU concept. The second focus is the need to consolidate requirements and acquisition planning for related RDSU missions. This approach provides a direct pipeline to RDSU elements for joint mission interaction with other forces to match requirements to the acquisition process between AFSPACECOM and combatant commanders.

Organization

The organizational concept for RDSUs is based upon the composite wing. For discussion purposes, *group* (GRP) is the parent organization for assignment of individual RDSUs, and *element* identifies each mission team and equipment within the organization (e.g., a single deployable ballistic missile defense team is an RDSU element). Presently, any mobile or deployable mission element is assigned to the functional organization based upon mission. The shortcoming here is that the equipment and manpower are multilayered with many requirements, multiple chains of command, and regulations from different commands and services. The composite RDSU organization will consolidate equipment, manpower, chain of command, regulations, training, logistics, and maintenance support and provide a single point of contact for related RDSU missions.

The composite RDSU organization is the logical choice for the changing US military. The drawdown of manpower and reduced budgets provides justification for consolidation of like missions and capabilities. Having composite units provides the advantage of establishing a feeder source for equipment and manpower to address the changing global threats and mission requirements for theater commanders.

The organizational concentration on equipment is in the areas of vehicles, antennas, computer hardware and software, spare parts, and logistic support lines. The consolidated RDSU concept produces a distinct savings in procurement costs, maintenance, and man-hours. Multiple RDSU elements can use the same types of vehicles, trailers, and shelters. Having one group of individuals maintaining like equipment, regardless of mission, will reduce the man-hours required for maintenance and training. Assigned personnel can be multimission-qualified, and maintenance and logistic personnel can focus their efforts on one type of equipment instead of learning and maintaining multiple skills and knowledge needed for different or unique equipment. Additionally, having one group of people to support and maintain similar equipment eliminates the need for larger manpower pools. The greatest benefit of using similar equipment is the supportablity of the equipment. A smaller number of maintenance personnel and support kits can support a larger number of RDSU elements because the spares are as common as possible to each element within the composite organization.

An additional benefit of organizing into composite groups is the interoperability of missions and equipment to support any requirement. The composite approach provides the foundation to meet any requirement for support and command and control of RDSU elements.

For example, if a CINC has a requirement for intertheater satellite communications, then the RDSU group could deploy a satellite communication element and a command and control element to the combatant CINC's air component commander, who has operational control of the assigned RDSU elements. After a few weeks, intelligence sources could identify a possible risk of attack on US and allied forces from both short- and medium-range ballistic missiles. After the theater CINC requests support for theater ballistic missile warning, ballistic missile-warning RDSU elements having both space- and ground-based detection, tracking and assessment capabilities could deploy to the theater. Upon arrival in the theater, the warning RDSU elements are connected with the RDSU command and control element and establish the warning area surveillance coverage needed to detect, track, and warn theater forces. If after a few weeks, the air conditioning system for the satellite communications element breaks down, maintenance personnel can use the same support kit to fix the air conditioning equipment for the satellite communications RDSU element as the command and control element, the dedicated satellite support element, or the ballistic missile warning elements. This maintenance approach can support anything from portable, ruggedized personal computers to large vehicle-mounted equipment. Having operators using similar equipment that is supported by a small number of maintenance personnel creates a smaller highly effective maintenance and logistic force.

Elements

RDSU organizations need to base specific elements upon missions and equipment capability. This approach allows organizations to manage personnel and equipment more effectively than if elements consist of multiple mission functions and equipment. Individual operations and support squadrons need to be tailored to the missions. The following areas need to be organized into mission-tailored units:

- Ballistic missile warning and defense units would contain space- and ground-based warning systems and ballistic missile defense systems.

- Space control units would consist of both active and passive space surveillance sensors to track and identify orbiting objects. As technology develops systems to protect US space systems and negate threats, the USAF should add counterspace elements.
- Force enhancement units would consist of individuals and equipment to provide direct support to theater combatant commanders by providing for navigation/positioning, communications, and weather/environmental data and analysis, mapping, charting, and geodesy services.
- Space satellite control units would have the necessary expertise and equipment to control and manage individual satellites or satellite constellations from global locations.
- The command and control unit would provide the command and control link between the individual RDSU elements and the combatant commander's staff and between the theater and headquarters AFSPACECOM or USSPACECOM.

