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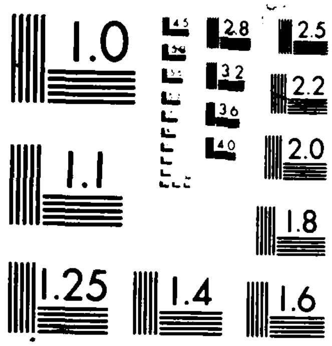

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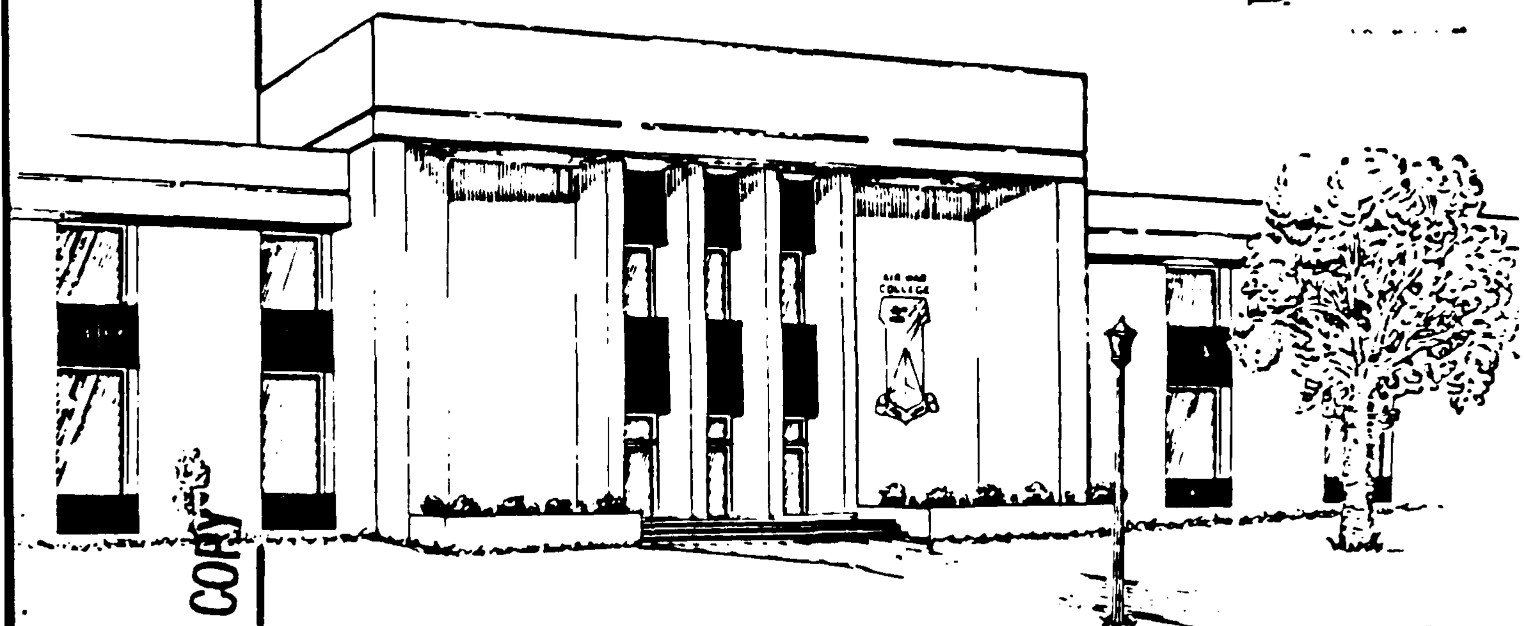
AIR WAR COLLEGE (7)

RESEARCH REPORT

No. AU-AWC-86-161

ORGANIZING FOR MILITARY SPACE OPERATIONS

By COLONEL KENNETH A. MYERS



AIR UNIVERSITY
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MAXWELL AIR FORCE BASE, ALABAMA

AIR WAR COLLEGE
AIR UNIVERSITY

ORGANIZING FOR MILITARY SPACE OPERATIONS

by

Kenneth A. Myers
Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE RESEARCH

REQUIREMENT

Research Advisor: Lt Col John G. Tockston

MAXWELL AIR FORCE BASE, ALABAMA

May 1986

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AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: Organizing for Military Space Operations

AUTHOR: Kenneth A. Myers, Colonel, USAF

The newly established United States Space Command ~~(USSPACECOM)~~ consolidates operational control of US military space forces within a single unified command. This may address near term difficulties in operational control of US military space assets, but the long term problem of space force provisioning remains unresolved. A detailed look at the nature of military space operations and an analysis of space organizational characteristics indicates the need for a systems resource management infrastructure to insure that future space forces are effective and responsive to requirements of the Defense Department and the USSPACECOM. Only by centralizing the space support activities of all three military services into a single organization or service department can future space forces be organized, trained, and equipped to perform prompt and sustained offensive and defensive operations in space.

