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Defense Space Systems Study (U)

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Final Report (U)

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SECTION I

EXECUTIVE SUMMARY

(U) The Secretary of Defense directed the Under Secretaries for Acq and Policy to lead a comprehensive review of U.S. national security programs. The Secretary's January 1988 tasking said the review wou accomplished in two phases. The first, led by USD(P), resulted in a Joint C. of Staff Memorandum titled "Space Component of U.S. Military Strategy Warfighting Requirements for U.S. Military Systems" (JCSM 91-88). T second phase, led by USD(A), resulted in the deficiencies specified in JCS 91-88 being clarified and program options to solve them identified. The Phase II effort was performed in cooperation with a broad segment of the DoD space community.*

(U) This Final Report documents the results of the Phase II portion of the review. It is divided into three sections: Deficiency Analysis Results, Program Options Results, and Major Findings and Recommendations. Additionally, there are two appendixes which provide supplemental information concerning the study: Study Tasking and Guidance, and Space Systems Descriptions.

(~~S~~)

(U) This report provides a basis for developing an overall acquisition strategy for DoD space programs. Work should continue to resolve which options to pursue based upon priorities and costs and to develop an overall space systems acquisition strategy.

*(U) Initial deficiency analysis and program options were presented during a workshop in November 1988. Participants from OSD, Joint Staff, SDIO, DCA, DMA, USSPACECOM and its components, and all four Service Staffs reviewed the initial deficiencies and program options. The results of the workshop were incorporated into the study effort.

(U) Deficiency Analysis Results

(U) The following conflict levels were defined and agreed upon to ensure all Functional Planning Areas, as identified in the DoD Space Policy, were consistently evaluated against the same scenario:

Unstressed - Day-to-day operation of space systems.

Stressed - Space systems are operating in an environment where satellites are being attacked via one or more forms of ASATs and the ground segments are being attacked. CONUS is still a sanctuary, therefore, any attacks within CONUS are covert.

War - U.S. Forces, along with our allies, are involved in a conflict against our main adversaries in many regions around the world. Nuclear weapons are being exchanged, including strategic assets. CONUS is not a sanctuary.

Post-SIOP - The period after war when the world is transitioning back to peace and recovery.

(S) [

]

(U) Program Option Analysis Results

(S) The Program Options Analysis examined ways to correct the deficiencies identified in JCSM 91-88. (These are summarized beginning on page III-19.) The Space Support Functional Planning Area needs substantial investment for an assured capability. A new initiative should be considered that addresses all aspects of access to space, not just booster technologies and launch procedures. For example, a balanced mix of several options which include, but not limited to, launch on schedule, standardized interfaces between boosters and satellites, and providing on-orbit contingency capabilities, should be considered. [

]

ABILITY TO MEET WARFIGHTING REQUIREMENTS (U)

FY94

Space Support

- Access to Space
- Satellite Control

Force Enhancement

- Ballistic Missile TW/AA
- C2 Communications
- Space Surveillance
- Navigation
- Intelligence Collection
- Environmental Monitoring
- NUDET Detection
- Ocean and Battlefield Surveillance
- Friendly Missile Operations
- Enemy Space Activity
- Mapping, Charting, & Geodesy

Space Control

- Space Surveillance
- ASAT Capability
- Survivability & Endurance

Force Application

- Defensive
- Offensive

* See alternative view, page II-8

(S)

(S)

(U) The Force Application Functional Planning Area comprises two functions: Defensive Force Application (Ballistic Missile Defense and Air Defense) and Offensive Force Application (space-based weapon systems against terrestrial targets). Options for Ballistic Missile Defense were deferred pending resolution of the comprehensive set of options under consideration for the Strategic Defense Initiative. Options for Air Defense were deferred until development of the Air Defense Initiative is better formulated. Offensive Force Application is not included in the deficiency and option analyses because the requirements have yet to be formulated.

(U) Overall space operations C2 can be defined as the integrated function encompassing all space functions which cannot be allocated among the four functional planning areas of Space Support, Force Enhancement, Space Control and Force Application, or among the individual functions that constitute these functional planning areas. Overall Command and Control (C2) of space operations is accomplished by several operations centers and their backups under direction of USSPACECOM and the three component space commands. Although the overall C2 function is not explicitly addressed in JCSM 91-88 nor was a consensus reached during the Phase II study, the for need examining this function is presented in the report.

(U) Major Findings and Recommendations

(S) Major Findings

[

The study assumed systems and system improvements already in the FYDP through FY94 would be implemented. If funding for these systems is decreased, significant changes could occur to the deficiency values for some functions. For example, [

]

(U) Recommendations

System planners and developers should place priority on incorporating survivability options in space systems and the interrelationships of their system within the overall U.S. military space program. The systems should be as survivable as the forces they are supporting. Survivability options should consider all segments of the system; i.e., ground, space, communications links, and user.

Explicit Post-SIOP requirements should be developed for all space systems that are expected to be needed in the post-SIOP time frame.

Overall space operations command and control (C2) should be defined and treated as a separate functional planning area.

A prioritized list of options for each function needs to be developed based upon requirements and National space policy objectives.

Rough order of magnitude costs need to be obtained once there is adequate definition of the options.

An acquisition strategy needs to be developed when the results of the prioritization and costing are blended into an acceptable list.

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SECTION II

DEFICIENCY ANALYSIS RESULTS

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INTRODUCTION

(U) The Requirements and Deficiencies portions of the Defense Space Systems Study Workshop examined the conflict levels and the Functional Planning Area Deficiencies. The Workshop participants agreed on the Levels of Conflict. They are:

Unstressed - Day-to-day operation of space systems.

Stressed - Space systems are operating in an environment where satellites are being attacked via one or more forms of ASATs and the ground segments are being attacked. CONUS is still a sanctuary, therefore, any attacks within CONUS are covert.

War - U.S. Forces, along with our allies, are involved in a conflict against our main adversaries in many regions around the world. Nuclear weapons are being exchanged, including strategic assets. CONUS is not a sanctuary.

Post-SIOP - The period after war when the world is transitioning back to peace and recovery.

(~~S~~) The requirements to be satisfied within each Functional Planning Area were examined. Many requirement assumptions were made for each system within the Functional Planning Areas as the areas were evaluated against each conflict level.

(U) The deficiency analysis/review resulted in a bottom line value for each Functional Planning Area. The individual elements that contributed to the overall deficiency value and/or any weighting among elements within a Functional Planning Area were not specificly addressed. The individual elements were reviewed as they related to the Functional Planning Area, however it was a very subjective consensus that resulted in the overall red/yellow/green rating. It was stressed that a green value did not mean all requirements could be accomplished in that area; but, most requirements could be accomplished although there may be some minor deficiencies. Red, likewise, was not an indication that all requirements were unsatisfied, but major deficiencies existed that prevented most requirements from being met. Yellow, on the other hand, meant there are some deficiencies, but many requirements could be met. The requirements for the individual systems dictated what is considered red, yellow or green. Their summation within a Functional Planning Area is subjective, and workshop attendees reached a consensus with the above stated considerations. The following pages describe the overall deficiency consensus of the attendees for each Functional Planning Area. The total picture is presented as the "Ability to Meet Warfighting Requirements." The values are based upon what is programmed to be operational (at least IOC) in FY94

ABILITY TO MEET WARFIGHTING REQUIREMENTS (U)

FY94

Space Support

- Access to Space
- Satellite Control

Force Enhancement

- Ballistic Missile TW/AA
- C2 Communications
- Space Surveillance
- Navigation
- Intelligence Collection
- Environmental Monitoring
- NUDET Detection
- Ocean and Battlefield Surveillance
- Friendly Missile Operations
- Enemy Space Activity
- Mapping, Charting, & Geodesy

Space Control

- Space Surveillance
- ASAT Capability
- Survivability & Endurance

Force Application

- Defensive
- Offensive

* See alternative view, page II-8

(S) Space Support

ACCESS to SPACE

Unstressed	Stressed	War	Post-SIOP
[			]

(S) The Space Launch Recovery Program has made a near-term significant contribution to the capacity and resiliency of the U.S. launch infrastructure, however, the study participants felt there were still areas needing improvements. Because of numerous single points of failure within the Function, unstressed was considered yellow. If a booster has a major malfunction, the entire launch system is put on hold until the cause can be identified and any appropriate corrections to the system implemented. Likewise, a damaged launch pad can put future launches from that pad on hold. Timeliness of launch was also a factor in assessing the unstressed level yellow. Although no specific requirements have been formalized in terms of days, weeks, or month for satellite launch and timeliness is unique for each satellite system, the study participants felt it was still deficient.

(S) Stressed is considered [ ] primarily because of lack of surge capability. During this conflict level, the ability to quickly replace failed/damaged/destroyed satellites would have a high priority. [ ] While the lack of a surge capabilit affects each satellite systems differently, there was general agreement that improvements are needed in our repleminishment capabilities. This conflict was rated [ ] because of the varriety of possible scenarios.

(S) [ ]

(S) Space Support

SATELLITE CONTROL

Unstressed	Stressed	War	Post-SIOP
[			]

(S) Unstressed is [redacted] the systems are capable of performing Satellite Control. The requirements are adequately met as demonstrated by day-to-day operations.

(S) * Although most believe the Unstressed environment is [ ] the Naval Space Command believes it should be [ ] They feel the current systems (primarily the AFSCN) are being stretched to their capacity. If all planned satellite launches are successful and no satellites are retired, they feel there may not be sufficient capacity to control all on-orbit assets. Major modifications are required to the Data Systems Manager (DSM) at the AFSCN's control station to correct the situation.

(S) A stressed conflict level causes the value to be scenario dependent. [

] Likewise, low earth orbiting satellites scheduled for updates in that area would have to rely on other ground control stations. These stations could become overloaded and fail to provide all required satellite contacts/updates. Additionally, an increase in satellite contacts is highly possible due to the nature of the conflict. This increase in tasking could overload the ground control centers/sites with some resulting degradation in satellite operations. Although

(S) Force Enhancement

TACTICAL WARNING/ATTACK ASSESSMENT & FRIENDLY MISSILE OPERATIONS*

Unstressed	Stressed	War	Post-SIOP

(U) The following evaluation is limited to ballistic missile tactical warning/attack assessment. The function Friendly Missile Operations is the detection and tracking of US and Allied ballistic missile operations and uses the same systems as TW/AA. It is a subset under TW/AA and senses the same phenomenology used by enemy missiles.* The workshop attendees could see no basic difference in the two Functional Planning Areas, thus they are combined from a deficiency analysis viewpoint.

(U) Unstressed is green. The systems are capable of performing their assigned missions on a day-to-day basis.

(S)

* Friendly Missile Operations is a specified requirement from three different CINCs. It is considered a separate Functional Planning Area to better reflect the CINC's warfighting requirements and not lose it in consolidation of requirements among broad traditional categories.

(S) Force Enhancement

C2 COMMUNICATIONS

Unstressed	Stressed	War	Post-SIOP
(S)			
(S)			
(S)			
(S)			

(S) Force Enhancement &
Space Control

SPACE SURVEILLANCE

Unstressed	Stressed	War	Post-SIOP
(S)			
(S)			
(S)			

(S) Force Enhancement

NAVIGATION

Unstressed	Stressed	War	Post-SIOP
(S)			
(S)			
(S)			
(S)			

(S) Force Enhancement

INTELLIGENCE COLLECTION

Unstressed	Stressed	War	Post-SIOP
(S)			
(S)			
(S)			
(S)			

(S) Force Enhancement

ENVIRONMENTAL MONITORING

Unstressed	Stressed	War	Post-SIOP
(S)			
(S)			
(S)			

(U) Force Enhancement

NUCLEAR DETONATION DETECTION

Unstressed	Stressed	War	Post-SIOP

(~~S~~) Force Enhancement

OCEAN & BATTLEFIELD SURVEILLANCE

Unstressed	Stressed	War	Post-SIOP
(~~S~~)			
(~~S~~)			
(~~S~~)			
(~~S~~)			

(~~S~~) Force Enhancement

ENEMY SPACE ACTIVITY *

Unstressed	Stressed	War	Post-SIOP

(U) Enemy Space Activity* is a combination of Space Surveillance, Intelligence Collection and some aspects of Tactical Warning/Attack Assessment. The same reasons that Space Surveillance and Intelligence Collection were assessed their associated values apply to this function.

(~~S~~)

(~~S~~)

* Enemy Space Activity is a specified requirement from three different CINCs. It is considered a separate Functional Planning Area to better reflect the ASATs warfighting requirements and not lose it in consolidation of requirements among broad traditional categories.

(S)

(S) Force Enhancement

MAPPING, CHARTING & GEODESY

Unstressed	Stressed	War	Post-SIOP

(S)

(S)

(S)

(U) Space Control

ANTISATELLITE CAPABILITY

Unstressed	Stressed	War	Post-SIOP
[redacted]			

(S) Space Control

SURVIVABILITY & ENDURANCE

Unstressed	Stressed	War	Post-SIOP

(U) This function is integral to the one for Satellite Control within the Space Support Functional Planning Area. Many of the same reasons affect the values displayed for this functional area. The systems are designed and do survive and endure in the day-to-day, undisturbed by man, natural, space environment, therefore, a green value.

(S)

(S)

(S)

(U) Force Application

DEFENSIVE & OFFENSIVE APPLICATIONS

Unstressed	Stressed	War	Post-SIOP

(U) The United States presently does not have any defensive or offensive force application capability from space ~~therefore the values are red.~~ This is compatible with the National Space Policy which states that the DoD will, consistent with treaty obligations, conduct research, development, and planning to be prepared to acquire and deploy space weapons systems for strategic defense should national security conditions dictate.

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DEFICIENCY ANALYSIS BRIEFING CHARTS

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Space Support(U)

ACCESS to SPACE(U)

Unstressed | Stressed | War | Post-SIOP

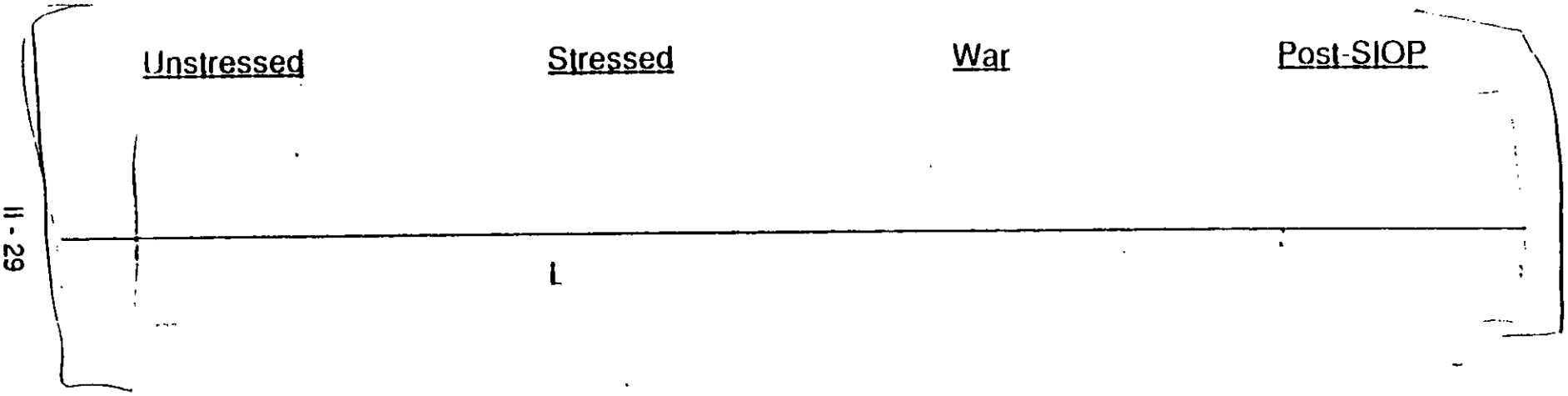
Space Support(U)

SATELLITE CONTROL(U)

Unstressed | Stressed | War | Post-SIOP

Force Enhancement(U)

TACTICAL WARNING/ATTACK ASSESSMENT(U)
FRIENDLY MISSILE OPERATIONS(U)



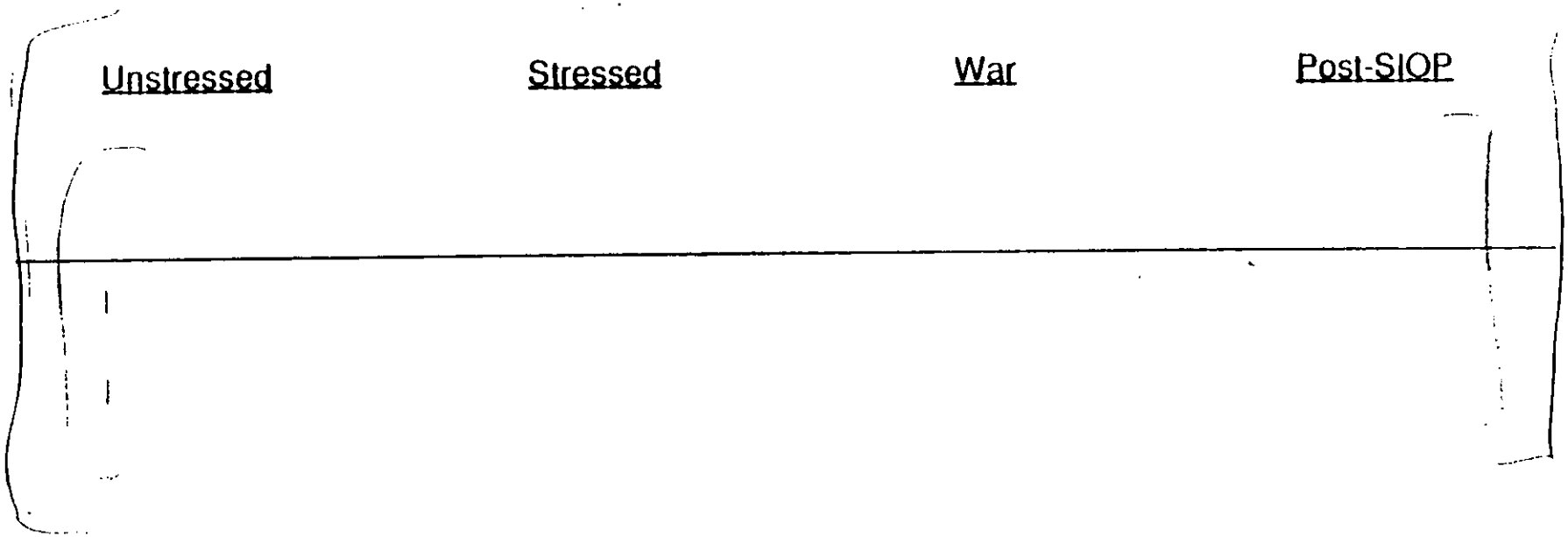
Force Enhancement(U)

C2 COMMUNICATION(U)

Unstressed	Stressed	War	Post-SIOP

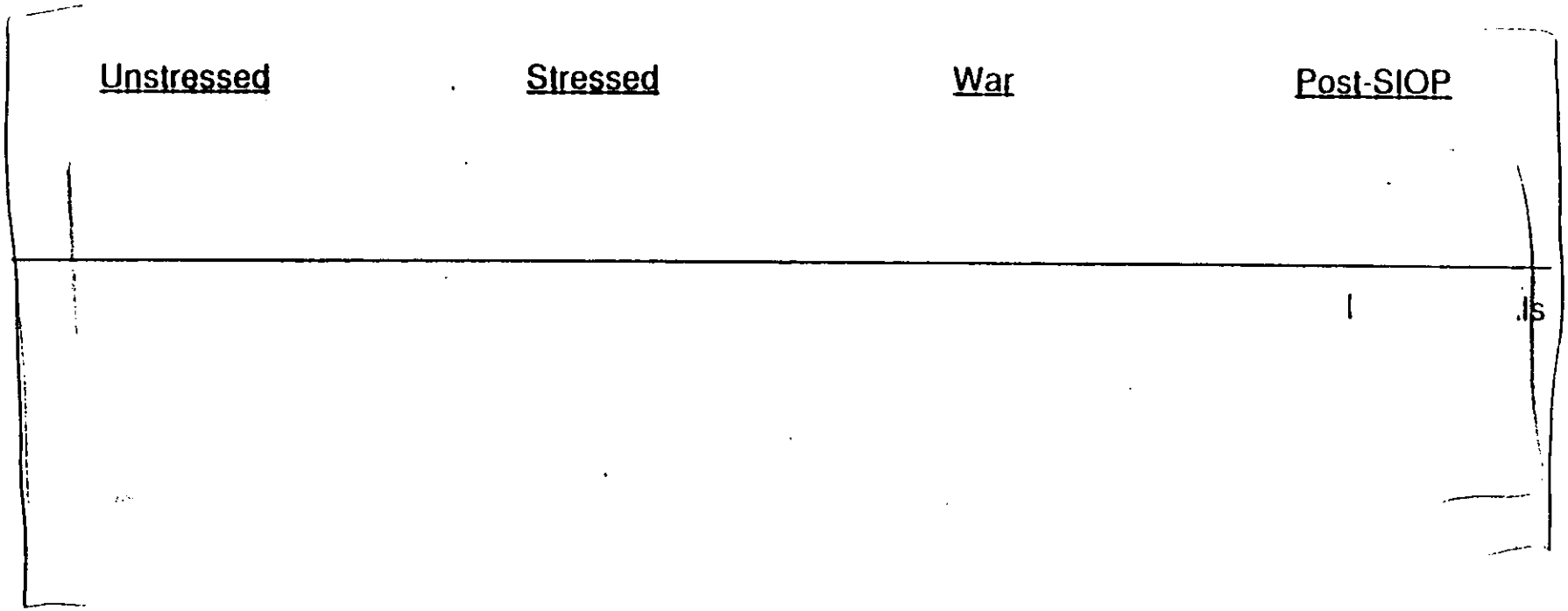
Force Enhancement(U)
Space Control(U)

SPACE SURVEILLANCE(U)



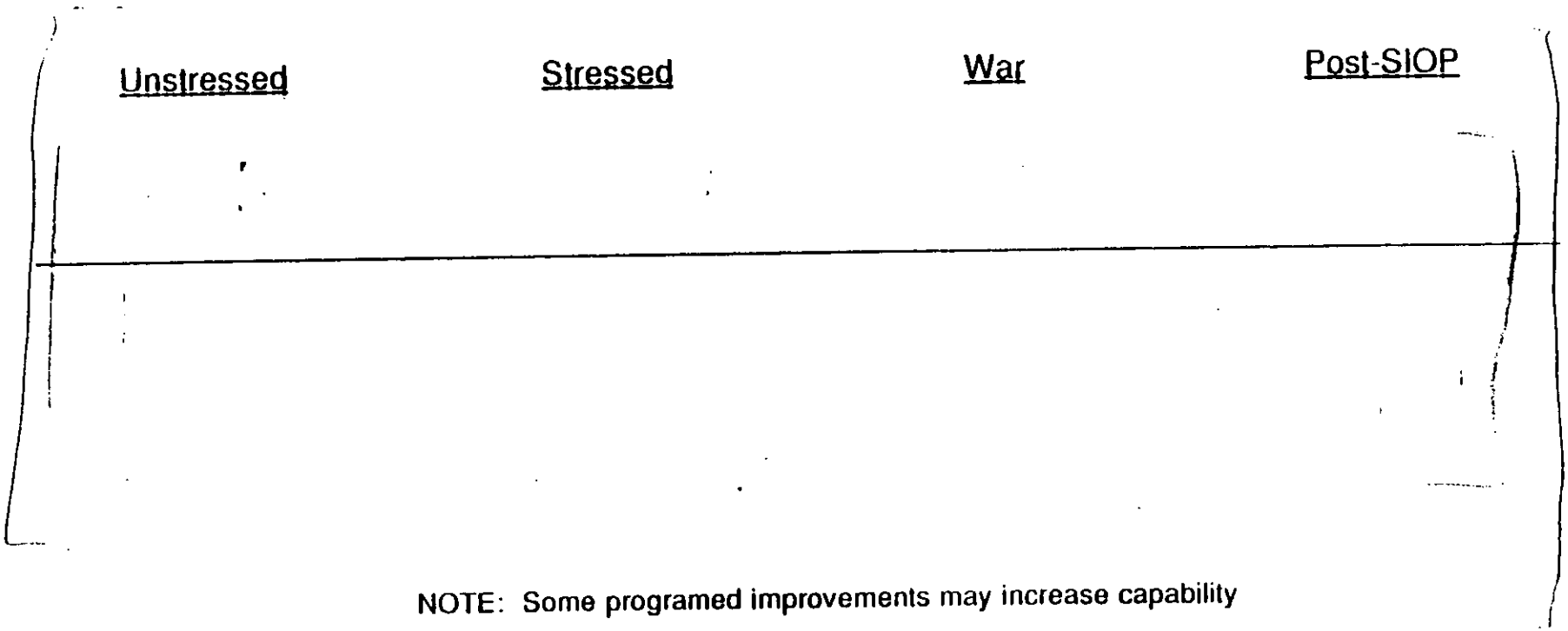
Force Enhancement(U)

NAVIGATION(U)



Force Enhancement(U)

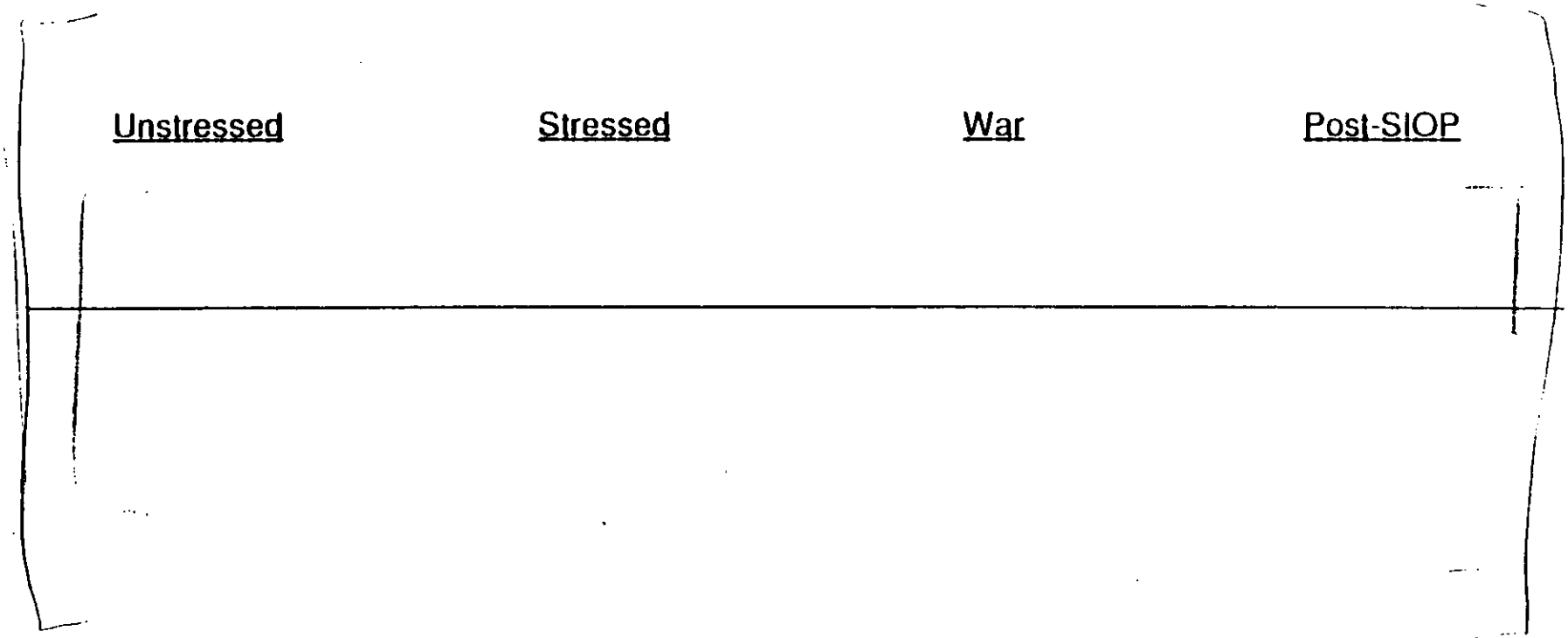
INTELLIGENCE COLLECTION(U)



