AU/AWC/RWP179/97-04

AIR WAR COLLEGE

AIR UNIVERSITY

WHAT THE WARFIGHTER SHOULD KNOW ABOUT SPACE

A REPORT ON U.S. SPACE COMMAND JOINT SPACE SUPPORT TEAMS

by

George E. Slaven Jr., Captain, United States Navy

A Research Report Submitted to the Faculty

In Partial Fulfillment of the Curriculum Requirements

Advisor: Colonel Charles L. Thompson Jr.

Maxwell Air Force Base, Alabama

April 1997

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (FROM - TO)
01-04-1997	Thesis	xx-xx-1997 to xx-xx-1997

4. TITLE AND SUBTITLE What the Warfighter Should Know About Space A Report on U.S. Space Command Joint Space Support Teams Unclassified	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Slaven, Jr., George E. ;	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME AND ADDRESS Air War College Maxwell AFB, AL36112	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS ,	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APUBLIC RELEASE
,

13. SUPPLEMENTARY NOTES

14. ABSTRACT
U.S. Space Command (USSPACECOM) began an outreach program in 1993 to better support the regional warfighting Commanders in Chief (CINCs). The main emphasis of this initiative was to train a group of officers from within the command on exactly what space had to offer the warfighter, and deploy them to the individual CINCs to integrate space into their resident missions, tasks and operations plans. These officers formed what came to be known as the Joint Space Support Teams (JSST). The customer oriented approach that began to develop by the use of these teams was in no small measure spurred on a few years earlier by the dramatic, yet apparently ad hoc methodology of the Scud warning reports transmitted to coalition forces during the Gulf War. From this inauspicious beginning, many planners and operational commanders wondered what other space products were available to support or enhance the warfighters? efforts. In this paper, the organization of the JSST teams, their mission, and exactly what they had to bring to the table in the way of enhancing the waging of war will be examined. Furthermore, interspersed throughout the discussion will be a look into what is now occurring to improve that support. Finally, the conclusion will briefly discuss what could, or should, be done to better support the warfighter in the future.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19. NAME OF RESPONSIBLE PERSON
			Public Release	53	Fenster, Lynn lfenster@dtic.mil
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 703767-9007 DSN 427-9007

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39.18

Disclaimer

Contents

Preface

My interest in the military use of space, the Joint Space Support Teams (JSST), and the variety of missions that can support military forces in the field was generated by a three-and-one-half-year tour of duty at U.S. Space Command from 1993 to 1996. My initial assignment there was as a Mission Director (Space Command's senior officer on duty) in the main command center at the Cheyenne Mountain Complex for a little less than one year. After that top-view introduction to the assets, forces, and responsibilities of the command, I was reassigned as one of the first of four Joint Space Support Team Chiefs. Our mission was, basically, to proselytize the wonders of space to the regional warfighting Commanders in Chief (CINCs). It was in this assignment that I developed the opinions, ideas, and concerns that generated the basis for initiating this project.

From U.S. Space Command, I would like to thank CAPT Monty Squires, the director of J36S (current operations, and head of all JSST teams), as well as Lt Col Bill Pierce, assistant to the Atlantic Command Team Chief, and SSgt Dawn Vannatten, J36S administrative and operational assistant to all the Teams, for their individual efforts in expeditiously collecting and making available much of the background material.

Additionally, I would like to thank my advisor, Col Charles L. Thompson Jr., for his wise counsel and sound advice in the preparation and production of this report.

Abstract

U.S. Space Command (USSPACECOM) began an outreach program in 1993 to better support the regional warfighting Commanders in Chief (CINCs). The main emphasis of this initiative was to train a group of officers from within the command on exactly what space had to offer the warfighter, and deploy them to the individual CINCs to integrate space into their resident missions, tasks and operations plans.

These officers formed what came to be known as the Joint Space Support Teams (JSST). The customer oriented approach that began to develop by the use of these teams was in no small measure spurred on a few years earlier by the dramatic, yet apparently ad hoc methodology of the Scud warning reports transmitted to coalition forces during the Gulf War. From this inauspicious beginning, many planners and operational commanders wondered what other space products were available to support or enhance the warfighters' efforts.

In this paper, the organization of the JSST teams, their mission, and exactly what they had to bring to the table in the way of enhancing the waging of war will be examined. Furthermore, interspersed throughout the discussion will be a look into what is now occurring to improve that support. Finally, the conclusion will briefly discuss what could, or should, be done to better support the warfighter in the future.

Chapter 1

Introduction

Historical Organization

In 1993, officials at the headquarters of U.S. Space Command (USSPACE) at Peterson AFB in Colorado Springs, Colorado came up with a plan that would dramatically change the way this Unified Command did business, both internally and, more importantly, outwardly in its role as a supporting command to the regional warfighting Commanders in Chief (CINCs). The general reorganization was the result of a combination of unique circumstances that had occurred in the previous few years.

Certainly the most visible was the Iraqi Scud ballistic missile warning provided to coalition forces during the Gulf War.[1] Besides Scud missile warning, however, enough other assistance from various military satellites occurred that USCINCSPACE at the time, General Donald J. Kutyna, called it the "first space applications war."[2] The Gulf War was instrumental in bringing military, as well as public, attention to USSPACE as a supporting partner in the execution of tactical operations.

Other lesser-known circumstances that caused important changes to be made included the assignment of duties in accordance with the Joint Strategic Capabilities Plan (JSCP), and renewed emphasis on allocating scarce, and continually declining, DOD funds towards only those military functions that truly supported the "warfighters."

The command changed its focus from a primarily strategic emphasis, to altering procedures and operational plans in support of the "tactical" requirements of the warfighting CINCs. In the past, USSPACE was an organization whose chief benefactor was the North American Aerospace Defense Command (NORAD), which shares a common command center within the Cheyenne Mountain Complex in Colorado Springs, Colorado.[3] A second strategic customer was U.S. Strategic Command (STRATCOM) at Offutt Air Force Base in Omaha, Nebraska. Little other support was accomplished outside this strategic circle of mutual interests; and, along with the National Military Command Center (NMCC) in Washington, D.C., the investment in training exercises for USSPACE were kept within the confines of these highly classified command centers.

In addition, another enormous component of military space existed that constituted research and development personnel (primarily Air Force), who were "not considered part of mainstream military tactical or strategic forces."[4] Between this grouping of technicians and engineers and the strategic elements, little else in the way of space programs, procedures or personnel were left to support the regional CINCs.

Most of the new effort, however, concentrated on customer orientation, and the new customers were the regional CINCs. The focus was to support these warfighters with all the benefits of space tools and space products through a program of education, training, involvement in developing contingency and operations plans, and participation in any and all exercises that formed the basis for doctrine or procedures to be used in real-world operations. The key was to ensure those commanders and their staffs know what is, and is not, available from space and where to find that information in a timely manner.

The Joint Space Support Teams (JSST), along with subordinate teams from the individual service space commands, have been tasked with educating and training the warfighting CINCs as to what space has to offer.[5] USSPACE and its components are assigned responsibilities in four broad mission areas: space forces support, space force application, space control, and space force enhancement. Force enhancement is further broken down into communications, missile warning, navigation, environmental, and reconnaissance areas.[6] The majority of USSPACE support is in force enhancement, of which missile warning and navigation will be discussed in much greater detail.[7]

In this paper, the organization of the JSST teams, their mission, and exactly what they had to bring to the table in the way of enhancing the waging of war will be examined. Furthermore, interspersed throughout the discussion will be a look into what is now occurring to improve that support. Finally, the conclusion will briefly discuss what could, or should, be done to better support the warfighter in the future.

The Space Commands

U.S. Space Command is one of the nine unified Commanders in Chief directly responsible to the Secretary of Defense (SecDef) for broad and continuing missions in a specified geographical or functional area. The USSPACE mission can involve either a geographical or a functional area, depending on whether you consider space a "place," and be controlled like one of the regional CINCs (EUCOM, PACOM, etc.), or a medium, and be controlled like one of the services (Navy for sea, Air Force for air, etc.). While that classification does not appear important today, it may be once military weapons are stationed in space in the not so distant future. In the meantime, USSPACE primary mission areas include both a strategic and a tactical side.

The strategic mission area dominated the command's thinking and resources during its beginning years, and the command organization and structure reflected that dominance until very recently. Because of the shared USSPACE and NORAD Command Center, most of the command, control and communications equipment was oriented towards either the NORAD or STRATCOM missions. The USSPACE watchstanders worked directly for the Operations Directorate (J-3); however, the command, as well as its Crisis Action Team/Battle Staff (CAT/BS), were located in the HQ at Peterson AFB. This situation existed until 1995 when a reorganization took place that established the Space Crisis Action Center (SPACC) at the HQ, in addition to the watch at CMC.[8]

The SPACC would be manned 24 hours a day also, but would be oriented more toward the tactical situations involving the regional CINCs. After much careful thought, and a number of complex exercises that supported the CINCs, a USSPACE instruction with firm guidance on supporting this newly established tactical mission came about:

> A regional crisis usually develops with little or no warning. USCINC-SPACE and the USSPACECOM Director of Operations, in concert with the National Command Authorities (NCA), must make timely, sound, and responsive decisions to support a combatant CINC . . . USCINCSPACE has the responsibility to ensure continuity of command and control for space operations. This instruction defines the USSPACECOM Crisis Action System (CAS) . . . prescribes the concept of operations and procedures . . . [and] . . . guides the USSPACECOM Crisis Action Team (CAT) and Battle Staff through . . . execution of an operations order (OPORD) or other specific force posturing actions.[9]

As the internal organization and procedures within the command were being refined, the relationships with the space component commands were also being reevaluated. USSPACE has three component commands that are administratively run by each of the services; they include Navy Space Command (NAVSPACE), Army Space Command (ARSPACE), and finally, 14th Air Force (SPACEAF).[10] A recent Air Force reorganization replaced Air Force Space Command (AFSPC) with the 14th Air Force (SPACEAF) as the official component operationally assigned to USSPACE. Other than sharing the same commander, no other formal relationship exists between AFSPC and USSPACE; however, Air Force Space Command provides nearly all of the funding and space expertise necessary for USSPACE to satisfactorily perform its duties.