BIOGRAPHICAL SKETCH

Colonel Kenneth A. Myers has been involved with the military space program for over 20 years. His academic degrees include a BS in Aerospace Engineering from The Pennsylvania State University (1964); an MS in Astronautics from the AFIT Resident School of Engineering (1967); and, a PhD in Aerospace Engineering from the University of Texas at Austin (1973). He also holds an MA degree in Business Management from the University of Nebraska-Lincoln (1980) and is currently enrolled in a Master of Political Science program with the University of Auburn at Montgomery. His military assignments include tours with the Space Systems Division (AFSC), Los Angeles AFS, CA (1967-1971); Aerospace Research Laboratories and the Avionics Laboratory, Wright-Patterson AFB, OH (1973-1977); the 4000th Space Operations Group (SAC), Offutt AFB, NE (1977-1980); and, Office of the Secretary of the Air Force/Space Systems, Pentagon, DC (1980-1985). He has completed non-resident professional military education in Squadron Officer School, Air Command and Staff College, and National Security Management. Colonel Myers is a graduate of the Air War College, Class of 1986.

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ORGANIZING FOR MILITARY SPACE OPERATIONS

Introduction

"Space is a place." (1) The essence of this rhetorical statement obscures the reality and substance of space operations which have been actively underway in the Department of Defense (DoD) for over 25 years. Yes, space is a "place"; just like land, sea, and air are "places." More importantly, however, each is a distinct medium (2) through which unique operational forces may be employed in support of national security policy and strategy.

The distinction between "place" and "medium" has profound implications for military doctrine and organization. The word "place" signifies a position, such as a geographic location; however, "medium" connotes an environment or substance through which an object or force may be transmitted. Although the same types of systems may be cabable of operating in different places, they are not necessarily capable of operating in different media.

Since the media of land, sea, air, and space are different, the systems and techniques for operation in each are different; and, it follows that the support infrastructure for each should also be different. (3) While the implications of this argument for doctrine are developed elsewhere (4,5), the intent here is to outline the broad organizational implications for effective military operations in space, the fourth medium.

The problem is approached by first assessing the relationship between current space policy guidance and military space organization. Then, the nature of military space operations is detailed to identify the unique organizational functions involved in space activities. Next, intraorganizational relationships and problems which characterize the environment of space systems development, operation, and support are analyzed. The evaluation suggests a systems management organizational approach for effective employment of operational space forces. An institutional framework is then developed to insure effective command and management of future space forces consistent with US National and Defense Department space policies.

The Unified Space Command--A Panacea?

It is perhaps the notion of "place" that has led to the creation of the new unified United States Space Command (USSPACECOM). (6) By viewing space as a "geographic" position or area, a Unified Space Command becomes analogous to other unified commands located at "places" around the world which support joint and combined defense operations. Unlike other unified commands which may employ a variety of land, sea, and air force components, however, only space components are involved in the new Unified Space Command. Space components include the Air Force Space Command, the Naval Space Command, and an Army Space Planning Group. (7)

Conversely, the Unified Space Command arrangement places all space force elements in a single command, rather than employing them with different force components under a single commander, as in other unified commands. The functional equivalent, of course, would be to have separate Unified Land, Sea, and Air Commands, an absurd concept. Regardless of these inconsistencies, a single military operational focal point has finally been designated for space. This constitutes a major institutional development, but it does not resolve all of our organizational dilemmas for space.

The organizational problem can be traced to the basic definitions of functions for the DoD, the JCS, and the

Military Departments. DoD Directive 5100.1 (8) prescribes specific functions of land, sea, and air forces for the Army, Navy (including the Marine Corps), and Air Force, respectively; but, the word "space" is conspicuous by its absence in the directive. The functions and missions currently being accomplished in space, however, directly parallel those defined in the directive for land, sea, and air forces.

In spite of its omission in DoD Directive 5100.1, the space mission is to prepare space forces to conduct combat and service operations in support of DoD requirements; and, the primary function of current military organizations for space is to organize, train, and equip space forces to perform prompt and sustained offensive and defensive operations in space. While all of this is in fact transpiring within the DoD today, it is not evolving within the most efficient and effective institutional hierarchy.

Institutional concerns are heightened when one searches for policy and guidance to the military departments for development of space systems estimated to cost the DoD over $15 billion per year. (9) The best that can be found is an obscure, two-page memo signed by the Deputy Secretary of Defense in 1970. (10) Basically, the DepSecDef assigned functional responsibilities for space systems acquisition to the military departments; he left undisturbed any existing space system development responsibilities; subjected all new space system developments to the DSARC process; and, assigned DDR&E (which no longer exists) as monitor of space technology where the interests of more than one department are concerned.

Although a National Space Policy (11) and a DoD Space Policy (12) have been more recently defined, they contain no provisions for infrastructure or organizational responsibilities in space. All of this discussion begs the following question: Can the current organizational approach be effective and responsive for system development and provision of forces to the newly established operational Unified Space Command? At best, it would appear that the Unified Space Command organizational structure may serve merely as a "way station" toward a broader, more effective space establishment for command and support of defense missions in space.

So, even if space is a place, it is more importantly a medium; it is a distinct , unique realm for defense operations warranting more than a Unified Space Command for an institutional hierarchy. The remainder of the report develops an institutional arrangement which could be more effective and responsive for command and management of our future space forces.

Military Space Operations

The purpose of this section is to illustrate the unique nature of military space operations, as distinct from operations in other media, and to characterize the unique support infrastructure requirements for operational space missions. This requires a detailed look at the missions, systems, functions, and activities involved in military space operations. Basically, space operations consist of command and control of satellite systems to provide information or other support to designated military users.