An individual RDSU force can provide direct support for any mission or to augment existing space personnel for an operation without drawing down the theater commander's staff. The capabilities of the tailored force could range from providing dedicated satellite command and control for a communications satellite operationally controlled by the theater commander to providing weather personnel with dedicated equipment and capabilities. The RDSU concept plans for the elements to establish a rapid deployable space capability to the theater, but not to establish a single source of personnel and equipment for nonspace-specific capabilities.

Manning

Proper manning of the RDSU is essential for rapid deployment of mission elements. The following approach will provide manpower for RDSU organizations in a reduced military force environment. This manning approach has a three-tier plan. The first tier consists of a standard unit manning document establishing the manpower core for the RDSU group. The second tier establishes an RDSU ready reserve listing of personnel assigned to other units with specific space expertise for deployment duties. The third tier establishes both Air National Guard and Air Force Reserve RDSU units and active duty manpower augmentation positions. This plan establishes an infrastructure for manning and mission augmentation.

The active duty RDSU personnel would be responsible for training, standardization, certification, maintenance of equipment and vehicles, planning, organizing, deployment, and garrison or field operations.

The RDSU ready reserve is a listing of personnel who have critical duty experience. The people assigned to the RDSU ready reserve will need to maintain currency in their respective fields of expertise. The missile warning officer (MWO) is a critical ready reserve position. This position would be filled by individuals who have previous experience as an MWO assigned to the Cheyenne Mountain Complex. This position is critical because of the limited number of individuals who have the skill to evaluate missile launches and can characterize attack assessment from multiple indicators. The establishment of a ready reserve would have refined the Scud missile warning process during the Gulf War. Warning data could have been sent directly to Desert Shield/Storm's command center for processing by an RDSU ready reserve MWO and missile warning technician to evaluate and assess Scud launches for the JFACC and CINC. During the Gulf War, either a warning satellite or a fixed in-theater radar system detected and tracked Scud launches. Sensor units transmitted this data to Colorado Springs for evaluation and assessment by a crew in Cheyenne Mountain and then relayed information to the command center in Saudi Arabia. In future conflicts, the RDSU ready reserve can be a valuable asset for direct and immediate space operations support to a theater commander or to augment an individual RDSU element.

The third tier for RDSU manning consists of both Air National Guard and Air Force Reserve RDSU elements and manning lists to augment either fixed space units or individual RDSU elements. Currently, when a space officer or an enlisted person separates from active duty, the Air Force loses the expertise, leadership, investment of time, and experience of each individual because the provision to retain these individuals in a nonactive duty status has not been available. The regular space operations forces were manned to meet the Soviet threat against the CONUS. The changing threat will stretch the responsiveness of space operations. The establishment of Guard and Reserve units can provide the means to meet future threats, and when needed the units can augment fixed space systems and RDSU elements.

This manning concept maintains access to trained and experienced personnel and provides flexibility and depth of available manpower to accomplish any space mission in multiple theaters. It also provides for maintaining the defense of the CONUS and does not strip the manpower of the regular space forces.