NAVSPACE is commanded by a Rear Admiral and is located, along with its space support teams, in Dahlgren, Virginia. ARSPACE is commanded by a Colonel and is located with its space support teams in Colorado Springs, Colorado just a few miles from Peterson AFB. The 14th Air Force is commanded by a General Officer and is located at Vandenberg AFB, California, but its space support teams are stationed at Falcon AFB (about 10 miles east of Peterson AFB).[11] The component commands have been avid supporters of the warfighter programs, but each is still greatly influenced by the parent service that funds it.

NAVSPACE, as a USSPACE component and assigned to the Navy's Director of Space and Electronic Warfare (SPAWAR), is organized to provide the latest in space support and equipment, particularly in the communications, indications and warning, and imagery mission areas, to deploying Battle Group commanders.[12] Additional NAVSPACE duties include control of two world-wide communications satellite systems, and operations of a "fence" of space surveillance radars across the continental U.S that monitor the movement of adversary satellites.[13] The Navy emphasis on satellite communications, navigation, and enemy satellite surveillance capabilities are traditional concerns for a mobile naval force that is used to going over the horizon and operating autonomously.[14]

ARSPACE operates directly with its operational units, often attempting to integrate the latest technologies in space support equipment to assist the soldier in the field. Initially organized functionally, ARSPACE has also reorganized along the lines of USSPACE and adopted a much more operational flavor.[15] Army space personnel operate and control much of the Defense Satellite Communications System (DSCS) network, and are heavily involved in the Joint Tactical Ground System (JTAGS), a theater ballistic missile (TBM) mobile warning, command and control system. Besides being a USSPACE component, ARSPACE is attached to the U.S. Army's Space and Strategic Defense Command (SSDC).[16]

The 14th Air Force (SPACEAF) is the USSPACE Air Force component and administratively assigned to AFSPC. This command, along with the Space Warfare Center (SWC), which is the AFSPC space application and development command at Falcon AFB, have the most equipment, the most skilled personnel, and by far the most money in the space business. AFSPC maintains the space launch infrastructure, including launch vehicles and launch pads, for all the services. In addition, the latest in space high tech equipment for the pilot in the cockpit or the Joint Force Air Component Commander (JFACC), can usually be found in some SWC program. All other service space programs pale in comparison, particularly in funding and space infrastructure.[17]

Notes

[1] John T. Correll, "The Command of Space," *AIR FORCE Magazine*, October 1996, 3.

[2] Dwayne A. Day, "The Air Force in Space: Past, Present and Future," *Space Times,* March-April 1996, Vol. 35, No. 2, 15-21.

[3] *Space and Missile Applications Handbook*, Space Warfare Center, Falcon AFB, Co., 1996, 6.

[4] William B. Scott, "Major Cultural Change on Tap in Military Space," Aviation Week & Space Technology 143, no.12 (September 18, 1995): 37.

Notes

[5] Ibid., 37-42.

[6] Correll, "The Command of Space."

[7] United States Space Command, *Space Support to the Warfighter Briefing*, Peterson AFB, Co., 1996.

[8] United States Space Command, *Crisis Action System Procedures*, Ul10-16, 1 July 1995.

[9] Ibid.

[10] *Space and Missile Applications Handbook*, 7-10.

[11] Ibid.

[12] James W. Canan, "Forward...Into Outer Space," *Sea Power* 38, no. 9 (September 1995): 38-42.

[13] Lieutenant Colonel Steven J. Bruger, USAF, "Not Ready for the First Space War: What about the Second," *Naval War College Review* 48, no. 1 (Winter 1995): 75.

[14] LT JG Ron Foudray, "Space Support to the Fleet Just Got Better," *Naval Space Command SPACE TRACKS*, Winter 1997, 10-12.

[15] "Army Expands Combat Support," *Aviation Week & Space Technology* 143, no. 12 (September 18,1995): 56.

[16] Lt Gen Edward G. Anderson III, "Space and Missile Defense: A Global Challenge," *ARMY* 46, no. 12 (December 1996): 17.

[17] MSgt Larry Gedemer, "Forward Space Support," *Space Tactics Bulletin* 1, Issue 1 (June 1994): 4.

Chapter 2

Space Support Teams

Joint Space Support Teams

To promulgate this new outreach program of space support to the warfighter, Joint Space Support Teams (JSSTs) were formed from, primarily, senior (O-5/6) officers within the command.[1] The team members, however, were not career Air Force space professionals, but officers with operational expertise from a variety of disciplines (mostly from the other services) that are normally and conveniently available in joint commands. This astute maneuver allowed for a certain amount of credibility in the program at the outset, since many of the officers came from the very commands that they were now trying to support.

Additionally, supported commands were more comfortable when a slow and incremental plan to integrating space play into command exercises was personally monitored and executed by USSPACE representatives. This measured approach to establish in-theater credibility and reliability cannot be overstated, and was key to early JSST success, irrelevant of the real or potential value added of space involvement. The inertia established in large CINC exercises for maintaining the status quo and preparing current exercises in accordance with what occurred at the previous exercise, with little disruptions or changes, is a well known and very difficult to overcome phenomenon.

The actual number of formal members of the JSST is established as only two officers.[2] The team chief and his assistant, normally an O-6 chief with O-5/4 assistant, were free to select augmentees from throughout the command depending on theater requirements. It was soon realized that an Intelligence Officer was nearly always required during exercises or in real world operations, since much of what USSPACE has to offer overlaps Intelligence activities. Because of the continual demands of the JSST team chiefs, USSPACE Intelligence soon developed a special division just to service theater operations, designated J-2OS. Those deployable officers who directly traveled with the JSST team became known as the Intelligence Operations Support Group (IOSG).[3] Other heavily tasked Directorates included space communications, missile warning, and GPS navigation. In an attempt to equitably allocate the duties and responsibilities of space support, four teams were formed by dividing the warfighting CINCs accordingly:

Team 1: USACOM, USSTRATCOM, USSOUTHCOM, and NORAD.
Team 2: USPACCOM (includes major subunified command in Korea).
Team 3: USCENTCOM and USSOCOM.
Team 4: USEUCOM and USTRANSCOM.[4]

Eventually, all other USSPACE directorates followed suit in organizing along the same lines. The component commands also began to adjust accordingly, but none have thus far exactly duplicated USSPACE divisions.

Component Space Support Teams

In addition to the superb support acquired from within the command, the JSST teams derived a great deal of outstanding technical, educational, and personnel support from the component commands. After initial coordinating efforts were overcome (any new idea seems to inherently develop some resistance in the military), a momentum developed that was synergistic in effect. In 1994, USCINCSPACE, General Joseph Ashy, directed that a more direct relationship be established between this unified command and its components, much as exists with all other unified commands. Thus, the service components soon established the Naval Space Support Team (NSST), the Army Space Support Team (ARSST), and the Air Force Space Support Team (AFSST), which are now consistent in title and in regular contact with the JSST.[5]

Component space support teams are made up from personnel from their respective services, and each of those services is responsible for team manning, training, and funding. While each team is free to directly support its parent service, once a regional CINC or Joint Force Commander (JTF) requests support, USSPACE is tasked as the supporting CINC, and retains COCOM (combatant command) and OPCON (operational control) of all personnel and equipment unless otherwise directed. Component teams are then tasked to coordinate all their activity through the JSST.[6]

In addition to the components, the space teams have developed professional relationships with other like supporting commands. The National Intelligence Support Team (NIST), for example, is a conglomerate of the Defense Intelligence Agency (DIA), Central Intelligence Agency (CIA), National Security Agency (NSA), and other intelligence agencies. The NIST operates through the office of the JCS J-2, and has occasionally deployed with the JSST in providing support to the warfighters.[7]

To assist the space support teams in training the warfighters, USSPACE developed a Theater Support Operations Cell (TSOC). This computer system can depict satellite data in user friendly graphics. Views from or to imaging, weather, warning or even enemy satellites can be delivered in real time. The information derived from this system can be manipulated to assist the warfighter in briefing, planning, and timely decision making. TSOC systems are also being procured by the component teams.[8]

Prior to discussions of exactly what space systems constitute the support that team personnel bring to the warfighter, it might be beneficial to quickly review the territory. Space is not just the upper reaches of the atmosphere; and in fact, it has been said that there are more differences than similarities between space and atmospheric flight. Therefore, a basic understanding of satellites and their orbits might be helpful.