As shown in the mission model (13) of Figure 1, space systems comprise both the satellite systems in space and the ground command and control facilities, called satellite control systems, which support specific military missions in space. The satellite systems, depicted as circles in Figure 1, represent each set of satellites which supports a functional mission area. The satellite control systems, depicted as rectangles with a tracking antenna, represent all terrestrial-based facilities which are required to operate and maintain each of the satellite systems in space.

Space Missions

Satellite system A represents the currently operational set of two Defense meteorological satellites in

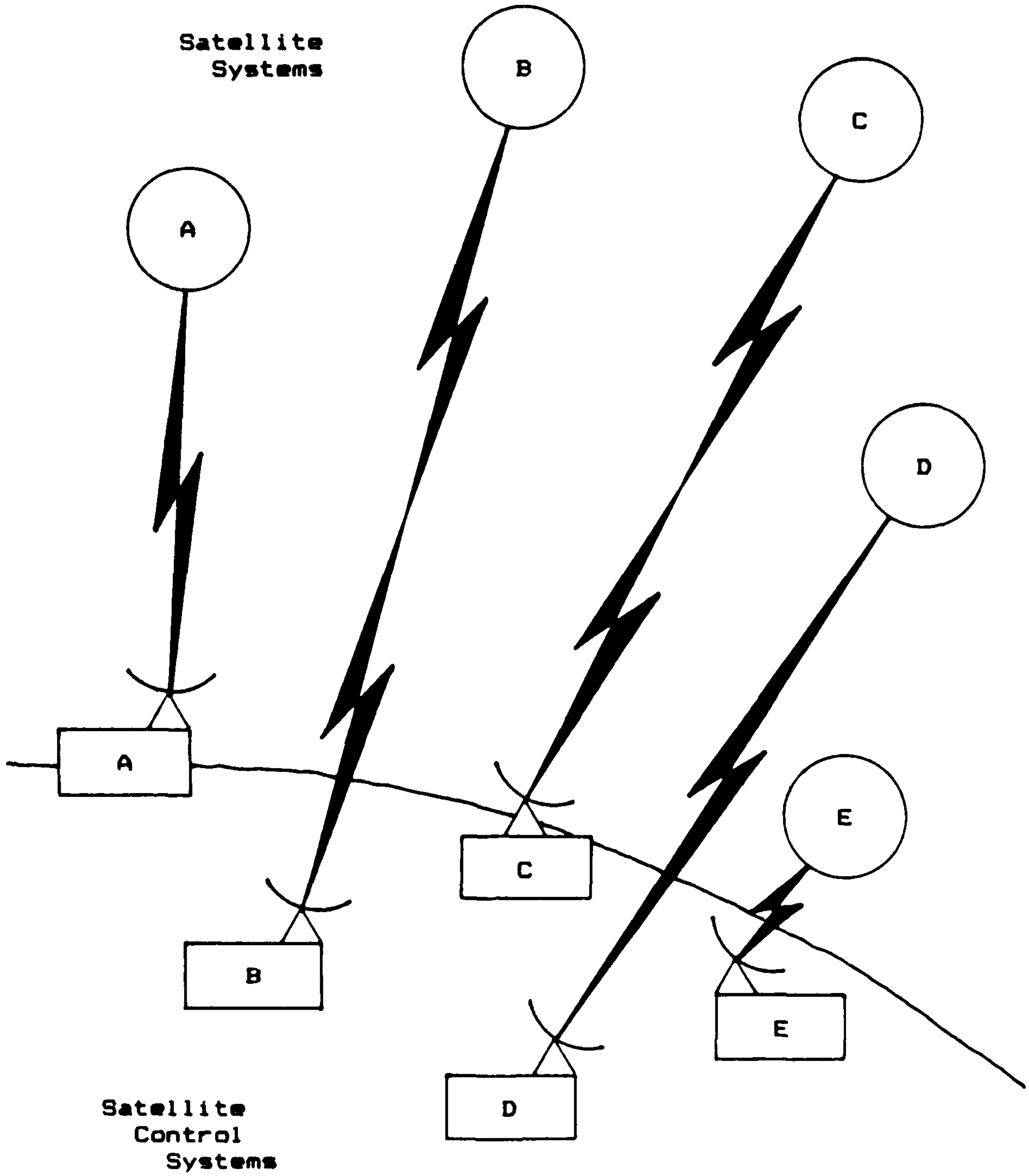

Figure 1

Space Systems

low-altitude orbits. Each of these satellites is equipped with on-board visual and infra-red sensor subsystems for meteorological data (mission data) collection. Mission data collected by the satellites is relayed to user agencies, such as Air Force Global Weather Central and weather detachments at military bases and ships around the world. As a second example, satellite system B represents the 18 satellites planned for operation in the NAVSTAR Global Positioning System (GPS). Each satellite is equipped with a high precision clock for transmission of timing and ranging data (mission data) to properly equipped users for navigation anywhere on earth.