NOTE: Some programed improvements may increase capability

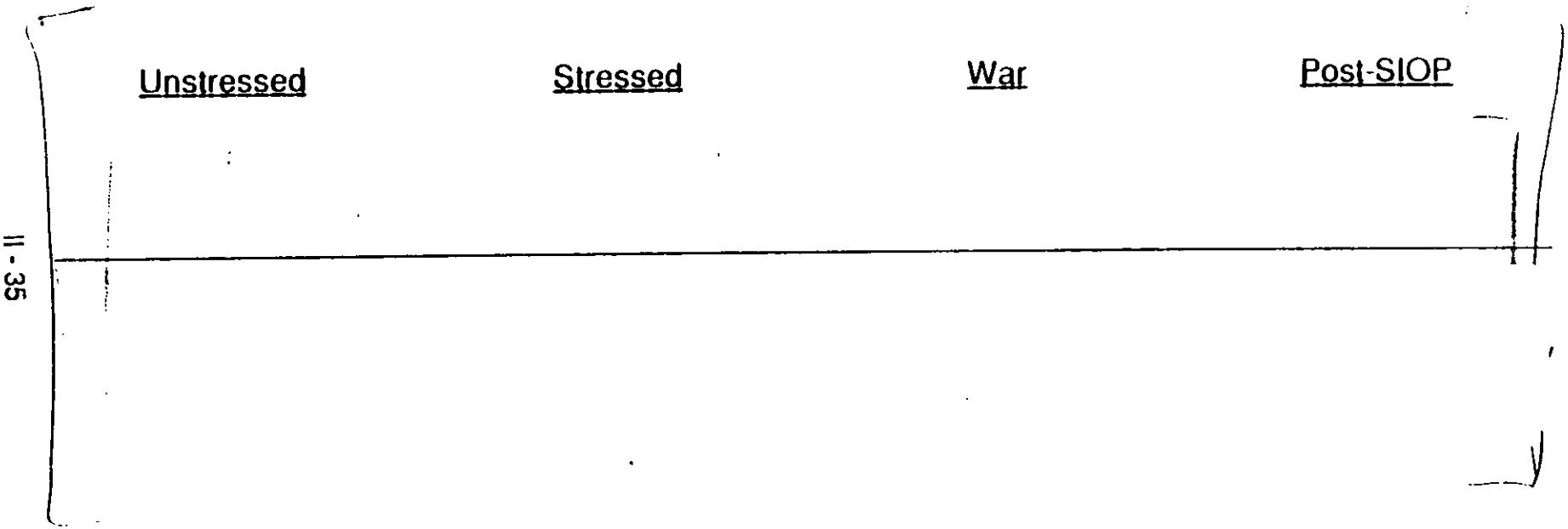
Force Enhancement(U)

ENVIRONMENTAL MONITORING(U)



Force Enhancement(U)

NUCLEAR DETONATION DETECTION(U)



Force Enhancement(U)

OCEAN & BATTLEFIELD SURVEILLANCE(U)

Unstressed	Stressed	War	Post-SIOP

NOTE: Some programed improvements may increase capability

Force Enhancement(U)

ENEMY SPACE ACTIVITY(U)

Unstressed | Stressed | War | Post-SIOP

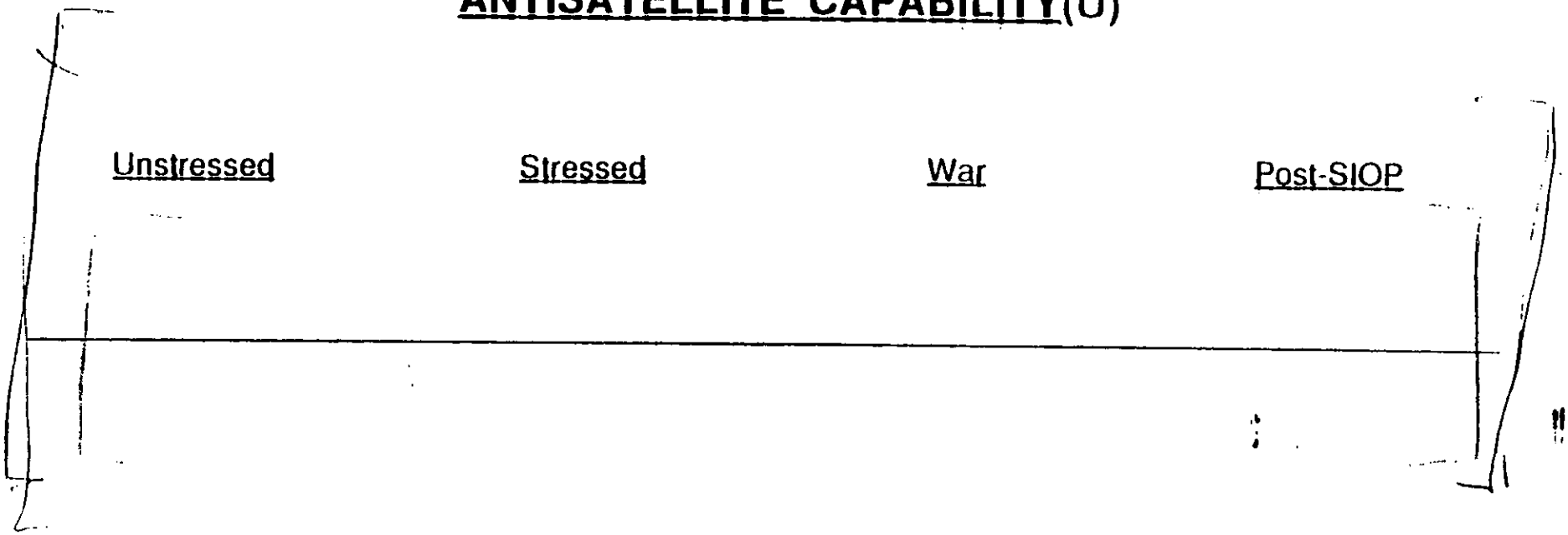
Force Enhancement(U)

MAPPING, CHARTING & GEODESY(U)

Unstressed	Stressed	War	Post-SIOP

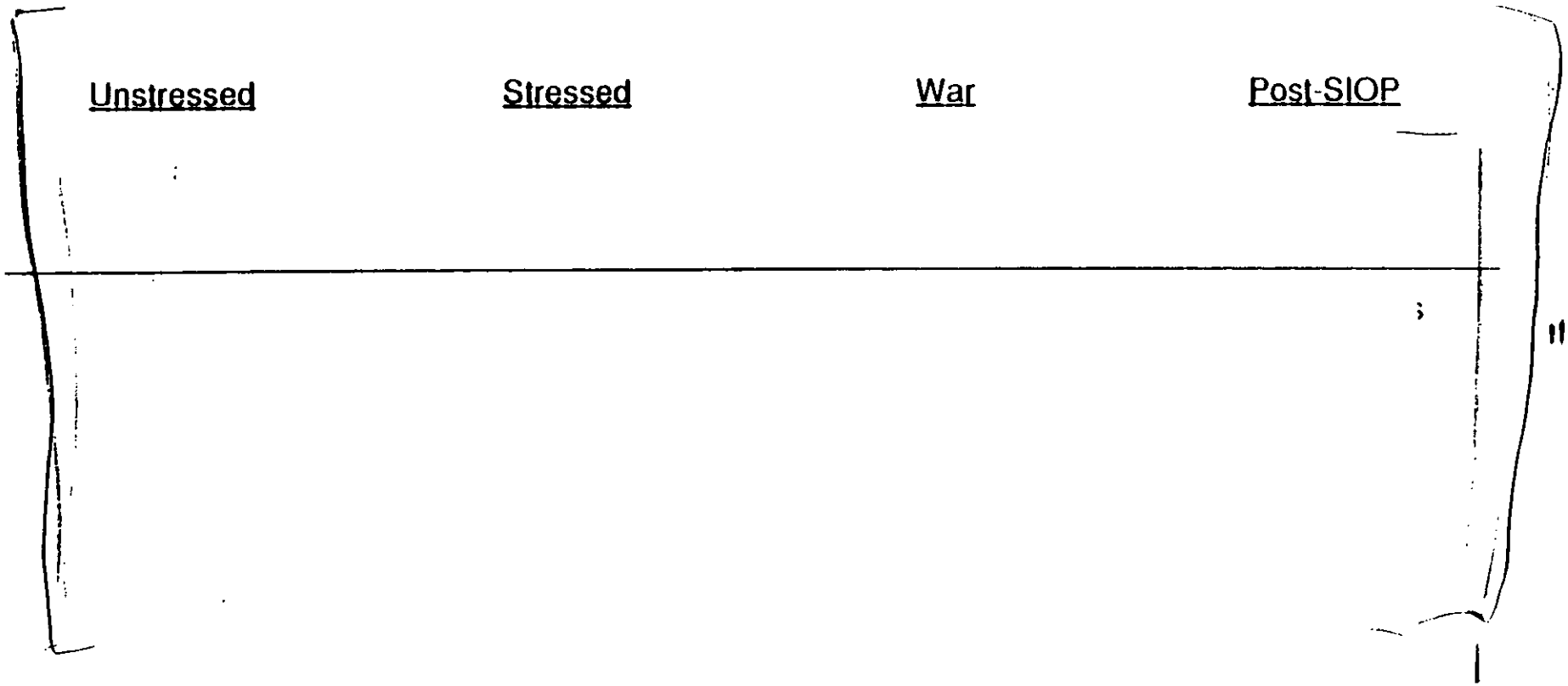
Space Control(U)

ANTISATELLITE CAPABILITY(U)



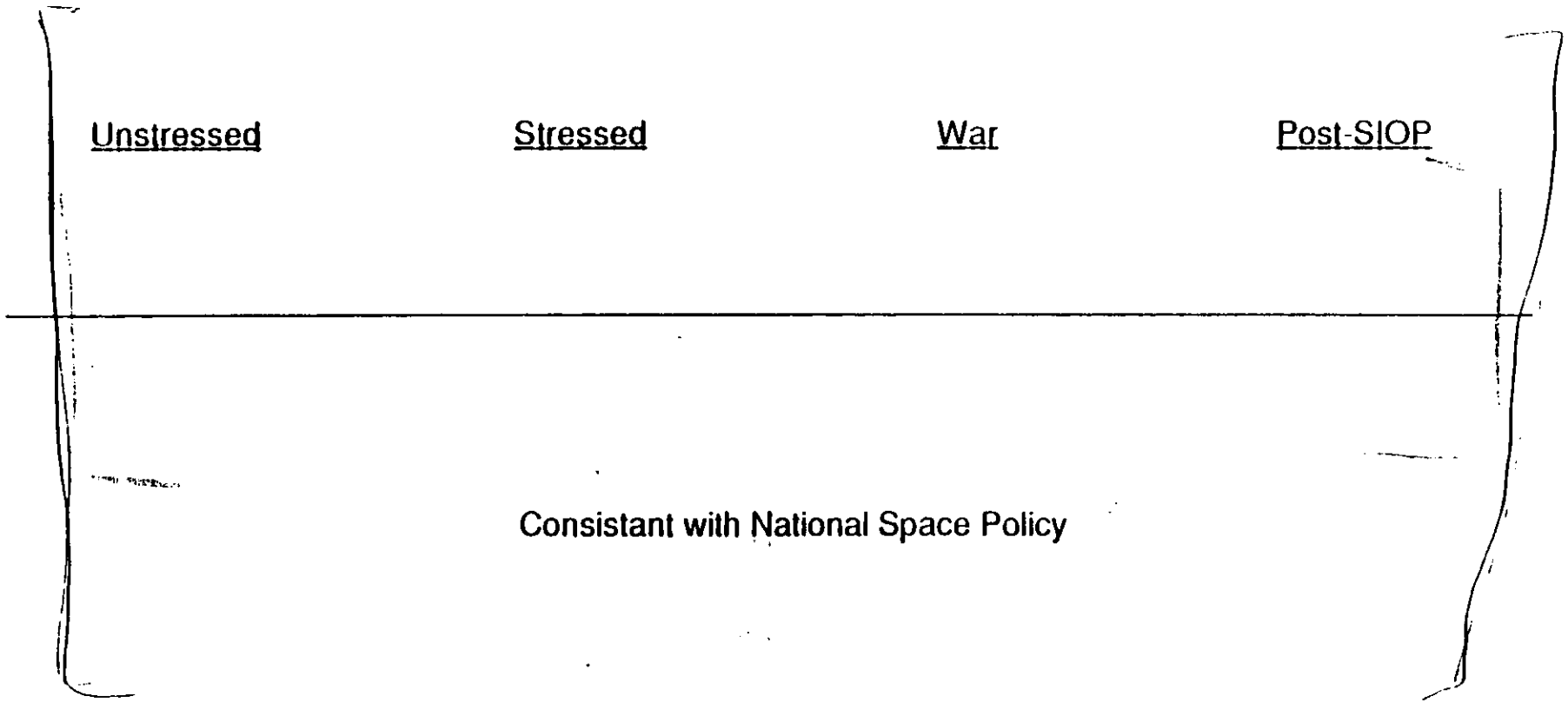
Space Control(U)

SURVIVABILITY & ENDURANCE(U)



Force Application(U)

DEFENSIVE APPLICATIONS(U)
OFFENSIVE APPLICATIONS(U)



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SECTION III

PROGRAM OPTION ANALYSIS RESULTS

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PROGRAM OPTIONS ANALYSIS RESULTS

Introduction

(U) The program options analysis of the Defense Space Systems Study examined ways to correct the deficiencies identified in Joint Chiefs of Staff Memorandum (JCSM) 91-88 and are summarized in Section II of this report. The methodology for options identification used the requirements and deficiencies in JCSM 91-88 as a starting point.

(U) Next, a parameterization of the requirements and deficiencies was performed if validated documentation could be located. This was not always the case for each space functional area. It was often necessary to express requirements in terms of quantitative parameters in order to determine whether an option would satisfy a requirements deficiency. An example of requirements parameterization is given in the chart on methodology (Page III - 13). Meetings between personnel from headquarters and acquisition program offices were used to identify concepts and options that these experts considered plausible. Possible choices were reviewed and integrated into a set of options for each functional planning area.

(S)

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Results Overview

(U) **Space Support**

(U) The Space Support Functional Planning Area needs substantial investment for an assured capability. Since the multiple launch failures of 1986, an extensive review and revision of space launch policy and booster procurement has restored national capabilities for launching satellites to pre-1986 levels. Nevertheless, these are peacetime launch capabilities and are inadequate to assure access to space during hostilities. For this purpose, an entirely new initiative is needed. This initiative must address all aspects of access to space, not just booster technologies and launch procedures. Assured access to space can be achieved with a balanced mix of the following options: launch on schedule, providing on-orbit contingency capabilities; planned ground storage of satellites and boosters to support launch surges; standardized interfaces between boosters and satellites, providing booster selection flexibility; additional and multiple use launch pads; and a new, quick-response launch system. Satellite Control deficiencies can be eliminated by developing an integrated satellite control network, as defined in MROC 04-88, and by using Extremely-High-Frequency (EHF) for telemetry, tracking & control (TT&C), satellite crosslinks, mobile control stations, and standardized TT&C for all space systems.

(U) Force Enhancement

(U) Six of 11 Force Enhancement Functional Planning Area functions were analyzed for program options. Of the five remaining functions, one Space Surveillance is analyzed under the Space Control Functional Planning Area and another, Tactical Intelligence Collection, was deferred because of classification constraints. Two, Friendly Missile Operations and Enemy Space Activity, were considered as part of other functional areas. The last one, Mapping, Charting and Geodesy (MC&G), was only addressed from a survivability/endurability standpoint because JCSM 91-88 did not identify any deficiencies.

(S) The options proposed for Tactical Warning and Attack Assessment (TW/AA) are Defense Support Program (DSP) related. [redacted] TW/AA will benefit collaterally from improvements in Space Control, C2 Communications and Ocean and Battlefield Surveillance functions.

(U) The Command and Control (C2) Communications area has specific survivability and endurance options in addition to dynamic, real-time allocation of channels, laser communications, additional satellites in inclined orbits, crosslinks, and low data rate packages in inclined orbits.

(U) Navigation options include accelerated acquisition of presently developed military terminals, satellite updates via Ultra High Frequency (UHF) crosslinks, mobile ground stations for satellite control, and relocatable monitor stations.

(U) Nuclear Detonation Detection systems are available, however, more terminals need to be procured for the tactical forces. Survivability and endurance options for nuclear detonation detection are the same as for navigation, because the principal space system for both functions is the Global Positioning System/Nuclear Detection System (GPS/NDS).

(S) Options for Ocean and Battlefield Surveillance are closely related to improvements in Space-based sensors dedicated to tactical forces have high priority in Ocean and Battlefield Surveillance. Other options provide improved responsiveness, timeliness, dissemination of data to tactical users, as well as increased survivability and endurance.

(U) Many technical options are identified for Environmental Monitoring. They include a new satellite for oceanographic sensing, environmental monitoring sensors on host satellites, contingency military utilization of commercial and Allied weather satellites, acquisition of commercial and more military receivers, and additional sensors on the Defense Meteorological Support Program (DMSP) satellites.

(U) Prioritization of these many options relative to other functional areas is required to formulate a meaningful acquisition plan.

(U) **Space Control**

(S) Options for the Space Control Functional Planning area are centered on needs for antisatellite (ASAT) capabilities to deny our adversaries the use of space and to defend U.S. satellites against hostile ASATs. During 1988, a General Officer steering group formulated an ASAT acquisition plan, and in January 1989, the Defense Acquisition Board approved the ASAT plan. This plan directed that an ASAT program for a surface based kinetic energy weapon proceed to Milestone 1 by December 1989. In addition to planned ASAT weapon systems, other options that are effective in solving space control deficiencies include space-based space surveillance systems, a deep-space surveillance radar network, , data processing automation, and improvements in systems command, control and communications (C3).

(U) Increased survivability and endurance of US space systems are part of the balanced approach required for space control. Survivability and endurance are particularly effective in creating a dilemma for adversaries attacking U.S. space systems. This dilemma strategy is a principal component of the warfighting strategy presented in JCSM 91-88.

(U) Improvements in survivability and endurance must be tailored for each space system and mission. Therefore, rather than identifying specific improvements for each space functional area, options for Survivability and Endurance are listed in terms of the following generic categories: ground station mobility, electronic counter-countermeasures, satellite crosslinks, on-board sensors, ASAT countermeasures, nuclear and laser hardening, and

mitigation of RF propagation degradation by nuclear weapon effects. Implementation of these generic concepts in terms of specific options must be planned and funded for each U.S. military space systems.

(U) **Force Application**

(U) The Force Application Functional Planning Area comprises two functions: Defensive Force Application (Ballistic Missile Defense and Air Defense) and Offensive Force Application (space-based weapon systems against terrestrial targets). Options for Ballistic Missile Defense were deferred pending resolution of the comprehensive set of options under consideration for the Strategic Defense Initiative. Options for Air Defense were deferred until development of the Air Defense Initiative is better formulated. Offensive Force Application is not included in the deficiency and option analyses because the requirements have yet to be formulated.

Command and Control of Space Functions

(U) Overall space operations C2 can be defined as the integrated function encompassing all space functions which cannot be allocated among the four functional planning areas of Space Support, Force Enhancement, Space Control and Force Application, or among the individual functions that constitute these functional planning areas. Overall Command and Control (C2) of space operations is accomplished by several operations centers and their backups under direction of USSPACECOM and the three component space commands. Although the overall C2 function is not explicitly addressed in JCSM 91-88 nor

was a consensus reached at the workshop, the need for examining this function is presented in the report.

Options Versus Deficiencies Analysis

(U) In this subsection, options are assessed versus deficiencies for the functions analyzed. The baseline for each function encompasses programmed improvements through FY94. Each option is to be considered as an addition above the programmed baseline.

(U) The options for each function are presented in random order and unprioritized. The next logical step is to price the options and to prioritize them in accordance with budget constraints. Although costs can be determined analytically, prioritization is judgmental. Low-cost, low-priority options may win out over high-cost, high-priority solutions because the latter often imply new space systems that cost billions of dollars.

(U) The following charts present the methodology for the options analyses, summarizes the analysis performed, and present the results as an assessment of options versus deficiencies. The assessment itself was primarily accomplished during the 15-17 November 1988 OUSD(A) Defense Space Systems Study Workshop.

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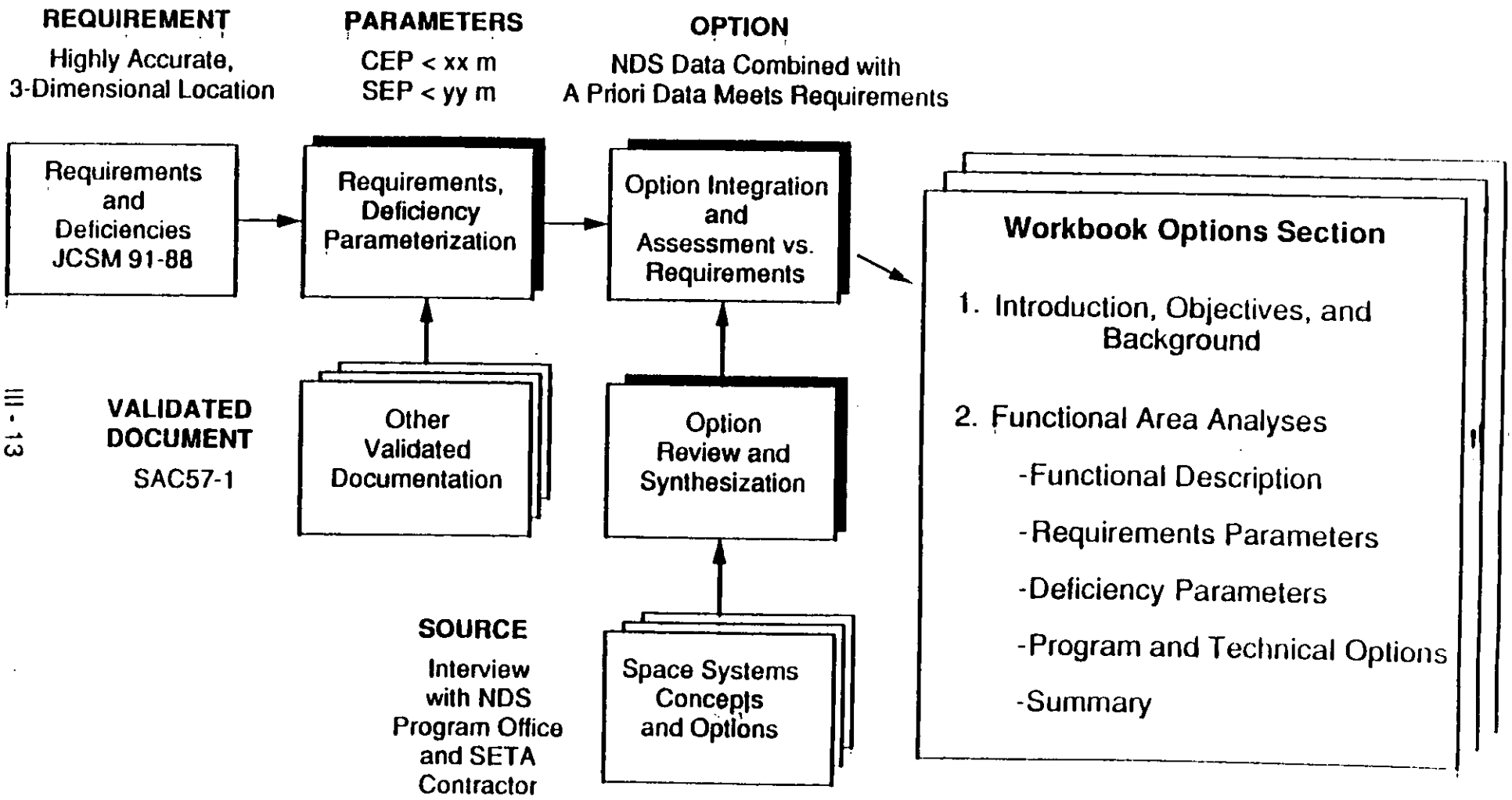
METHODOLOGY

UNCLASSIFIED

METHODOLOGY FOR OPTION IDENTIFICATION
(NDS Example)



FUNCTIONAL PLANNING AREAS

Space Functions are organized under four Functional Planning Areas: Space Support, Force Enhancement, Space Control, and Force Application. Although there are functional interdependencies among the planning areas, it is possible to analyze requirements, deficiencies, and options for each space function separately.

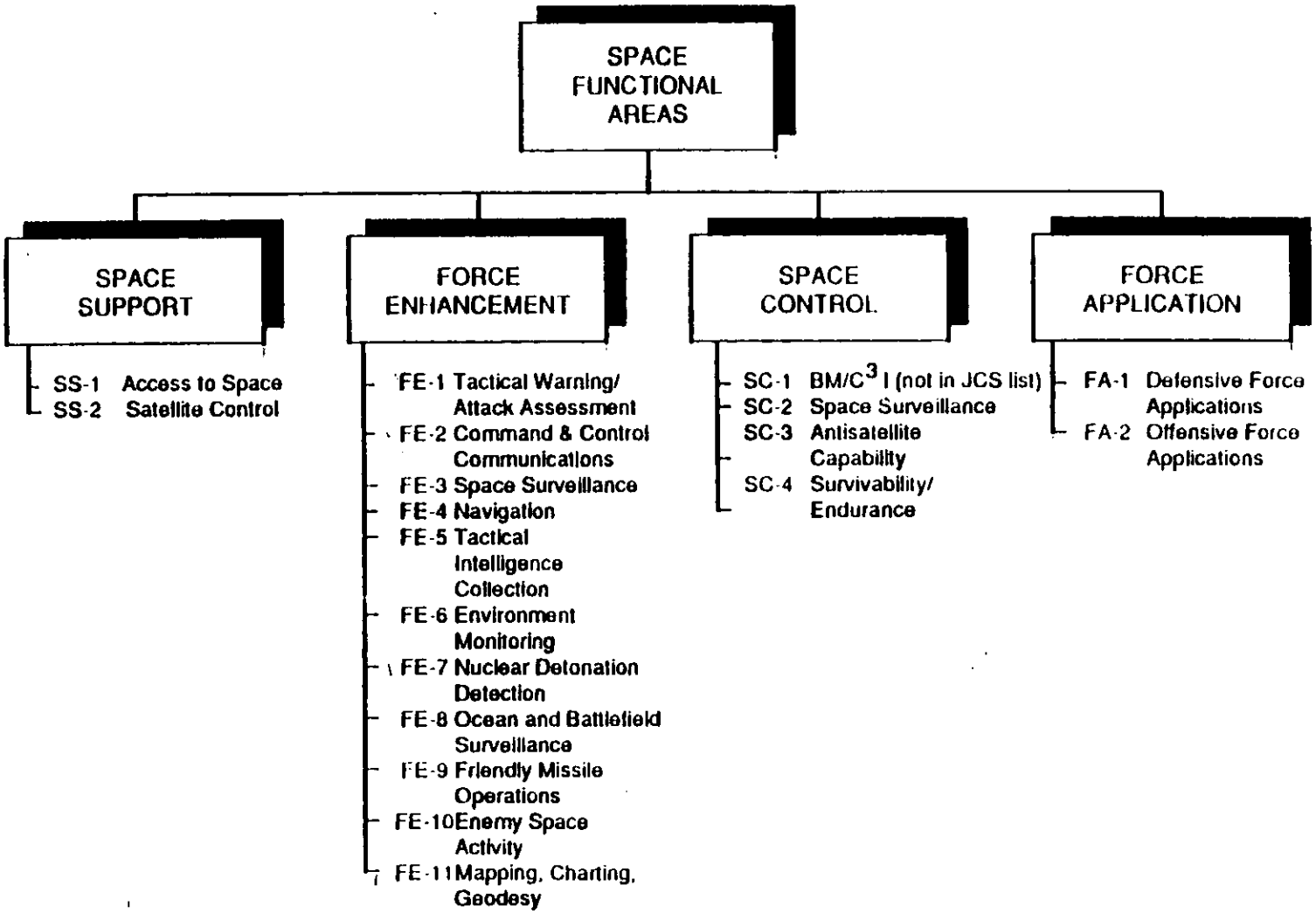
Space Support comprises functions of launching satellites into space, maintaining adequate on-orbit capability to meet contingencies with sufficient mission availability, and controlling satellites in orbit.

Force Enhancement is the support provided terrestrial military forces by space systems.

Space Control ensures United States access to space and denies any adversary the use of space for military purposes.

Force Application is characterized by space weapon platforms for ballistic missile and aerospace defense and for offensive missions against terrestrial targets.

FUNCTIONAL PLANNING AREAS



OPTIONS LIST COMPILED FROM EXISTING BACKGROUND

A preliminary options list was complied from interviews with relevant organizations and program offices as shown on the left of the chart and from documents shown on the right side.

The options for each functional area were then researched and augmented by participants during the November 1988 workshop.

METHODOLOGY FOR OPTION IDENTIFICATION

The shadowed boxes show the tasks performed in option identification. The methodology is demonstrated using the Nuclear Detection System (NDS) as an example.

The starting point is the result from Phase I of the Defense Space Systems Study, JCSM 91-88 (Space Component of US Military Strategy and Warfighting Requirements for US Military Space Systems). Although JCSM 91-88 is comprehensive, it is necessarily top-level and unable to address requirements and deficiencies in terms of quantitative parameters.

The first subtask in options identification is to identify the parameters and values corresponding to the qualitative requirements and deficiencies identified in JCSM 91-88. The source of these parameters must be a validated document. For some space functions, it was not possible to locate validated quantitative parameters for requirements and deficiencies. For the NDS example, SAC 57-1 specifies classified values for circular error probability (CEP) and spherical error probability (SEP) as requirements.

The next subtask is to obtain descriptions of options being considered for the baseline capability. Typically these options were identified as a result of interviews with experts in each functional area. For the example of NDS, interviews were conducted with the joint program office at USAF Space Division and with the NDS systems engineering and technical assistance (SETA) contractor.

The third and last subtask is to integrate the information obtained on program or functional area options with the parameterized requirements and deficiencies, if any. For the NDS case, it was determined that an enhancement of circular error probability can be obtained by fusing NDS data with previously known information in a terrestrial processing center.

As will be subsequently summarized, this methodology was applied to each of the space functions such as Satellite Control, Navigation, and Space Surveillance.