A Short Space Primer

For purposes here, space begins at that point where a viable orbit can be maintained, which is approximately 60 miles above the earth's surface.[9] The simplest description of a satellite in orbit is the resultant vector of two forces; a force parallel to the surface of the earth that was achieved from the initial thrust of the vehicle that pushed the satellite out of the earth's atmosphere, and the force of gravity.[10] Once positioned at an altitude where the two forces are equal, the satellite will travel along its orbital path and fall towards earth at the same rate that the earth is curving away from it. With little drag in space, additional or continued boost is not required to maintain an orbit.

To describe a particular satellite's unique orbit, a grouping of parameters called an orbital Element Set (ELSET) is used. The ELSET usually consists of eight parameters that define the orbit, and, for a given time, exactly where the satellite is in that orbit. A brief description of a few of those parameters would be useful:

1. *Inclination* describes the angle from the plane of the equator to the plane of the orbit; measured in positive degrees from east through north (counterclockwise).

2. *Eccentricity* describes how circular or oval the orbit is; with 0 equal to a perfect circle, 0.9 being a very flat oval, and 1 equal to a straight line.
3. The *Semi-Major Axis* is half the distance from the perigee (point in orbit closest to earth) to the apogee (point in orbit farthest from earth); measured in miles, this usually describes the overall size of the orbit.
4. The *Ascending Node* is the point on the equator where the orbit crosses travelling south to north, usually given in latitude and longitude.
5. The *True Anomaly* is the description of where the satellite is in its orbit at a given time; measured from perigee in the direction of travel to the satellite.
6. The remaining parameters include *Right Ascension, Argument of Perigee*, and *Epoch Time*, each adding to further differentiate specific orbits.[11]

An orbit must rotate about the theoretical center of the earth; therefore, an orbital plane must cross (or fly directly over) the equator. Most orbits are elliptical, and revolve about two central points called foci (one of which will be that theoretical center of the earth). The time it takes for one revolution of the earth is called the orbital period.[12] If an orbit travels in the same direction as the rotation of the earth, it is a prograde orbit; and, if it travels opposite the rotation, it is a retrograde orbit. An orbit that travels in a north-south plane over the poles in either direction is called a polar orbit.[13]

Orbits are normally categorized by their altitude: those from the minimum orbit altitude of 60 miles to 300 miles are called Low Earth Orbits (LEO); those from 300 miles to 22,300 miles are called Medium Earth Orbits (MEO); and finally, those from 22,300 miles out to 60,000 miles are called High Earth Orbits (HEO). The most common types of HEO are geosynchronous and geostationary orbits. Geosynchronous orbits (GEO) are characterized by the placement of a satellite at an altitude of 22,300 miles, with a period of 24 hours (matching the speed of the rotation of the earth). This satellite will appear to remain constantly overhead a fixed *area* on earth at the equator. If the orbital plane of that satellite is also at zero degrees inclination, then it will remain overhead a fixed *spot* on earth at the equator, and is known as a Geostationary Orbit (also

GEO). Another type orbit, utilized heavily by the Russians, is called a Molniya orbit, which is a highly eccentric (apogee in the Northern Hemisphere), 64-degree inclination, semi-synchronous (12-hour period) orbit. The unusual element set parameters in a Molniya orbit allows a satellite to effectively remain over the high northern hemisphere latitudes for long periods of time.

The selection of an orbit from a wide variety of choices is usually dependent on the function of that satellite or where on earth it is to be used. For example, many communications satellites are put in GEO orbits so that fixed antenna dishes can be permanently aimed in one direction. Weather satellites are put in sun synchronous orbits, which are low altitude polar orbits that maintain the same relative orientation to the sun and pass over the same area on earth at the same times each day. Finally, many Russian communications satellites use that previously described Molniya orbit, which can remain above Russian territory for as much as 23 hours of its 24-hour period.[14]

While the above space primer is certainly not an in-depth instruction of space fundamentals, it should present enough of an understanding to grasp issues to be discussed later. More detailed space education courses are offered by each of the service SPACECOMs; however, the Air Force offers, by far, the most comprehensive instruction and the most variety of choices.

Notes

[1] LCDR Mark Davis, "Space Support to the Warfighting Community—From a Unified Action Officer Perspective," *Space Tactics Bulletin* 2, Issue 3 (Summer 1995): 9.

[2] UMD 38-2, 3.

[3] Davis, 9.

[4] UMD 38-2, 3-4.

[5] United States Space Command, *Warfighter Briefing*.

Notes

[6] United States Space Command, *Space Support Team Operations*, UMD 38-2, Peterson AFB, CO, 2 January 1996, 2-3.

[7] Davis, 9.

[8] Scott, 42.

[9] Tamar A. Mehuron, ed., "Space Almanac," *AIR FORCE Magazine*, August 1996, 28.

[10] Major William G. Clapp, "Space Fundamentals for the Warfighter," Research Paper AD-A279 703 (Newport, R.I.: Naval War College, 1994), 7.

[11] SSgt Kurt Reynolds, "Space 101—Principles of Space Ops," *SPACE TACTICS BULLETIN* 2, no. 4 (Fall 1995): 22.

[12] SSgt Kurt Reynolds, "Space 101—Principles of Space Ops," *SPACE TACTICS BULLETIN* 2, no.3 (Summer 1995): 16.

[13] JSTM 3-14, *Joint Space Fundamentals Student Text*, 3rd Edition, April 1992, I-4-14.

[14] Col Robert B. Giffen,"Space Basics," Extract from *US Space System Survivability: Strategy Alternatives for the 1990s*, National Defense University Monograph No. 82-84, Chapter 2 (November 1982) 31-36.

Chapter 3

Mission Areas

These mission areas that encompass the duties and responsibilities of USSPACE-COM and its components are general in nature, and are an attempt to codify everything that either exists in or passes through space, to include all supporting functions and equipment. The recent dramatic growth in all areas of space usage is increasingly expanding the importance and involvement of a military presence. This discussion will cover Space Forces Support and Force Application in only a cursory fashion, and will get into a little more depth with Space Control. The Force Enhancement mission allows for more description, provides the warfighter with greater support from the SST's, and will therefore be presented in much greater detail.

Space Forces Support

The space forces support mission means that USSPACE will maintain the infrastructure to ensure the capability to launch and support satellites in orbit. Or as General Joseph Ashy (USCINCSPACE 1994-96) so succinctly describes ". . . the business of putting things in space and operating them. . . ."[1] While this mission area is, for the most part, transparent to the warfighter, a launch call can be requested should some specific satellite need be necessary. The space launch facilities that the military maintains rest with Air Force Space Command and their two facilities at Vandenberg AFB, California and Cape Canaveral AS, Florida.[2] JSST members rarely get involved with this mission area.

Force Application

The force application mission is the ability to project military force through or from space.[3] For the most part this mission area remains in the world of research and development, because there are presently no assigned forces. An example of force application forces would be satellites that carry weapons for use against terrestrial targets. General Ashy has stated, "We will engage terrestrial targets someday—ships, airplanes, land targets—from space. We will engage targets in space, from space. And this command will engage quickly; (the missions are) already assigned, and we've written the concepts of operations."[4] Although this military subject is rich with proposed weaponry and has spawned an array of clever futuristic designs, the space support teams do not as yet have any options available for the supported warfighters.

Space Control

The space control mission includes those actions taken to ensure freedom of action in space for friendly forces and to prevent freedom of action for enemy forces.[5] Space control (or superiority) is very similar in concept to air superiority, except the weapons platforms are satellites vice aircraft.

Every space system has three major segments; a ground segment, a space segment, and a communications segment. The ground segment consists of the ground station and associated physical equipment to operate or control the satellite, the space segment is merely the satellite itself, and the communications segment is the radio-frequency means of correspondence between the satellite and its ground control. Space control must ensure the safety of all three segments of any friendly force system, while eliminating any one segment of an adversary's system will render it inoperative.[6]

As a prelude to controlling space, USSPACE must know everything that is in space, including friendly, enemy, and neutral satellites, as well as the inordinate amount of useless space junk that could ruin a very expensive working satellite should they collide. That mission is now being executed by the Space Control Center (SCC) located within the Cheyenne Mountain Complex.[7] The SCC is a new organization made up of the former Space Surveillance Center (SSC) and Space Defense Operations Center (SPADOC). The SCC is supported by a worldwide network of space surveillance facilities that can, through a series of radars and electro-optical sensors, monitor and track all space objects. SCC is able to track all objects down to the size of a golf ball. Besides formal notification procedures with customers such as NASA, the SCC can alert JTF and/or Joint Force Air Component Commanders (JFACCs) on an ad hoc basis during times of conflict.[8]

Upon request, any authorized warfighter can also receive one of two formats of reports on enemy satellites of concern. Satellite Reconnaissance Advance Notification (SATRAN) reports are formatted to describe which enemy satellites will pass over a certain point on earth at a given time (generated by AFSPACE for Air Force or occasionally Army units).[9] Satellite Vulnerability (SATVUL) reports give basically the same type information, but it usually lists the satellites that will appear over a broader range within a wider window of opportunity (these reports are generated by NAVSPACE for its mobile Naval forces).[10]

As well, the command must have procedures in place to respond to attempts on friendly assets, whether on the ground or in space. Various threat conditions (THREATCONS) can alert ground units during periods of heightened tension, and notification procedures are used if some satellite is predicted to enter a collision course with another object. Although USSPACE is developing classified procedures to respond to intentional attack against friendly satellites (systems that target satellites are known as anti-satellite or ASAT weapons), there are, currently, no forces available to employ.[11]

For the warfighter, space control support flows from the USSPACE Crisis Action Team (CAT) or Battlestaff through the deployed JSST as a recommendation for the regional CINC to make an in-theater decision (USSPACE does not fight a simultaneous, separate and independent space war).[12] Information from USSPACE components, other DOD support agencies, the SCC, and target recommendations from the USSPACE Joint Target Steering Group (JTSG) concerning enemy space system targets are all responsibilities that can be executed by USSPACE as functions of its space control mission. The JTSG concept emphasizes that space targets are recommendations for integration into the regional CINC or JTF theater targeting process.[13] Another dilemma that might also face the modern warfighter today is what to do about commonly shared satellites (communications, imagery or weather) that might be used by friendly as well as adversary forces.

