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### **A REQUIREMENTS ANALYSIS OF THE 2008 MILSATCOM ARCHITECTURE**

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**Master of Science in Space Systems Operations-September 1997**

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The U.S. Navy is different from the other armed forces in its communications requirements. Due to the lack of terrestrial connectivity possessed by other services, the Navy has become highly reliant on SATCOM for all forms of communication. This thesis presents a requirements analysis of a proposed MILSATCOM architecture. The architecture, when fielded, will form the backbone for all U.S. military satellite communications. It is expected to be operational in the year 2008. The purpose of the study is to determine if the proposed architecture meets Naval communications requirements as defined in the Emerging Requirements Data Base (ERDB). In keeping with the stated purpose, only Naval requirements were loaded for the analysis. Requirements from other services and government agencies were not considered for this study.

As we enter the Information Age, communications connectivity and capacity will equate to operational effectiveness for Naval forces. This thesis identifies requirement shortfalls in the proposed architecture. It specifies the frequency bands where deficiencies are evident. It also proposes alternatives to fulfill or augment noted requirement shortfalls.

### **COBRA BRASS FOR BATTLESPACE CHARACTERIZATION AND BATTLE DAMAGE ASSESSMENT (U)**

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Battlespace characterization and battle damage assessment are important to the warfighter and must be a part of the strike planning. The Cobra Brass research and development sensor has the capability to provide information the warfighter can use to aid in his decision making. Navy TENCAP is using Cobra Brass in an operational mode to test the feasibility of operationally tasking this type of sensor. This thesis educates the warfighter on the Cobra Brass family of sensors, investigates the utility of Cobra Brass for battlespace characterization and battle damage assessment, and develops a concept of operations for the non-imaging infrared sensors presently deployed and for future such sensors.

### **SATISFYING NAVAL LOW DATA RATE MOBILE COMMUNICATION REQUIREMENTS**

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In today's electronic age, the Department of Defense is relying more heavily on the transfer of information to maintain battlespace awareness and command and control efficiency. Current military satellite communication systems are unable to keep pace with the growing requirements for electronic transfer of voice, data, and video information. Additionally, these systems are expected to begin failing in the 2003 to 2007 timeframe with no identified replacement. Naval Forces consist of highly mobile units that often operate in harsh environments. New communication systems must be designed that can satisfy the needs of these mobile forces that cannot rely on secure landlines for the timely transfer of information.

This thesis first examines the process for developing requirements and how they relate to the military acquisition and system engineering processes. Established methods for documenting satellite communications requirements are also reviewed. Next, potential technological drivers for a system to satisfy the low data rate needs of tomorrow's Naval Forces are presented. Current systems and plans are examined to provide information on current capabilities. Following that, a set of

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future architecture options and tradeoffs are presented to satisfy these mobile communications needs. Finally, conclusions and recommendations about the organizations and groups tasked with guiding the military and its use of space are provided.

### **THE ARMY TACTICAL COMMAND AND CONTROL SYSTEM**

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This thesis is a summary of the capabilities of the Army Tactical Command and Control System (ATCCS) and the guiding Command, Control, Communications, Computers and Intelligence (C4I) documents as they apply to the ATCCS. Its purpose is to strengthen the knowledge base of Army officers entering the Joint C4I curriculum by providing a summary of Joint and Army C4 doctrine and guidance as it applies to ATCCS.

ATCCS is the Army's primary Command and Control (C2) system at echelons corps and below. ATCCS consists of five smaller systems, each a Battlefield Functional Area Control System (BFACS) controlling seven Battlefield Functional Areas (BFA). The five BFACS are the Maneuver Control System (MCS), the Advanced Field Artillery Tactical Data System (AFATDS), the Forward Area Air Defense Command, Control and Intelligence System (FAAD C21), the Combat Service Support Control System (CSSCS), and the All Source Analysis System (ASAS).

A clear strategy for the functional design of ATCCS is supported by three documents. Related to and supportive of each other, the three documents are Joint Pub 6-0, Doctrine for Command, Control, Communications and Computer Systems Support to Joint Operations; The Army Enterprise Strategy consisting of The Vision and The Implementation Plan; and Army Field Manual 100-5, Operations. This thesis draws threads of continuity from joint doctrine through Army guidance into implementation in ATCCS.