OPTIONS LIST COMPILED FROM EXISTING BACKGROUND

ORGANIZATION AND PROGRAM OFFICE INTERVIEWS

- USSPACECOM
- NAVSPACCECOM
- MILSTAR Joint Program Office
- GPS/NDS Joint Program Office
- USAF Space Division SPOs
- Office of Naval Research
- NASA

DOCUMENTATION

- USCINCSPACE Master Plan
- Navy Space Master Plan
- Army Space Architecture
- MROCs, ROCs, and SONs
- Program Office Baseline Documentation
- Functional Area Architectures

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FUNCTIONAL PLANNING AREA SUMMARIES

SPACE SUPPORT SUMMARY

Integrated Approach for Assured Access Required

Access to Space is often interpreted as being limited to satellite launches and their associated boosters. Access to Space encompasses a logistics approach that will assure sufficient assets in space to provide mission availability whenever needed. This includes sufficient capacity to account for contingencies such as launch failures or unanticipated increases in need.

Each space system should have a logistics approach based on mission models and wartime scenarios. The logistics plan must be broader in scope than just launching weight into space.

Satellite Control is being performed adequately. Nevertheless, the existing satellite control capability must be integrated into a network that is operable during hostilities by military personnel under a single, unified command structure.

FORCE ENHANCEMENT
Functions Not Addressed

- TACTICAL INTELLIGENCE COLLECTION
  - Closely Related to Ocean and Battlefield Surveillance
  - Out of Scope for this Study due to Classification Considerations
- FRIENDLY MISSILE OPERATIONS
  - Detection and Tracking of US and Allied Ballistic Missiles
  - No Deficiencies Identified in JCSM 91-88
  - Satisfied by TW/AA Capabilities
- ENEMY SPACE ACTIVITY
  - Interpreted as Foreign Space Order of Battle
  - No Deficiencies Identified in JCSM 91-88
  - Satisfied Collaterally in Space Surveillance, Ocean & Battlefield Surveillance and Tactical Intelligence Collection
- MAPPING, CHARTING, AND GEODESY
  - No Deficiencies Identified in JCSM 91-88

SPACE SUPPORT SUMMARY
Integrated Approach or Assured Access Required

- SPACE SUPPORT FUNCTIONAL AREAS
  - Access to Space
  - Satellite Control

- ACCESS TO SPACE MORE THAN LAUNCH SYSTEMS
  - Extensive National Review and Revision of Launch System Acquisition Policy Since 1986 Launch Failures
    - -- Focused on Restoring Launch Capability
    - -- Based Primarily on Weight in Orbit
  - Space Systems Logistics Approach Required
    - -- Driven by Military Space Mission Models and Scenarios
    - -- Includes Factors Other Than Weight in Orbit: Availability, Launch Responsiveness and Flexibility, Survivability/Endurability
    - -- Based on Logistics Plans for Each Military Space System

- SATELLITE CONTROL MUST TRANSITION TO MILITARY OPERATIONS ENVIRONMENT
  - Integrated C^2 Networks, Not Fragmented
  - Operable by Military Personnel, Not Contractors
  - Survivable and Enduring in Hostilities, Not a Peacetime Operation

- BOTTOMLINE: ACCESS TO SPACE AND SATELLITE CONTROL NEEDS SUBSTANTIAL INVESTMENT FOR ASSURED CAPABILITY

FORCE ENHANCEMENT

Functions Needing Substantial Augmentation (U)

(S) Although the Ocean and Battlefield Surveillance function has high priority, it is
function areas because of the cost associated with even an initial capability. Unlike other space functions, e.g. Communication, Navigation and Environmental Monitoring, it is difficult to obtain useful ocean and battlefield surveillance capability with a modest beginning. There is considerable potential to increase the utility for ocean and battlefield surveillance, just as there are multiple proposals for development of sensors and deployment technologies. These options tend to be considered individually and separately. There is a need for an overall plan to meet joint service requirements for Ocean and Battlefield Surveillance.

(U) Command and Control Communication suffers primarily from capacity deficiencies. Although these deficiencies can be corrected by investing in more capacity, there is also potential for effectively increasing existing capacity with dynamic allocation of channels, communality and standardization among the Services, and backup utilization by commercial systems to provide some surge capability.

(U) Adequate sensor technology exists for Environmental Monitoring. This space function is characterized by far more civil capability than military capability. In addition to augmenting existing military environmental systems, there is potential for dual military and civil programs, e.g. GPS.

(U) Effective Force Enhancement requires Command, Control, and Communications (C3) between the military forces being supported and the commands that operate the satellites. This C3 is essentially nonexistent and is part of the overall issue regarding deficiencies in the Command and Control structure for Space Operations.

FORCE ENHANCEMENT
Functions Needing Substantial Augmentation (U)

- (S) OCEAN AND BATTLEFIELD SURVEILLANCE
  - One Dedicated Space System
  - Starting Point: Overall Plan to Meet Joint-Service Requirements Needed

- (U) COMMAND AND CONTROL COMMUNICATIONS
  - Capacity and Responsiveness Deficiencies
  - Fragmented, Statically-Allocated Space Communications Networks
  - Considerable Potential for Cost-Effective Capacity Increases
    - -- Dynamic Allocation of Existing Communication Resources
    - -- Commonality and Standardization Among Future Networks

- (U) ENVIRONMENTAL MONITORING
  - Adequate Sensor Technology Exists
  - Most Environmental Monitoring Satellites Are Civilian U.S. and Allied
  - Military and Civil Systems Have Many Similarities
  - Potential for Dual Military/Civil Programs, Like GPS

- (U) OPERATIONAL COMMAND, CONTROL, AND COMMUNICATIONS
  - Force Enhancement Is Space Support of Military Forces
  - C^3 Between Military Forces and Space System Operational Control Is Essentially Nonexistent

FORCE ENHANCEMENT

Functions Needing Some Augmentation (U)

(S) Programmed improvements in Tactical Waring and Attack Assessment (TW/AA) are keeping pace with the increasing space threat. Improvements are needed in terms of other space functions like Space Surveillance and Ocean and Battlefield Surveillance and in terms of collateral C3 capabilities needed for Space Control. There are several options that could be implemented on the or its successor the that will correct some TW/AA deficiencies.

(U) Capabilities for Navigation and Nuclear Detonation Detection are well matched The principal needs are accelerated acquisition of terminals

FORCE ENHANCEMENT
Functions Needing Some Augmentation (U)

(S) • TACTICAL WARNING/ATTACK ASSESSMENT

- Collateral Improvements from Other Functional Areas
  - -- Space Surveillance
  - -- Space Operations Centers: USSPACECOM, Army, Navy, Air Force Space Operations Centers and SPADOC
  - -- Future Ocean/Battlefield Surveillance
  - -- C^3 Improvements

(U) • NAVIGATION AND NUCLEAR DETONATION DETECTION

- Cost Effective Terminals
- Autonomy Improvements

FORCE ENHANCEMENT
Functions not Addressed

Classification precluded identification and analyses of systems options for the Tactical Intelligence Collection function. Because National Systems can collaterally provide support for Ocean and Battlefield Surveillance, options identified for that function may also improve some aspects of Tactical Intelligence Collection.

The function of tracking U.S. and Allied ballistic missiles is accomplished with the same assets used in Tactical Warning and Attack Assessment. Although no deficiencies were identified for Friendly Missile Operations in JCSM 91-88, it is assumed that these requirements are met by the TW/AA function.

Likewise, requirements for the Enemy Space Activity function are assumed to be collaterally satisfied by the functions of Space Surveillance, Ocean and Battlefield Surveillance and Tactical Intelligence Collection.

There were no deficiencies identified for Mapping, Charting and Geodesy. Because the space portion of these functions are accomplished prior to hostilities, it is concluded that survivability and endurance are not major issues.

SPACE CONTROL
Driven by ASAT

Although the Space Control Functional Planning Area includes Surveillance, Antisatellite Capability, and Survivability and Endurance, the requirements are currently being driven the ASAT program approved on 9 January 1989 by the Defense Acquisition Board for Milestone 1. National and DoD space policy requires a capability for response in kind and flexibility. These policy requirements imply the need for multiple negation approaches and ASAT weapon types. Management of this multiplicity of approaches for negation implies, in turn, a Battle management/C3 fountain that will also have the requirement to allocate surveillance, survivability and negation resources in a balance response.
At this time, there is no capability for negation. The ASAT weapon systems and the requisite BM/C3 must be acquired.

Space Surveillance will have to be modified to support the negation function. In addition, because of budget constraints, capability and timeliness improvements in U.S. space surveillance have considerably lagged increases in requirements for surveillance, detection, tracking, and identification of space threats. Space surveillance upgrades are required to satisfy these deficiencies as well as to to satisfy the requirements for ASAT support. The Current space surveillance networks was not designed for ASAT support.

Survivability and endurance technology development is funded in 6.2 and 6.3 programs as well as in SDI. If the SDI budget is significantly reduced, technology developments in 6.2 and 6.3 programs for survivability and endurance will have to be augmented. Implementation of survivability and endurance is accomplished by individual system program offices and is addressed separately in this study.

Access to Space is often interpreted as being limited to satellite launches and their associated boosters. Access to Space encompasses a logistics approach that will assure sufficient assets in space to provide mission availability whenever needed. This includes sufficient capacity to account for contingencies such as launch failures or unanticipated increases in need.

Each space system should have a logistics approach based on mission models and wartime scenarios. The logistics plan must be broader in scope than just launching weight into space.

Satellite Control is being performed adequately. Nevertheless, the existing satellite control capability must be integrated into a network that is operable during hostilities by military personnel under a single, unified command structure.
Classification precluded identification and analyses of sys-

SPACE CONTROL: DRIVEN BY ASAT

- SPACE CONTROL FUNCTIONAL AREAS
  - Space Surveillance
  - ASAT
  - Survivability/Endurability
  - Battle Management, Command and Control (Not in JCSM 91-88)
- SPACE SURVEILLANCE ASSESSMENT
  - Capability and Timeliness Improvements Substantially Lagging Requirements Increases
  - Low Survivability and Endurance
  - Upgrades Required to Support ASAT
- ASAT: NEW ACQUISITION NEEDS FUNDING
- SURVIVABILITY/ENDURANCE
  - Implementation Included Within Each Space System Program
  - Technology Development in Technology Base (62XXX), Development (63XXX), and SDI
- BATTLE MANAGEMENT AND C^2
  - Typically Underemphasized
  - Needs Inclusion in Overall Space Operations C^2
  - Addressed in ASAT Defense Acquisition Board Milestone 0 Decision

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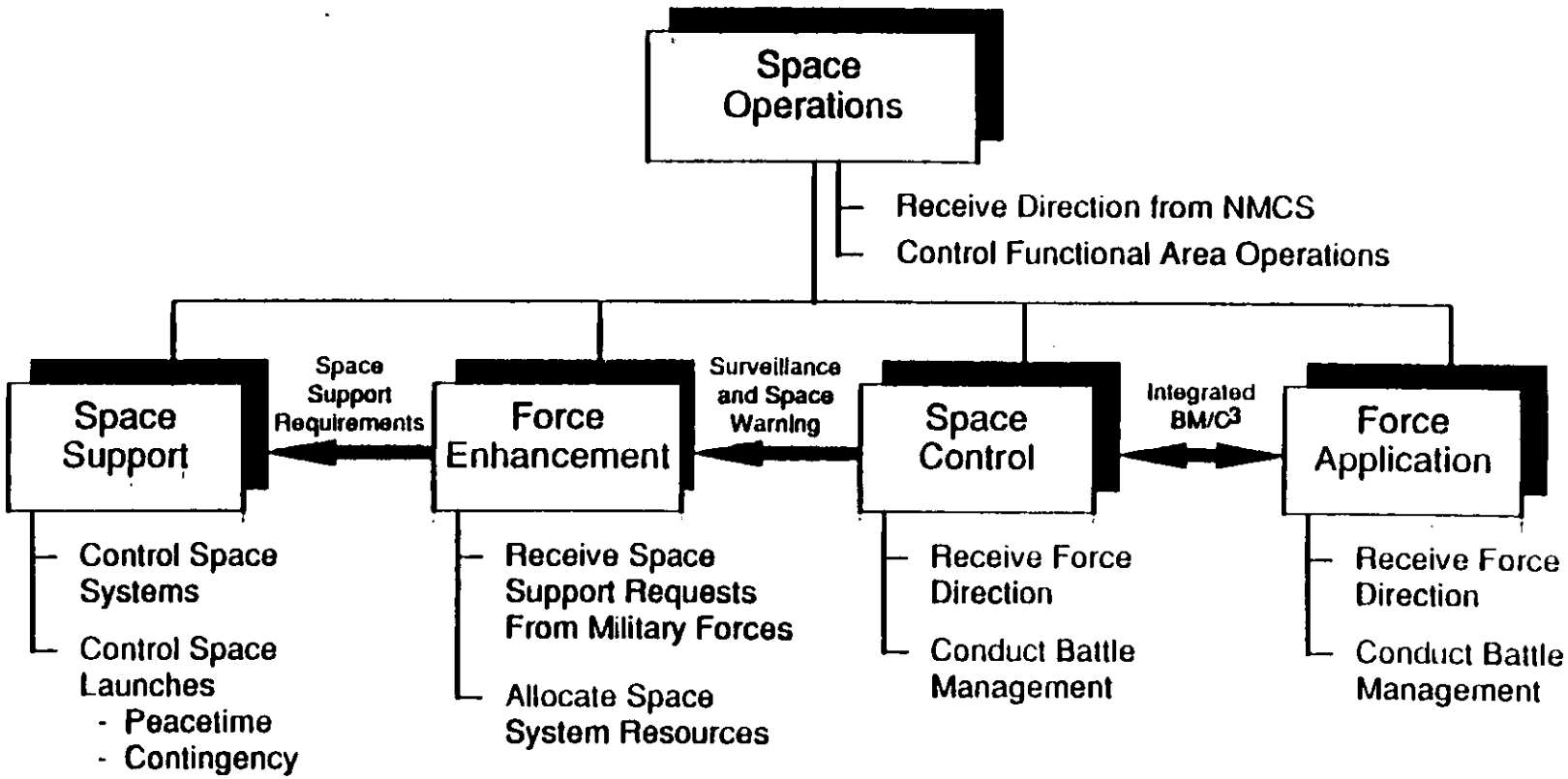
COMAMND AND CONTROL STRUCTURE

for

SPACE OPERATIONS

UNCLASSIFIED

SPACE OPERATIONS
Functions Need Integrated C^2 Structure



EXAMPLE OF C2 INTERDEPENDENCIES REQUIRING INTEGRATED C2 APPROACH

This chart illustrates C2 data flows from the Space Control Functional Planning Area to the Force Enhancement and Space Support Functional Planning Areas, as well as information flows among the functions that constitute Space Control. A Battle Management/C3I function for Space Control and an overall C2 approach for Space Operations are required to ensure that these data exchanges occur accurately and in a timely manner.

Although the procedures for executing individual space functions are know and understood, the scenario of events that probably will occur during hostilities are unpredictable. Command and Control is required to apply space resources effectively in response to the unfolding and counteracting flow of hostile actions.

SPACE OPERATIONS

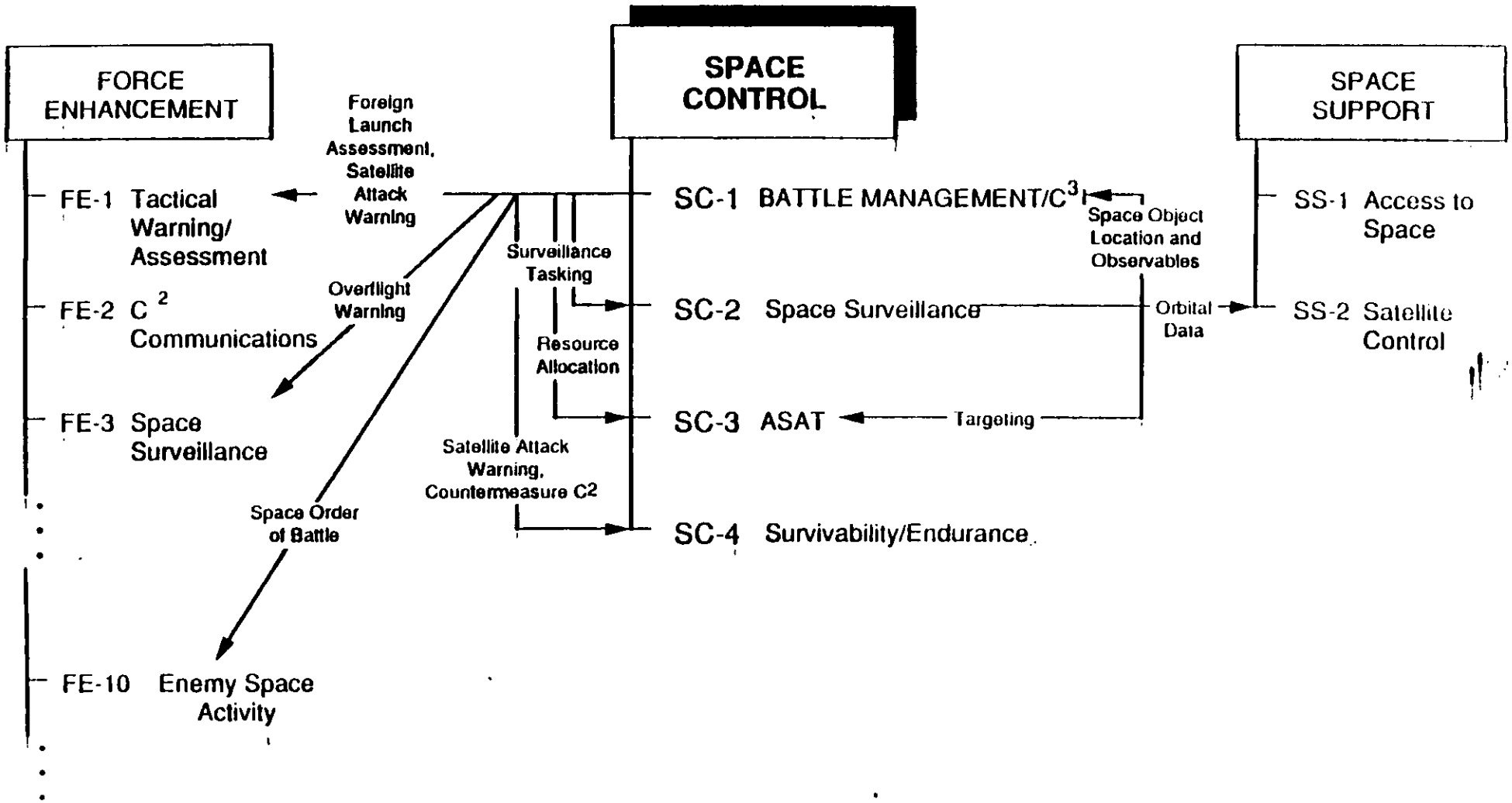
Functions Need Integrated C2 Structure

Command and Control (C2) provides the entire Space Operations area functional structure. Although C2 is common to all space functions, Space Operations C2 is a function unto itself, requiring resources such as command centers, computers, software and communications.

As shown in the chart, the Functional Planning Areas have interdependencies that require integrated C2. Furthermore, to effectively allocate costly space resources to those military forces with the highest priority needs, the space operational commands must receive prioritized requests from the military forces in a timely manner.

Space operations C2 must be recognized as an explicit function needing implementation. If it is not stated explicitly, interfaces will be neglected and total costs will be underestimated.

EXAMPLE OF C^2 INTERDEPENDENCIES REQUIRING INTEGRATED C^2 APPROACH

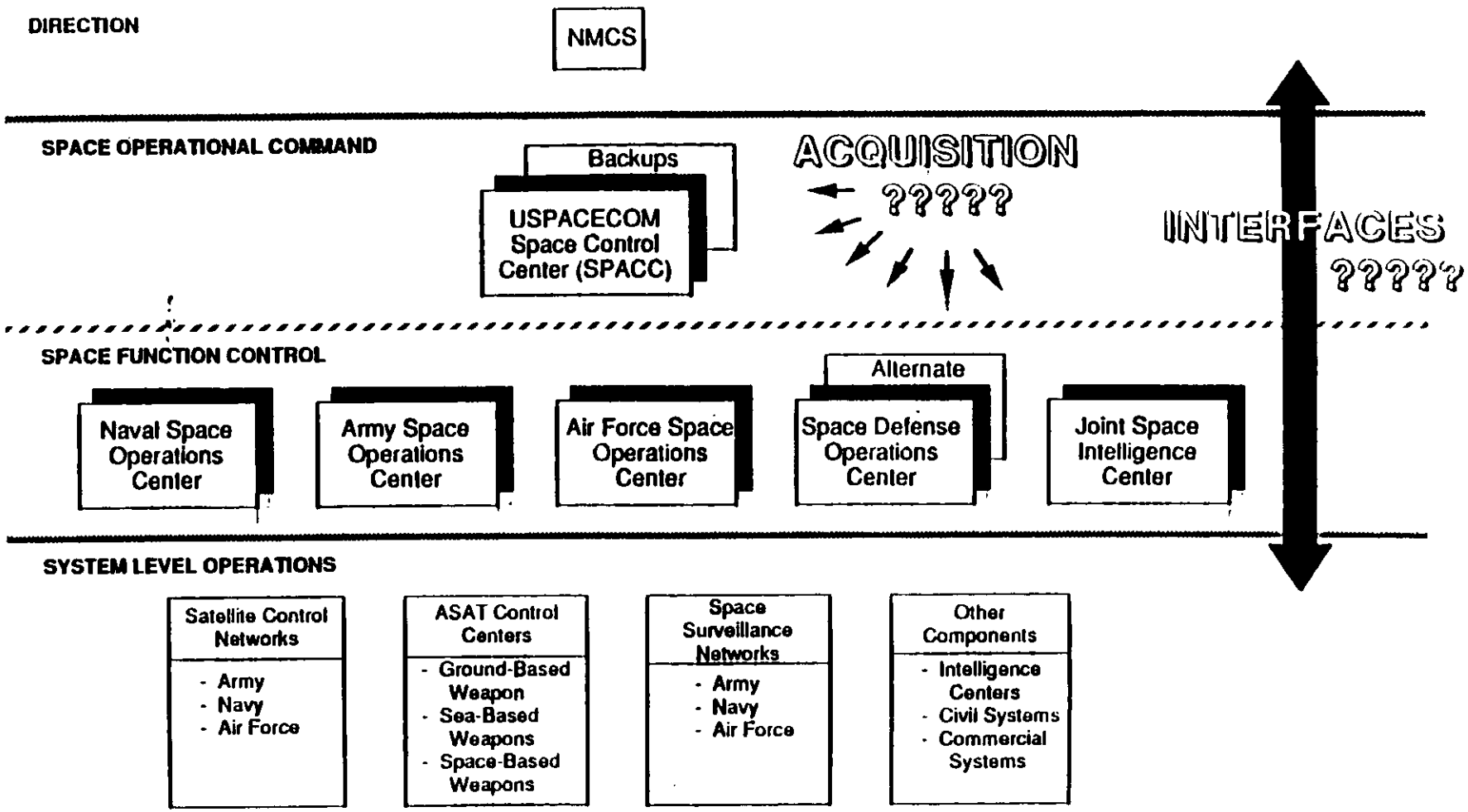


NEW OR UPGRADED SPACE C2 ELEMENTS IDENTIFIED

Space C2 elements identified in validated documentation are illustrated on the chart by shadowed boxes. These centers, the interfaces among them, and the interface to other space operations elements are in varying stages of development.

Although the overall C2 architecture is in the progress of being defined, it is unlikely that the funding programmed through FY 94 will be adequate to provide the Command and Control model for assured space mission performance.

NEW OR UPGRADED SPACE C^2 ELEMENTS IDENTIFIED



SUMMARY OF SPACE OPERATIONS C2

An assessment of options for Space Operations C2 was infeasible for this study because Command and Control is treated implicitly. Requirements, baseline, and deficiencies cannot be isolated for analysis.

This treatment is changing in view of the establishment of a Battle Management/Command, Control and Communications (BM/C3) element for ASAT development and the attention being paid to an overarching architecture in the U.S. Space Command study on Assured Mission Support Space Architecture being performed throughout 1989.

Additional funding above the FY89 level will probably be required to implement the necessary C2 structure.

SUMMARY OF SPACE OPERATIONS C^2

- SITUATION
  - Space C^2 Elements (CCEs) Exist in Varying Levels of Implementation, for Example, SPACC, SPADOC, NAVSPOC, . . .
  - Various Space C^2 Architectures Initiated; None Validated

- ASSESSMENT
  - No Overall Space C^2 Architecture or Plan Located
  - Most Space C^2 Operations Centers and Interfaces Need Upgrades
  - FYDP Funding Probably Inadequate

- RECOMMENDATION
  - Decide Whether Space C^2 Is an Issue
  - Formulate Approach for Identifying Requirements and Concepts
  - Include Planning Wedge in FYDP if Necessary

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ASSESSMENT

of

OPTIONS versus DEFICIENCIES

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

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DEFICIENCIES: ACCESS TO SPACE (U)

DEFICIENCIES SUMMARY	INTERPRETATION
Responsiveness	- Timeliness: Turnaround Times Too Long - Capacity: No Additional Capacity for Contingencies and Unanticipated Workloads
Flexibility	- Inability to Launch Boosters from Different Pads - Inability to Mate Payloads to Different Boosters
Survivability	- Pads as Single-Point Failures [redacted] - Vulnerable Launch Sites [redacted]

OPTIONS: ACCESS TO SPACE

1. LAUNCH ON SCHEDULE, INCLUDING ON-ORBIT CONTINGENCY CAPABILITY

2. SPACE SYSTEMS SURVIVABILITY:
   - Ground Station Mobility
   - ECCM
   - Satellite Crosslinks
   - On-Board Sensors (SOARS)
   - ASAT Countermeasures (Maneuvering, ECM, OCM)
   - Nuclear and Laser Hardening
   - Mitigation of RF Propagation Degradation

3. ACQUIRE ADDITIONAL SATELLITES AND BOOSTERS TO SUPPORT SURGE AND LAUNCH ON SCHEDULE

4. SURVIVABLE AND ENDURING LAUNCH CAPABILITY OF MILITARY OPERATIONAL SUPPORT SATELLITES (MOSS) AND LIGHTSAT CONCEPTS

5. STANDARDIZED BUS/BOOSTER INTERFACES

6. EVOLUTION TO SDS HIGH-RATE LAUNCH SYSTEMS

7. ADDITIONAL AND MULTIUSE PADS

8. DUAL-SOURCE INDUSTRIAL BASE

9. NEW, QUICK-RESPONSE LAUNCH SYSTEMS (NDV)

DEFICIENCIES VERSUS OPTIONS: ACCESS TO SPACE (U)

DEFICIENCIES	CONFLICT LEVEL: UNSTRESSED	STRESSED	WAR	POST-SIOP
Responsiveness: Timeliness and Capacity (Surge)	1+3+9, 6	1+3+9, 6	(1+3 or 3+9 Obviate Need in War or Post-SIOP) 4	4
Flexibility: Boosters to Pads, Payloads to Boosters	5 + 7	5 + 7	Deficiencies Not Applicable	
	7, 4	7, 4	4	4
[redacted]	8	8		
Survivability: Vulnerable Launch Sites	No Deficiency	4	4	4
[redacted]	No Deficiency	2	2	2

○ Deficiency Fully Satisfied ◐ Deficiency Partially Satisfied

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
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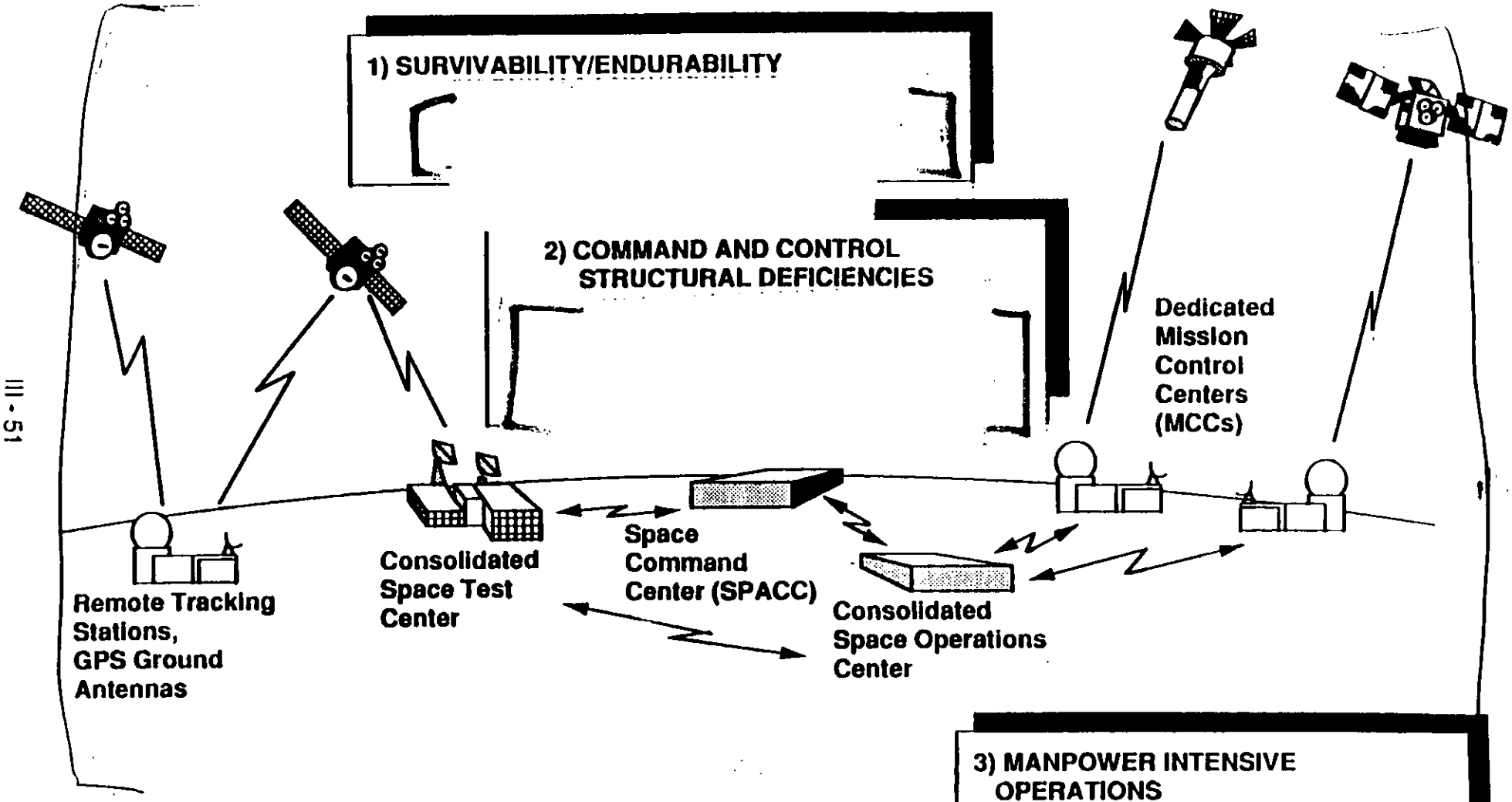
DEFICIENCIES: SATELLITE CONTROL (U)