Force Enhancement

Force enhancement includes those mission areas in which space assets can act as a force multiplier, to ensure better execution of air, ground or sea military actions. These mission areas provide the gist of what the JSST teams provide to the warfighter.[14] As previously mentioned, the missile warning and navigation missions will receive greater emphasis than the other areas.

Communications

The military satellite communications (MILSATCOM) network is an amalgamation of complex systems that would defy any attempt to simply explain in a short summary. The simplest way to inform the warfighter may be to just discuss the three types of frequency differentiated systems that support U.S. forces and the organizations that field and operate them. The central requirement of the military, however, can be simply explained as the continual need for reliable, survivable, and secure worldwide command, control, and communications (C3) systems on demand.[15]

Normally, these requirements fall into three frequency bands: Ultra-High Frequency (UHF), which provides good short to middle range communications with moderate capabilities for size and speed movement of information; Super-High Frequency (SHF), which provides for an excellent long haul capability, with the capacity to move much larger amounts of information in a shorter time frame; and, Extremely High Frequency (EHF), which has the largest capacity and speed, and because of its security and nuclear hardening protection features is usually reserved for higher echelon and National Command Authorities (NCA) usage.

For UHF communications, the vast majority of voice and data transmissions are sent over the Navy's aging Fleet Satellite (FLTSAT) communications satellite system. Since this five-satellite system has been in operation for many years, it is now being replaced by the UHF Follow-On (UFO) satellite communications system. UFO will consist of eight satellites (plus one spare) spread around the earth in geosynchronous orbits, as were

FLTSAT satellites. Besides a large increase in UHF capacity, the latter six UFO satellites will have an EHF capability, which will allow a unique direct connectivity to the Milstar system, which will be discussed later.[16]

For long haul communications over the SHF frequency range, the Defense Satellite Communications System (DSCS) is the main system. Begun in the late 1960s, DSCS satellites have been constantly upgraded and replaced to ensure secure voice and high data-rate communications. DSCS provides the military with voice, data, digital and television transmissions between major fixed sites and national command authorities. There are now five active satellites in GEO orbit (and four older spares), with an additional five more in the program to be launched.[17]

The crown jewel, as well as the most expensive potential white elephant, in the military satellite communications arsenal is the Milstar satellite system. Milstar was conceived to withstand a nuclear conflict to provide connectivity between national command authorities and dispersed military commanders. The system's sophisticated, secure and jam-proof EHF communications capabilities were intended for use during the cold war period, and have since been changed to provide similar support for today's tactical commanders. There are currently two Milstar satellites in GEO orbit, with four more planned to complete the constellation.[18]

The last major contributor to the MILSATCOM system are the commercial satellites that are leased on either a long term or an as-needed basis. INTELSAT and INMARSAT, of which the U.S. is a signatory partner in a multi-national venture, are two of the most well known communications systems that the military uses regularly for peacetime operations. In addition, LEASAT satellites (specific, commercially-leased systems) have been used to fill longer-term requirements, but were scheduled for decommission in late 1996.[19] Current DOD discussions involve how much commercial satellite communications should be purchased without compromising military needs during times of conflict. As well, due to the cost of satellite systems, many commercial communications leasing companies are owned and controlled by multi-national conglomerates or foreign countries. Under these unusual circumstances, both friend and foe could be using the same satellite! This situation further worries military planners and commanders.[20]

Command and control of the majority of military communications satellites is provided by the Air Force, with assistance from the Army and Navy for the DSCS and FLTSATCOM/UFO satellites, respectively. An additional DOD agency, the Defense Information Systems Agency (DISA), also provides services by controlling and allocating many of the transponders (the active relays on communications satellites that receive, then retransmit, the voice and data information) between CINCs and other authorized users.[21] An often heard problem with this system may be the demands placed by competing CINCs on DISA, when that agency does not control all communications links.

While all CINCs and Joint Task Force (JTF) Commanders have a communications deputy, usually designated the J-6, additional assistance is also often provided. DISA representatives can play an important role in temporarily reallocating satellite transponders between regional CINCs. As well, a communications officer from the USSPACE JSST team can also offer assistance by releasing satellites early from test phases or "flying" satellites into advantageous positions to fulfill temporary military requirements. The JSST recommends that in the event of planned or contingency operations, communications representatives from USSPACE and DISA should be requested to maximize response options for all C3 needs.[22]

Missile Warning

The ballistic missile warning mission is supported by the Defense Support Program (DSP), which consists of a constellation of five (or at times six, depending on the replacement cycles) satellites placed in a circular, equatorial, geosynchronous orbit. Each satellite is equipped with an array of photoelectric cells (PECs) contained within an infrared (IR) sensor which is spun on an earth-pointing axis so that the satellite can scan throughout its field of view. The sensor detects targets of interest that are sources of IR radiation (such as the rocket motors of ballistic missiles). Because of the stationary nature of satellites to remain over one spot on earth when in GEO orbit, three satellites could effectively achieve global coverage.[23] However, considering the number of DSP satellites, their mission, and their ability to scan the earth's perimeter within their field of view, the DSP constellation is positioned to provide overlapping coverage, particularly so for selected areas of interest.

This system was built to detect, track the burn time, and predict the ballistic trajectory to impact point of Soviet Intercontinental Ballistic Missiles (ICBMs). For that purpose, the satellites were developed, manufactured and launched beginning in the early 1970s.[24] DSP was, and still is, highly capable of executing that strategic mission.

DSP IR detections are reported to line-of-sight ground stations, which transmit the data through a circuitous route to the Missile Warning Center at the Cheyenne Mountain

Complex (CMC). The DSP data is fused with additional information from other sensors to calculate a more accurate time of impact and point of impact.

There are two radar systems that complement the DSP system and further refine its impact data: the Ballistic Missile Early Warning System (BMEWS), which consists of three radar sites positioned to pick up ICBMs coming from over the north pole; and PAVE PAWS, which is a series of radar sites located along the U.S. east and west coasts to better acquire sea-launched ballistic missiles (SLBMs).[25]

All data eventually is reported to the Command Director (CD) for NORAD and the Mission Director (MD) for USSPACE within the CMC Command Center, who then issue integrated warning and attack assessment recommendations. This procedure is a snapshot of how the USSPACE strategic warning mission is accomplished.[26]

During the 1991 Gulf War, an ad hoc tactical warning procedure was developed that used the same equipment and personnel that the strategic system employed. This procedure was called the Tactical Events Reporting System (TERS), and it was an untimely and inaccurate method to warn troops at risk of impending Tactical Ballistic Missile (TBM) impact. Soon after, and, coincidentally, upon the arrival of General Charles Horner as USCINCSPACE from his assignment as the USCINCCENT JFACC, a concerted effort was begun to improve TBM warning procedures. By combining the efforts of service programs that were already in work, the Tactical Events System (TES) was created.[27]

TES is an umbrella system consisting of three separate sub-systems that were all in some stage of the research and development pipeline of each of the services: Attack and Launch Early Reporting to Theater (ALERT) is an Air Force sponsored system; Joint

Tactical Ground Station (JTAGS) is an Army sponsored system; and finally, Tactical Detection and Reporting (TACDAR) is a Navy-sponsored system.[28]

Located at Falcon AFB, the ALERT facility continuously receives information from all DSP satellites through a separate reporting and distribution system than the legacy strategic system. The main ALERT computers, newer and faster Silicon Graphics Onyx models, can then fuse the DSP data with other types of information, such as from radars or classified national assets. Because of the increase in computing power, lower IR threshold limits for the DSP, and an extensive integration with other sensors, the accuracy and reliability in missile launch reporting was dramatically improved.[29] Additionally, a greater tolerance for false reporting allowed for a quicker average time to release launch warnings (obviously theater reporting can be allowed to make launch mistakes that would be intolerable for the strategic reporting requirements upon which a nuclear exchange would hinge).[30]

The second sub-system within TES is the Army's JTAGS, which is a transportable system that uses the same computers as ALERT. JTAGS can be brought to the theater, and operate solely for the local commander. Obviously, this is a very popular asset for commanders in the field. However, JTAGS operates independently of all other systems, and since it contains its own antennae, it can only receive inputs from those DSP satellites within direct line of sight (normally that would be sufficient, since only line of sight DSP satellites would likely be scanning that theater; however, there are occasions when multiple hits from satellites not within line of sight are fused to generate a faster and more reliable report).[31]

The third subsystem within TES, the Navy's TACDAR, also receives inputs from all of the DSP satellites, but this system fuses that data directly with data from classified national asset systems. This fusion results in highly accurate and, at times, much quicker classifications and confirmations of missile launch. TACDAR is located in the midwest U.S., and is also the source for the national asset input to the ALERT system.[32]

Generally, missile launch warning data is electronically dispensed over the Air Force's Tactical Information Broadcast Service (TIBS) and the Navy Tactical Data Dissemination System (TDDS).[33] In addition, communications networks were also set up for voice warning, clarification, and confirmation. Despite the greater speed of the data reporting network, most CINC and JTF commanders demanded a voice link back-up to the professionals at the SPACECOMs to confirm and validate what was reported.