Thirdly, satellite system C could represent a set of military data relay satellites which may interface directly with other satellite systems for two-way relay of command and telemetry data as well as mission data to the ground-based satellite control system. Conceptually, other satellite systems may communicate directly with their own satellite control systems through satellite system C; however, command and telemetry data from other satellite systems is handled as mission data by satellite system C.

Other military satellite systems are readily incorporated into this organizational concept by functional mission area. For instance, satellite system D could represent the series of high-altitude Defense surveillance satellites; and, satellite system E could represent a future series of directed energy weapon satellites for strategic defense against ballistic missiles.

Satellite Systems

Individual satellites in each mission area are typically equipped with the following types of major subsystems: payload data collection and processing, communications, telemetry and commanding, attitude determination and control, thermal control, and power. Space system operators upload command data to the satellite system(s) from their respective ground-based satellite control systems. Command uploads to the satellites include realtime and programmed commands to support user requirements and to manage on-board subsystems.

Command uploads also include ephemeris data and star catalogs for use in satellite on-board computations, mission data location, and attitude control. Ephemeris data provides the predicted satellite position and velocity in space as a function of time. Star catalogs provide positions or look angles of heavenly bodies such as stars, the sun, and the moon which are used by on-board attitude determination subsystems. Ephemeris data and star catalogs are normally updated on a daily basis to insure continuous accurate pointing of the satellite consistent with mission requirements.

Space system operators also receive and process telemetry from the satellite system(s). Telemetry data includes information on the satellite status, environment, and operating characteristics. In addition, each satellite produces mission data outputs which are transmitted to user agencies. The users are engaged in defense combat and service activities not directly associated with the operation of space systems and so are not illustrated in Figure 1. User organizations, however, will typically employ organic capabilities to process satellite derived information or exploit satellite support; and, they are the chief determinants in defining mission requirements and tasking to the space system operator.

Satellite Control Systems

The satellite control systems in Figure 1, have two primary purposes: (1) to generate and transmit commands to the satellites to support mission data requirements and maintain nominal satellite operations; and, (2) to receive and process telemetry from the satellites to insure state of health of all subsystems and analyze satellite performance. For all practical purposes, and contrary to many "Buck Rogers" notions, this is where the action is in space operations. Care and feeding of the satellites is a demanding operational challenge which will continue to require the very best operational and technical talent the military can afford for many years into the future.

A satellite control system is typically composed of the following types of subsystems: radio frequency telecommunications, antenna/tracking, command and telemetry data processing, ephemeris determination and prediction, simulation and analysis, and operator entry/display. Geographic distribution of these components is tailored to operational requirements of each space system.

Space Organizational Functions

Operational functions in a satellite control system are illustrated in Figure 2. Specific activities associated with each of those functions are detailed in Table I. The functions divide into the conventional military employment categories of operations (Table Ia) and logistics (Table Ib). A single commander is responsible for the space system(s) being operated by a particular satellite control organization.

Organizational elements which operate the satellite control system normally include an executive command section, administrative/personnel section, and the following line and staff functions: operations, engineering and analysis, data systems, logistics, standardization/evaluation, training, and requirements/planning. Specific duties of personnel within each functional area are tailored to the particular space system which it supports. The size of a space operations unit will vary, again depending upon mission requirements, but it typically ranges from 300 to 800 professional military and civilian personnel for each satellite control system.