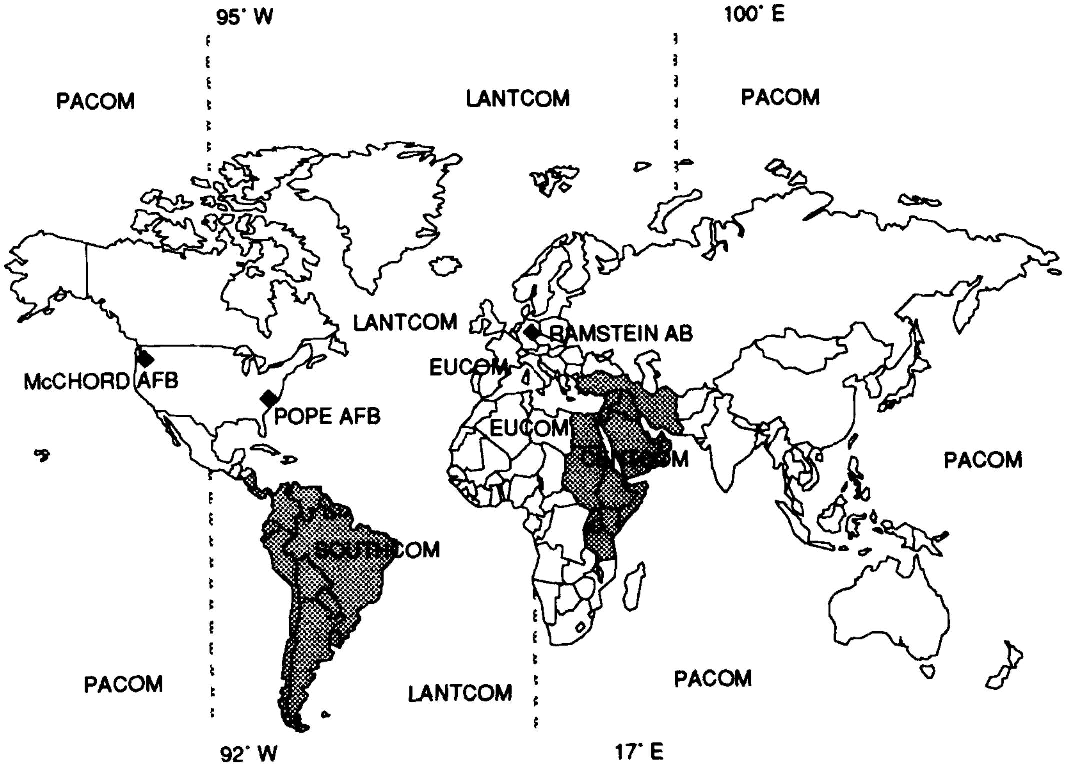
Rapid Deployable Space Unit Positioning

The geographical locations of the parent RDSU organizations are important for training and operations. Two criteria critical for selecting the most effective locations to stage the parent group of the RDSU elements are access to rapid airlift support to any theater and the day-to-day ability to train and exercise with ground and naval forces in a joint combat environment.

Locating the RDSU main unit near or on bases with the necessary airlift can cut down on the staging time of units assembling for deployment. Additionally, an advantageous location of RDSU squadrons or detachments can streamline both the coordination and logistic issues the RDSU may encounter from either an operations or maintenance perspective.

The second criteria would provide a means for activities at a joint level. In most cases, the RDSU will be working with Army and Marine units as joint combat arms for the combatant commander. The location of the parent organization needs to provide the peacetime capability to train as a joint force. Exercising will enhance the effectiveness of space operations as a function of joint operations. The logical choice for locating the RDSU is near the forces most likely to be deployed.

The three best possible locations for RDSU positioning are McChord AFB, Washington; Pope AFB, North Carolina; and Ramstein Air Base, Germany. These locations provide the flexibility to support any contingency for deployment to any location for operations and more importantly, allows for training and exercise in the same manner as the forces would fight (fig. 4).



UNIFIED COMMANDS	
CENTCOM - US CENTRAL COMMAND	SOCOM[a] - US SPECIAL OPERATIONS COMMAND
EUCOM - US EUROPEAN COMMAND	SOUTHCOM - US SOUTHERN COMMAND
FORSCOM[b] - FORCES COMMAND	SPACECOM[a] - US SPACE COMMAND
LANTCOM - US ATLANTIC COMMAND	STRATCOM[a] - US STRATEGIC COMMAND
PACOM - US PACIFIC COMMAND	TRANSCOM[a] - US TRANSPORTATION COMMAND

[a]Major command having global operational responsibilities.
[b]FORSCOM is CONUS-based to supplement forces for other unified commands.