Once the TBM warning data entered the theater, USSPACE responsibilities ended, because inter-theater distribution was the responsibility of the theater commander. On most occasions, however, when the JSST deployed to a theater, a TBM warning expert or communications officer was usually added to the team to assist in constructing a missile warning dissemination plan. As well, numerous other TBM considerations besides distribution have to be planned for or decided:

1. Intelligence preparation, determine types and numbers of enemy TBMs.
2. Ensure warning gets proper integration into pre-planned responses, including active defense, passive defense, and attack operations plans.
3. Develop a warning script, i.e., what immediate info should be passed to the troops?
4. Determine the method of describing the warning, i.e., by area at risk or by named military unit.
5. Will TBM information be shared with other foreign countries; if so, who tells them, USSPACE or theater CINC?[34]

While this is not an all-inclusive list, it can be seen that the simple act of providing TBM warning to theater is by no means a simple task. The earlier and more often JSST teams participate in major theater exercises, then the faster the correct information gets to the troops at risk. While improvements are continually being made on TBM warning equipment, the greatest need today involves educating and training the warfighters on how best to exploit these critical and potentially life-saving assets.

Due to age, some of the DSP satellites now on orbit are incapable of detecting the low IR signature of modern theater ballistic missiles (TBMs); additionally, the slow scan rate of the sensor may not be able to detect the short burn time of the shorter ranged TBMs.[35] The latest upgrade plans involve replacing the aging DSP constellation with a combination of GEO, LEO, and highly elliptical orbiting platforms collectively known as the Space Based IR System (SBIRS). The SPACECOMs have wrung out about as much as can be from DSP, and SBIRS promises to be much more responsive to the tactical needs of the warfighter faced with a proliferating TBM threat.[36]

Navigation

One of the most critical, yet least understood, systems that the warfighters use, which is directly controllable by USSPACE, is the GPS navigation system. Initial JSST contact with military planners during many exercises found a profound and disturbing lack of knowledge of the system equipment being used by our own forces. In-depth briefings, a count of what receivers one's own forces had, and an effort to obtain the correct equipment became realizable goals once this simple information was revealed.

The purpose of the NAVSTAR Global Positioning System (GPS) is to provide precise, all weather navigation, continuously and cost-free, to U.S. military forces and commercial users worldwide. Developed by the Department of Defense (DOD) over a 10 year period at a cost of over 10 billion dollars, this space navigation system has been such a remarkable success for all users that the military may be on the verge of losing any semblance of control it once enjoyed.[37] This past March, Vice President Al Gore, speaking on behalf of the President, announced that while funding and operation of the system would remain with DOD, management and augmentations would transfer to a GPS Executive Board co-chaired by DOD and the Department of Transportation (DOT).[38]

GPS is an outstanding navigation system consisting of 24 satellites in a nearly circular Medium Earth Orbit (MEO) of approximately 11,000 NM. There are 4 satellites in six separate orbital planes of approximately 55 degrees inclination.[39] Because the receivers operate passively, the system can service an unlimited number of users.

A concept of one-way time of arrival (TOA) ranging is used to enable receivers to compute a distance from an individual satellite. By simultaneously taking TOA ranging measurements from multiple satellites, two and three dimensional user positioning can be achieved. For two-dimensional navigation, a GPS receiver must lock on to three satellites, and for three-dimensional positioning (i.e., including altitude) four satellites are required.[40] For any point on the earth's surface, the system guarantees at least five satellites will be within receiver field of view at any time (although there are apparently some temporary holes for short bursts of time).

While navigation signals are available to all users, a special signal is reserved solely for military use to allow for greater accuracies. Each GPS satellite transmits two separate frequencies simultaneously, L1 and L2. The L1 frequency transmits a Coarse/

Acquisition (C/A) code and a Precision (P) code, while L2 transmits only the P code. The C/A code is intended for all users, but the P code is intended for military and other authorized users only. Commercial and nonmilitary users are provided Standard Positioning Service (SPS), which receives only the C/A signal on the L1 frequency. Military users, however, are provided with Precise Positioning Service (PPS), which receives both signals on the L1 frequency and the P signal on the L2 frequency. The C/A code repeats itself every millisecond for quick acquisition, but the P code is repeated only every week. This long repetition cycle makes the P signal more resistant to jamming, but also, unfortunately, makes it too difficult to acquire directly; therefore, military receivers must first acquire the C/A code then transition to also pick up the P code.[41]

There are two security features associated with the GPS system that help ensure system integrity. The first is called Selective Availability (SA). SA is the intentional introduction of positional error into the navigation signal, thereby increasing the circular error probable (CEP) in order to retain the option to control the level of accuracy that users receive. SA is roughly comparable to a rheostat where incremental increases or decreases of error can be dialed in as desired. SA is entered into the transmitted signal using an encrypted algorithm. The current SA setting is for 100-meter error accuracies for SPS service users.[42] PPS service users, if properly keyed, can decrypt the SA algorithm and use it to correct for the SA error. The Chairman, Joint Chiefs of Staff (CJCS) has the authority to decrease SA upon request by any military Commander in Chief (CINC); but the National Command Authorities (NCA) must approve any increase.[43]

The second security feature is known as Anti-Spoofing (AS), which is the encrypting of the P code (using the same crypto as in SA). The encryption changes the P code to a Y code. This process prevents hostile attempts to reduce accuracies by injecting errors (spoofing) into the system (as we do with SA!). Properly keyed (again) PPS users can decrypt the Y code to obtain P code information. While AS has no effect on SPS users, it also does not provide anti-spoofing protection. The AS feature is currently on, and will remain in that status for the foreseeable future.[44]

There are two types of portable GPS receivers; a large and widely varying grouping of commercial hand-held units, known as Small Lightweight GPS Receivers (or SLGRs), and the encryptable military version, known as Precision Lightweight GPS Receivers (or PLGRs). One characteristic in the use of these receivers is that atmospheric phenomena distort the signals from the satellites in an irregular manner depending on the ground location of the receiver and the locations and angles of the satellites in use. SLGRs are constructed with a simulation model built in to roughly estimate and counter such effects regardless of location on earth. The PLGR does not have a model built in, because it can make very accurate local area corrections by comparing distortion changes between the two P signals it receives on the L1 and L2 frequencies. However, with AS on and an improperly keyed or unkeyed PLGR, the Y code would not be decrypted, negating acquisition of the P code and preventing signal comparison corrections. In this instance, the *precise* military receiver could be *less* accurate than its commercial counterpart![45]

Under normal conditions, there are errors in the accuracy of the GPS signal besides those induced by SA. Many of these errors merely occur due to the normal operations of the equipment in the system, such as minor orbit anomalies, slight timing signal errors, or simple signal noise, etc.

Recently, dramatic improvements in accuracy that rival and even better PPS service have been achieved from augmentation systems such as Differential GPS (DGPS). DGPS involves placing a normal GPS receiver at a known surveyed site (reference receiver), receiving inputs from appropriate GPS satellites, calculating the errors, and retransmitting a correction signal (via data link) out to specifically equipped users.[46] The user equipment can be a separate radio receiver tuned to these data linked retransmissions that plugs directly into a port on a regular GPS receiver; or, as in a recently developed system, the surveyed site broadcasts a refined corrections transmission exactly simulating a GPS satellite signal directly to the user's GPS receiver. The equipment in this latter method is known as a "pseudolite" (from pseudo satellite).[47] Both of these systems are called Local Area DGPS (LADGPS).

Another type of DGPS, known as Wide Area GPS (WADGPS), uses the same principles in computing the error corrections as in LADGPS. But with WADGPS, the corrections are uplinked to a communications satellite in geosynchronous orbit for retransmission over a large footprint area over the earth's surface. Accuracies using either DGPS can, reportedly, be reduced to as low as 5 to 10 meters.[48]

As is usually the case with evolving technologies, even newer procedures are now on the horizon which combine distinct upgrades to the GPS control segment with optional user equipment upgrades that can achieve positioning accuracies of less than 1 meter, and this without the additional equipment required for DGPS.[49] Given these significant improvements in accuracy, the rationale for maintaining an encrypted, complex, and extremely expensive military special access signal hardly seems worth the trouble.