THREE MAJOR AREAS



3) MANPOWER INTENSIVE OPERATIONS

- Personnel Intensive, Unique Space Systems
- Contractor Support Dependencies
- Multiplicities of Logistics Requirements

OPTIONS: SATELLITE CONTROL

1. INTEGRATED NETWORKS AS PER MROC-04-88 FOR INTEGRATED SATELLITE CONTROL SYSTEM, DATED 30 SEPTEMBER 1988
2. EHF TTC
3. CROSSLINKS
4. MOBILE CONTROL STATIONS
5. SATELLITE AUTONOMY
6. STANDARDIZED BUSSES AND MULTIPLE MODULAR PAYLOADS
7. SOME AUTONOMY OF TTC FUNCTIONS
8. TTC STANDARDS

DEFICIENCIES VERSUS OPTIONS: SATELLITE CONTROL (U)

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
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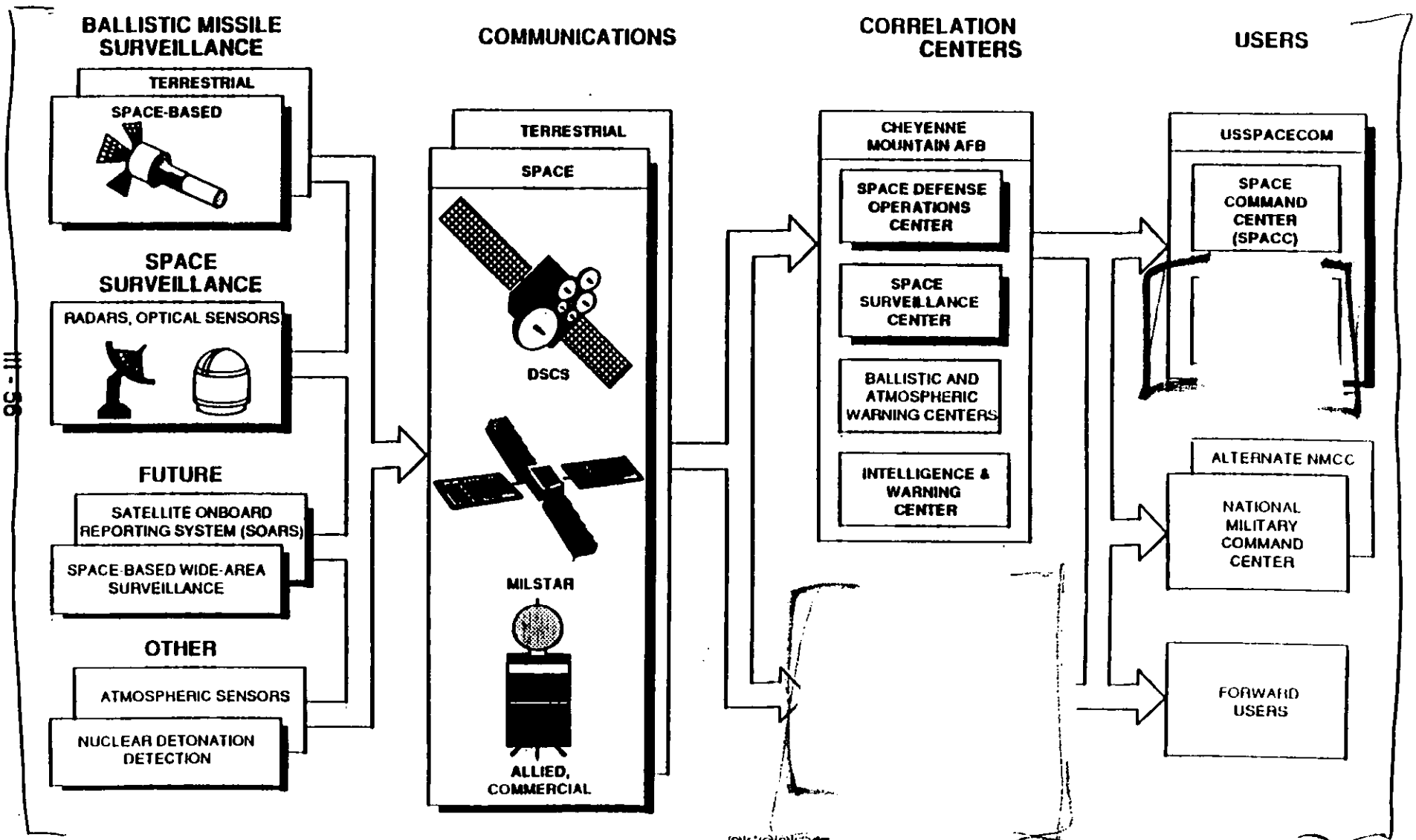
10. SURVIVABILITY/ENDURANCE

SPACE IS ONE COMPONENT OF TW/AA (U)

SPACE-RELATED COMPONENTS INDICATED IN **SHADOWED BOXES**

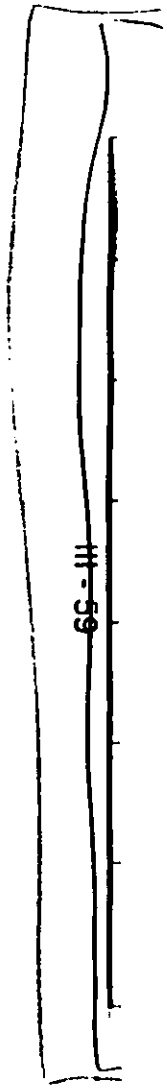


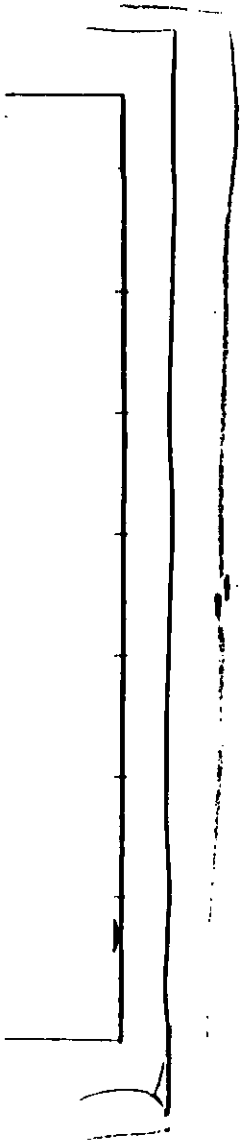
DEFICIENCIES: TW/AA (U)
PRIMARILY FROM SENSOR LIMITATIONS

OPTIONS: TWAA (U)
(All Options Are DSP-Related)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10. BSTS OR DSP FOLLOW-ON

DEFICIENCIES VERSUS OPTIONS: TW/AA*(U)





* DSP Only

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
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DEFICIENCIES: C^2 COMMUNICATIONS (U)

PRIMARILY CAPACITY AND COVERAGE

OPTIONS: C^2 COMMUNICATIONS

1. LOW DATA RATE PACKAGE IN INCLINED ORBITS
2. MORE SATELLITES IN INCLINED ORBITS
3. UTILIZATION OF CIVIL AND COMMERCIAL SATELLITES
4. LIGHTSATs
5. EHF STANDARD WAVEFORM
6. INTEROPERABLE UHF WAVEFORMS
7. DYNAMIC, REAL-TIME ALLOCATION OF CHANNELS
8. MILSTAR-LIKE CROSSLINKS, EHF CONTROL LINKS, MOBILE GROUND STATION
9. COMMON BUS, MULTIPLE PAYLOAD ARCHITECTURE
10. SATELLITE LASER COMMUNICATIONS
11. SATELLITE SURVIVABILITY TECHNIQUES AS PER SURVIVABILITY/ENDURANCE FUNCTIONAL AREA

DEFICIENCIES VERSUS OPTIONS: C^2 COMMUNICATIONS (U)

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ASSESSMENTS OF PROGRAM OPTIONS

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EGLIN (AN/FPS-85) (U)

PURPOSE (U): Space surveillance.

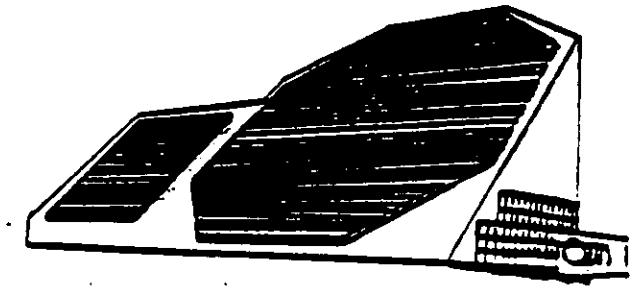
CAPABILITIES (U): Provides tracking information on space objects in near-earth orbit with a limited deep-space capability.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(~~S~~)

(~~S~~)



GROUND-BASED ELECTRO-OPTICAL
DEEP-SPACE SURVEILLANCE (GEODSS) SYSTEM (U)

PURPOSE (U): Deep-space surveillance.

CAPABILITIES (U): Optical tracking and identification of space objects to geostationary altitudes.

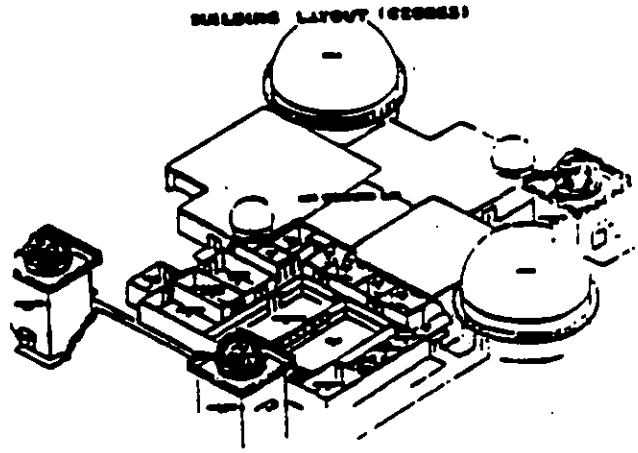
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. GEODSS is a dedicated deep-space surveillance system. It provides deep-space metric track data and deep-space Space Object Identification (SOI) data.

(U) Facilities. The GEODSS systems currently consist of four facilities: Site I at White Sands Missile Range, (Socorro) New Mexico; Site II at Taegu, Korea; Site III on Mr. Haleakala, Maui, Hawaii; and Site IV on Diego Garcia in the Indian Ocean. Negotiations are currently underway to build a fifth GEODSS site in Portugal.

(U) Optical tracking systems consist of two 1 m (40 inch) electro-optical telescopes and one 0.4 m (15 inch) auxiliary electro-optical telescope. Diego Garcia uses three 1 m (40 inch) telescopes but no 0.4 m (15 inch) auxiliary telescope. Operations take place when weather and light conditions are adequate to allow data collection/observation.



KAENA POINT (AN/FPQ-14) (U)

PURPOSE (U): Near-earth satellite observation.

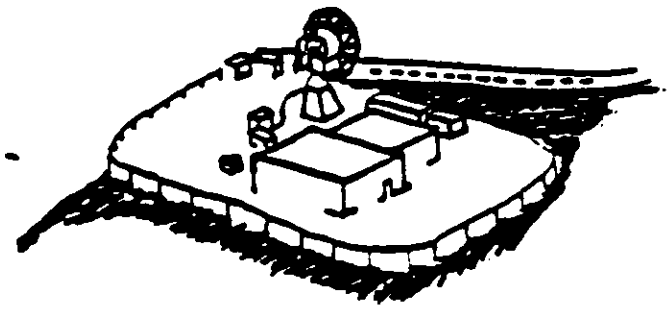
CAPABILITIES (U): High precision and highly accurate pulsed radar transfer. Capability for near-earth and acquisition handoff to the Air Force Maui Optical Station (AMOS).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. The mission of the AN/FPQ-14 is to provide near-earth satellite observation and in the future narrow-band space object identification (SOI) data in support of space and missile launches from the Western Space and Missile Center (WSMC). The AN/FPQ-14 is tasked on a limited basis to support the space surveillance mission, primarily for high priority objects requiring instantaneous observational data. The computer and communications equipment is being upgraded to support space surveillance on a full-time basis commencing FY 1989.

(U) Facilities. The AN/FPQ-14 Kaena Point site is located on the island of Oahu, Hawaii. Computer, communications and support equipment are all located in a single building. The site operates 24 hours per day, 7 days per week, and is civilian operated.



MILLSTONE AND HAYSTACK RADARS (U)

PURPOSE (U): Near-earth and deep-space satellite observations.

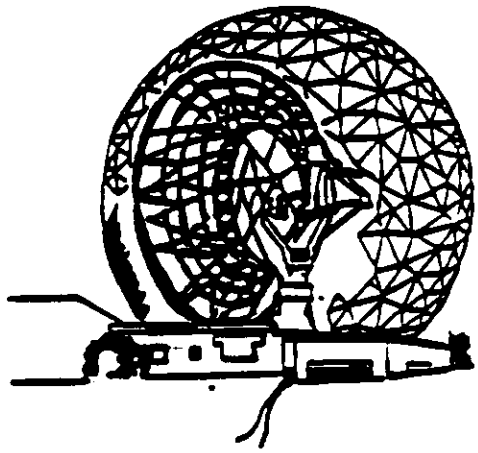
CAPABILITIES (U): Part-time; Millstone: deep-space, large-dish tracking radar capable of tracking one square meter target at geosynchronous altitude; Haystack: high-quality imaging radar employing wideband coherent waveforms; deep-space, very-large-dish tracking radar providing an improved search capability.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. Millstone provides metric data observations and narrowband Space Object Identification (SOI) data on deep-space satellites. Haystack provides wideband satellites radar images on both near-earth and deep-space satellites.

(U) Facilities. Both Millstone and Haystack are located at the Millstone Hill Field Station of Massachusetts Institute of Technology (MIT) Lincoln Laboratory near Tyngsboro, Massachusetts. The two radars are approximately one half mile apart. Main communications facilities for Millstone and Haystack data transmission are located at the Millstone site.



MAUI OPTICAL TRACKING AND IDENTIFICATION FACILITY (MOTIF) (U)

PURPOSE (U): Near-earth and deep-space satellite tracking.

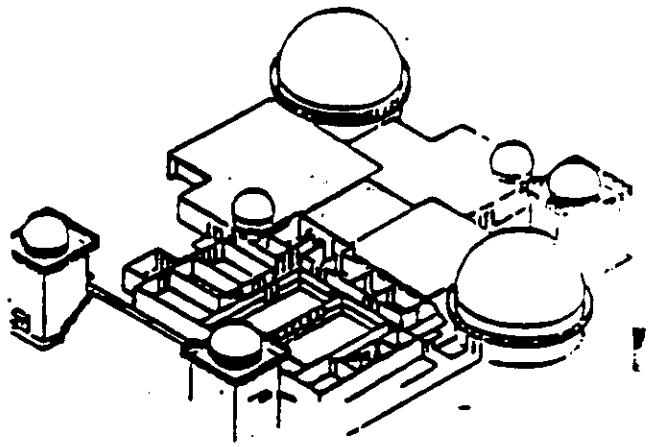
CAPABILITIES (U): Photometric and long-wave infrared (LWIR) data and visual light imaging.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. The MOTIF performs near-earth and deep-space satellite tracking and Space Object Identification (SOI) through photometric and Long Wave Infrared (LWIR) data and visual light imaging.

(U) The MOTIF facility is collocated with the Ground-Based Electro-Optical Deep-Space Surveillance (GEODSS) System Site III and the Air Force Maui Optical Station (AMOS) on Mr. Haleakala, Hawaii. MOTIF can receive satellite pointing data from the Kaena Point radar for satellite acquisition when necessary.



(U) Facilities. The AMOS/MOTIF facility consists of a main building which is interconnected with two large domes (AMOS 1.6 m (63 in) telescope dome and MOTIF 1.22 m (48 in) telescope dome) and two small domes (AMOS 0.56 m (22 in) laser beam director and independent beam director domes). The Maui GEODSS is also connected to this facility.

A. (U) The MOTIF optical equipment consists of two co-mounted 1.22 m (48 in) cassegrain telescopes on a common mount with a 0.56 m (22 inch) dual aperture acquisition telescope.

B. (U) Operational period is 12 degrees nautical twilight to 12 degrees morning twilight.

NAVAL SPACE SURVEILLANCE SYSTEM (NAVSPASUR) (U)

PURPOSE (U): Space surveillance and satellite tracking.

CAPABILITIES (U): Three transmitting stations emit a fan-shaped pattern of continuous-wave radio energy to illuminate space objects, when orbiting objects penetrate this fence, radio energy is reflected back to six receiving stations. The command and headquarters also serves as Alternate Space Defense Operations Center and Alternate Space Surveillance Center for USSPACECOM.

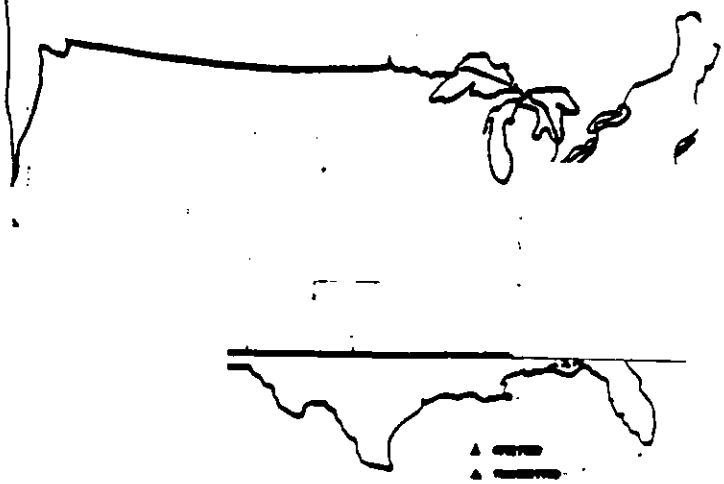
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. NAVSPASUR maintains constant surveillance of space and provides satellite tracking data as directed by the Commander, Naval Space Command to fulfill Navy, U.S. Space Command and national requirements.

(S) Facilities. NAVSPASUR consists of three transmitting and six receiving sites located across the United States. The correlation center for all site data is located at:

Operating as a large radio interferometer, NAVSPASUR detects orbiting objects whose paths cross the continental United States.



SAIPAN RADAR (U)

PURPOSE (U): Space surveillance

CAPABILITIES (U): C-band mechanical space tracking radar.

DEVELOPMENT OR OPERATIONAL STATUS (U): IOC: 1990

TECHNICAL DESCRIPTION (U):

(U) Planned central sensor in the three-sensor Pacific Radar Barrier (PACBAR) to be located on Saipan in the Northern Mariana Islands north of Guam. The ARPA Long-Range Tracking and Instrumentation Radar (ALTAIR) is the eastern PACBAR anchor and San Miguel is the western anchor. The sensor will be a C-band mechanical tracker removed from the U.S. Navy Ship (USNS) Arnold and refurbished at the Eastern Space and Missile Center (ESMC) where it was erected and tested. Site will be a dedicated space surveillance asset owned by Air Force Space Command (AFSPACECOM) but initially operated by Western Space and Missile Center (WSMC) civilian contractors. The sensor has a secondary mission to support Western Test Range (WTR) test tracking. System plans include wideband imaging capability. Initial Operational Capability (IOC) is 1990.

SAN MIGUEL (AN/GPS-10) (U)

PURPOSE (S): Near-earth surveillance, detection, and tracking of Peoples' Republic of China and USSR northerly prograde launches.

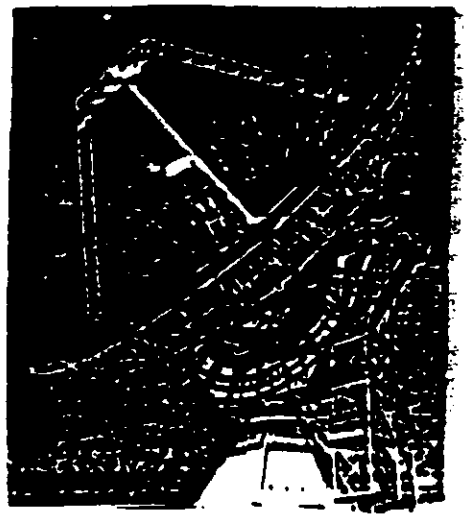
CAPABILITIES (U): Radar surveillance; mechanical, long-range, high-power, monopulse radar with a 25.9 meter diameter antenna.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(S) Mission. The mission of the AN/GPS-10 is to provide [illegible] near-earth surveillance and detection and tracking [illegible] The Space Surveillance Center (SSC) is responsible for operational command and control of the AN/GPS-10 radar. Tasking is directed by the Space Surveillance Center (SSC) or Alternate Space Surveillance Center (ASSC).

(U) Facilities. The AN/GPS-10 is a mechanical, long range, high power, line-of-sight radar system located at the Naval Communications Station, San Miguel, Republic of the Philippines.



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OPTIONS: NAVIGATION

1. ACCELERATE ACQUISITION OF MILITARY TERMINALS
2. SATELLITE-TO-SATELLITE NAVIGATION UPDATES VIA UHF CROSSLINKS
3. MILSTAR-LIKE EHF SATELLITE CONTROL UPLINK
4. GPS/NDS SATELLITE CONTROL VIA CROSSLINKS
5. MOBILE GROUND STATIONS FOR SATELLITE CONTROL
6. RELOCATABLE MONITOR STATIONS

DEFICIENCIES: NAVIGATION (U)

DEFICIENCIES VERSUS OPTIONS: NAVIGATION (U)

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

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DEFICIENCIES: NUCLEAR DETONATION DETECTION (U)

OPTIONS: NUCLEAR DETONATION DETECTION

1. BUY MORE TERMINALS

2. MERGE NDS DATA WITH A PRIORI WEAPON FUSING DATA IN NUCLEAR PLANNING AND EXECUTION SYSTEM ON ABNCP

3. IMPLEMENT GPS/NDS SURVIVABILITY FEATURES IDENTIFIED IN NAVIGATION FUNCTIONAL AREA

DEFICIENCIES VERSUS OPTIONS: NUCLEAR DETONATION DETECTION (U)

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

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DEFICIENCIES: OCEAN/BATTLEFIELD SURVEILLANCE (U)

(ALSO APPLIES TO MOST INTELLIGENCE COLLECTION ASSETS)

OPTIONS: OCEAN/BATTLEFIELD SURVEILLANCE (U)

(U) 1. SPACE-BASED SENSORS

(U) 2. MILITARY OPERATIONAL SUPPORT SATELLITES (MOSS)

(S) 3.*

(S) 4.*

(S) 5.*

* NOTE:

DEFICIENCIES VERSUS OPTIONS: OCEAN/BATTLEFIELD SURVEILLANCE (U)

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

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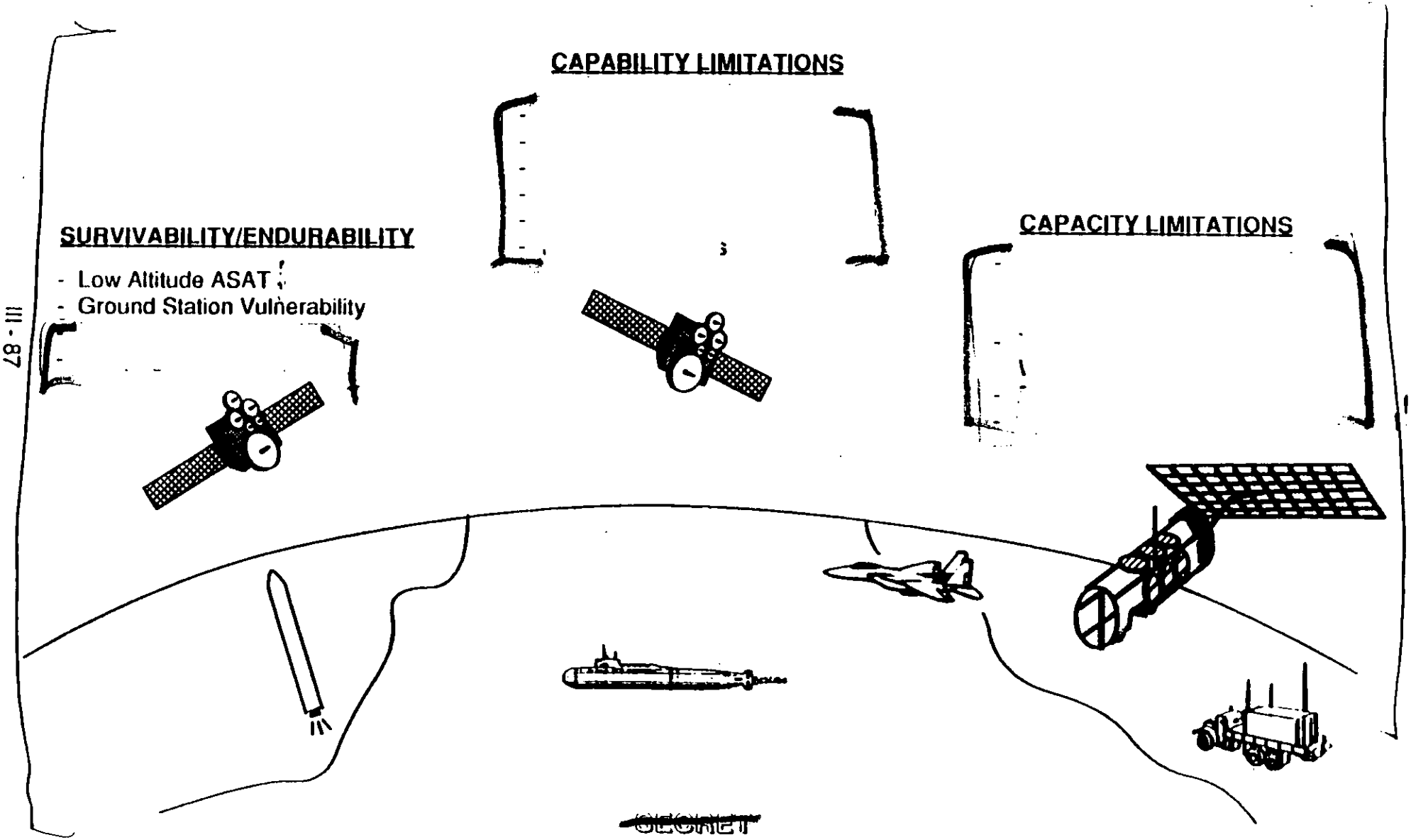
DEFICIENCIES: ENVIRONMENTAL MONITORING (U)



OPTIONS: ENVIRONMENTAL MONITORING

1. MILITARY OCEANOGRAPHIC SENSING SYSTEM
2. JOINT ALLIED CIVIL OCEANOGRAPHIC SENSING SYSTEM
3. ENVIRONMENTAL MONITORING SENSOR PAYLOADS ON LIGHTSATs
4. CONTINGENCY MILITARY UTILIZATION PLAN FOR U.S. GOES
5. CONTINGENCY MILITARY UTILIZATION PLANS FOR ALLIED GEO WEATHER SATELLITES
6. SURVIVABLE/ENDURING DMSP
7. DMSP-TIROS COMMONALITY
8. ACQUISITION OF COMMERCIAL WEATHER RECEIVERS
9. ACQUISITION OF MORE MILITARY WEATHER RECEIVERS
10. ADD LIDAR, RADAR ALTIMETER, SCATTEROMETER TO DMSP
11. CONNECTIVITY OF NASA SPACE MONITORING SATELLITES TO MILITARY WEATHER

DEFICIENCIES VERSUS OPTIONS: ENVIRONMENTAL MONITORING (U)

CONFLICT LEVEL

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ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

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DEFICIENCIES: SPACE SURVEILLANCE (U)

(U) Includes: 1989 Baseline Plus Processing Upgrades, GEODSS Site 5, Saipan C-Band Radar

OPTIONS: SPACE SURVEILLANCE (U)

Primarily Space-Based

[redacted]

DEFICIENCIES VERSUS OPTIONS: SPACE SURVEILLANCE (U)