Source: Adapted from Adm Paul D. Miller, *Both Swords & Plowshares: Military Roles in the 1900s*, National Security Paper no. 10 (Cambridge, Mass.: Institute for Foreign Analysis, 1992), 20.

Figure 4. Rapid Deployable Space Unit Positioning

Command and Control

Command and control activities for the RDSU have two operational paths. The first path is the same day-to-day C^2 structure fixed units used to provide mission status for daily activities to USCINCSPACE and AFSPACECOM staff organizations. Existing command channels can serve RDSUs for status monitoring and crisis planning to assist in meeting the needs of the theater and combatant commanders. The AFSPACECOM Operations Center (AFSPOC) will track operational mission capabilities, personnel status, and deployment reaction times for critical mission equipment and personnel.[1] Close coordination with the AFSPACECOM Forward Space Support In-Theater (FSST) team staff can enhance RDSU responsiveness by identifying RDSU assets for deployment.[2] The AFSPOC also should monitor the readiness status of the RDSU ready reserve personnel and both Reserve and Guard equipment and personnel.

The composite group reaction center (RC) is the next level in the C^2 structure. The reaction center is responsible for maintaining detailed status of operations, maintenance, and logistic support personnel and equipment. The RDSU reaction center acts as the facilitator for integrating the RDSU ready reserve, Guard, and Reserve personnel and equipment as active duty space assets.

The second path covers operational deployment of RDSUs. As AFSPACECOM tasks the RDSU elements for theater deployment, the C^2 structure shifts to include an RDSU C^2 element to maintain C^2 continuity for all in-theater RDSUs. The C^2 element will maintain continuity of actions and activities for all space operations units while the theater CINC has operational control of these space assets. The C^2 RDSU will maintain a line of communication with the theater FSST for RDSU activities to the CINC's operations staff.[3] Peacetime and contingency command and control paths are proactive for RDSUs supporting any theater commander's requests. Figure 5 illustrates the peacetime command and control paths.

The C^2 structure should respond to the space enhancement capabilities of US forces. Each of the reaction centers, in coordination with higher headquarters, is the point of contact to provide space-related data and products to US and allied forces. The reaction centers are aligned this way because of the focus for RDSU participation in joint training and exercises. Joint training and exercises will help the RDSU group to be more responsive to air, land, and sea forces, since the RDSU personnel can relate operationally to the need for the product or support request. This response is critical for disseminating remote earth sensing data, mapping, navigation, and other force enhancement services to the tasked forces prior to deployment. Figure 6 provides a contingency command and control path showing the relationship to other combat forces in reference to a CENTCOM support request.