Another error inherent to GPS usage exists that is due to the geometric positioning of the constellation of satellites that the receiver is locked onto, and it is called Dilution of Precision (DOP).[50] Since the satellites that a GPS receiver uses are continually moving and changing, DOP cannot be corrected for in real time. However, for a given position on earth at a specific time, DOP can be predicted. Computer simulation models, updated with current satellite ephemeris (position and time data), have been developed to predict when the DOP in a particular area will be at its lowest.[51] These predictions are critically important during certain military operations where the highest accuracies are required, as when precision guided munitions (PGMs) are being employed or special operations forces are inserted into specified close quarters areas. One often-used DOP modeling program is called the System Effectiveness Model (SEM).[52] The SEM program is resident in the TSOC computer, which deploys with any of the space support teams.

Of the many problem areas associated with understanding the system and its proper employment, the greatest threat to military use stems from the success enjoyed by commercial users. Some commercial demands for accuracy rival or exceed that of military levels, and there are fears that civilian control will ensue. Some recent studies, however, argue that the system must remain in the hands of the military, to be able to take back during times of national emergency, or when American lives are at stake in some foreign land.[53] It has also been suggested that some type of emergency procedures such as the SCATANA system (where aviation navigation aids are taken over by the military during times of national crises) be instituted for GPS and all of its augmentation and add-on systems.[54]

As another option, the military could, and should, develop capabilities for area denial that would selectively and temporarily turn off GPS satellites as they pass over an adversary's territory, or be able to jam the downlink signal only within that specified area. In other recommendations, DOT has proposed adding a second civilian signal to the SPS service that would increase accuracies by better countering the atmospheric distortion errors, as in the PPS service.[55] This improvement, along with a change that would allow the military a direct access to the P/Y code, might also satisfy commercial users enough to prevent continued demands that encroach on the military PPS side of the system.

The Presidential Decision Directive (PDD) of 28 March 1996 on GPS policy directed that beginning in the year 2000, an annual decision will be made on the continued use of SA.[56] In the meantime, if some interim capabilities could be developed so that U.S. forces could maintain or transition to a position of distinct advantage in navigation accuracies over an adversary during crisis situations, then compromises are likely to be worked out for the mutual benefit of all.

Armed with the most recent status of the GPS system, the JSST could bring to the warfighter the following navigation considerations in the planning and preparation for combat operations or exercises:

1. How many and where are either commercial or military GPS receivers within assigned friendly forces?
2. Ensure that a GPS satellite prediction model with current ephemeris data is available to plan for optimum launch or execution windows.
3. For enemy forces, how many and where are GPS receivers? What types of GPS guided weapons and/or weapons systems does the enemy possess?

4. Based on the above, should SA be increased, decreased or left as is?
5. Are local area GPS enhancements available, who controls them and what can be done about it?
6. And finally, are GPS jamming capabilities available for own force use in localized areas?

As can be seen from the above questions, without a thorough understanding of this powerful space warfighting tool, a distinct advantage for U.S. military personnel could be squandered. For example, at a major USACOM sponsored exercise during one of the first JSST deployments, it was found that nearly one third of the ground forces had commercial vice military receivers. Unknowingly, command decisions could have been made that would have been as detrimental to friendly forces as to the adversary. The value-added to the warfighter in the navigation arena is only now beginning to be fully exploited with the latest in standoff weaponry, and it is certain that a greater understanding of this system is required.

Environmental

The environmental mission consists of two main sections; weather satellites and multi-spectral imagery. The military weather satellite system is known as the Defense Meteorological Support Program (DMSP). There are two DMSP satellites in a low earth, circular, 98.75-degree inclination, sun-synchronous, 101-minute period orbit. This retrograde orbit ensures that the satellite will pass over an area at the same time every day (with the same sun angle and light level).[57] These satellites, working in conjunction with TIROS (Television and Infrared Operational Satellite) and GOES (Geostationary Operational Environmental Satellite) weather satellites from the U.S. National Oceanic and Atmospheric Administration (NOAA), normally satisfy the needs of all warfighters.

Utilizing these systems, CINC and JTF weather professionals have been doing a superb job in supporting their commands, and require little assistance from USSPACE.[58]

Recently, the AFSST assisted operators in Bosnia by lashing together a network to feed DMSP and TIROS weather data directly into theater. The design and installation of this equipment provided rich detail in weather data that has significantly improved Unmanned Aerial Vehicle (UAV) flight planning and helicopter Search and Rescue (SAR) missions, and is having an impact in many other worthwhile applications.[59]

There is one unique weather area in which only a space command unit can assist, and that area is space weather. AFSPC's 50th Weather Squadron tracks solar flare-ups on the surface of the sun, which emit massive waves of energized particles toward earth that can wreak havoc with radars, communications systems and even star navigation systems of satellites. There are flare cycles that have been discovered that allow an accurate prediction in advance in some cases; however, when requested, an alert can be generated to warn of unforeseen shock waves of solar energy. The Weather Squadron also assists in anomaly assessment, where telemetry or communications between owners or users and their satellites is disrupted for unknown reasons.[60] Space Support Teams can ensure that space weather is included as a planning consideration for inter- and intra-theater communications, as well as other disciplines that may be affected.

MSI is a rapidly growing space capability that provides outstanding images to the warfighter. The imagery is purchased from commercial satellite systems, then exploited by the military, which manipulates selected bands of the visible light and infrared range spectrum. By using various combinations of the spectrum bands, differentiations between various types of soil or vegetation can be detected, and, when combined with

Digital Terrain Elevation Data (DTED), elevation information can be overlaid to create a virtual three dimensional image. There are two main satellite systems that provide imagery for this type of exploitation, the U.S. Landsat system and the French Satellite Pour l'Observation de la Terre (SPOT) system.[61] USSPACE as well as each of the service space commands have a division that can obtain, manipulate and deliver MSI.

In the past, a major difficulty with MSI products has been the difficulty to distribute the images because of the huge volume of data it takes to make up an image. Newer and larger communications pipelines are now correcting that shortfall. For example, the Navy recently transmitted MSI images from the U.S. to the Sixth Fleet command ship in the Mediterranean Sea during evacuation operations in Liberia by using a newly developed direct broadcast system called the Joint Broadcast System (JBS).[62] By continuing to explore newer and more inventive uses of MSI, as well as how to best deliver and distribute the product to the end users, requests and deliveries will soon become routine operations.

JSST teams have demonstrated possible uses of MSI data that could very well be a major assistance to military planning. Selection of helicopter landing areas, analyzing topography for heavy armored equipment movement, or area delimitation to identify potential enemy theater ballistic missile sites are all superb uses of this impressive capability. All of the services are currently engaged in a number of MSI initiatives that may prove to be outstanding support to the warfighters.

Reconnaissance

The reconnaissance mission area (includes all types of space derived intelligence) is an unusual one for the SSTs, because none of the assets are owned, operated or controlled by the space commands. The National Reconnaissance Office (NRO) is the DOD agency (highly classified until only recently) whose responsibilities consist of the development, acquisition, and operation of intelligence and reconnaissance satellites in support of U.S. national security. The NRO Director has a Deputy Director for Military Support and an Operational Support Office (OSO) that acts as a liaison to the military services and regional CINCs.[63] Additionally, USSPACE and each of the service components have Tactical Exploitation of National Capabilities (TENCAP) organizations that are dedicated to making national systems data more readily available to the warfighter by focusing on developing equipment and improving procedures.[64]

NRO satellites, often referred to as "national assets," are organized in two broad categories defined by the type of information they provide, either Signals Intelligence (SIGINT) or Image Intelligence (IMINT). SIGINT satellites, placed in a variety of different orbits, monitor and analyze signals of interest throughout the electromagnetic spectrum from anywhere in the world.[65] Much of the specialized equipment and procedures involved in SIGINT operations remain highly classified; however, recent declassifications, coupled with a sincere attempt to support the warfighter, has opened up new dissemination and distribution channels not routinely available previously. SIGINT support is normally handled strictly through intelligence or cryptological channels, and while the process works reasonably well, recent changes have resulted in significant improvements. JSST teams rarely address the SIGINT process, but the intelligence community's NIST teams and support teams from OSO often complement space support teams in theater to more fully operationalize all aspects of space support to the warfighter.[66]

The IMINT system consists of multiple types of image producing satellites usually placed in low earth orbit to ensure better resolution of its images. For the warfighter, the IMINT process has not worked very well in the past. A labyrinth of intelligence and DOD agencies and boards existed that controlled and set tasking priorities for the limited number of imaging opportunities available. In addition, the enormous demand placed on the system by all levels of the national security and intelligence chains of command, plus the cumbersome shroud of top level security classifications, has, for years, confused and frustrated warfighters attempting to meet tasking requirements.[67]

Over time, warfighter tasking demands, and interest, had atrophied. JSST teams found an astonishing lack of knowledge of imaging assets available. While JSST's have been briefing CINC and JTF staffs attempting to generate an interest in imaging, a reorganization of tasking, control, and exploitation agencies has been taking place. The recently formed National Imagery and Mapping Agency (NIMA), a DOD combat support agency, is a compilation of the Defense Mapping Agency, the Central Imagery Office, and parts of other organizations with imaging related functions.[68] NIMA is a superb example of what can be accomplished to refocus support toward warfighter needs.