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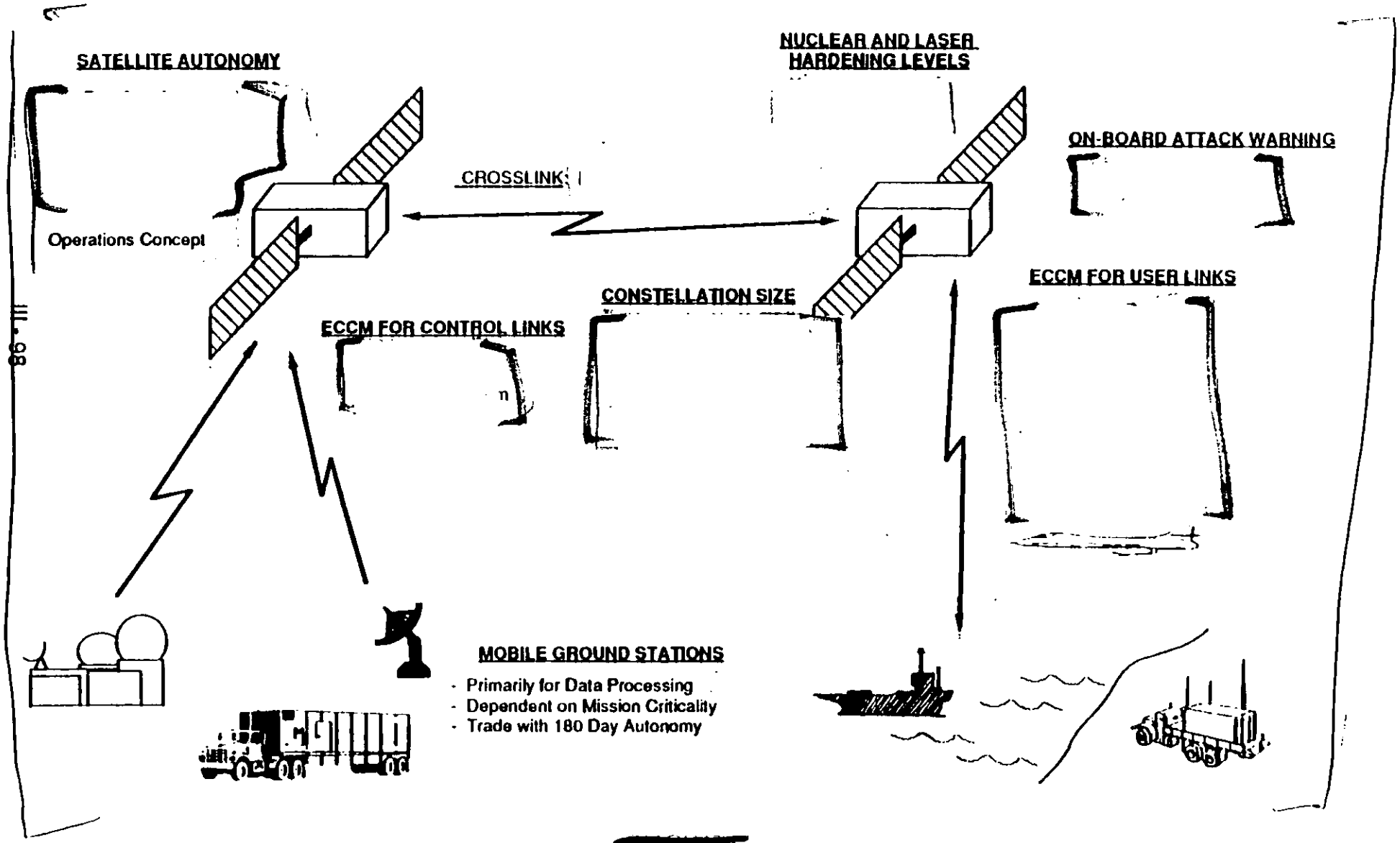
ASSESSMENTS OF PROGRAM OPTIONS

1. ACCESS TO SPACE
2. SATELLITE CONTROL
3. TACTICAL WARNING/ATTACK ASSESSMENT
4. COMMAND AND CONTROL COMMUNICATIONS
5. NAVIGATION
6. NUCLEAR DETONATION DETECTION
7. OCEAN AND BATTLEFIELD SURVEILLANCE
8. ENVIRONMENTAL MONITORING
9. SPACE SURVEILLANCE
10. SURVIVABILITY/ENDURANCE

EACH SPACE MISSION NEEDS A TAILORED SURVIVABILITY PROFILE (U)



DEFICIENCIES: SURVIVABILITY/ENDURANCE (U)

OPTIONS: SURVIVABILITY /ENDURANCE
(GENERIC FOR ALL SPACE SYSTEMS)

1. GROUND STATION MOBILITY
2. ELECTRONIC COUNTER-COUNTERMEASURES
3. SATELLITE CROSSLINKS
4. ON-BOARD SENSORS (SOARS)
5. ASAT COUNTERMEASURES: MANEUVER, ELECTRONIC COUNTERMEASURES, OPTICAL COUNTERMEASURES
6. NUCLEAR AND LASER HARDENING
7. MITIGATION OF RF PROPAGATION DEGRADATION IN NUCLEAR WEAPON DISTURBED ENVIRONMENT

DEFICIENCIES VERSUS OPTIONS: SURVIVABILITY/ENDURANCE (U)

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Major Findings

(S)

Out of Functional Planning Sub-areas specified in JCSM 91-88, expected to remain fully operational through war and post-SIOP. others will be operational, but degraded. All the rest are expected to be

The chart "Ability to Meet Warfighting Requirements" summarizes the expected operational status of the Functional Planning Areas.

(S)

SECTION IV

MAJOR FINDINGS

and

RECOMMENDATIONS

(U) Substantial progress has been made in survivability and endurance of space systems supporting TW/AA, navigation, and nuclear detonation detection. Similar progress can be made for other space functions that are considered deficient in survivability and endurance.

(~~S~~)

(U) Most space systems development offices view options for their systems in terms of augmenting on-orbit capabilities, rather than increasing efficiency and utilization of existing capabilities. Efficiency can be increased using technology advances such as processing automation, expert systems, and workstations. Additionally, space system developers do not adequately consider the integration of their systems into the overall U.S. military space program.

(~~S~~) Command and Control (C2) for space operations is an implied functional planning area. It is not an explicit functional area. In order for functional planning areas and their functions to interact, there must be an explicit top-down architecture pervading all levels of space operations.

(U) A broad-area mission analysis could not be located for Ocean and Battlefield Surveillance, a high priority function identified as needing augmentation.

(U) Criteria and mission analyses for assessing the sufficiency of survivability and endurance on a system by system basis are lacking, even though there is a tendency to generalize and attribute survivability and endurance deficiencies to all space systems.

(~~S~~) The study assumed systems and system improvements already in the FYDP through FY94 would be implemented. If funding for these systems is decreased, changes could occur to the deficiency values for some functions.

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Recommendations

1. System planners and developers should place priority on incorporating survivability options in space systems and the interrelationships of their system within the overall U.S. military space program. The systems should be as survivable as the forces they are supporting. Survivability options should consider all segments of the system; i.e., ground, space, communications links, and user.

2. Explicit Post-SIOP requirements should be developed for all space systems that are expected to be needed in the post-SIOP time frame.

3. Overall space operations command and control (C2) should be defined and treated as a separate functional planning area.

4. A prioritized list of options for each function needs to be developed based upon requirements and National space policy objectives.

5. Rough order of magnitude costs need to be obtained once there is adequate definition of the option.

6. An acquisition strategy needs to be developed when the results of the prioritization and costing are blended into an acceptable list.

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APPENDIX A

STUDY TASKING AND GUIDANCE

In January 1988, the Secretary of Defense directed the Under Secretaries for Acquisition and Policy to lead a comprehensive review of the U.S. national security space programs. This review was performed in two phases. The OUSD(A) Defense Space Systems Study Workshop was the focal point for Phase II of the study. This final report is the results of the following letters as they relate to Phase II.

20 Jan 88	SECDEF Letter	Space Systems Study for DRB Program Review
29 Jan 88	USD(P) Letter	Space Systems Study for DRB Review
01 Mar 88	USD(A) Letter	Space Systems Study for DRB Review
27 Oct 88	ODDRE Letter	Defense Space Systems Study Workshop

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SECRET

THE SECRETARY OF DEFENSE

WASHINGTON, THE DISTRICT OF COLUMBIA

10 JAN 1988

MEMORANDUM FOR THE SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN, JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

SUBJECT: Space Systems Study for DRB Program Review (U)

(S)

(U) With these circumstances in mind, I have directed the Under Secretaries for Acquisition and Policy to lead a comprehensive review of U.S. national security space programs within the context of our military strategy and broader national security goals. The review will include: (1) a concise description of all deployed space systems and all funded systems under development; (2) a statement of the warfighting requirements for space systems, including the required level of survivability for each system; (3) identification of deficiencies in meeting our policy goals and warfighting requirements; (4) identification of program options needed to satisfy fully warfighting requirements across the spectrum of conflict; and (5) an explanation or rationale and cost estimate for each of the options. This review will be accomplished in two phases. The first phase, led by USD(P), will deal with the development of strategy/warfighting requirements and the evaluation of them for consistency and compliance with DoD and National space policies (items 1-3, above). The second phase, led by USD(A), will address the implementation/program review aspect (items 4 and 5, above).

- The Services will provide technical information and funding profiles on deployed and programmed systems.

- SDIO and the Defense Advanced Research Projects Agency will provide information on the space technologies and programs it is pursuing that have application to space missions other than ballistic missile defense.

- OJCS, in coordination with the CINCs and the Services, will provide or develop warfighting requirements for space systems.

- All addressees will participate in identifying, developing, and evaluating new program options.

Classified by: ADUSD(P)
Declassify on: OADR

SECRET

Sec Def Cont No X45748

- The Services will provide cost estimates for new program options proposed by the study group. ODPA&E will review the cost estimates.

(U) The study should be completed by 1 June 1988 to support next year's Program Review. An interim report will be provided by 1 March 1988.

SECRET

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THE UNDER SECRETARY OF DEFENSE

WASHINGTON, D. C. 20301-2000

In reply refer to: I-05004

29 JAN 1988

POLICY

MEMORANDUM FOR THE SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN, JOINT CHIEFS OF STAFF
UNDER SECRETARY OF DEFENSE FOR ACQUISITION
DIRECTOR, PROGRAM ANALYSIS & EVALUATION
DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

SUBJECT: Space Systems Study for DRB Review

REFERENCE: SecDef Memorandum, dtd. 20 Jan. 1988, same subj.

This is to formally initiate the subject study and to request that you designate representatives to participate in working and review groups for carrying out the study. The Working Group will have responsibility to provide required technical and programmatic information, to make recommendations on issues addressed by the study, and to draft sections of the study report. Members should be military officers at the 05 or 06 level, or civilian equivalent, with TS/SITK and "B" clearances. The JCS, in conjunction with OSD/Policy, will have primary responsibility for strategy and requirements definition. The Review Group will direct the overall organization of the report, address issues not resolved at the Working Group level, and approve drafts of the study report. Members of the Review Group should be officers at the 07 level or above, or civilian equivalent, with TS/SITK and "B" clearances. Only one individual from each component shall attend Review Group meetings. If important issues cannot be resolved by the Review Group, the study report will note the dissenting view.

Philip Kunsberg will be responsible within OSD/Policy for directing the study and will serve as Chairman of the Review Group during the first phase of the study. (The Under Secretary for Acquisition will designate a Chairman for the second phase of the study.) The Chairman of the Review Group will designate a Chairman of the Working Group. Please provide Mr. Kunsberg with the names, social security number, and clearances of your representatives, no later than February 4, 1988. The initial meeting of the Review Group will be scheduled for February 9.

The space systems study initiated by the Secretary will enable us to take stock of our space programs and to align them with our military strategy and warfighting requirements. This should provide us with a sure footing and a long-range perspective during a critical period in the U.S. military use of space.

Fred C. Ikle

Fred C. Ikle

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THE UNDER SECRETARY OF DEFENSE

WASHINGTON, DC 20301

ACQUISITION
(S&TNF)

01 MAR 1988

MEMORANDUM FOR THE SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
ASSISTANT SECRETARY OF DEFENSE (COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE)
ASSISTANT SECRETARY OF DEFENSE (INTERNATIONAL SECURITY AFFAIRS)
DIRECTOR, PROGRAM ANALYSIS & EVALUATION
DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

SUBJECT: Space Systems Study for DRB Review

The Secretary of Defense, by his memorandum of January 20, 1988, initiated a comprehensive review of U.S. national security space programs to support the Defense Resources Board FY 1990 Program Review. In addition, the Secretary assigned USD(A) in cooperation with USD(P) the responsibility to address the implementation/program review phase of the study. Accordingly, I have assigned Dr. Eugene Sevin, Assistant Deputy Under Secretary of Defense (Offensive and Space Systems), to chair the Review Group during this second phase of the study.

I will ask the Chairman of the Review Group to convene a meeting in early March 1988, to establish terms of reference and a planning schedule for the study's second phase. Members of the Review Group for this second phase should be the same as those assigned for the first phase. If there are any differences, please inform Dr. Sevin of your assignment by March 4, 1988. Members assigned should be knowledgeable in the findings of the study's first phase and have TS/SI/TK and "B" clearances.

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OFFICE OF THE DIRECTOR OF
DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301

(S&TNF)

27 October 1988

MEMORANDUM FOR PARTICIPANTS

SUBJECT: Defense Space Systems Study Workshop

I am pleased that you are able to participate in the Defense Space Systems Study Workshop. It is part of a study directed by the Secretary of Defense in a memorandum dated 20 January 1988 (Attachment 1). The study's five tasks, partitioned into two phases, are depicted in Attachment 2. The first phase focused on space systems' descriptions, war-fighting, and survivability requirements and deficiencies. These first three task areas have been completed. The second phase, which focuses primarily on identifying program options to meet the requirements and overcome the shortfalls, is in process.

The goals of this workshop are to provide a forum to review the military user requirements for space systems, to understand the shortfalls of current and planned space systems which respond to those requirements, and to achieve a broad-based consensus for existing and emerging program options. These program options, in turn, will be used to develop a military space systems acquisition strategy for use by the new Administration.

Your task in preparing for the workshop will be to familiarize yourself with the strawman material contained in the workbook. During the workshop, you will be assigned to at least one panel which will be seeking to achieve consensus on the various program options. The options presented in the workbook are not meant to be "solutions looking for a blessing" but points of departure for the workshop proceedings. They are, in effect, "a step beyond a blank sheet of paper." If there are major omissions in the strawman program options section, please bring the appropriate data regarding that option to the workshop and advise the panel chairman. After the workshop, the material developed will be reviewed by DoD components in conformance with routine staffing procedures, and a determination will be made as to the appropriate follow-on actions.

I think you will agree that we have a wealth of material to review and a very ambitious schedule. Your knowledge of this material, as well as your invaluable professional experience, will be essential ingredients to the success of this workshop. Please take some time to review the workbook material so that the three days can be as productive as possible. Thank you for your cooperation and I look forward to your participation.

Eugene Sevin
Director, Offensive & Space Systems

Attachments

THIS MEMORANDUM BECOMES UNCLASSIFIED WHEN SEPARATED FROM ATTACHMENT 1

~~SECRET~~

UNCLASSIFIED

SECRET

THE SECRETARY OF DEFENSE

WASHINGTON, THE DISTRICT OF COLUMBIA

10 JAN 1988

MEMORANDUM FOR THE SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN, JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

SUBJECT: Space Systems Study for DRB Program Review (U)

(U) With these circumstances in mind, I have directed the Under Secretaries for Acquisition and Policy to lead a comprehensive review of U.S. national security space programs within the context of our military strategy and broader national security goals. The review will include: (1) a concise description of all deployed space systems and all funded systems under development; (2) a statement of the warfighting requirements for space systems, including the required level of survivability for each system; (3) identification of deficiencies in meeting our policy goals and warfighting requirements; (4) identification of program options needed to satisfy fully warfighting requirements across the spectrum of conflict; and (5) an explanation or rationale and cost estimate for each of the options. This review will be accomplished in two phases. The first phase, led by USD(P), will deal with the development of strategy/warfighting requirements and the evaluation of them for consistency and compliance with DoD and National space policies (items 1-3, above). The second phase, led by USD(A), will address the implementation/program review aspect (items 4 and 5, above).

- The Services will provide technical information and funding profiles on deployed and programmed systems.

- SDIO and the Defense Advanced Research Projects Agency will provide information on the space technologies and programs it is pursuing that have application to space missions other than ballistic missile defense.

- OJCS, in coordination with the CINCs and the Services, will provide or develop warfighting requirements for space systems.

- All addressees will participate in identifying, developing, and evaluating new program options.

Classified by: ADUSD(P)
Declassify on: OADR

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Sec Def Cont No X45748

- The Services will provide cost estimates for new program options proposed by the study group. ODPA&E will review the cost estimates.

(U) The study should be completed by 1 June 1988 to support next year's Program Review. An interim report will be provided by 1 March 1988.

Attachment 1

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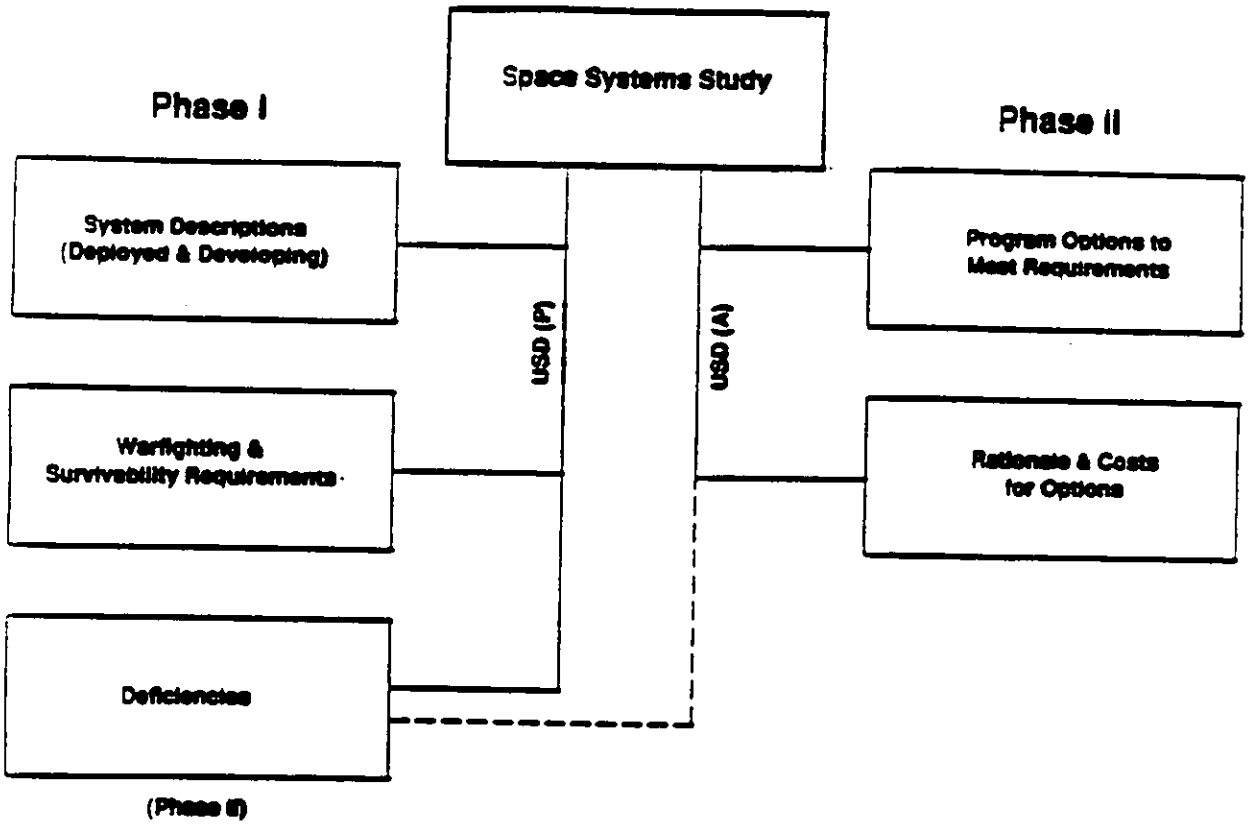

Attachment 2

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APPENDIX B

SPACE SYSTEMS DESCRIPTIONS

This appendix contains a brief description of the space systems currently operational or due to become operational in the near future. The systems are grouped according to the functional planing areas they primarily support.

Space Support

Access to Space	(pages B-3 thru B-12)
Satellite Control	(pages B-13 thru B-18)

Force Enhancement

TW/AA	(pages B-19 thru B-26)
C2 Communications	(pages B-27 thru B-40)
Navigation	(pages B-41 thru B-44)
Environmental Monitoring	(pages B-45 thru B-50)
NUDET Detection	(pages B-51 thru B-54)
Mapping, Charting, & Geodesy	(pages B-55 thru B-58)

Space Control

Space Surveillance	(pages B-59 thru B-76)

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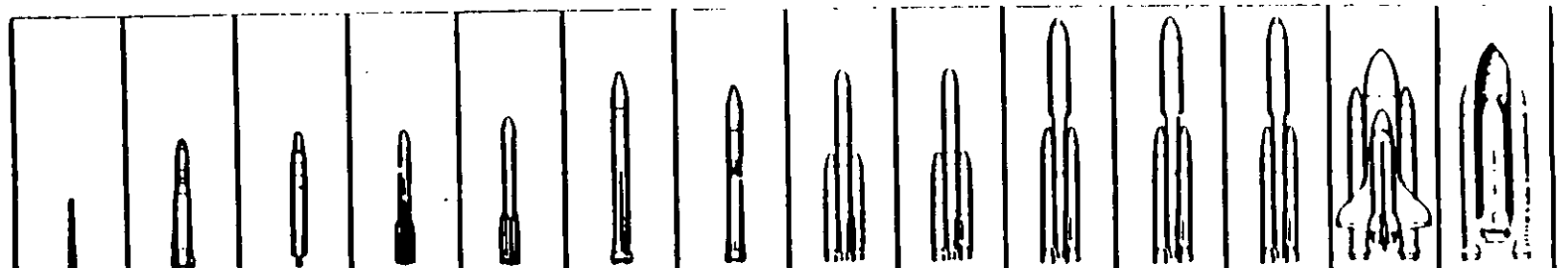
ACCESS to SPACE

Launch Sites	Launch Vehicles*
ESMC	Scout
WSMC	Titan
Wallops Island	Delta
	Atlas
	STS

* Based upon data inputs, performance capability varies.

LAUNCH VEHICLE SUMMARY



	SCOUT	ATLAS E*	TITAN II**	DELTA	DELTA II**	ATLAS II**	ATLAS* CENTAUR	TITAN* 34D/NUS	TITAN* 34D/TS	TITAN IV** NUS	TITAN IV** IUS	TITAN IV** CENTAUR	SIS	SHUTTLE C
RESPONSIBLE AGENCY	NASA	USAF	USAF	NASA	USAF	USAF	NASA	USAF	USAF	USAF	USAF	USAF	NASA	NASA
PERFORMANCE CAPABILITY (LB)														
100 NM EAST	570	N/A	N/A	3,600	11,100	14,500	N/A	N/A	N/A	39,100	N/A	N/A	58,200	112,186,000
100 NM POLAR	460	1,350	4,200	5,500	N/A	N/A	N/A	27,600	N/A	31,100	N/A	N/A	N/A	84-127,000
GEO	-	-	-	1,450	1,850 (GPS)	5,000 (GTO)	1,750	N/A	4,100	N/A	5,250	10,250	5,200	10,000***
OPERATIONAL	ENDS 1990+	ENDS 1989	BEGINS 1988	ENDS 1989	BEGINS 1988	BEGINS 1991	ENDS 1989	ENDS 1989	ENDS 1989	BEGINS 1989	BEGINS 1988	BEGINS 1990	RESUME 1988	2000
LAUNCHES PER YEAR	2-3	2	2-3	1-2	3-6	1-3	1	1-3	1-3	1-4	1-3	2-4	10-14	2-4 NOMINAL
HARDWARE AND LAUNCH COST (MILLIONS OF FY 86 DOLLARS)	9	45	43	33	38	60	75	124	158	142	191	211	115[11]	200 (AVG)
COST PER POUND (TO 100 NM EAST)	15,800	11,900	8,100	9,300	3,400	4,100	5,900	3,800	4,200[1]	3,600	5,100[1]	4,400[1]	2,100	1,500-2,500
PAYLOADS (EXAMPLES)	SEP TRANSIT	NOAA DMSP	DMSP	MULTIPLE	GPS	DSCS	FSC	MULTIPLE	DSCS DSP	MULTIPLE	DSP	DSCS MILSTAR	MULTIPLE	SPACE STATION OTHERS
EAST/WEST COAST	BOTH	WEST	WEST	BOTH	EAST	EAST	EAST	BOTH	EAST	BOTH	EAST	BOTH	EAST	EAST[111]
LAUNCH CALL UP (DAYS)	N/A	90	120	N/A	45-70	90	N/A	90-120	90	70-100	90-120	120-150	100	100

*NO PRODUCTION CAPABILITY FOR NEW PROCUREMENT
**ACTIVE RDT&E/PROC
***USING CENTAUR G'

[1] PAYLOAD WEIGHT INCLUDES SATELLITE, UPPER STAGE AND UNUSED PROPELLANT
[11] BASED ON DOD/NASA MOA COST OF ALLOW/FLIGHT
[111] WEST LAUNCH POSSIBLE WITH ACTIVATION/MODIFICATION OF SIS PAD

N/A NOT AVAILABLE
NOT WITHIN HARDWARE CAPABILITY

UNCLASSIFIED

SPACE AND MISSILE TEST ORGANIZATION (SMTO) (U)

PURPOSE (U): Satellite launch operations

CAPABILITIES (U): Supports prelaunch, launch, and ascent operations from Eastern Space and Missile Center (ESMC) and Western Space and Missile Center (WSMC).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Consists of the ESMC and WSMC. ESMC consists of Patrick AFB, Cape Canaveral AFS, and five downrange stations. Provides telemetry, metric radar, optics, data processing and flight safety support to SRAM operational testing (OT), Navy fleet ballistic missile OT, Army pershing OT, USAF and NASA space missions, NASA shuttle operations, and USAF aircraft flight tests.

(U) WSMC consists of Vandenberg AFB, Pillar Point AFS, California, and Kaena Point, Hawaii. Provides telemetry, metric radar, optics, data processing and flight safety support to program including SAC Minuteman OT, AFSC MX and advanced strategic missile systems R&D, USAF and NASA space missions, DoD shuttle operations and Aeronautical System Division Flight tests.

WALLOPS FLIGHT FACILITY (U)

PURPOSE (U): Scout launch operations

CAPABILITIES (U): Support prelaunch, launch, and ascent operations from Wallops Island launch sites for the Scout launch vehicle

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Consist of the Wallops Orbital Tracking Station and Wallops Range Control Center. Located on the Eastern Shore of Virginia. The Goddard Spaceflight Center controls the operations of the Wallops Flight Facility. The Scout Launch vehicle is the only space launch vehicle capable of operating at the facility. A variety of sounding rockets can be launched from the facility.

SCOUT LAUNCH VEHICLE (U)

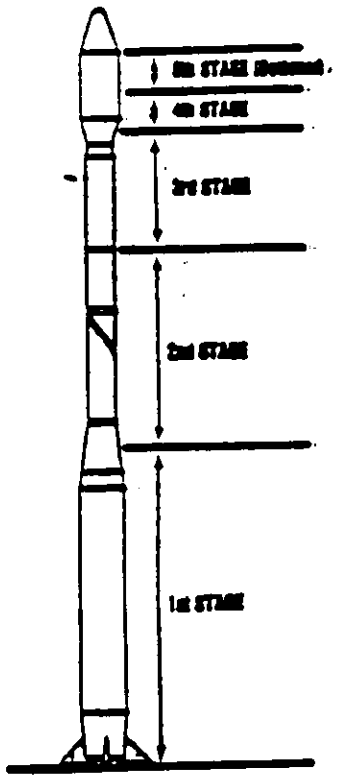
PURPOSE (U): Satellite launch (expendable).

CAPABILITIES (U): Launch vehicle lift, 193 kg (425 lb) to 500 km (310 mi) altitude easterly orbit.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Scout is used to deploy TRANSIT payloads. It is produced by Vought. Compatible with Apogee Kick Motor as a fifth stage. Scout has had a 95 percent success. Launch sites - Western Test Range (WTR), Wallops Island, and San Marcos launch platform.



TITAN LAUNCH VEHICLE (U)

PURPOSE (U): Satellite launch (expendable).

CAPABILITIES (U): Launch vehicles to lift payload capacity up to 17,690 kg (39,000 lbs) to low-earth orbit and 4536 kg (10,000 lb) to geosynchronous orbit.

DEVELOPMENT OR OPERATIONAL STATUS (U): Titan 2, 3, and 34D deployed; Titan 4 available in CY88.