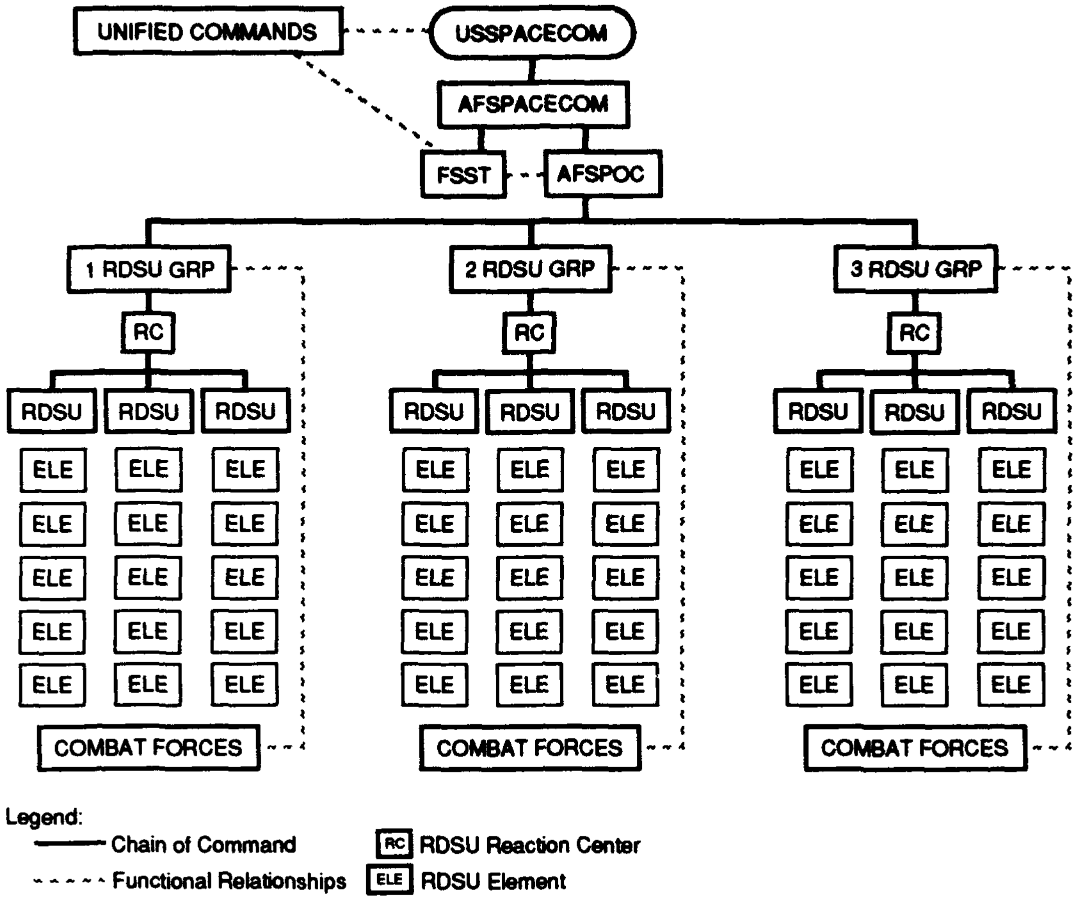


Figure 5. Peacetime Rapid Deployable Space Unit Command and Control Paths

Rapid Deployable Space Unit Implementation

The RDSU implementation process starts with the acquisition of equipment for each RDSU. One of the tenets of the RDSU concept is to maximize off-the-shelf equipment and technology from both commercial and existing government sources. To meet this requirement, the acquisition process needs to have the flexibility of a "basket" system program office (SPO) to interact with existing military or federal programs which have the capabilities for RDSU application. Also, the SPO has the flexibility to procure capabilities through an integration contractor or directly from an equipment manufacturer. A basket program office within an established SPO can provide the acquisition infrastructure and expertise needed to match the available capabilities against specific RDSU functions. Acquiring equipment through a nondevelopmental integration process can accelerate the implementation process, since operational evaluations can be done during the selection and integration stages.