### **THE DESIGN OF THE RADIO FREQUENCY (RF) SUBSYSTEM PRINTED CIRCUIT BOARDS FOR THE PETITE AMATEUR NAVY SATELLITE (PANSAT)**

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The Petite Amateur Navy Satellite (PANSAT) is a small digital communication satellite being developed by the Space Systems Academic Group and the Naval Postgraduate School. This thesis describes the layout of the three final flight printed circuit boards for the radio frequency (RF) subsystem for PANSAT. The circuits and layouts are documented in detail. A link analysis is performed to verify system design and a power budget provided for integration with other satellite systems. Printed circuit board design fundamentals and high frequency printed circuit board construction techniques are also described.

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### **AN OPERATIONAL OVERVIEW OF NATIONAL SIGINT COLLECTION (U)**

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National SIGINT collection remains both a national and fleet level priority. As such, a basic understanding of these collection systems is given emphasis at the Naval Postgraduate School for curriculums such as Space Systems Operations, Space Systems Engineering, and Information Warfare. Yet no one document or reference contains all relevant material for instruction of the subject, as taught at NPS. Also, most references do not present the material in a format readily assimilated by students with little or no experience in related fields.

This thesis is intended to produce a document which will provide an operational overview of all relevant national SIGINT collection systems. The primary product of this thesis is a hard copy paper which could be used both as a source for professors and as a reference for students studying national SIGINT collection. Operational usefulness, communications paths, and system differences are the primary topics of the paper. All topics will be researched with an operational, vice technical, consideration.

Additionally, a version of this operational overview has been placed on the INTELINK secure network. In the form of a web page (not unlike web pages found on the World Wide Web/Internet), the thesis then becomes a user-interactive learning tool. Users can visit the site, download relevant information, then follow hypertext links to related sites such as mission offices or reporting sites.

### **FINAL DESIGN, INTEGRATION, AND VALIDATION OF THE PANSAT ANTENNA SYSTEM**

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In this thesis, the final design for the Petite Amateur Navy Satellite (PANSAT) antenna system is constructed, integrated, and validated. The antenna elements and matching network are field tested and compared to the Numerical Electromagnetics Code (NEC) model. The final free-space radiation pattern and its power gain distribution will be used to help track PANSAT's rotation during its orbit.

### **USSOCOM METRICS – A CASE STUDY IN MODERN C4I NETWORK MANAGEMENT ISSUES**

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Modern Department of Defense C4I systems utilize high speed commercial computer networks, composed of commercial equipment and connectivity. The United States Special Operations Command (USSOCOM's) SCAMPI (not an acronym) Network was a forerunner of this trend. Industry uses the same type of circuits but approaches the network management of these circuits from a financial interest versus the military strategic and tactical aspects considered by the service user. This thesis analyzes this representative network in the context of industry network management and metrics practices. The thesis first surveys and explains the industry practices most prevalent in this changing environment and then examines the practices in place at USSOCOM. The compilation of industry-wide network management and metrics procedures is followed

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by a series of solution recommendations for the SCAMPI network. These recommendations are explained in the context of current industry practices. This is followed by a series of emerging industry trends and technical developments which most likely will affect the implementation of network management and metrics tools. These developments are followed by a comprehensive industry definitions section, network bibliography, and a hypertext link guide to current military, industry and educational institutions networking solutions.

### **INTEGRATION OF COMMERCIAL MOBILE SATELLITE SERVICES INTO NAVAL COMMUNICATIONS**

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Mobile Satellite Services (MSS) need to be integrated into Naval Communications. DoD SATCOM military-owned systems fall well short of meeting DoD SATCOM requirements in general and mobile SATCOM specifically. This thesis examines DoD SATCOM requirements, especially those affecting communications on the move. From these requirements, three systems—Inmarsat, Iridium and Globaistar—are identified and evaluated for potential use in Naval Communications. An overview of space communications and each of the three systems is provided to identify general operational capabilities, system strengths, and system weaknesses. The Naval narrowband functional requirements process is explored and DoD SATCOM and Commercial MSS ability to satisfy those requirements is assessed. Potential Naval MSS communications missions are examined and possible DoD enhancements are considered for each system as well as the impact these enhancements will have on each system. Recommendations are provided as to which Naval communications missions are best suited for these enhanced MSS.

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