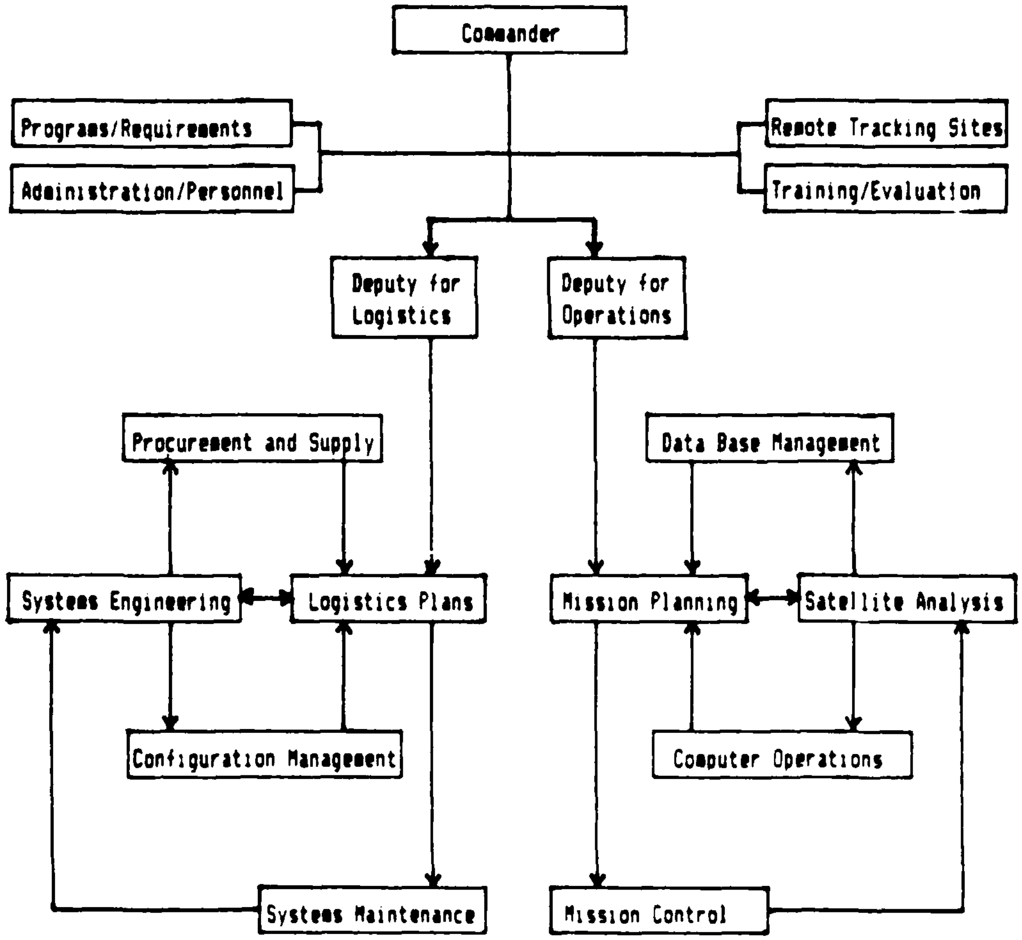

Figure 2

Operational Functions

in a Satellite Control System

TABLE Ia

OPERATIONS FUNCTIONS AND ACTIVITIES
IN A SATELLITE CONTROL SYSTEM

o Mission Control: Operations Processing

- Operate control center and remote sites
- Transmit commands and receive mission and telemetry data
- Implement contingency commanding procedures
- Distribute data products to users
- Monitor satellite status and state-of-health
- Submit problem reports to engineering and maintenance

o Mission Planning: Operations Input

- Prepare master operations production schedule
- Build operations command and telemetry load files
- Generate mission data and telemetry product requests
- Support satellite analysis and test planning
- Maintain inventory of satellite control system files

o Data Base Management: Operations Data Generation

- Maintain satellite system configuration control
- Generate satellite commands and load data
- Provide mission planning input data
- Update satellite command and telemetry data bases
- Adjust telemetry limits and display formats

o Satellite Analysis: Operations Technical Support

- Provide satellite engineering analysis support
- Conduct satellite tests and performance analysis
- Maintain satellite anomaly status reports
- Recommend operations contingency procedures
- Conduct satellite orbital analyses

o Computer Operations: Operations Control

- Operate computer systems
- Manage satellite control system computer resources
- Support computer operating systems
- Maintain inventory of operational data files

TABLE Ib

LOGISTICS FUNCTIONS AND ACTIVITIES
IN A SATELLITE CONTROL SYSTEM

o Systems Maintenance: Logistics Processing

- Maintain satellite control system in operational status
- Implement changes in satellite control system design
- Monitor current satellite control system status
- Report satellite control system malfunctions
- Operate and maintain test equipment

o Logistics Plans: Logistics Input

- Plan and budget for satellite control organization
- Allocate resources within satellite control system
- Schedule equipment modification and installation
- Coordinate development, maintenance, and test plans

o Procurement and Supply: Logistics Materiel

- Procure parts and documentation for new systems
- Stock supplies for satellite control organization
- Maintain spare parts inventory
- Procure contract technical support

o Systems Engineering: Logistics Technical Support

- Conduct test and evaluation of satellite control systems
- Prepare engineering design documentation
- Develop satellite control system hardware and software
- Write statements of work for contractor technical support

o Configuration Management: Logistics Control

- Maintain satellite control system configuration statu
- Establish documentation requirements and standards
- Maintain library of design and user/operator manuals
- Monitor satellite control system design changes

An example of one satellite control organization is the 1000th Space Operations Group, headquartered at Offutt AFB, NE, which operates the Defense Meteorological Satellites. The Offutt AFB command/control center (CCC) comprises a dedicated computer and communications network which interfaces with two dedicated remote control/readout sites at Loring AFB, ME, and Fairchild AFB, WA. The CCC operates the satellites through the remote tracking sites and retrieves mission data from the sites through a geosynchronous data relay communications satellite (a separate space mission) for the user, Air Force Global Weather Central, also at Offutt AFB. In addition, the CCC issues commands through the sites to the meteorological satellites for direct transmission of data to weather detachments located at defense installations all over the world.

Required Organizational Structure

The organizational concept for satellite control systems is decentralized by mission area, as detailed above. The fundamental reason for adopting this concept, as opposed to centralized control, is to maximize operational systems effectiveness and to enhance system survivability. These are paramount considerations in military space missions, where high priority defense operations are dependent upon full time, worldwide satellite mission data coverage across a broad threat spectrum.

Even civil operational space systems are decentralized to insure reliable service; for example, commercial communications satellite systems require an end-to-end communications link availability typically around 0.95. (14) Military requirements for high availability impose rather severe design constraints on the satellites and the satellite control systems. In turn, this results in the incorporation of many redundant and backup features and a dedicated, decentralized control architecture. Furthermore, basic system and personnel management functions in the satellite control organization fully merit a self-sustaining or decentralized unit for each major mission area. (13)

While the decentralized architecture is well established in current space operational units, there exists no single organizational infrastructure to organize, train, equip, and sustain those space units (provision). Instead, the provision of space forces is fragmented both within and between military service departments and government agencies. For this reason, basic issues continue to surface within military and government organizations such as: who should pay for a new space system; what terrestrial- or air-based systems does it supplement or replace; who establishes requirements for the system; who is the owner, the operator, or the system manager for a particular space system?