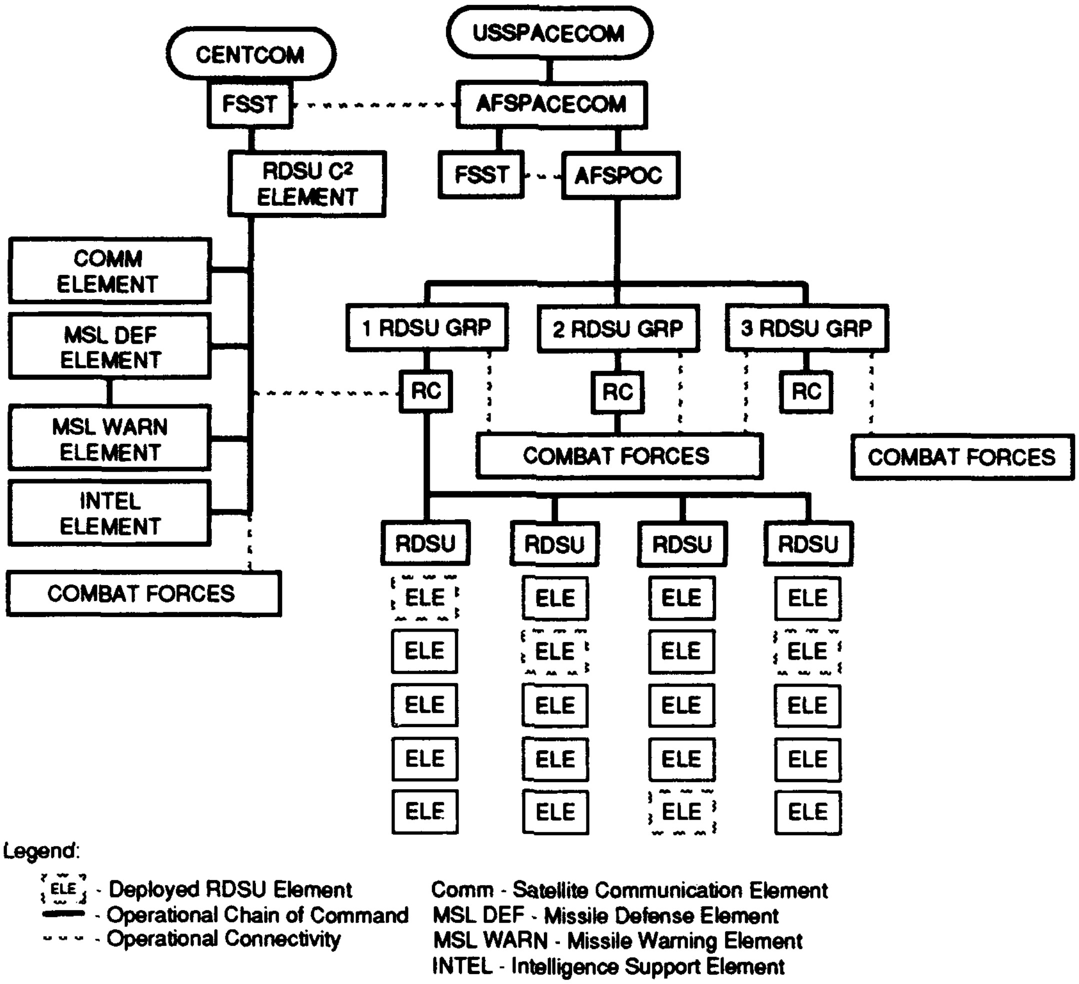


Figure 6. Contingency Rapid Deployable Space Unit Command and Control Paths

Additional benefits from this process include the existence of established and proven maintenance and logistic paths to either government or commercial sources. These benefits are critical when determining the capabilities needed by a theater commander because the support infrastructure can replace and repair RDSU equipment lost or damaged during a conflict. The basket SPO offers an approach to testing and evaluation of each integrated system against identified RDSU functions without the high costs of developing each RDSU system as a new program. In our reduced budget environment, this approach lets us fine tune RDSU equipment and avoid the high costs associated with changes in a major program development effort.

Notes

1. During the time of this report, AFSPACECOM transferred day-to-day operations of the AFSPOC to the 50th Space Wing Command Post. The AFSPOC assumes command during exercises and crisis events. For discussion purposes, the AFSPOC has operational command.

2. Air Force Space Command (AFSPACECOM/DOX), *Concept of Operations for Forward Space Support In Theater (FSST) Team*, 1 February 1993, 3.

3. Ibid., 2.

Chapter 6

Recommendations

Previous chapters considered the emerging threat, space operations missions, RDSU applications, a system operational concept, and an acquisition implementation approach for projecting US space power globally. Chapter 1 gives evidence of an evolving global threat based upon multiple centers of regional power and a strategy of using low-cost, nondevelopment, mobile, function-specific equipment and associated personnel to meet the changing threat. Chapter 2 identifies emerging countries that can acquire ballistic missile technology for either weapons development or space operations and applications for RDSU ballistic missile warning and defense units. Chapter 3 details the direction the national space policy has guided the military on maintaining access and operations in space. Chapter 3 also indicates possible missions for RDSU space control units for peacetime and conflict. Chapter 4 shows how RDSUs can provide increasing reliance on space support missions for both terrestrial force enhancements and on-orbit satellite control. Chapter 5 identifies an operational system concept, a strategy for acquiring equipment for RDSU organizations, manning, and geographical positioning. This chapter presents courses of action to establish RDSUs.