The unfortunate reality has been that too few warfighters knew enough about satellite reconnaissance systems to ask for what could be tactically applicable. While the SSTs can not provide direct support, acting in their capacity as a proponent of all military space requirements, they can continue to educate and raise awareness of existing capabilities.

Notes

[1] Scott, 37.
[2] Mehuron, 48.

Notes

[3] UMD 38-2, 1.

[4] William B. Scott, "USSC Prepares for Future Combat Missions in Space," *Aviation Week & Space Technology* 145, no. 6 (August 5,1996): 51-52.

[5] Scott, "USSC Prepares for Future," 51.

[6] United States Space Command, *Warfighter Briefing*.

[7] Suzann Chapman, "Space Junk," *AIR FORCE Magazine*, November 1996, 39.

[8] Lt Col James R. Walton et al., "Operational Support to the Warfighter," *SPACE TACTICS BULLETIN* 2, Issue 4(Fall 1995): 12-14.

[9] Major Duane R. Cozadd, "Air Force Space Support Teams," *SPACE TACTICS BULLETIN* 2, Issue 4 (Fall 1995): 15-16.

[10] Foudray, 11.

[11] Peter Grier, "The Arena of Space," *AIR FORCE Magazine* 79, no. 9 (September 1996): 47.

[12] United States Command, *Warfighter Briefing*.

[13] Major Kendal Cunningham, "USSPACECOM Targeting Support to the Warfighter," *SPACE TACTICS BULLETIN* 2, Issue 3 (Summer 1995): 10.

[14] UMD 38-2, 1.

[15] United States Space Command, *Warfighter Briefing*.

[16] Mehuron, 34.

[17] Ibid.

[18] Capt Phil Verret, "Milstar: Providing Secure, Assured Communications," *SPACE TACTICS BULLETIN 2, Issue 4 (Fall 1995): 8-9.*

[19] Mehuron, 34.

[20] United States Space Command, *Warfighter Briefing*.

[21] *Space and Missile Applications Handbook*, 112.

[22] United States Space Command, *Warfighter Briefing*..

[23] *Space and Missile Applications Handbook*, 148-152.

[24] Dwayne A. Day, "Top Cover: Origins and Evolution of the Defense Support Program—Part 1," *SPACEFLIGHT* 38, no. 1 (January 1996): 22-26.

[25] Day, Top Cover—Part 1, 22.

[26] JSTM 3-14, 1-5-7 to 1-5-11.

[27] United States Space Command, Warfighter Briefing.

[28] William B. Scott, "Air Force 'ALERT' System Speeds Missile Warnings," *Aviation Week & Space Technology* 142, no. 18 (May 1, 1995): 56-57.

[29] Ibid.

[30] Bruger, 81.

[31] Scott R. Gourley, "Soldier Armed The Joint Tactical Ground Station," *ARMY* 46, no. 12 (December 1996): 24-25.

[32] William B. Scott, 'ALERT' System, 56.

[33] Capt Shane Scott, "Parallel Reporting of Theater Ballistic Missiles," *SPACE TACTICS BULLETIN* 2, Issue 3 (Summer 1995): 8.

[34] LCDR Rob Vaughan, "Theater Ballistic Missile Exercise Support," *SPACE TACTICS BULLETIN* 3, Issue 1 (Winter 96): 7-8.

Notes

[35] Joseph C. Anselmo, "Pentagon Readies SBIRS Award," *Aviation Week & Space Technology* 145, no. 19 (November 4, 1996): 94.

[36] Ibid.

[37] Scott Pace, "The Global Positioning System: policy issues for an information technology," *SPACE POLICY* 12, no. 4 (November 1996): 265.

[38] Ibid, 274-275.

[39] JSTM 3-14, 2-4-34.

[40] Elliott D. Kaplan, ed., *Understanding GPS Principles and Applications* (Norwood, MA: ARTECH HOUSE , 1996), 3-4.

[41] Pace, 266-267.

[42] Mehuron, 34.

[43] United States Space Command, *Briefing.*

[44] Ibid.

[45] Ibid.

[46] Kaplan, 321-346.

[47] Neil Ackroyd and Robert Lorimer, *Global Navigation: A PPS User's Guide* (London: Lloyd's of London Press, 1990), 52-53.

[48] Ibid., 45.

[49] Mark L. Moeglein, David H. Nakayama, and Cheryl L. Hammer, "Options for PPS Space Segment Accuracy Enhancement," *Navigation: Journal of The Institute of Navigation* 43, no. 3 (Fall 1996): 221.

[50] Ackroyd, 23-24.

[51] United States Space Command, *Briefing.*

[52] Walton, 14.

[53] Bruse Nordwall, "Rand Recommends Military Control GPS," *Aviation Week & Space Technology* 144, no. 7 (February 12, 1996): 45.

[54] Pace, 271.

[55] Jennifer Heronema, "GPS Could Get Second Signal," *Space News* 7, no. 19 (May 13-19, 1996): 6.

[56] Glen Gibbons, "A National GPS Policy," *GPS World* 7, no. 5 (May 1996): 48-50.

[57] *JSTM 3-14, 2-4-41.*

[58] United States Space Command, Warfighter Briefing.

[59] Staff Sgt. Timothy Hoffman, "Better Pictures A gusher of Satellite Information Flows from a small Link in Bosnis," *GUARDIAN* 4, no. 7 (December 1996): 8-10.

[60] " 'Weather' Forecasters Work on Higher Plane," *Aviation Week & Space Technology* 143, no. 12 (September 18, 1995): 49.

[61] Mehuron, 35.

[62] Jennifer Heronema, "Navy Sends Multispectral Imagery to Ships at Sea," *SPACE NEWS* 7, no. 20 (May 20-26, 1996): 16.

[63] Jeffrey K. Harris, "Meeting the Challenge Then and Tomorrow The National Reconnaissance Office Enters the 21st Century," *American Intelligence Journal* 16, no. 1 (Spring/Summer 1995): 27-31.

[64] Lieutenant Colonel William A. Ross, "Space Support to the Warfighter," *Military Intelligence Professional Bulletin* 21, no. 1 (January-March 1995): 23-25, 53.

Notes

[65] Allen Thomson, "Satellite vulnerability: A post–Cold War issue?" *Space Policy* 11, no.1 (February 1995): 19.

[66] United States Space Command, Warfighter Briefing.

[67] United States Space Command, Warfighter Briefing.

[68] "National Imagery and Mapping Agency Established," *National Imagery and Mapping Agency Home Page*, http://164.214.2.59/org/backgrn.html, 7 January 1997, 1.

Chapter 4

Conclusions

A Military Space Future

Given the previous discussion as background, and with only a little imagination, it may be possible to postulate where the organization of military space is heading in the future by extrapolating from where it has been in the past and where it stands today.

USSPACE met the strategic needs of the military and the NCA during the cold war period by providing ICBM strategic warning. Any support given at the tactical level was on an ad hoc basis. If the space effort during this time frame could be categorized as *Phase One* in the life of military space organization, then the Gulf War, where space support to the warfighter first became publicly acknowledged and tactically capable, would be *Phase Two*. Presently, USSPACE is still transitioning through phase two by ensuring faster, more comprehensive, and easier access to space products and procedures. The space support teams have, since 1994, been educating their customers on a temporary additional duty (TAD) basis through in-theater briefings, schoolhouse sessions at various command and staff and senior war colleges, and participation in numerous theater exercises to integrate the benefits of space into routine operations.

It appears that more and better support may soon be necessary. A suggested future *Phase Three* could be the formation of a permanent staff within each regional CINC that could better support that warfighter on a continuing and dedicated basis. Not that the JSST teams are disloyal to their supported CINCs now, but own staff might afford more familiarity and continuity with command procedures and personnel, which would allow for a more rapid and effective integration into OPLANS and contingency operations. Also, a slice group from this permanent space staff could then directly support locally generated JTF staffs (supplemented only if needed by a few key experts from USSPACE).

Following this flow of space support personnel to reside with the warfighters, and the rapid expansion of the relative importance of space in the next conflict, it might be time to create a Joint Force Space Component Commander (JFSCC) as a functional combat commander of the JTF. [1] This transition would be *Phase Four* in the evolving organization of military space activity. Within this time frame, space weaponry (force application) may likely emerge as a preferred method of projecting power. Because of its safety, lethality, and speed of response, space warfare options could begin dominating courses of action available to operational commanders. Eventually, with a preponderance of the firepower, and expanding capabilities in all warfare support disciplines, the space component commander would be constrained by local CINC/JTF command and control.

The last transition then, to *Phase Five,* would involve the formation of a separate U.S. Space Service, to functionally tie together all professional aspects of military space. USSPACE, acting as a *supported* CINC, would be the fighting arm of the Space Service, whose responsibilities would include acquisition and the training and equipping of personnel. While seemingly a little farfetched at the moment, not only is a Space Service possible, but from the preceding direction of military requirements and weapons systems discussed here, it may be inevitable. Current space policies that proceed along these measured and transitional phases appear to be a forward looking and logical approach to future military space organization; and, are strongly recommended for consideration.