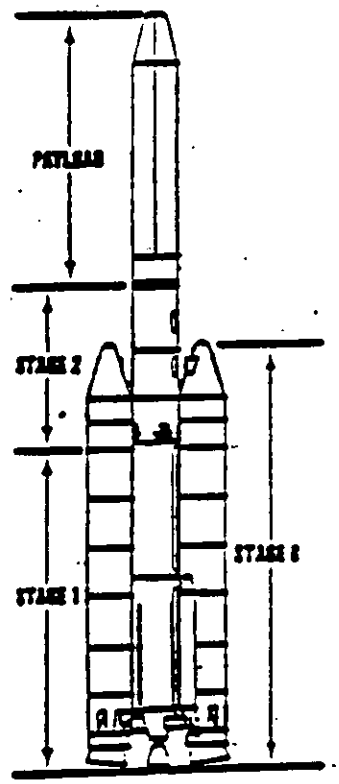
TECHNICAL DESCRIPTION (U):

(U) Titan II: Refurbished intercontinental ballistic missiles (ICBM). First launch available by 1988. Payload capacity is 1,900 kg (4,200 lb) to polar orbit from Western Test Range (WTR).

(U) Titan III: Primarily commercial lift. 3B through 3E include combinations of two-stage core, two solid rocket boosters (SRB), and compatible upper stages (Transtage, TOS, Inertial Upper Stage (IUS), Centaur, Payload Assist Module (PAM) and SCOTS). Payload capacities are 15, 875 kg (35,000 lb) to low-earth orbit (with upper stage) and 3,175 kg (7,000 lb) to Escape velocity. Titan 3 has a 94 percent success rate. Launch sites - Eastern Test Range (ETR), WTR.

(U) Titan 34D: Stretched Titan 3 core, two SRBs, and IUS. 12,545 kg (27,600 lb) to low-earth orbit, 1,818 kg (4,000 lb) to geosynchronous orbit. Launch sites - ETR, WTR.

(U) Titan IV (CELV): Complementary Expendable Launch Vehicle to compliment the shuttle. Formerly Titan 34D-7. Compatible with Centaur G and IUS. Payload capacities are 17, 690 kg (39,000 lb) to low-earth orbit and 4,536 kg (10,000 lb) to geosynchronous orbit. Launch sites - ETR, WTR.



TITAN IV

UNCLASSIFIED

DELTA LAUNCH VEHICLE (U)

PURPOSE (U): Satellite launch (expendable).

CAPABILITIES (U): Launch vehicle to lift payload capacity up to 5,039 kg (11,886 lb) to low-earth orbit and 1,810 kg (3,982 lb) to geosynchronous orbit.

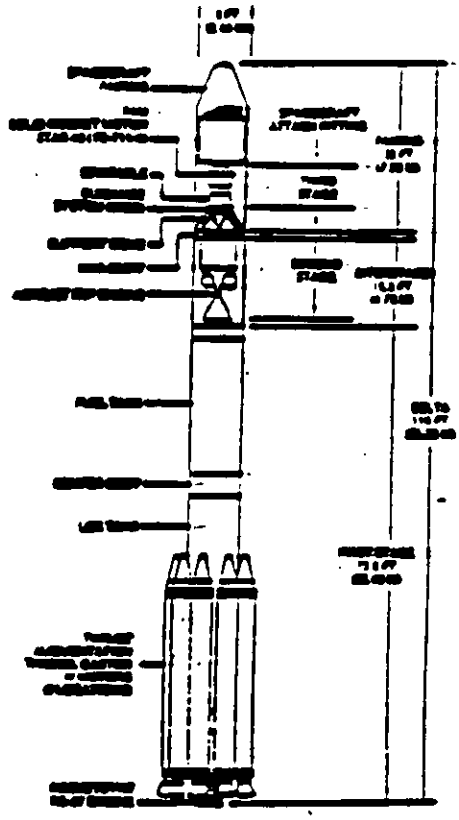
DEVELOPMENT OR OPERATIONAL STATUS (U): Delta - deployed , Delta II - available in FY 1989.

TECHNICAL DESCRIPTION (U):

(U) Delta 2000-4920: These Delta Launch Vehicles have a core tank plus combination of up to nine strap-ons. It is compatible with Payload Assist Module (PAM-D). Delta payload capacities range from 1,880 kg-3,452 kg (4,100-7,600 lb) to low-earth orbit and 700 kg-1,250 kg (1,500-2,800 lb) to geosynchronous orbit.

(U) Delta 5920-7920: Delta 5920 was designed for NASA's Cosmic Background Experiment (COBE), 3,849 kg (8,500 lb) low-earth orbit and 1,406 kg (3,100 lb) geosynchronous orbit. Delta 6920 was designed for initial NAVSTAR payloads, 3,983 kg (8,800 lb) low-earth orbit and 1,447 kg (3,200 lb) geosynchronous orbit. Delta 7920 was designed for heavier NAVSTARS (starting with tenth launch in 1990), 4,459 kg (9,800 lb) low-earth orbit and 1,615 kg (3,600 lb) geosynchronous orbit.

(U) Delta II (8920): These Delta Launch Vehicles are enhanced Deltas for use as U.S. Air Force Medium Launch Vehicle (MLV). Payload capacities are 5,039 kg (11,000 lb) to low-earth orbit and 1,819 kg (4,000 lb) to geosynchronous orbit. Available late 1988 or early 1989. Commercial lift vehicles will also be available.



ATLAS/CENTAUR LAUNCH VEHICLE (U)

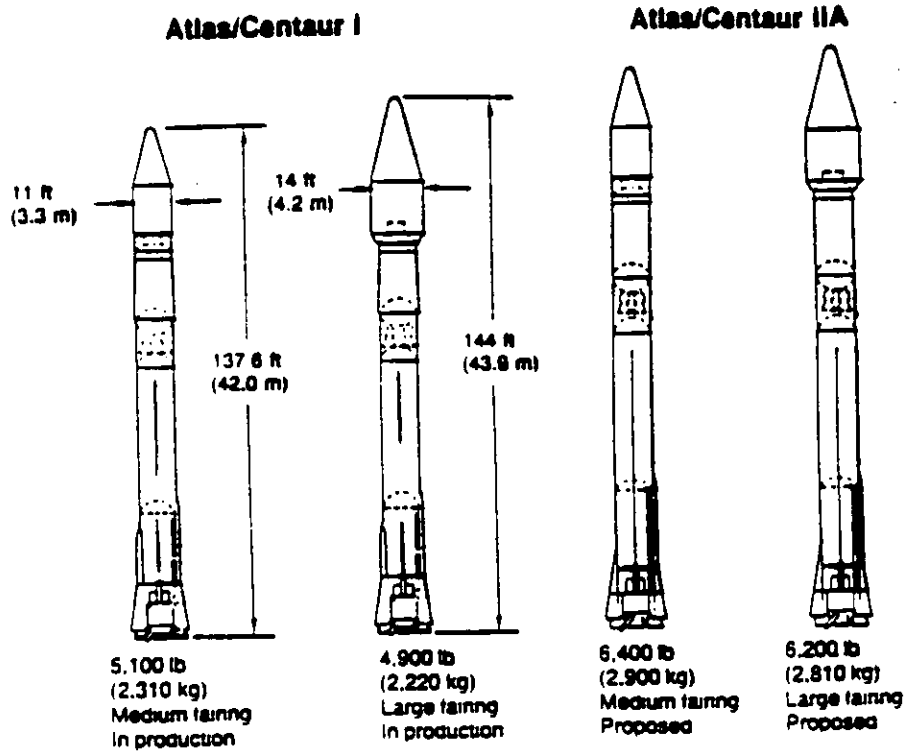
PURPOSE (U): Satellite launch (expendable).

CAPABILITIES (U): Launch vehicle to lift payload capacity 5,942 kg (13,000 lb) to low-earth orbit, 2,222 kg (4,900 lb) to geosynchronous orbit, 1,179 kg (2,600 lb) to escape.

DEVELOPMENT OR OPERATIONAL STATUS (U): Available in several variations. Atlas/Centaur II available in 1989.

TECHNICAL DESCRIPTION (U):

(U) Atlas-G is compatible with Centaur or payload assist module (PAM) and providing approximately 2,300 kg (5,000 lbs) to geosynchronous orbit. This system has had an 86 percent success rate. Atlas improvements will increase geosynchronous performance to approximately 2,900 kg (6,400 lb).



SPACE TRANSPORTATION SYSTEM (STS) (U)

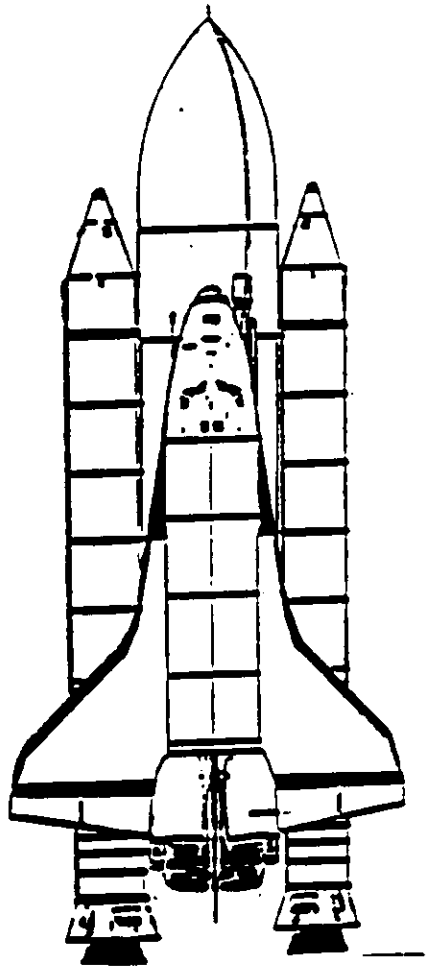
PURPOSE (U): Satellite launch (recoverable).

CAPABILITIES (U): Multipurpose launch vehicle payload capability (pre-Challenger accident): 23,130 kg (51,000 lb) to low-earth orbit (LEO), 2,280 kg (5,000 lb) to geostationary orbit (GEO). Nominal 28.5° orbit inclination.

DEVELOPMENT OR OPERATIONAL STATUS (U): Three shuttles available, next launch in 1988.

TECHNICAL DESCRIPTION (U)

(S) The STS is produced by Rockwell International. Its designated payloads include Tracking and Data Relay Satellite System (TDRSS), Defense Support Program (DSP), and Global Positioning System (GPS). Compatible with Payload Assist Module (PAM-D), PAM-D2, and Inertial Upper Stage (IUS) upper stages. Launch site - Kennedy Space Center (KSC).



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SATELLITE CONTROL

Spacecraft Main Command and Control Centers

CSOC
CSTC
NAVASSTROGRU
NASA
RTSs

CONSOLIDATED SPACE OPERATIONS CENTER (CSOC) (U)

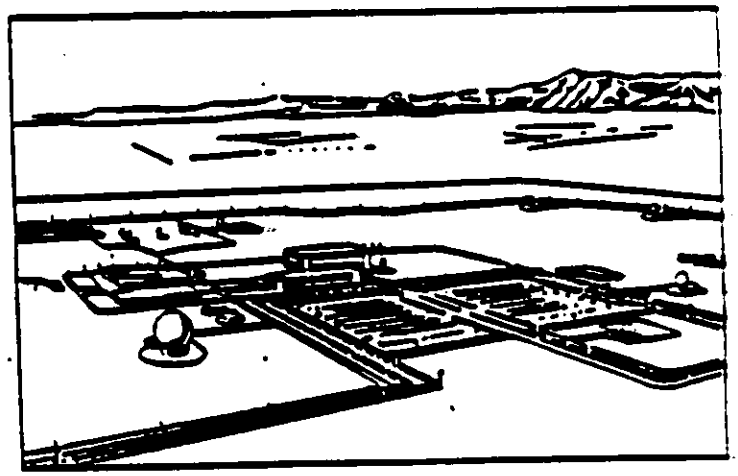
PURPOSE (U): When fully operational, CSOC will assume primary telemetry, tracking, and commanding (TT&C) responsibility for operational DoD satellite programs currently controlled by the Consolidated Space Test Center (CSTC).

CAPABILITIES (U): Resource Control Complex (RCC), Mission Control Complexes (MCC), and shared Remote Tracking Stations (RTS).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Falcon AFS, Colorado, houses the Consolidated Space Operations Center (CSOC) which is currently operational, and capabilities are being expanded. The CSOC is functionally similar to the Onizuka AFS, California, facility, as it contains an RCC and several MCCs. When fully operational, CSOC will assume primary TT&C responsibility for operational DoD satellite programs currently controlled by the CSTC. As the Master Control Station, it will share the satellite control workload while eliminating single critical node vulnerabilities. CSOC consists of AFSCM Operations Command Center (OCC); Navstar GPS Master Control Station, Milstar Master Control Center, and a Satellite OPS Complex (SOC) consisting of four MCCs, an RCC and Operational Software Maintenance Complex (OSMC).



CONSOLIDATED SPACE TEST CENTER (CSTC) (U)

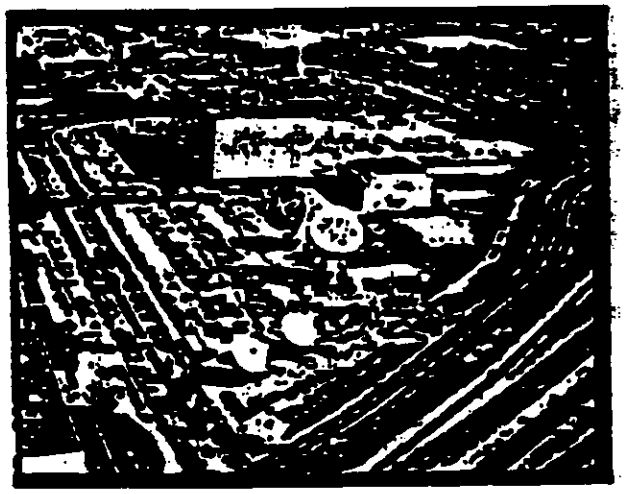
PURPOSE (U): Telemetry, tracking and commanding (TT&C) responsibility for research and development DoD satellites.

CAPABILITIES (U): Mission Control Complexes (MCC).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Onizuka AFS, in Sunnyvale, California, serves as a prime command and control node. It consists primarily of a group of Mission Control Complexes (MCCs), known collectively as the Consolidated Space Test Center (CSTC) supporting Air Force space test programs and national satellite programs.



NAVY ASTRONAUTICS GROUP (NAVASTROGRU) (U)

PURPOSE (U): Operate and maintain the Navy Navigation Satellite System (NNSS).

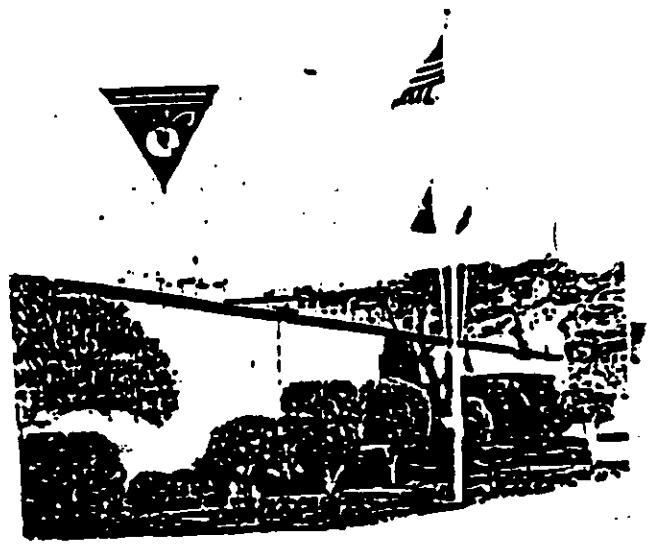
CAPABILITIES (U): Using doppler radar observations from a ground tracking network, provides satellite control for NNSS. Operates Fleet EHF package and tracking and injection facilities.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The Navy Astronautics Group operates and maintains the satellites of the NNSS. The ground network is composed of tracking and injection stations located at Prospect Harbor, Maine; Rosemount, Minnesota; Laguna Peak, Point Magu, California; and Wahiawa, Hawaii. The headquarters, located at Point Magu, California, contains a communications center, test and evaluation station, and an operational control center to manage the systems.

(U) As each satellite passes over the tracking stations, its doppler data are recorded and transmitted to the headquarters computer center. The computer compares the actual recorded doppler data with theoretical doppler data and establishes a navigational fix for the station. This fix is compared with the known location. If the fix is wrong or out of tolerance, Navy Astronautics Group mathematicians will analyze the problem and the satellite memory will be refilled with valid data.



(U) NAVASTROGRU ALSO OPERATES THREE R&D satellites and will operate the transportable Fleet (EHF) Package Operations Center beginning in the Summer of 1988.

NASA SPACE CENTERS (U)

PURPOSE (U): Satellite launch and control.

CAPABILITIES (U): Design, development, and testing of spacecraft operations; launch facilities and support for NASA and DoD space systems.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Johnson Space Center. Responsible for design, development and testing of manned spacecraft operations to include astronaut selection and training. JSC is located 32 km (20 mi) southeast of Houston, Texas. The Space Transportation System (STS) missions are planned and directed from NASA's Shuttle Mission Control Center (MCC). Control of all manned launches pass from the Launch Control Center (LCC) at Cape Canaveral to JSC 10 seconds after lift-off. The DoD Controlled Mode Complex handles classified DoD shuttle operations. The Kennedy Space Center and Eastern Space and Missile Center (ESMC) are collocated on Merritt Island, Florida. Provides launch facilities and support for NASA and DoD space systems.

(U) Goddard Space Flight Center (GSFC). Responsible for design, development, testing and operation of unmanned spacecraft. GSFC is located in Greenbelt, MD, in the metropolitan Washington, DC area, and is comprised of numerous elements. The spaceflight tracking and data network is a integrated part of GSFC. It encompasses the network control center which operates the ground network and the space network. Also it coordinates with/or controls the appropriate launch ranges and other research/control facilities. There are eight ground network locations around the world to provide accurate tracking and communications to user satellites. The space network will consist of three Tracking and Data Relay satellites and their associated ground support facilities. The space network should be fully operational in the early 1990's.

REMOTE TRACKING STATIONS (RTSs) (U)

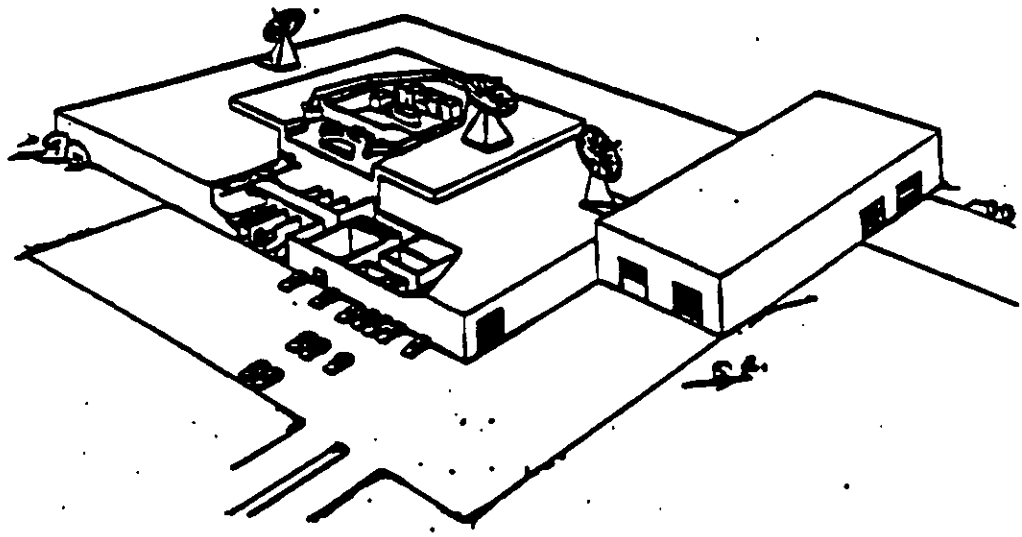
PURPOSE (U): Tracking and communications for satellite control.

CAPABILITIES (U): Shared RTSs for telemetry, tracking, and commanding (TT&C)

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The Consolidated Space Operations Center (CSOC) and the Consolidated Space Test Center (CSTC) share a network of RTSs for tracking, uplinking commands and collecting telemetry from satellites. The RTSs are linked to the CSOC and CSTC by voice, data and teletype circuits using primarily satellite communications. The RTSs are currently located at Kaena Point, Hawaii; Guam; Seychelles Islands; Vandenberg AFB, California; New Hampshire; Thule, Greenland; and Oak Hanger, England. A new RTS is also under development at Falcon AFS, Colorado.



TACTICAL WARNING/ATTACK ASSESSMENT
&
FRIENDLY MISSILE OPERATIONS

Spacecraft	Ground Sensors
DSP	BMEWS
BSTS	PAVE PAWS
	PARCS
	PIRINCLIK
	COBRA DANE

DEFENSE SUPPORT PROGRAM (DSP) (U)

SATELLITE TYPE (U): Surveillance

PURPOSE (S): [

]

CAPABILITIES (S):

]

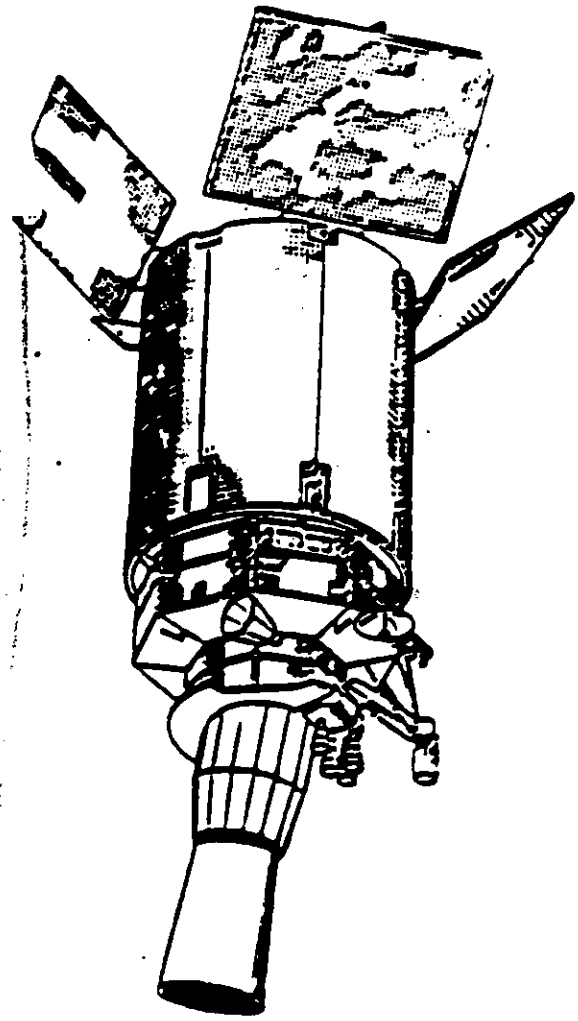
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(S) [

(S) [

]



BOOST SURVEILLANCE AND TRACKING SYSTEM (BSTS) (U)

SATELLITE TYPE (U): Surveillance

PURPOSE (U): TW/AA - Provide early warning of ICBM activity
SDI - Provide warning, tracking, and missile type information to SDI battle management.

CAPABILITIES (U): Multi-line infrared detection: SWIR and MWIR

DEVELOPMENT OR OPERATIONAL STATUS (U): In development. Deployment of this system is anticipated to be in mid 1990's.

TECHNICAL DESCRIPTION (U):

(U) BOOST SURVEILLANCE AND TRACKING SYSTEM (BSTS) is in the concept definition state of procurement by Air Force Systems Command in conjunction with the Strategic Defense Initiative Organizations. Two contractors, Lockheed Space and Missiles and Grumman Aerospace Corp, are proving mission and systems analysis to develop a system and satellite design capable of satifying the dual missions.

(U) The Phase I Strategic Defense System is currently considered to comprise six satellite in 24 hour orbits slightly inclined with respect to the equatorial plane. System and Mission control of the satellites will be from a combination of fixed and mobile ground stations still under definition. SDI mission data will be communicated directly to the various user platforms. TW/AA mission data will be communicated to appropriate C^2 centers. The spacecraft will employ on-orbit processing of sensor data and will be designed for autonomous spacecraft and mission operations.

BALLISTIC MISSILE EARLY WARNING SYSTEM (BMEWS) (U)

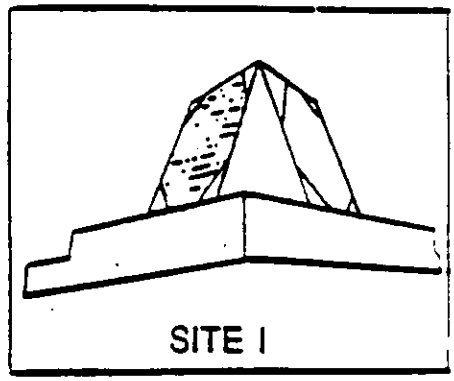
PURPOSE (U): Warning of intercontinental ballistic missile (ICBM) or submarine-launched ballistic missile (SLBM) launches.

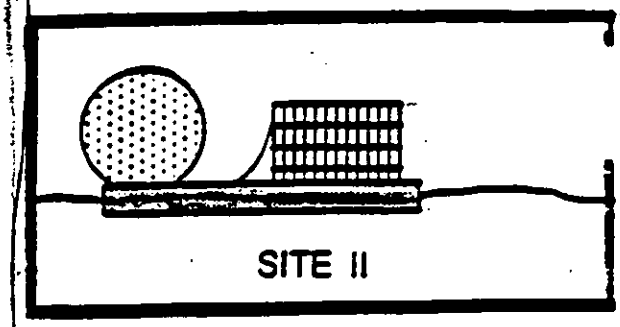
CAPABILITIES (U): See below for primary capabilities; provides support to Space Surveillance Network (SSN) by tracking orbiting space objects (secondary mission).

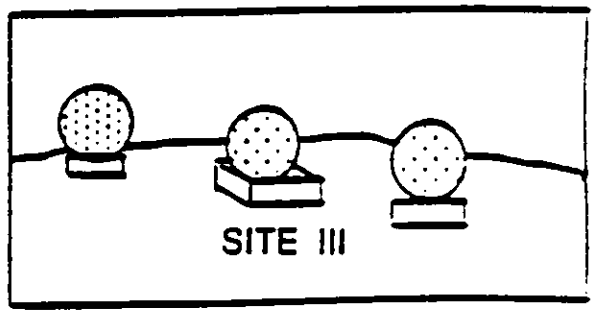
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

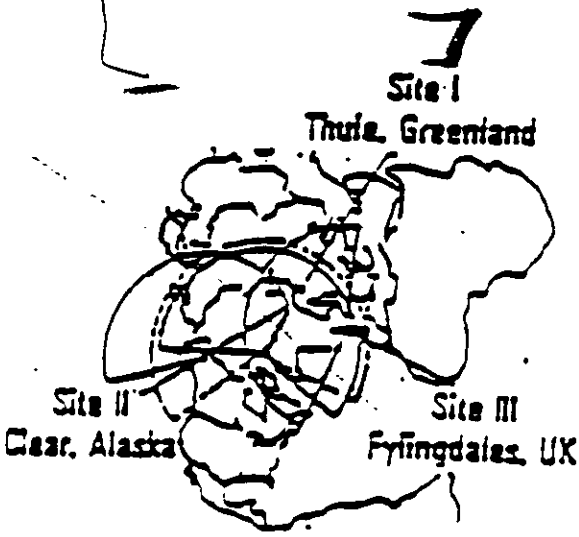
TECHNICAL DESCRIPTION (U):

(S)









PAVE PAWS (U)

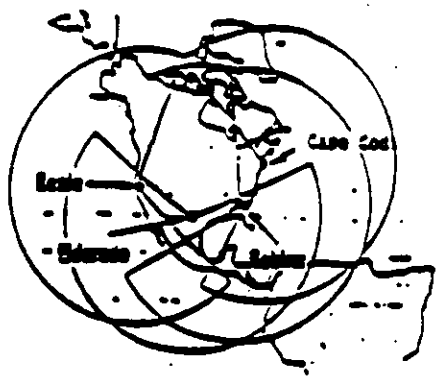
PURPOSE (U): Warning, detection, and tracking of sea-launched ballistic missiles (SLBM) launched from Atlantic, Pacific, and the Gulf of Mexico toward North America.

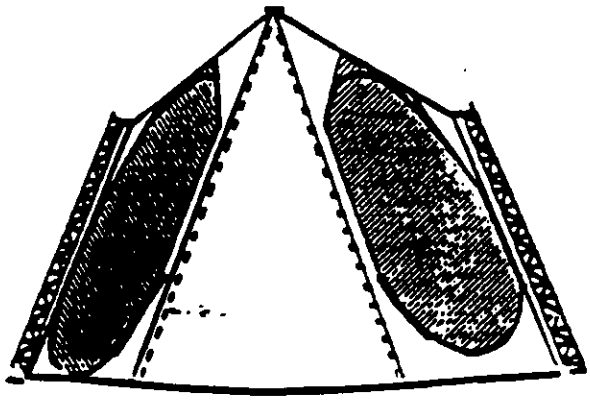
CAPABILITIES (U): Ballistic missile and space object tracking radars via four two-faced, phased-array radars.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) PAVE PAWS is designed to provide tactical warning and attack assessment (TW/AA) information on SLBMs launched from the Atlantic and Pacific Ocean areas and the Gulf of Mexico toward North America. Four two-faced, phased-array radars provide the coverage of these threat corridors. These radars perform SLBM surveillance using rapidly directed radar pulses to form a fan or fence. When a detection is made, the radar enters the track mode to collect data for TW/AA reports. Also, the sites will accomplish TW/AA processing on any intercontinental ballistic missiles (ICBMs) penetrating their coverage. Secondary mission is to provide satellite tracking data to Space Surveillance Center (SSC). Sites are located at Beale AFB, CA; Elorado AFS, TX; Robins AFB, GA; and Cape Cod AFS, MA.