Courses of Action

One problem with the US approach to space missions is that the Air Force, Army, and Navy have carved out their own unique space operations.[1] Gen Colin Powell addressed this problem in his February 1993 *Report on the Roles, Missions, and Functions of the Armed Forces of the United States.* General Powell recommended changes to consolidate space missions and functions by merging all military space functions under the Air Force Space Command.[2] This approach will improve the war-fighting capability of all US forces. The following recommendations affect operations, planning, acquisition, and consolidation of missions. These actions cover RDSU missions and functions for the success of future space operations.

- Compare combatant requirements with existing capabilities. In conjunction with the education and planning efforts of the FSST team to integrate space missions into the joint plans of theater commanders, AFSPACECOM needs to analyze current capabilities to identify space support requirements at both the operational and tactical levels of operation. This analysis needs to consider both political and geographic limitations.

• Establish an RDSU roles and mission strategy. The Air Force needs to establish an integrated space roles and mission strategy to support military services and US political plans when they require active space operations. This strategy needs to identify specific political goals and establish requirements to support humanitarian efforts, disaster relief, and peace-keeping operations as well as foreign government space support and sales of RDSU capabilities. Part of this strategy establishes a threat and mission baseline to forecast RDSU contingency roles. A yearly review is needed by operations, intelligence, and political personnel from the services, DOD agencies, and federal departments and agencies. The review would ensure that the roles and capabilities of the RDSUs match our force projection performance instead of building capabilities based on a perceived threat. By doing this, we will build our capability on overall global conditions rather than focusing on the specific threat from a country, such as Iraq and its Scuds.

• Establish an Air Force integrated ballistic missile warning and defense system. The Air Force needs to identify its ballistic missile defense capabilities based on existing system technology. To properly accomplish this task, the Air Force needs to establish responsibility for air and space defense roles to address the Army's contention that it has a role in the ballistic missile defense arena. The Army has taken this position because it modified the Patriot mobile aircraft defense system during Desert Shield to provide anti-ballistic missile defense against the Iraqi Scud threat. The establishment of a US Air Force mobile BMD system is a natural evolutionary approach, since the Air Force has the capability of detecting, identifying, tracking, and characterizing a missile launch. The next step would be engaging and negating the threat, including the primary role for US air defense. This approach would create a single integrated warning and defense system for both air and space with the flexibility to meet any threat rapidly. Additionally, it would consolidate expertise in one single organization and provide a single organization to plan and develop future capabilities for both the warning and defensive systems not only within the US defense structure but as a source for working with a multinational force.[3]

• Establish an RDSU concept team to identify and evaluate potential equipment and manpower for RDSU operations. The team should focus on equipment sources for existing military and commercial systems that the RDSUs can use as is or can modify and integrate for its mobile capability. The range of equipment must include vehicles, shelters, power production, personnel services, and equipment for each RDSU mission. Criteria for this evaluation should consider simplicity of operations and maintenance, transportation size and weight compared with geographical areas of operations, current and planned military mobility capabilities, cost, and supportablity of the equipment. The final evaluation should identify the simplest equipment that fulfills the needed capabilities at the lowest costs. After this evaluation is complete, the concept team can determine the manpower needed for mission and support operations, maintenance, and support services. The team can use the current efforts of AFSPACECOM/DOX's FSST teams activities with unified command staffs as a baseline for part of the concept evaluation.

- Establish an RDSU system program office. Create a basket SPO and operational test team. The basket SPO would act as the acquisition office, while the concept test team would field-test the equipment.