The crux of the problem is illustrated in Figure 3, which displays the "quadrumvirate" nature of space force provisioning and a representative list of military and government organizations currently involved in the process.

The Quadrumvirate Crux

Four types of "agents" are involved in organizing, training, equipping, and sustaining all space forces. First, the acquisition agents comprise the many DoD research and development (R&D) organizations currently involved in acquiring space systems. Traditionally, acquisition agents have had the lead in defining new systems, sometimes to meet self-generated R&D requirements for which there is no designated advocate, user, or operator. When fielded, the system may or may not service the needs of intended users.

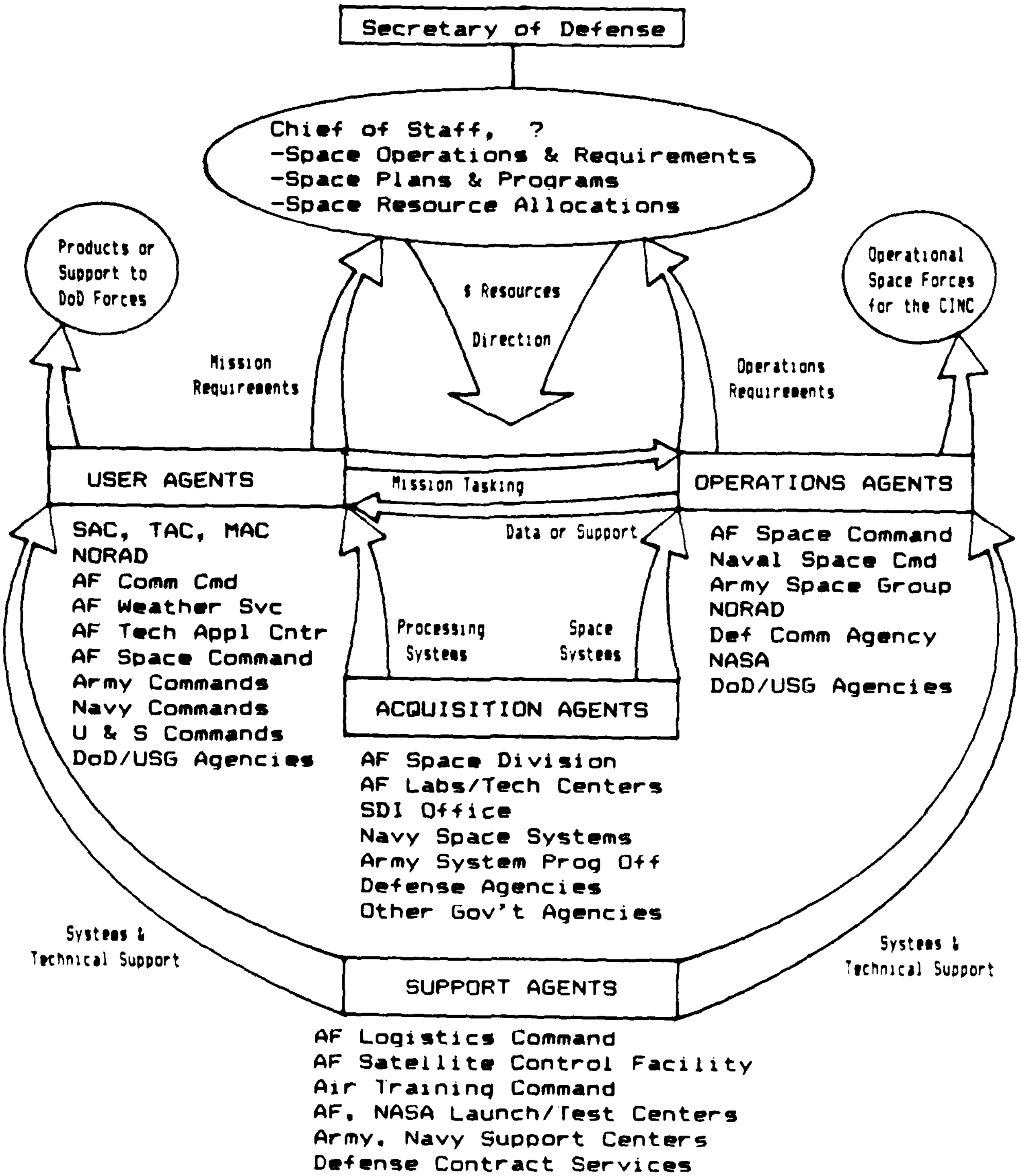

Figure 3

The Qua'rumvirate Crux

Also, to a large extent, acquisition agents have retained operations responsibilities for space systems which has led to management difficulties across command lines.

The operations agents, also found scattered among the military services, operate and maintain the space systems once developed by the acquisition agents. Clearly, operations agents should be charged with ownership of an assigned space system; this includes complete operations responsibility once a fully operational capability is established by the acquisition agent. Operations requirements for new or modified space systems should also be provided by the operations agents to acquisition agents. The operations agents should comprise operational space forces which may be assigned to an operational commander (e.g., the CINC, Unified Space Command) reporting to the SECDEF through the JCS for employment of forces.