PERIMETER ACQUISITION RADAR
ATTACK CHARACTERIZATION SYSTEM (PARCS) (U)

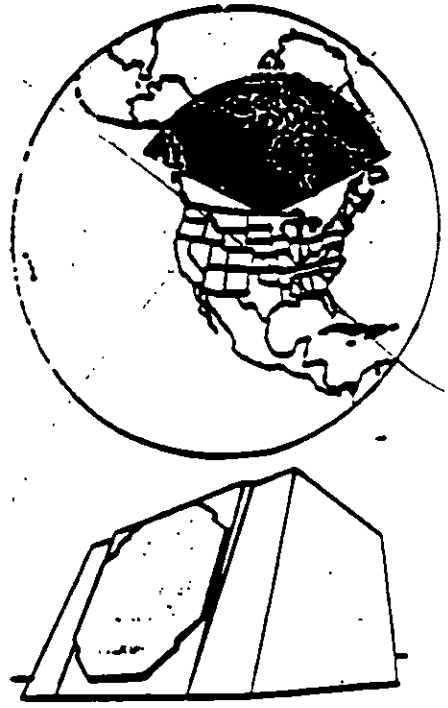
PURPOSE (U): Warning of sea-launched ballistic missile (SLBM) attacks on the U.S. and Southern Canada. Secondary mission is to provide Space Surveillance Network (SSN) support as tasked by the Space Surveillance Center (SSC) and to provide narrowband space object identification (SOI) data to the Joint Space Intelligence Center (JSIC).

CAPABILITIES (U): Ballistic missile and space object tracking via single-faced, phased-array radar (AN/FPQ-16).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(S)



PIRINCLIK RADARS (U)

PURPOSE (U): Intelligence, missile warning, and space surveillance.

CAPABILITIES (U): Provides radar tracking data on orbiting space objects.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

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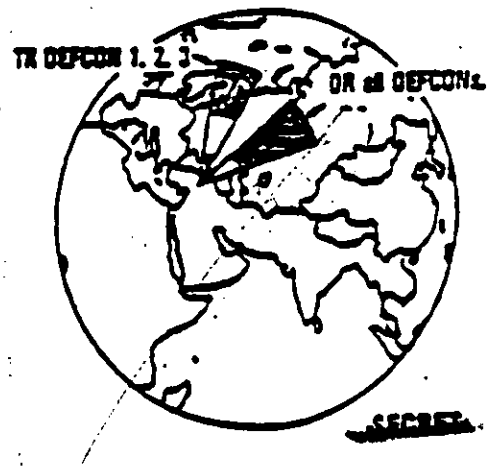
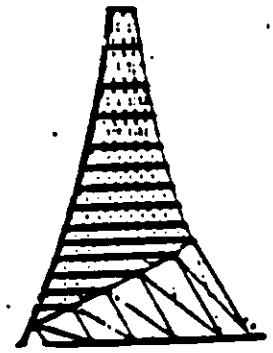




AN/FPS-17

SHEMYA (COBRA DANE) (U)

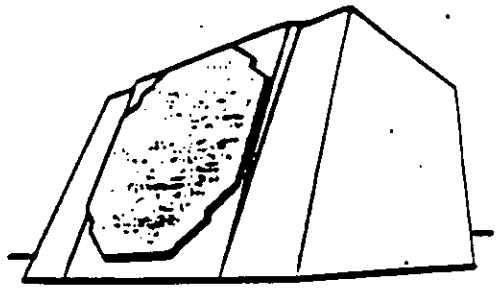
PURPOSE (U): Intelligence, missile warning, and space surveillance.

CAPABILITIES (U): Space object identification (SOI) single-faced, phased-array radar (AN/FPS-108).

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(S)



C2 COMMUNICATIONS

AFSATCOM
ANIK
COMMERCIAL
DSCS
FLTSATCOM
LEASAT
LES
MILSTAR
TDRSS
WESTAR

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AIR FORCE SATELLITE COMMUNICATIONS (AFSATCOM) SYSTEM (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Strategic military communications.

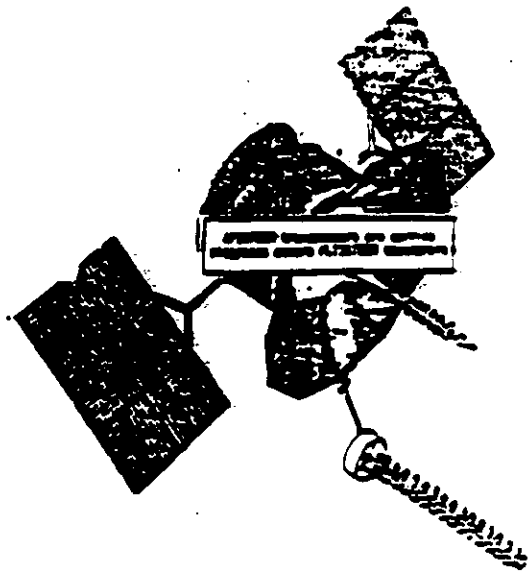
CAPABILITIES (U): Point-to-point Ultra-High Frequency (UHF) communications; worldwide, except the southern polar region.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(~~S~~) The AFSATCOM System is a multimode communication system

(~~S~~) The space segment is composed of a communications capability designed into other satellite programs with Air Force transponders carried piggyback on host satellites. AFSATCOM transponders are designed into geosynchronous satellites, providing earth coverage in all areas Two Lincoln Laboratory Experimental Satellites (LES) provide coverage in the North and South America area. Northern transpolar communications coverage is provided by satellites. Additional transponders are placed on various host satellites



ANIK (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Communications connectivity for the Thule and Fylin BMEWS radars.

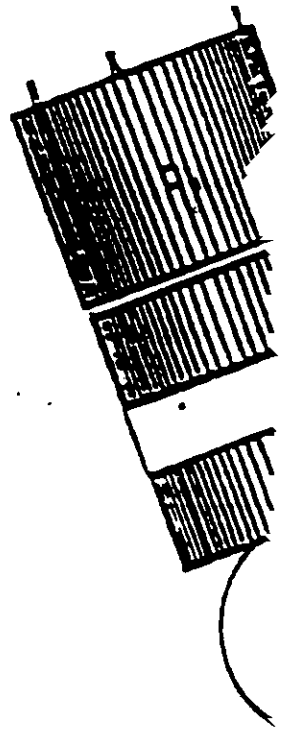
CAPABILITIES (U): C-band and six K-bands.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) ANIK is a geostationary communications satellite system owned and operates by Telesat Canada Corporation of Ottawa, Canada. Besides providing communications support for Canadian television, data, and telephone users, ANIK provides communications connectivity for the Thule and Fylingdales BMEWS radars in support of USSPACECOM.

(U) ANIK is a spin-stabilized satellite with despun antenna oriented to provide microwave communications in the 6/4 GHz bands. Command and control of the ANIK System originate from the Telesat Control Center (TCC) in Ottawa, Canada. Satellite commands generated from the Ottawa facility are transmitted via commercial land lines to two heavy-route terminals located in Toronto and Ontario.



COMMERCIAL COMMUNICATION SATELLITES (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Worldwide communications to subscribers

CAPABILITIES (U): Communications via UHF and other bands

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The United States uses many commercial satellites for normal communication services. Each satellite has its own system of priorities for the use of its limited channel capacity. The Defense Communication Agency manages the DoD use of these systems. If the event of higher DEFCONs, the control of some of these assets could CHOP (change operational control) to the military. The satellites and their parent company listed below are some of the ones that fall into the category of providing indirect support to DoD.

Agency	System
Alaska Communications Inc. (Pacific Telecom Inc.)	AURORA
American SAtellite Company	ASC
American Telephone and Telegraph Company	TELSTAR
Communications Satellite Corporation	COMSTAR
General Telephone and Electronics	SPACENET
GTE Satellite Corporation	GSTAR
Hughes Communications Inc.	GALAXY
Radio Corporation of America	SATCOM
Satellite Business Systems	SBS
Western Union	WESTAR

DEFENSE SATELLITE COMMUNICATION SYSTEM (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Direct point-to-point strategic long-naul communications.

DSCS II CAPABILITIES (U): Communication via two wide and two narrow-band channels in the X-band frequency range of 7-8 GHz; telemetry, tracking, and commanding links (TT&C) encrypted. Numerous two-way voice and data circuits.

DSCS III CAPABILITIES (U): Communications via six channels, 50 to 85 MHz bandwidth; transmit 7.25 to 7.75 GHz, receive 7.9 to 8.4 GHz; numerous two-way voice and data circuits.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

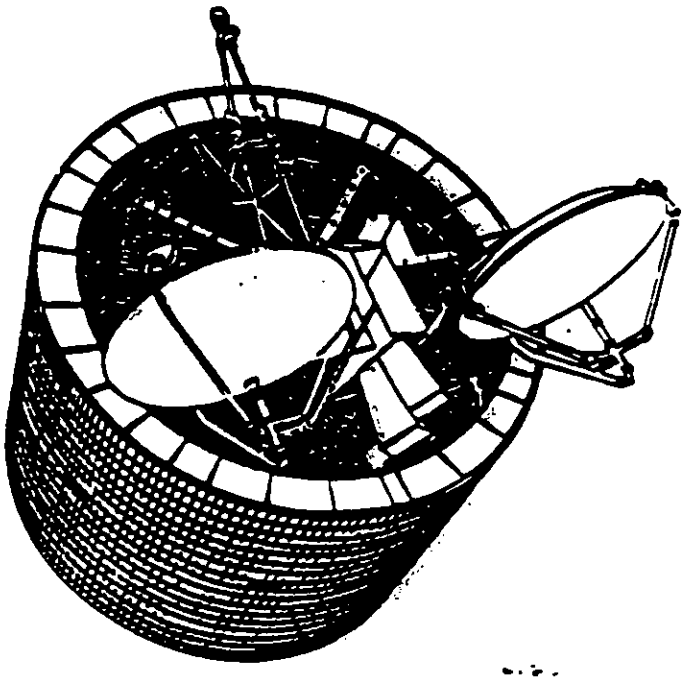
(S)

(S)

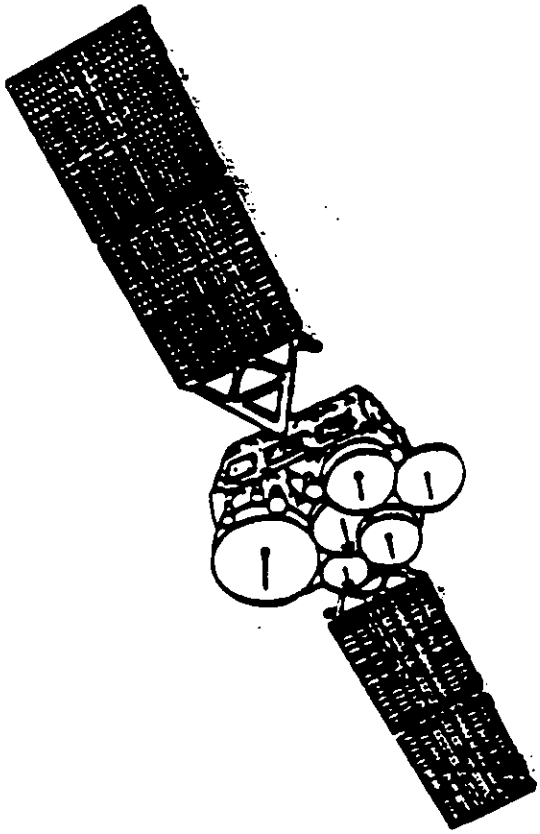
(S)

SECRET

(S)



DSCS II



DSCS III

FLEET SATELLITE COMMUNICATIONS (FLTSATCOM) SYSTEM (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Worldwide DoD tactical communications.

CAPABILITIES (U): Communications: 23 channels (1 - 86 Hz, 9 - 25 KHz, 12 - 5 KHz, and 1 - 500 KHz bandwidth channels). Follow-on: 39 channels (21 - 5 KHz, and 18 - 25 KHz, bandwidth channels).

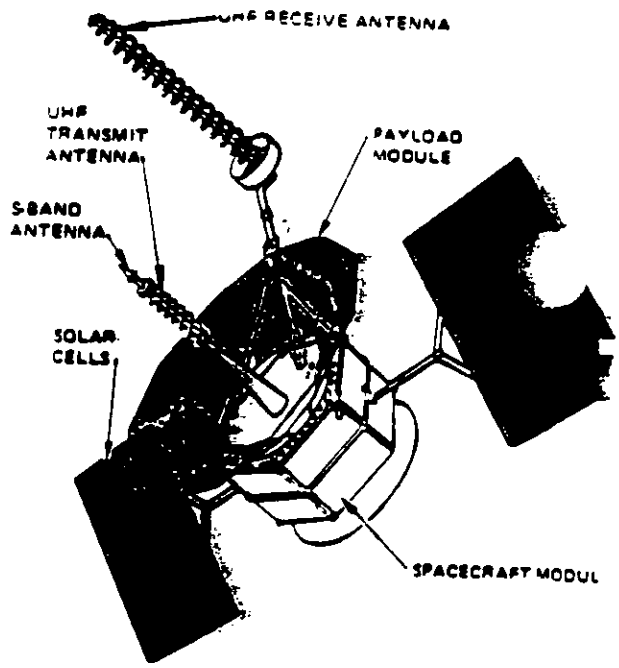
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed. A follow-on satellite system should be deployed starting in mid-1992.

TECHNICAL DESCRIPTION (U):

(U) The FLTSATCOM system is the Navy spaceborne element, providing worldwide DoD tactical communications to the Navy, Air Force, and other DoD agencies. FLTSATCOM provides ultra-high frequency (UHF)/super-high frequency (SHF) communications uplink and UHF downlink between command centers and fleet elements with naval surface, submarine, and airborne forces; it provides communications during contingency operations and "special requirements".

(U) FLTSATCOM has five deployed spacecraft in synchronous equatorial orbit providing worldwide coverage of the earth's surface between 70°W and 70°S latitudes. The earth segment consists of shore, shipborne, and airborne terminals. FLTSATCOM terminals are located at all Naval Communication Area Master Stations (NAVCAMS) and at the Naval Communication Station, Stockton, California.

(U) Currently, each satellite is capable of simultaneous reception and retransmission of nine dedicated UHF subsystems/channels plus the Fleet Broadcast System (FBS). The FBS is the SHF uplink. The satellite converts the signal to UHF and broadcasts the UHF downlink to FBS receivers on ships and shore stations. The FLTSATCOM satellite includes two piggyback AFSATCOM transponders, which are totally independent and have no interconnectivity with FLTSATCOM. The follow-on satellite is not programed to have any "specific requirements" or AFSATCOM transponders.



LEASED SATELLITE (LEASAT) (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Reliable communications through use of relay satellites.

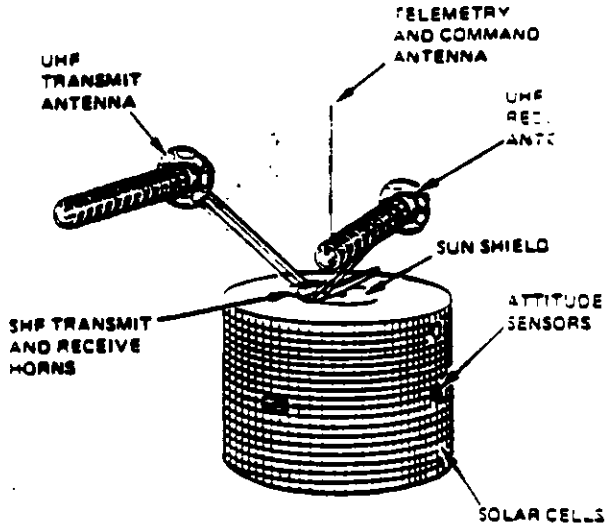
CAPABILITIES (U): Communications via ultra-high frequency (UHF)/super-high frequency (SHF); 13 channels (1 - 500 KHz channel, 7 - 25 KHz channels, and 5 - 5 KHz channels); telemetry and command links encrypted and with anti-jam capability.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed. A follow-on satellite system should be deployed starting in mid-1992.

TECHNICAL DESCRIPTION (U):

(U) The LEASAT program is designed to provide reliable communications channels through the use of relay satellites. The LEASAT system provides the exchange of tactical command and control communications between Navy commanders afloat and ashore by supporting automated information exchange systems, secure voice fleet broadcasts, and mission-oriented networks. LEASAT also supports nonnuclear Air Force mobile units.

(U) LEASAT consists of three operational geosynchronous satellites providing worldwide coverage between 70°N and 70°S. Access is controlled by Navy Communications Master Station (NAVCAMS) serving the eastern Pacific, western Pacific, Atlantic, and Mediterranean areas and by the Naval Communications Station in Stockton, California. FLTSATCOM equipment presently located at the NAVCAMS, other shore stations, and aboard ships and aircraft will be used for communication operations with the satellites. The contractor controls the satellites from their control center in El Segundo through Satellite Control Systems collocated at NAVCAMS worldwide.



LINCOLN LABORATORY EXPERIMENTAL SATELLITE (LES) (U)

SATELLITE TYPE (U): Communications

PURPOSE (U): Advanced research and development satellite program; strategic forces command and control (C^2) and Emergency Action Message (EAM)

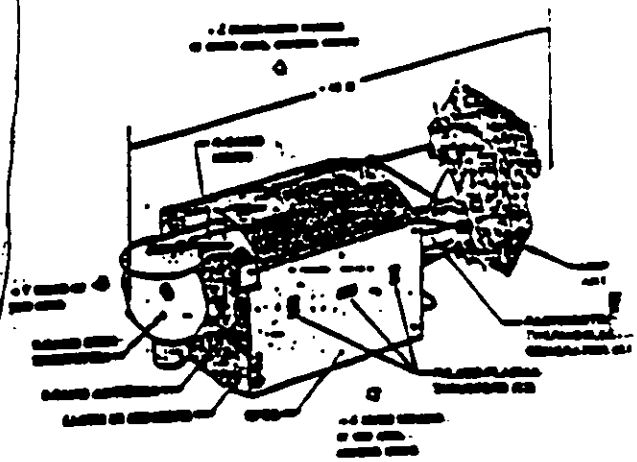
CAPABILITIES (U): Simultaneous communication using Ultra-High Frequency (UHF) and K-band; K-band crosslink.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The LES system is an advanced research and development (R&D) satellite program owned and operated by the MIT Lincoln Laboratory in Lexington, Massachusetts.

(S) Eight LESs have been launched since 1965.



(U) C^2 occurs at Lincoln Laboratories Operations Center (LLOC) and transfers to the Air Force Satellite Communications (AFSATCOM) System ground segment at Offutt AFB, Nebraska, when used in its capacity as an AFSATCOM host.

~~SECRET~~

MILITARY STRATEGIC, TACTICAL AND RELAY (MILSTAR) (U)

SATELLITE TYPE (U): Communications

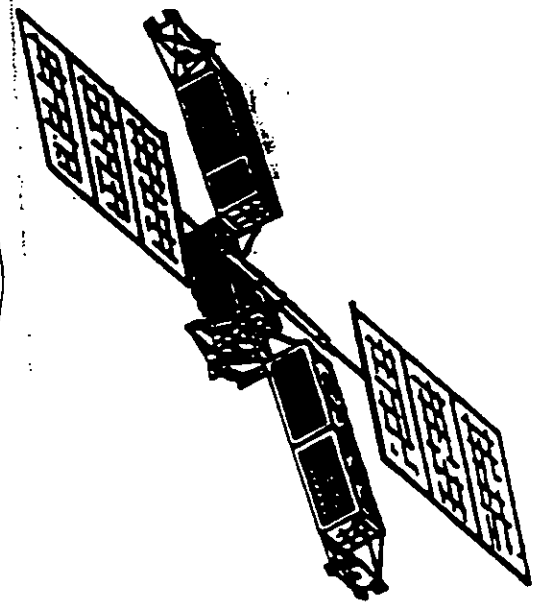
PURPOSE (U): Strategic and tactical survivable two-way communications.

CAPABILITIES (U): Ultra-High Frequency (UHF)/Extremely-High Frequency (EHF) uplinks, UHF/Super-High Frequency (SHF) downlinks, EHF crosslink.

DEVELOPMENT OR OPERATIONAL STATUS (U): In development. Initial Operational Capability (IOC) FY93 (minimum 3 satellites - provides crosslink capability).

TECHNICAL DESCRIPTION (U):

(~~S~~)



TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS)(U)

SATELLITE TYPE (U): Communications

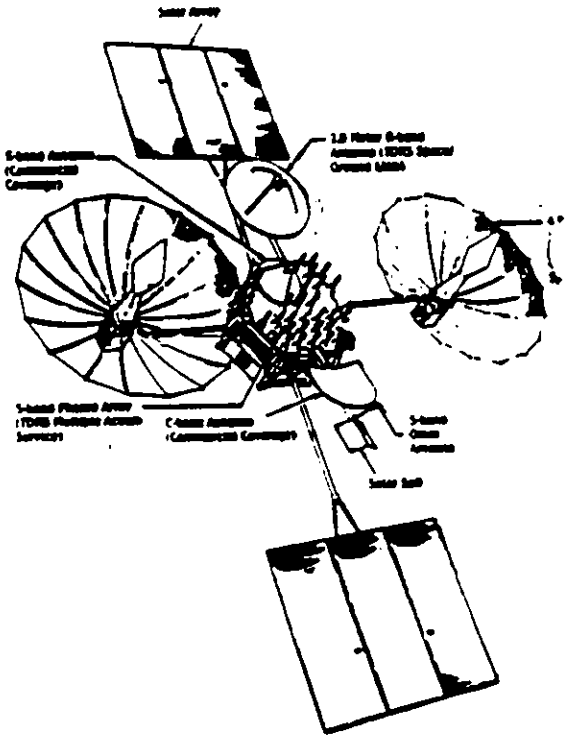
PURPOSE (U): Relay telecommunications between an earth station and user satellites

CAPABILITIES (U): Communications via multiple access at 2287 MHz, single access via S-Band at 2250 MHz and Ku-Band at 13.4 GHz

DEVELOPMENT OR OPERATIONAL STATUS (U): One satellite deployed, two more satellites expected to be operational in the early 1990s

TECHNICAL DESCRIPTION (U):

(U) When fully operational TDRSS will consist of three satellite in synchronous orbits, dual centrally located Ground Terminals at White Sands, NM, collocated NASA Ground Terminals (NGT) at White Sands and a NASA Control Center (NCC) at GSFC. Space Communications, Inc. (SPACECOM) maintains and operates the Tracking and Data Relay Satellite System (TDRSS) for NASA. NASA leases the tracking and data relay services from SPACECOM and maintains operational control for its satellite transmission services. Currently one satellite is in geostationary orbit at 41° West longitude. The TDRS telecommunications payload operates as a bent-pipe repeater, relaying signals to and from the earth station and user satellites. All user traffic relayed through TDRS and all housekeeping and control data are multiplexed on the Ku-Band Space-Ground Link (SGL) for communications with Shite Sands Ground Terminal (WSGT). For single access band service, TDRS has two dual-feed, 5-meter antennas. Each antenna can simultaneously support two user spacecraft as long as they are in the same footprint. The SGL consists of a 2.0-meter parabolic reflector. The NASA tracking and data relay portion of the telecommunications payload is separate from but carried by the basic bus which contains satellite operating and housekeeping equipment.



WESTAR (U)

SATELLITE TYPE (U): Communications

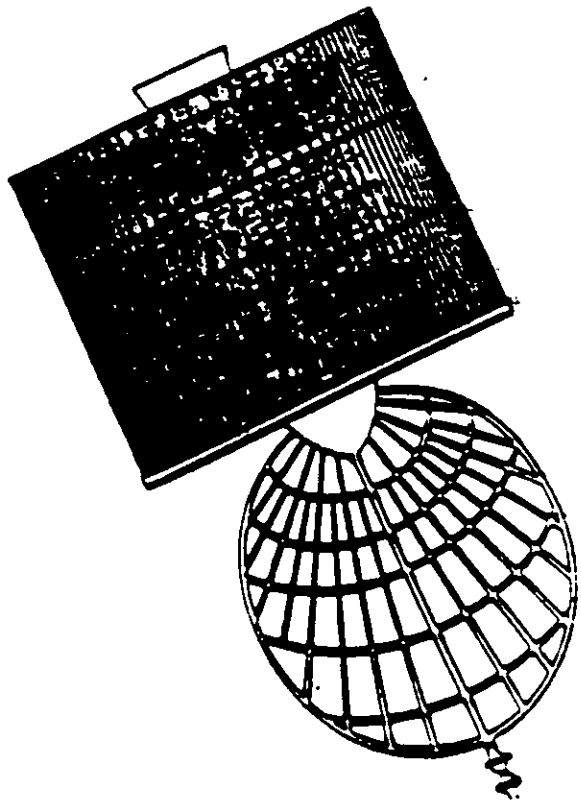
PURPOSE (U): Data transmission for the Defense Meteorological Satellite Program (DMSP).

CAPABILITIES (U): 24 transponders in the C-band.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The WESTAR satellites are operated by Western Union; the satellite capacity is leased to several companies including American Satellite Corporation, which provides the service to DMSP. The DMSP data transmission from the Remote Tracking Station (RTS) at Kaena Point and Command Readout Stations (CRSs) at Loring AFB and Fairchild AFB to Air Force Global Weather Central (AFGWC) at Offutt AFB and the Navy Fleet-Numerical Oceanography Center (FMOC) at Monterey is through the WESTAR; this is the only data routing from the CRS to Offutt and Monterey, the system control center and primary telemetry, tracking, and commanding (TT&C) terminal.



(U) WESTAR 1 (Western Union/Hughes) became the first U.S. domestic communications satellite when it was launched on 13 April 1974. WESTAR 4 is twice the size of earlier WESTARs and has four times the capacity. WESTARs 1, 2, and 3 have 12 transponders while 4 and 5 each carry 24 transponder channels.

(U) The system consists of five satellites in geosynchronous (35,700 km) orbit with longitudes of 79°W, 123.5°W, and 123°W.

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NAVIGATION

GPS
TRANSIT

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GLOBAL POSITIONING SYSTEM (GPS) (U)

SATELLITE TYPE (U): Navigation

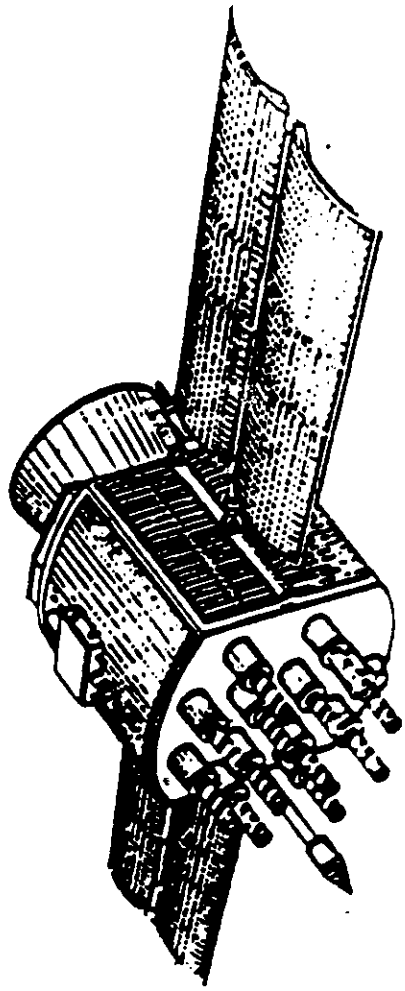
PURPOSE (U): Provide worldwide, three-dimensional position, velocity and time information.

CAPABILITIES (U): Provide 16m (52 ft) spherical error probable (SEP) worldwide positioning data for U.S. military and Allies; 76m (250 ft) SEP or better for commercial users.

DEVELOPMENT OR OPERATIONAL STATUS (U): Currently being deployed in order to achieve an 18 satellite plus 3 on-orbit spare constellation. Initial Operational Capability (IOC) is expected in FY90.

TECHNICAL DESCRIPTION (U):

(U) The GPS system is a space-based radio-positioning navigation system that will provide highly accurate, worldwide, three-dimensional position, velocity, and time information for suitably equipped users. When fully operational (FOC FY92), GPS will provide 16m (52 ft) positioning and location fixes (encrypted) to any number of passive users anywhere on or near the earth's surface or in space. The GPS space segment will consist of 18 active satellites in 12-hour, circular, 20,200 km (12,550 mi) orbits at an inclination of 55°, deployed in 6 orbital planes, with three satellites in each plane. Three active spares will also be on orbit. With this deployment, at least four GPS satellites will be in view above 10° elevation from any part of the earth.



(U) The GPS Control Segment elements will include five monitor stations and three ground antennas located throughout the world. The monitor stations will passively track all satellites in view and accumulate ranging data from the satellite signals. The information from the monitor stations will be processed at the master control station to determine satellite orbits and to update the navigation message of each satellite.