This approach has two distinct benefits. First, it creates a collective acquisition office for all RDSU-related missions and equipment and also serves as the RDSU agent with other SPOs. This will eliminate duplication of actions and costs, while at the same time create an environment to integrate capabilities creatively for different RDSU roles. Establishing this office should facilitate standardization of similar capabilities and reduce costs across the RDSU missions. The second benefit is a check and balance of identified capabilities of equipment against actual field performance. A spin-off function of the operational test team would be to actually deploy individual RDSU systems to conduct actual missions in different theaters of operation during joint training. The results would produce modification recommendations and identify unknown deficiencies from supporting activities ranging from special operations, to conventional coalition forces, to a US element of a peace-keeping force. The RDSU element would be fine-tuned, since the capability would be tested in a real operational environment.

Summary

The success or failure of implementing any concept results from how effectively the operations personnel define the roles and missions of the concept within the framework of what is actually needed to accomplish the mission. Planning personnel draw up the plans to meet the requirements of the CINCs based upon the Defense Planning Guidance for establishing requirements. Acquisition personnel translate the requirements from the narrative to an actual product, lay out an effective plan, and execute the program documentation. This study recommends operational implementation of the RDSU concept to provide practical aerospace power to meet the challenges the US will confront from future threats and the political, economic, and military changes into the next century.

Notes

1. Chairman of the Joint Chiefs of Staff, *Report on the Roles, Missions, and Functions of the Armed Forces of the United States* (Washington, D.C.: Government Printing Office, 1993), III-5.
2. Ibid., III-7.
3. The German Luftwaffe has the consolidated mission of air defense. The aircraft, antiaircraft missiles, and antiaircraft artillery are the responsibility of the German Air Force.

Glossary

ABM	antiballistic missile
ACC	air component commander
AFSATCOM	Air Force Satellite Communications System
AFSPACECOM	Air Force Space Command
AFSPOC	AFSPACECOM Operations Center
ASAT	antisatellite
BM	ballistic missile
BMD	ballistic missile defense
BSTS	Boost Surveillance and Tracking System
C^2	command and control
C^3	command, control, and communications
CENTCOM	US Central Command
CINC	commander in chief
CIS	Commonwealth of Independent States (former USSR)
CMC	Cheyenne Mountain Complex
CONUS	continental United States
CSO	counterspace operations
DE	directed energy
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
DSTS	Deep Space Tracking System
EUCOM	US European Command

FEWS	Follow-on Early Warning System
FORSCOM	Forces Command
FSST	Forward Space Support In Theater
GBR	ground-based radar
GEO	geosynchronous earth orbit
GPALS	Global Protection Against Limited Strikes
GPS	Global Positioning System
ICBM	intercontinental ballistic missile
IRBM	intermediate range ballistic missile
ITW/AA	integrated tactical warning and attack assessment
JCS	Joint Chiefs of Staff
JFACC	joint forces aerospace component commander
JSTARS	Joint Surveillance Target Attack Radar System
LANTCOM	US Atlantic Command
LDS	limited defense system
LEO	low earth orbit
LPS	limited protection system
MCC	mission control complex
MCCS	mobile command and control system
MDA	Missile Defense Act of 1991
MEO	medium earth orbit
MILSTAR	Military Strategic Tactical & Relay (satellite)
MWO	missile warning officer
NATO	North Atlantic Treaty Organization
NCA	national command authorities
NORAD	North American Aerospace Defense Command
PA	phased array

PACOM	US Pacific Command
PALS	Protection against Accidental Launch System
RC	reaction center
RDSU	rapid deployable space unit
RF	radio frequency
RORSAT	radar ocean reconnaissance satellite
RTS	remote tracking station
SCF	satellite control facility
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SLBM	sea-launched ballistic missile
SLV	space lift vehicle
SOCOM	US Special Operations Command
SOUTHCOM	US Southern Command
SPACC	USSPACECOM Command Center
SPACECOM	US Space Command
SPADOC	Space Defense Operations Center
SPO	system program office
SRBM	short-range ballistic missile
SSC	Space Surveillance Center
STRATCOM	US Strategic Command
TMD	theater missile defense
TRANSCOM	US Transportation Command
TT&C	telemetry, tracking, and commanding (satellites)
USCINCSPACE	commander in chief, US Space Command
WDT	Warning Display Terminal
WMD	weapons of mass destruction