User agents are found at many levels throughout the DoD and military services. These organizations or commands are the "exploiters" of operational space systems; they support combat and service requirements of the JCS and all four military force components. In the past, there has been confusion or inconsistent treatment of user-related issues such as: who develops and pays for the user processing systems; and, who operates the satellite "payload" and ground data handling systems? Also, there are major inconsistencies in assignment of roles and missions; for example, within the

Unified Space Command itself, responsibility is claimed for both attack warning (a user mission) and space operations (an operations mission). (7)

Obviously, the user agents must define and articulate requirements for operational production and for processing and display systems, but it is usually impossible to allocate costs because of the large number and variety of military users of a space system and its product. The user agents must also provide operational tasking and space mission requirements to the operations agents who, in turn, should conduct all space systems operations to provide information, products, or support for exploitation, production, or processing by the user agents. These distinctions should be cut clearly and consistently between military organizations for proper command and management of space forces.

Finally, support agents provide logistics and support to sustain both operations and user agents. Currently, logistics is the least understood and most fragmented aspect of space organization and doctrine. It need not be, if a cohesive management structure could be employed. Support agents should respond to requirements of user agents and operations agents with systems and technical support, supply, maintenance, and training to ensure that space forces remain ready for employment by operational commanders at every required level of potential conflict.

The Space Management Nightmare

The quadrumvirate crux is innate to the provisioning of space forces. Specific organizational implementations of the quadrumvirate structure have differred for practically every space system in operation today. Before the formation of Air Force Space Command (15), the implementations were particularly inconsistent and confusing. In practically every case the structure evolved as the most "expedient" means for program management, since no space organizational policies or doctrine existed at the time. The approach has usually succeeded, however, because top quality leadership and management was involved. But it has created an organizational and doctrinal nightmare that portends greater operational and management risks as space forces expand.

As indicated in Figure 3, space forces are currently administered and sustained separately by Army, Navy, Air Force, and other governmental agency units which have many vested interests other than space. This creates conflicts in priorities, competing demands for resources, and false economies across service boundaries. (3) For example, the Air Force NAVSTAR GPS Program must compete with the B-1B Program for Air Force dollars, but it supports critical targeting and navigation requirements of all four military service components. Significant military space opportunities can be lost with this approach, because no single service can afford to develop space forces without impacting their respective land, sea, or air capabilities.

The current organizational infrastructure, segregated by service component, also poses grave risks to the development and implementation of new space systems, because there is no central organization available to transfer knowledge and experience across system and organizational boundaries. New technology cannot be efficiently exploited without the development of coherent, unified plans and programs. And, operations "know-how", or doctrine, will mature differently in each separate organization leading to operational incompatibilities.

By virtue of its role as a unified command, the new Unified Space Command cannot resolve these management issues. Basic principles of Unified Action Armed Forces (16) clearly separate the roles of authority of the unified and specified commands from the military departments and services. Unified commands exercise operational control over forces which are provided, administered, and supported by the military departments and services. Service component commanders are responsible to unified and specified commanders in the operational chain of command, but to the military departments and services for purposes other than operational direction.

Thus, the Unified Space Command may suffice for operational control of space forces, but the provision, administration, and support of space forces is a role reserved for the responsible military service department.

Unfortunately, and this is the heart of the problem, three different military departments claim responsibility for providing, administering, and supporting space forces for the Unified Space Command.

Resource Management for Space

To attain the highest level of organizational effectiveness, a centralized resource allocation function is needed to support our military space forces. This would ensure timely distribution of resources to each organization involved in the military space program in accordance with DoD plans, policies, and requirements. Central allocation should apply to the full spectrum of resources, including research, development, test and evaluation, acquisition, facilities, equipment, operations, maintenance, logistics, supply, training, support, and personnel.

Such a function, inherent in traditional systems management organizational structures (17), is vital if future space forces are to be efficiently and effectively sustained for operational employment. The criticality of this function is only heightened by the fact that while annual DoD expenditures for space have now passed the $15 billion mark (9), they are continuing to increase year after year.

A top level management infrastructure needs to be established within the DoD to support the basic management functions of planning, organization, coordination, direction, and control for space forces. The management infrastructure, depicted at the top of Figure 3, would include three key elements which do not currently exist in the Defense Department. The first element, <u>space operations and requirements</u>, would approve both mission and operational requirements of the user agents and operations agents, respectively, and evaluate operational performance of the various space missions. Secondly, the <u>space plans and programs</u> element would prepare a unified long range plan for systems acquisition and technology development and implement programs to support that plan. Finally, a <u>space resource allocations</u> element would prioritize and control the expenditure of required resources to include men, machines, and materiel to accomplish the space mission.

The top level management infrastructure should be comprised of a wide cross-section of select executive and mid-level management personnel representing each of the services and key government agencies, drawn from all four agents of the "quadrumvirate." While the name of the top level infrastructure is not particularly critical, it should be placed at a level equal to the existing service departments or Defense agencies to be effective. The key contribution of the top level infrastructure, of course, would be to allocate resources and provide direction to all four agents of the quadrumvirate consistent with DoD mission and operational requirements.