NAVY NAVIGATION SATELLITE SYSTEM/TRANSIT (U)

SATELLITE TYPE (U): Navigation

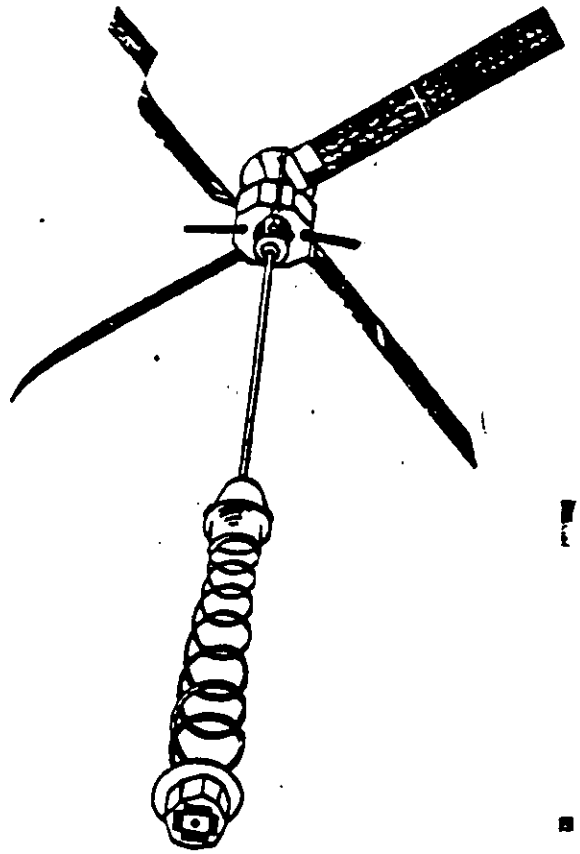
PURPOSE (U): Navigation for surface ships and submarines.

CAPABILITIES (U): Worldwide two-dimensional positioning.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The Navy Navigation Satellite System (NNSS) or TRANSIT provides passive, all-weather, worldwide, to surface ships and fleet The TRANSIT system consists of seven active plus two standby satellites in polar orbit and four dispersed tracking and injection facilities, and a headquarters, computation facility to calculate satellite ephemerides. The satellites broadcast ephemeral information continuously on two frequencies, 150 and 400 MHz. The position update is two-dimensional and requires knowledge of the user's velocity and antenna height. The waiting time between fixes is variable, depending on the user's latitude; normally 14 to 20 minutes, however, it may be as high as 12 hours. The new version of TRANSIT, NOVA, includes a more powerful transmitter, better reference clock, greater computer capacity, a degree of electromagnetic pulse (EMP) hardened receivers, and on-board ability to compensate for orbital disturbances.



Currently, there ae over 80,000 military. civilian, and commercial users.

ENVIRONMENTAL MONITORING

DMSP
GOES
NIMBUS
NOAA

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DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP) (U)

SATELLITE TYPE (U): Surveillance (environmental)

PURPOSE (U): To provide environmental data to strategic and tactical military users.

CAPABILITIES (U): Provides global visual and infrared (IR) cloud cover and other meteorological and space-environmental data.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) DMSP is the Department of Defense's meteorological satellite system. Its primary objective is to provide timely global visual and IR cloud cover and other specialized meteorological, oceanographic, and space-environmental data to Air Force Global Weather Central (AFGWC) and Fleet-Numerical Oceanography Center (FNOC) in support of special strategic missions and deployed tactical forces. The DMSP also provides direct readout of local weather data to fixed and mobile terminals throughout the world to support military operations.

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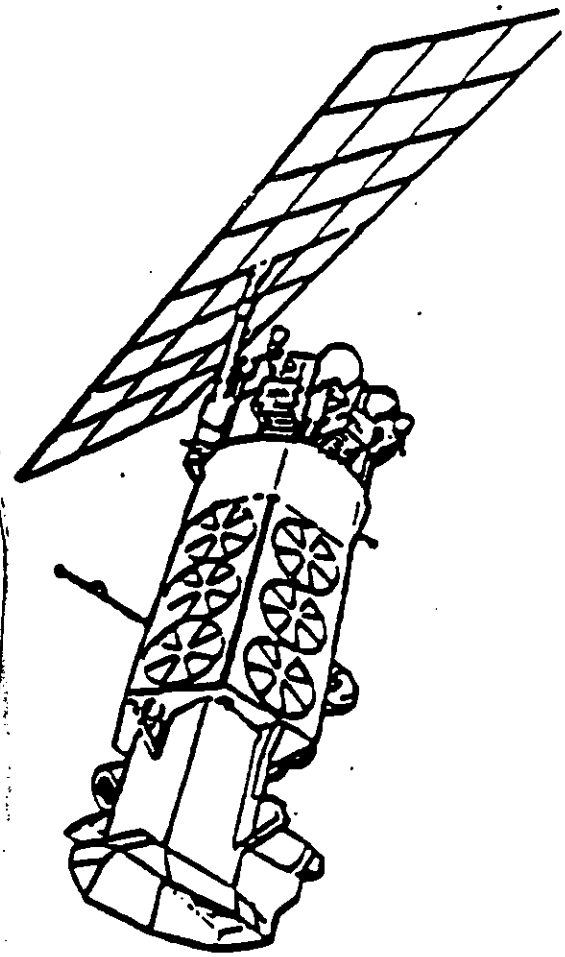


GOES (U)

SATELLITE TYPE (U): Metorological

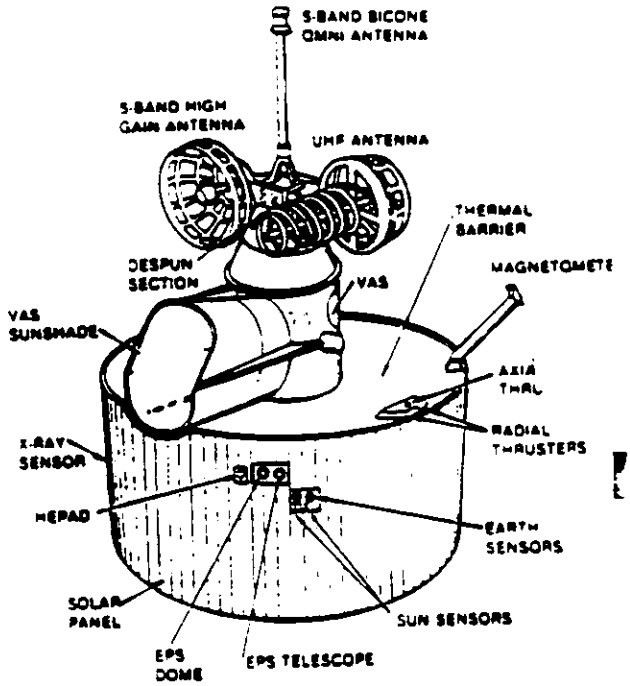
PURPOSE (U): Make continuous measurements of the earth's atmospnere over the western hemisphere.

CAPABILITIES (U): S-Band and UHF frequencies

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The Geostationary Operational Environmental Satellites (GOES) are owned by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). They are operated by NOAA's National Environmental Satellite Data Information System (NESDIS), and controlled from tne Satellite Operations Control Center (SOCC) at Suitland, MD. GOES provides day and night observations of weather in the western hemisphere, making continuous measurements of the earth's atmosphere and surface, determining the solar x-ray emissions and monitoring the near-earth environment, collection data from instruments located on or near the earth's surface and disseminating both data and analyzed environmental information to operational users. The Wallops Island Command and Data Acquisition Station supports GOES.



(U) The GOES system requires two operating satellites located at 75°W and 135°W longitude. Other GOES satellites which are in various states of health can provide back-up capabilities.

UNCLASSIFIED

NIMBUS (U)

SATELLITE TYPE (U): Environmental

PURPOSE: Test proof-of-sensor technology

CAPABILITIES (U): S-Band

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The NIMBUS satellite series is owned by NASA, operated by its Goddard Space Flight Center, and controlled from the Meteorological Operations Control Center (NETOCC) at Goddard. The only remaining satellite, NIMBUS-7, is in a sun-synchronous polar orbit, having local noon (ascending) and midnight (descending) equator crossings. Eight sensors are carried on board the NIMBUS spacecraft. They are Coastal Zone Color Scanner; Earth Radiation Budget; Link Infrared Monitoring of the Stratosphere; Stratospheric Aerosol Measurements II; Stratospheric and Mesopheric Sounder; Solar Backscatter Ultraviolet and Total Ozone Mapping Spectometer; Scanning Multichannel Microwave Radiometer; and Temperature Humidity IR Radiometer. Only the Earth Radiation Budget and the Solar Backscatter Ultraviolet and Total Ozone Mapping Spectometer are still operational.

(U) The NIMBUS communications and data handling subsystem is composed of the S-Band communications system and tape recorder subsystem and handles all spacecraft information flow. NIMBUS provides cloud cover data, weather predication to SAC, AFGWC and the Navy, and temperature provides to SAC. The system consists of one satellite in a sun-synchronous polar orbit.

NOAA (U)

SATELLITE TYPE (U): Metorological

PURPOSE (U): Provide measurement s of earth's surface and atmosphere

CAPABILITIES (U): S-Band, UHF and VHF frequencies

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) The NOAA satellites are owned by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). They are operated by the NOAA's National Environmental Satellite Data Information System (NESDIS) and controlled from the Satellite Operations Control Center (SOCC) at Suitland, MD. NOAA satellites provide operational coverage of the entire earth four times per day. One satellite is positioned in a morning sun-synchronous orbit while the other satellite is in an afternoon sun-synchronous orbit. It is a three-axis-stabilized spacecraft in a circular near-polar orbit with an inclination of 98.7 degree (retrograde) to the Equator. The satellite has a deployable solar array and a momentum wheel the gyroscopically stablizes the satellite to provide an earth oriented platform for its environmental sensors. The satellite carries four primary instrument systems to perform its mission of providing weather data for a variety of national and international users. The instrument systems are: Advanced Very High Resolution Radiometer (AVHRR), TIROS Operational Vertical Sounder (TOVS), Data Collection System (DCS), and a Space Environment Monitor (SEM). The SOCC provides the spacecraft commands to CDA stations in Gilmore Creek, AK, or Wallops Island, VA, for transmission to the satellites.

(U) The most recent launched satellites contain a search and rescue package to aid aircraft and ships in distress. NOAA and the Defense Metorological Satellite Program satellites are derived from the same satellite platform design.

NUCLEAR DETONATION DETECTION

NDS

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NUCLEAR DETONATION (NUDET) DETECTION SYSTEM (NDS) (U)

SATELLITE TYPE (U): Surveillance

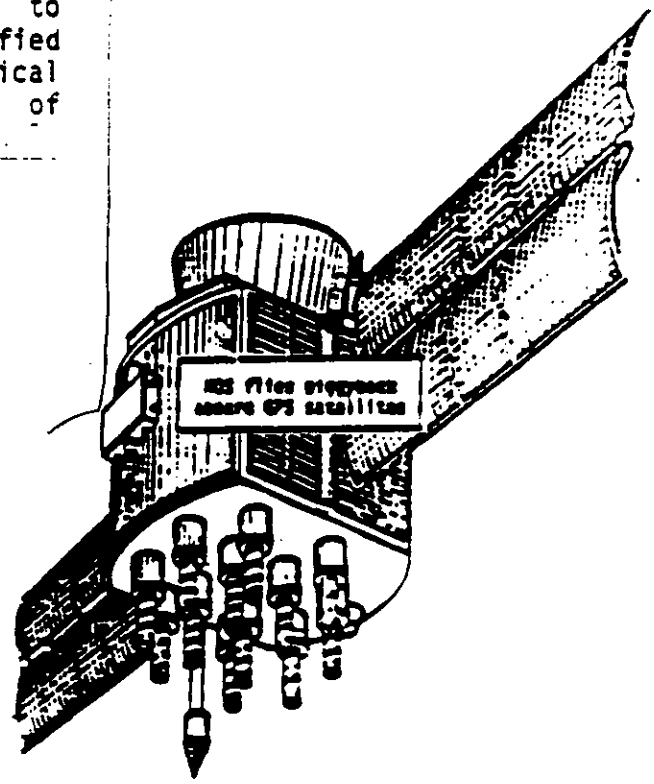
PURPOSE (U): Near-real-time detection of nuclear detonations.

CAPABILITIES (U): Nuclear detonation detection via visible light detectors (Bhangmeters) and x-ray sensors/dosimeters.

DEVELOPMENT OR OPERATIONAL STATUS (U): To be deployed piggyback on Global Positioning System (GPS), Initial Operational Capability (IOC) FY90.

TECHNICAL DESCRIPTION (U):

(S) The NUDET Detection System (NDS) is designed to provide near-real-time data on nuclear detonations (NUDETS) worldwide to National Command Authorities (NCA), Unified and Specified (U&S) commands, and tactical force commanders during all levels of conflict.



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MAPPING, CHARTING, & GEODESY

LANDSAT

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LANDSAT (U)

SATELLITE TYPE (U): Imaging

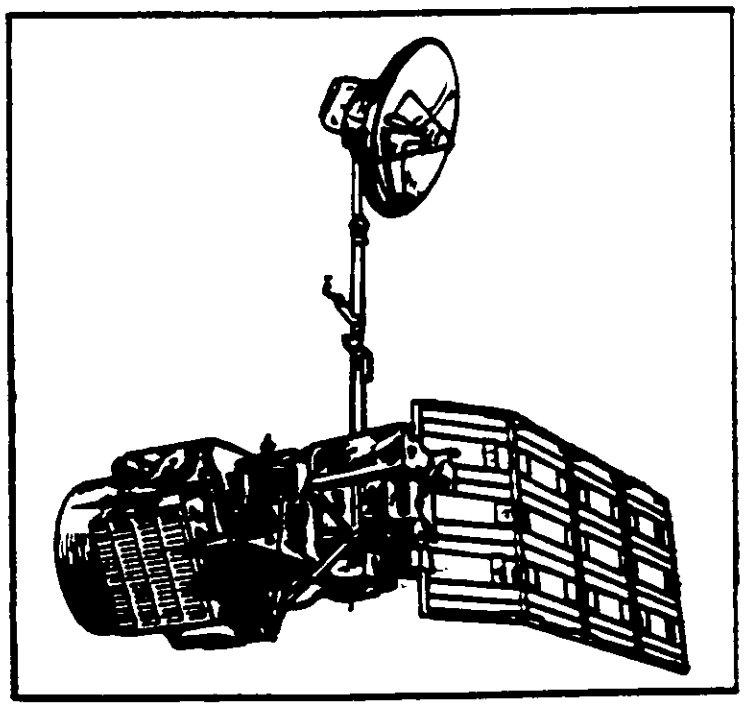
PURPOSE (U): Multispectral coverage for terrestrial analysis.

CAPABILITIES (S/NF): Seven different visibles, infrared and thermal spectral bands. Resolution is 30m at best. Synoptic and multispectral capabilities may be able to answer important military search and geographic questions for tactical military operations.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed.

TECHNICAL DESCRIPTION (U):

(U) Landsat operates in a circular, polar, sun-synchronous, 630 km (340 nm) altitude orbit. Each image frame is 160 x 160 km (100 x 100 nm). The seven spectral bands cover visible light (3 bands), infrared (2 bands), thermal (1 band) and reflective infrared (1 band). Data is downlinked to a transportable ground station, two EOSAT ground stations and to seven foreign ground stations.



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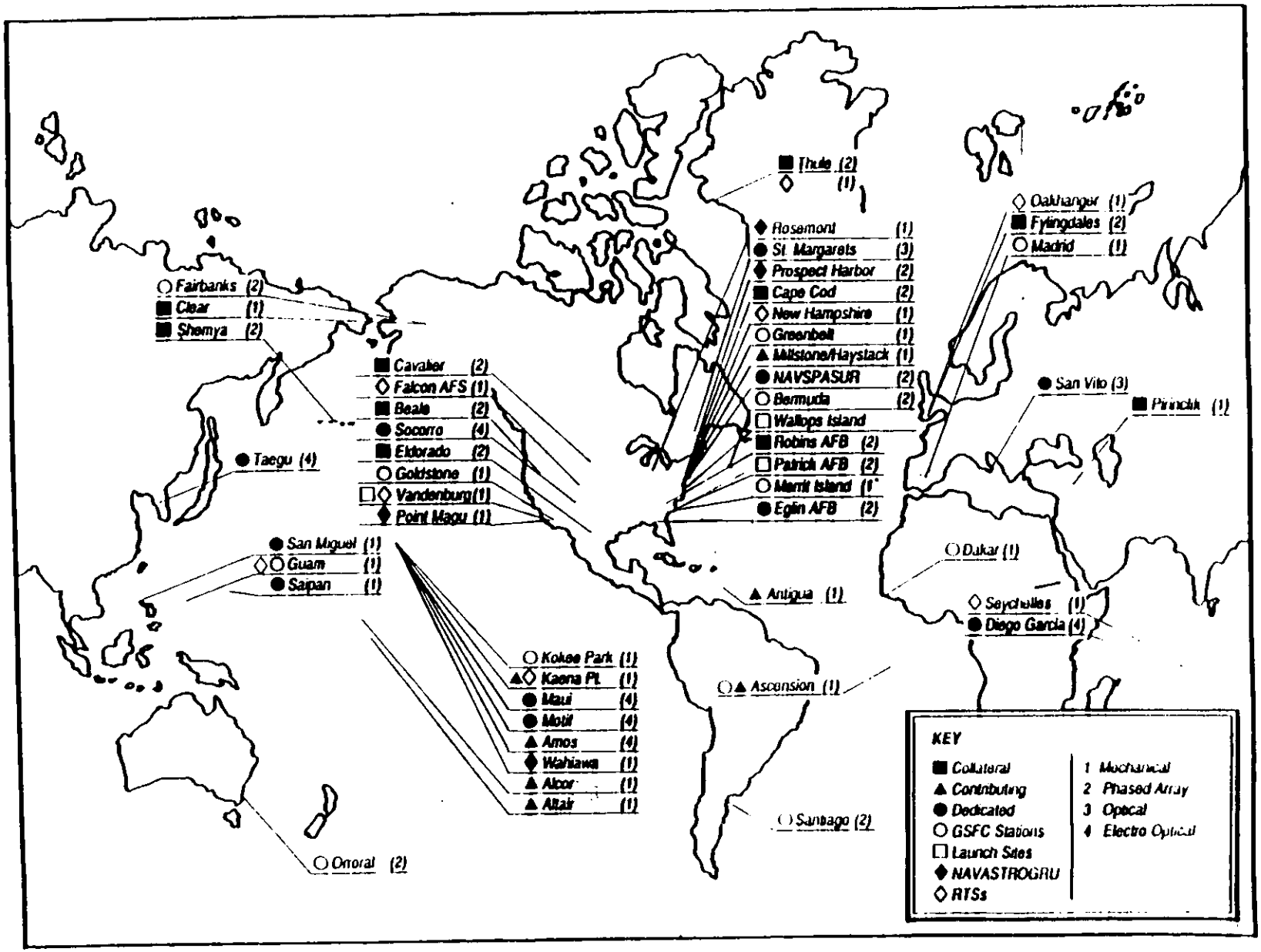
SPACE SURVEILLANCE

ALCOR
ALTAIR
AMOS
Ascension
Antigua
Baker-Nunn
Eglin
GEODSS
Kaena Point
Millstone/Haystack
MOTIF
NAVSPASUR
Saipan
San Miguel
SSTS

Ground-Based Surveillance and TT&C Facilities



UNCLASSIFIED

SPACE SURVEILLANCE TRACKING SYSTEM (SSTS) (U)

SATELLITE TYPE (U): Surveillance

PURPOSE (U): Space Surveillance - Provide surveillance of residence space objects and provide space defense warning and assessment of ASAT attacks

SDI - Provide tracking, discrimination, and kill assessment information to SDI battle management.

CAPABILITIES (U): LWIR and possibly visible detection

DEVELOPMENT OR OPERATIONAL STATUS (U): In development. Deployment of this system is anticipated in the mid-1990's.

TECHNICAL DESCRIPTION (U):

(U) SPACE SURVEILLANCE TRACKING SYSTEM (SSTS) is in the concept definition state of procurement by Air Force Systems Command in conjunction with the Strategic Defense Initiative Organization. Two contractors, Lockheed Space and Missiles and TRW are providing mission and system analysis to develop a system and satellite design capable of satisfying the dual mission.

(U) The Phase I Strategic Defense System is currently considered to comprise twelve satellites in 2000 km orbits. System and Mission control of the satellites will be from a combination of fixed and mobile ground stations still under definition. SDI mission data will be communicated directly to the various user platforms. Other space surveillance data will be provided to appropriate Space Command C^2 Centers. The spacecraft will employ on-orbit processing of sensor data and will be designed for autonomous spacecraft and mission operations.

ARPA LINCOLN C-BAND OBSERVABLE RADAR (ALCOR) (U)

PURPOSE (U): Wideband radar imaging data on near-earth satellites.

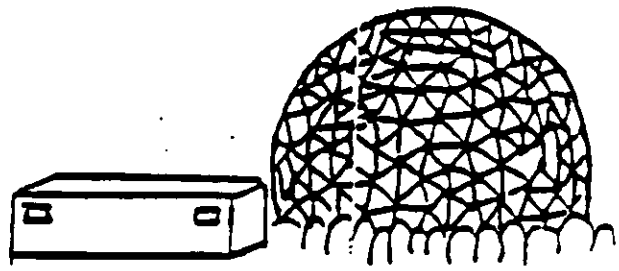
CAPABILITIES (U): 12.2-meter (40 ft) antenna wideband radar provides space object identification (SOI) imagery.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. ALCOR provides wideband radar imaging data for space object identification (SOI) on near-earth satellites. Support to the Space Surveillance Center (SSC) is on a noninterference basis with Kwajalein Missile Range (KMR) support. The ALCOR provides observations and non-real-time space object identification (SOI) data on near-earth satellites to the Joint Space Intelligence Center (JSIC) for analysis by SOI personnel.

(U) Facilities. The ALCOR is located on Roi-Namur Island, Kwajalein Atoll, Marshall Islands. ALCOR is operated and maintained for the U.S. Army Strategic Defense Command by Radio Corporation of America and other contractors under the technical direction of MIT Lincoln Laboratory.



ARPA LONG-RANGE TRACKING AND INSTRUMENTATION RADAR (ALTAIR) (U)

PURPOSE (U): Metric observations on both near-earth and deep-space satellites.

CAPABILITIES (U): Space surveillance radar part-time (128 hours per week) support; 46-meter (150 ft) paraboloid antenna provides metric data on spacecraft.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. ALTAIR provides metric observations on both near-earth and deep-space satellites and narrowband space object identification (SOI) data on near-earth satellites. Defense Advanced Research Project Agency (DARPA) provides the Space Surveillance Center (SSC) with 128 hours of deep space and near earth support per week.

(U) Facilities. ALTAIR is located on Roi-Namur Island, Kwajalein Atoll, Marshall Islands. The radar was built for the U.S. Army testing and is now a part of the Kwajalein Missile Range (KMR). ALTAIR is operated and maintained for the U.S. Army Strategic Defense Command (USASDC) by the Federal Electric Corporation under the technical direction of the Massachusetts Institute of Technology (MIT) Lincoln Laboratory. Space data is sent from ALTAIR to the Kiernan Reentry Measurements Site Control Center where it interfaces with the communications circuits.

AIR FORCE MAUI OPTICAL STATION (AMOS) (U)

PURPOSE (U): Space surveillance research and development.

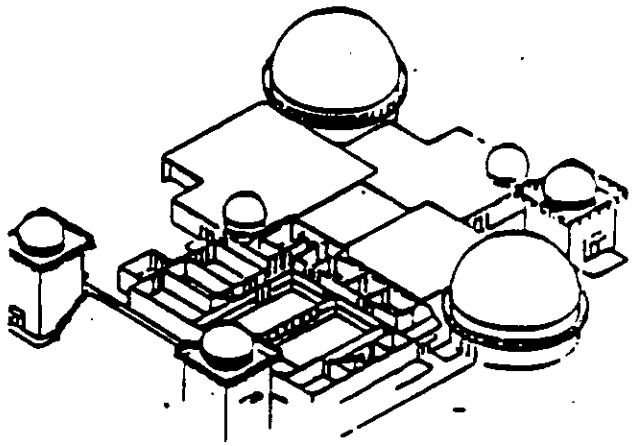
CAPABILITIES (U): Tracking, visible light, infrared, and compensated imagery.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed.

TECHNICAL DESCRIPTION (U):

(U) Mission. Space surveillance research and development work is performed at AMOS including metric tracking, visible-light and infrared space object identification (SOI), and compensated imaging. AMOS receives pointing data from the Kaena Point radar.

(U) Facilities. AMOS is a Rome Air Development Center photometric and laser facility located on Mr. Haleakala, Maui, Hawaii. Facilities are shared with Ground-Based Electro-Optical Deep-Space Surveillance (GEODSS) System Site III and Maui Optical Tracking and Identification Facility (MOTIF). AMOS mission equipment includes a 1.6 m (5.2 ft) cassegrain telescope with a satellite compensated imaging system package, a 0.6 m (2 ft) laser beam director, a small aperture beam director which is microprocessor controlled and an AMOS acquisition television system.



ASCENSION (AN/FPQ-15 AND AN/TPQ-18) (U)

PURPOSE (U): Space and missile launch support to Eastern Space and Missile Center (ESMC).

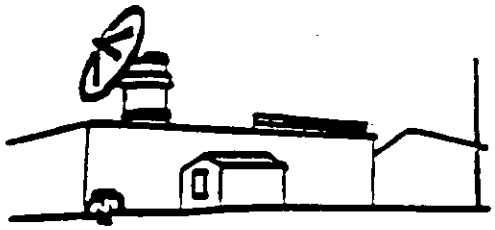
CAPABILITIES (U): Radar autotrack capability of both beacon and skin targets.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U): Mission. The AN/FPQ-15 radar at Ascension Island provides space and missile launch support to the ESMC, near-earth satellite observations to the Space Surveillance Center (SSC), and narrow-band space object identification (SOI) data to the Joint Space Intelligence Center (JSIC).

(U) Facilities. Ascension's primary radar is the AN/FPQ-15; the secondary radar is an AN/TPQ-18. Ascension Island is located in the South Atlantic Ocean at approximately 7 degrees South Latitude, 14 degrees West longitude, midway between the East Coast of Brazil and the West Coast of South Africa.



AN/FPQ-15
AN/FPQ-18 NOT SHOWN

ANTIGUA (AN/FPQ-14) (U)

PURPOSE (U): Support to Eastern Space and Missile Center (ESMC) to provide near-earth satellite observations.

CAPABILITIES (U): High precision and high accuracy pulse-tracker radar.

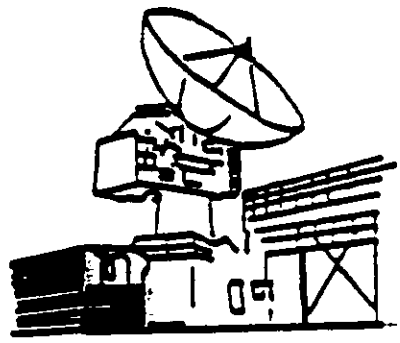
DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. Primary mission of Antigua is support of the ESMC, to provide near-earth satellite observations to the Space Surveillance Center (SSC), and narrowband space object identification (SOI) data to the Joint Space Intelligence Center (JSIC).

(U) Facilities. Antigua is located on the Leeward Islands of the eastern Caribbean.

(U) Performance. The AN/FPQ-14 radar is a high-precision and high-accuracy pulse tracker designed specifically to track missiles and space objects. The AN/FPQ-14 is directly interconnected with other radars of the Eastern Space and Missile Center (ESMC). The Antigua site is capable of space attack verification by providing bit detection through radar cross section measurements, piece count and space object identification (SOI) data.



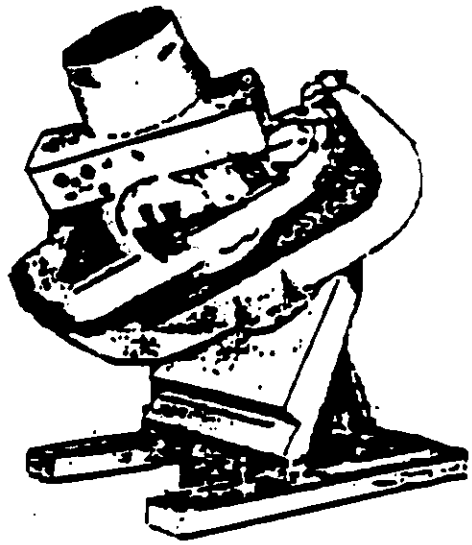
BAKER-NUNN (U)

PURPOSE (U): Deep-Space satellite observations.

CAPABILITIES (U): Optical telescope, satellite tracking camera, and precision timing system.

DEVELOPMENT OR OPERATIONAL STATUS (U): Deployed

TECHNICAL DESCRIPTION (U):

(U) Mission. The mission of the Baker-Nunn camera sites is deep-space satellite observation, photometric and St. Margarets space object identification (SOI) data collection. Sites remain operational to cover the synchronous belt area not covered by the Ground-Based Electro-Optical Deep Space Surveillance (GEODSS) system. Full surveillance coverage for the Baker-Nunn cameras include deep-space observation within the mechanical limits of the telescopes.

(U) Facilities. The Baker-Nunn sites are optical data facilities located at San Vito, Italy, and St. Margarets, New Brunswick, Canada. The cameras are located in slide-open roof enclosure adjoining the main operations/administration building. Both sites have a main telescope, satellite tracking cameras and a precision timing system. St. Margarets has a 64 centimeter (25 in) cassegrain telescope, which is used with a photometer, to collect photometric SOI data. Baker-Nunn is a manual operation. Photography takes place when weather and light conditions are adequate to allow data collection/observation.