Summary

The amount of information and support brought into theater by the JSST and component teams is valuable, timely and increasingly necessary for success. Some support is transparent to the warfighter, such as the space forces support of maintaining launch facilities and satellite operations infrastructure. This knowledge is none-the-less important, if only because of the increased leverage provided by the regional CINCs during allocation of resources in accordance with DOD requirements and capabilities guidelines. Additionally, the joint and service space commands are the space centers of excellence, as well as the research and development leaders of future force application initiatives that will benefit all warfighters.

The growing importance of information warfare places the space control mission squarely in the center of that emerging warfare realm. The ability of space assets to dramatically alter the situational awareness, tempo, and direction of any conflict, leaves the combatant who cedes this vital high ground one step behind at the outset. The capabilities available in the space control mission will continue to expand in the near term, and appear to have the greatest potential for further exploitation in the future.

The force enhancement mission areas form the bulk of what the warfighter can expect from space support today. Weather and communications are certainly important missions, but there is little additional support the JSSTs can offer in-theater weather organizations. In other mission areas, both MSI and national imagery areas need distribution systems restructuring to better meet warfighters' needs. While some gains have been realized with MSI, the support teams can do little with national imaging systems other than to continue to educate military customers. The mission areas where direct and measurable assistance can be offered now are navigation and missile warning. The details of options available, and how and when to use these systems, has been continually reemphasized to the warfighters through in-theater education and training.

The idea of having a deployable team involved in a supported CINC's planning process will become more commonplace as the JSSTs demonstrate their commitment, loyalty and knowledge of local procedures. Acknowledgement of the JSSTs as vital and necessary members of the planning staff team is taking root at the highest levels of all of the regional commands, and insistence for space participation is slowly becoming the status quo. From the JSST perspective, it is hopeful that more formal relationships be established with the warfighters, perhaps through Memoranda of Understanding (MOUs), that will further move along a growing dependency for space support. If the JSSTs are truly the beginnings of a shift towards a future military-in-space paradigm, then more attention, more money, and more people need to be put into the overall effort at once!

Notes

[1] Bruger, 81.

Bibliography

Ackroyd, Neil, and Robert Lorimer. *Global Navigation: A PPS User's Guide*. London: Lloyd's of London Press, 1990.

Anderson, Edward G. III, Lt Gen "Space and Missile Defense: A Global Challenge." *ARMY* 46, no. 12 (December 1996): 17.

Anselmo, Joseph C. "Pentagon Readies SBIRS Award." *Aviation Week & Space Technology* 145, no. 19 (November 4, 1996): 94.

"Army Expands Combat Support." *Aviation Week & Space Technology* 143, no. 12 (September 18,1995): 56.

Bruger, Steven J., Lieutenant Colonel, USAF. "Not Ready for the First Space War: What about the Second." *Naval War College Review* 48, no. 1 (Winter 1995): 73-83.

Canan, James W. "Forward . . . Into Outer Space." *Sea Power* 38, no. 9 (September 1995): 38-42.

Chapman, Suzann. "Space Junk." *AIR FORCE Magazine* 79, no. 11(November 1996): 39.

Clapp, William G., Major. "Space Fundamentals for the Warfighter." Research Paper AD-A279 703 (Newport, R.I.: Naval War College, 1994), 7.

Correll, John T. "The Command of Space." *AIR FORCE Magazine* 79, no. 10 (October 1996): 3.

Cozadd, Duane R., Major. "Air Force Space Support Teams." *SPACE TACTICS BULLETIN* 2, Issue 4 (Fall 1995): 15-16.

Cunningham, Kendal, Major. "USSPACECOM Targeting Support to the Warfighter." *SPACE TACTICS BULLETIN* 2, Issue 3 (Summer 1995): 10.

Davis, Mark, LCDR. "Space Support to the Warfighting Community—From a Unified Action Officer Perspective." *Space Tactics Bulletin* 2, Issue 3 (Summer 1995): 9-10.

Day, Dwayne A. "The Air Force in Space: Past, Present and Future." *Space Times,* March-April 1996, 15-21.

Day, Dwayne A. "Top Cover: Origins and Evolution of the Defense Support Program—Part 1." *SPACEFLIGHT* 38, no. 1 (January 1996): 22-26.

Ferster, Warren. "U.S. Military Makes Strides to Modernize." *SPACE NEWS* 7, no. 47 (December 9-15, 1996): 25-26.

Foudray, Ron, Lt.j.g. "Space Support to the Fleet Just Got Better." *Naval Space Command SPACE TRACKS*, Winter 1997, 10-12.

Gedemer, Larry, MSgt. "Forward Space Support." *Space Tactics Bulletin* 1, Issue 1 (June 1994): 4.

Gibbons, Glen. "A National GPS Policy." *GPS World* 7, no. 5 (May 1996): 48-50.

Giffen, Robert B., Colonel. "Space Basics." Extract from *US Space System Survivability: Strategy Alternatives for the 1990s*. National Defense University Monograph No. 82-84, Chapter 2 (November 1982): 31-36.

Gourley, Scott R. "Soldier Armed the Joint Tactical Ground Station." *ARMY* 46, no. 12 (December 1996): 24-25.

Grier, Peter. "The Arena of Space." *AIR FORCE Magazine* 79, no. 9 (September 1996): 47.

Harris, Jeffrey K. "Meeting the Challenge Then and Tomorrow: The National Reconnaissance Office Enters the 21st Century." *American Intelligence Journal* 16, no. 1 (Spring/Summer 1995): 27-31.

Heronema, Jennifer. "GPS Could Get Second Signal." *Space News* 7, no. 19 (May 13-19, 1996): 6.

Heronema, Jennifer. "Navy Sends Multispectral Imagery to Ships at Sea." *Space News* 7, no. 20 (May 20-26, 1996): 16.

Hoffman, Timothy, Staff Sgt. "Better Pictures A gusher of Satellite Information Flows from a small Link in Bosnia." *GUARDIAN* 4, no. 7 (December 1996): 8-10.

JSTM 3-14. *Joint Space Fundamentals Student Text*, 3rd ed. 3400 Technical Training Group, Peterson AFB, CO, April 1992.

Kaplan, Elliot D., ed. *Understanding GPS Principles and Applications.* Norwood, Ma.: Artech House Inc., 1996.

Mehuron, Tamar A. "Space Almanac." *AIR FORCE Magazine* 79, no. 8 (August 1996): 28-49.

Moeglein, Mark L., David H. Nakayama, and Cheryl L. Hammer. "Options for PPS Space Segment Accuracy Enhancement." *Navigation: Journal of The Institute of Navigation* 43, no. 3 (Fall 1996): 221.

"National Imagery and Mapping Agency Established." *National Imagery and Mapping Agency Home Page*, http://164.214.2.59/org/backgrn.html. 7 January 1997, 1.

Nordwall, Bruce D. "Rand Recommends Military Control GPS." *Aviation Week & Space Technology* 144, no. 7 (February 12, 1996): 45.

Pace, Scott. "The Global Positioning System: Policy Issues for an Information Technology." *Space Policy* 12, no. 4 (November 1996): 265-275.

Reynolds, Kurt, SSgt. "Space101—Principles of Space Ops." *SPACE TACTICS BULLETIN* 2, Issue 3 (Summer 1995): 16.

Reynolds, Kurt, Ssgt. "Space 101—Principles of Space Ops." *SPACE TACTICS BULLETIN* 2, Issue 4 (Fall 1995): 22.

Ross, William A., Lieutenant Colonel. "Space Support to the Warfighter." *Military Intelligence Professional Bulletin* 21, no. 1 (January-March 1995): 23-25, 53.

Scott, Shane, Capt. "Parallel Reporting of Theater Ballestic Missiles." *SPACE TACTICS BULLETIN* 2, Issue 3 (Summer 1995): 8.

Scott, William B. "Air Force 'ALERT' System Speeds Missile Warnings." *Aviation Week & Space Technology* 142, no. 18 (May 1, 1995): 56-57.

Scott, William B. "Major Cultural Change On Tap In Military Space." *Aviation Week & Space Technology* 143, no. 12 (September 18, 1995): 15-16.

Scott, William B. "USSC Prepares for Future Combat Missions in Space." *Aviation Week & Space Technology* 145, no. 6 (August 5, 1996): 51-52.

Space and Missile Applications Handbook. Space Warfare Center, Falcon AFB, CO, 1996.

Space Support to the Warfighter Briefing. United States Space Command, Peterson AFB, CO, 1996.

Thomson, Allen. “Satellite vulnerability: A post–Cold War issue?” *Space Policy* 11, no.1 (February 1995): 19.

Ul10-16. *Crisis Action System Procedures*. United States Space Command Instruction, Peterson AFB, CO., 1 July 1995.

UMD 38-2. *Space Support Team Operations*. United States Space Command Mission Directive, Peterson AFB, CO., 2 January 1996.

Vaughan, Rob, LCDR. “Theater Ballistic Missile Exercise Support.” *SPACE TACTICS BULLETIN* 3, Issue 1 (Winter 96): 7-8.

Walton, James R., Lt Col, et al. “Operational Support to the Warfighter.” *SPACE TACTICS BULLETIN* 2, Issue 4 (Fall 1995): 12-14.

“ ‘Weather’ Forecasters Work on Higher Plane.” *Aviation Week & Space Technology* 143, no. 12 (September 18, 1995): 49.

Air War College
Maxwell AFB, Al 36112