A separate service department would best fulfill requirements for the top level infrastructure, because it would lead to the most effective space organization; it could be readily implemented within the existing federalized structure of the Defense establishment; and, it has precedent with the decision that formed a separate Air Force in 1947. Organizational economies may dictate, however, that the service be organized as a separate joint agency or even a special corps, such as the US Marine Corps, within a newly structured US Aerospace Force. (18) Although much of the functional and organizational overhead for a separate space service is already available within the Defense Department, Congressional action will be required to effect the proper organizational and service realignments.

Space Force Command Structure

A separate military department for space, say a US Space Force, could be organized along the lines of that depicted in Figure 4. The command structure for that service could be readily derived through various realignments of existing institutions. For example, a Space Defense Command, reporting to the Chief, US Space Force, could comprise the space combat forces; this could be formed from those elements of both the Air Force and Naval Space Commands which provide for space control and space superiority; and, it could also include any future elements which support force applications missions in space.

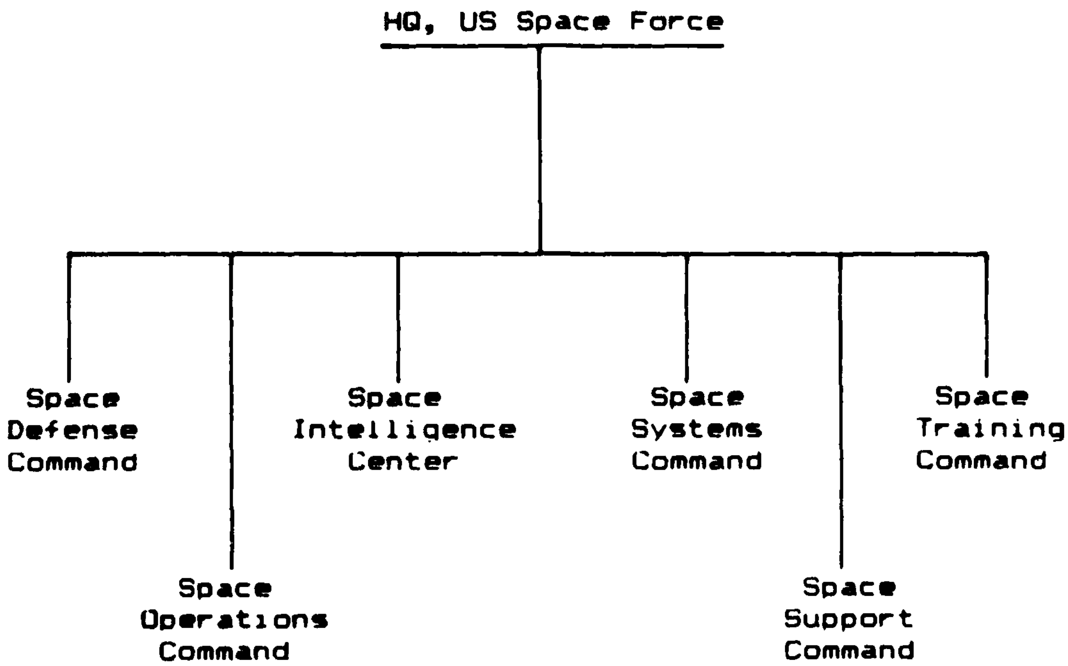

Figure 4

Organization for a

US Space Force

A Space Operations Command could include all existing and future operational satellite control units that provide force enhancement for combat support. Space operations which support attack warning, surveillance, reconnaissance, environmental monitoring, navigation, and communications could be assigned to this command. And, a Space Intelligence Center could be established to maintain the threat and the enemy space order of battle. This could evolve from a consolidation of existing Defense agencies that provide operational intelligence for foreign space systems and activities.

A Space Systems Command could be derived from the existing Space Systems Division (AFSC) and Army and Navy R&D organizations (such as the Army's Ballistic Missile Defense Program and the Navy's Space Systems program office) which conduct research, development, and acquisition of space systems. A Space Support Command could provide launch, early orbit test and evaluation for new systems, and logistics support. This could be organized from existing launch and test range organizations, test and evaluation centers, and Air Force Logistics Command facilities which currently support space activities. Finally, a Space Training Command could comprise existing elements of AF Space Command and Air Training Command which provide general and specialized training support for space system users, operators, and logisticians.

In addition to the resource management issues detailed above, a separate US Space Force could also address operational inconsistencies associated with the Unified Space Command, as pointed out early in the paper. Since space forces would all reside within a single military department, the operational command would comprise forces from but one service component. Therefore, instead of a unified command, a Specified Command could be organized and supported by the US Space Force, consistent with well proven fundamental doctrine established in JCS Pub 2. (16)

Summary

It becomes apparent that if space is not simply a place, but a medium; if the real differences between space and air operations are to be officially recognized; if defense applications in space are to be fully exploited; if national space policy is to be effectively implemented; and, if national objectives are to be attained; then, a new service department is needed to support the military mission in space.

The military space mission is to develop, operate, and employ satellites in support of Defense Department requirements. And, a single US Space Force should be organized, trained, and equipped to perform prompt and sustained offensive and defensive operations in space.

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