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Operational Requirements Document

AFSPC 002-94-I/II

SATELLITE CONTROL

ACAT Level II

4 August 1995

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//SIGNED//

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PREFACE

The Satellite Control Operational Requirements Document (ORD) identifies requirements for new operational capabilities with a specific focus on weapon system cost reduction and improved compatibility with other satellite control networks in order to facilitate resource sharing. Weapon system cost reductions are responsive to Fiscal Year 1993 National Defense Authorization Act direction to reduce space system costs by 15 percent and Air Force Chief of Staff initiated efforts to reduce costs. The Satellite Control ORD also responds to the Fiscal Year 1994 Senate Armed Services Committee direction to reduce operations and maintenance costs and to improve mission effectiveness. The Chairman of the Joint Chiefs of Staff has tasked United States Space Command to produce an integrated space systems tracking, telemetry and commanding architecture and roadmap for National; Department of Defense (DoD); Research, Development, Test and Evaluation; National Aeronautics and Space Administration; and other assigned missions. In response to this tasking, Commander in Chief, United States Space Command directed the Future Integrated Tracking, Telemetry and Commanding Architecture Study (FITAS) with an emphasis on satellite control infrastructure cost reduction. This Satellite Control ORD is consistent with the FITAS recommendations and vision for an interoperable, "plug and use" architecture, governed by standardized interfaces with distributed processing.

OPERATIONAL REQUIREMENTS DOCUMENT
FOR
SATELLITE CONTROL
AFSPC ORD 002-94-I/II

1. GENERAL DESCRIPTION OF OPERATIONAL CAPABILITY

Satellite Control System Objectives

We are going to invest $400 million of Operations and Sustainment (O&S) funding to significantly reduce the cost of Air Force satellite control operations. As a national asset, we want the satellite control system to support the warfighters and other users by providing more responsive and flexible satellite control capability. This will be less costly and manpower intensive to operate and maintain, consistent with Congressional and DoD guidance to reduce O&S costs. We want to maximize use of industry standards and Commercial or Government off-the-shelf (COTS or GOTS) hardware, software, and communications when they reduce acquisition and development timelines, and cost to operate and/or maintain. These are the basic requirements for the satellite control system. In the other areas of reliability, levels of automation, and capacity, we are willing to examine the trade-off between cost and improvement.

The current Air Force Satellite Control Network (AFSCN) is operated by Air Force Space Command (AFSPC). The AFSCN supports National; Department of Defense (DoD); Research, Development, Test and Evaluation (RDT&E); National Aeronautics and Space Administration (NASA); and other missions. The AFSCN is the primary command, control, and communications support capability providing satellite control for DoD space systems. The AFSCN consists of a Common User Element (CUE) and Mission Unique Elements (MUE). The CUE provides all users with Tracking, Telemetry, and Commanding (TT&C) support, defined interfaces, communications links, range control, and the Remote Tracking Stations (RTSs). For additional details see Section 3.1, General Description of Existing Systems, and the AFSCN Definition Document.

1.1 Mission Area

Satellite control is included in Mission Area 410, Space Launch and Orbital Support. As directed in the AFSCN Program Management Directive, the AFSCN provides Tracking, Telemetry, and Commanding (TT&C); mission data dissemination; and data processing support to operational DoD space systems; National space systems; RDT&E space systems; and other assigned allied, civil, and commercial space systems. The deployed space systems that are supported provide United States (US) combat and support troops with vital weather, navigation, surveillance, warning, and communications services, as well as with other strategic and tactical information. Mission Areas supported include Strategic Defense (Mission Area 120), Space Defense (Mission Area 123), Classified Programs (Mission Area 313), Tactical Intelligence and Related Activities: Geophysical and Space Support (Mission Area 325), Strategic Surveillance and Warning (Mission Area 332), Strategic Communications (Mission Area 333), Tactical Communications (Mission Area 345), Navigation and Position Fixing (Mission Area 357), and Weather Services (Mission Area 42 1).

1.2 Mission Need

The mission need is to support the warfighters and other network users by providing more responsive and cost effective satellite command, control, and communications (C3) support to DoD space systems and to those of selected allied, US government, and commercial agencies. This Operational Requirements Document (ORD) identifies required capabilities based on the Defense Planning Guidance, the AFSPC Satellite Control Mission Area Plan (MAP), the AFSPC Mission Need Statement (MNS) for Satellite Control (AFSPC MNS 002-94), and the 28 Oct 93 AFSPC Concept of Operations for Satellite Control (CONOPS). The AFSPC MNS is consistent with the US Space Command (USSPACECOM) Integrated Satellite Control (ISC) MNS (AFSPC 004-93). Needed mission capabilities and characteristics required by the ISC MNS and the MNS for Satellite Control are identified in Table l-l. In addition, specific support requirements are derived from satellite system ORDs and MNSs, warfighting Operations Plans (OPLANs), and various satellite program requirements documents. The requirements are defined in this ORD, Section 4, and the Requirements Correlation Matrix (RCM).

1.3 Type of System Proposed

The proposed satellite control system characteristics are consistent with the AFSPC and USSPACECOM Satellite Control MNSs and the 28 Oct 93 AFSPC Satellite Control CONOPS and will alleviate shortcomings addressed in Section 3.2 of this ORD. Detailed requirements for this system are defined in Section 4 and the RCM. The proposed system will provide an advanced satellite control capability and an enhanced and modernized communications system as the next incremental step in the AFSCN evolution. The system will reduce the overall cost of conducting O&M with a goal of improving current levels of security, reliability, dependability, and mission effectiveness. The system will be operable and maintainable with less personnel than currently required. The system will provide improved efficiency in the use of resources and a have a lower life cycle cost. The system will comply with the 29 June 1994 Memorandum from the Secretary of Defense, Subject: Specifications and Standards - A New Way of Doing Business, and the AFSPC Standardization Policy for the AFSCN. The system will be fault tolerant with no single point failures that result in loss of overall mission capability. The system will consist of fixed facilities (and be adaptable to mobile/transportable operations) equipped with capabilities to meet requirements of system users, operators, and support personnel. It will be developed such that unique elements, software, procedures, and interfaces are eliminated except where specifically justified. Commercial or Government off-the-shelf (COTS or GOTS) hardware, software, and communications will be used when they minimize development timelines and cost to acquire, operate and/or maintain. For example, long-haul communications connectivity will take full advantage of the capabilities provided by the Defense Information Systems Network (DISN).

Table l-l. Needed Mission Capabilities and Characteristics Related to Source Documents

Capabilities and Characteristics	Integrated Satellite Control MNS	MNS for Satellite Control
Standardization and Interoperability	1) Enhance interoperability among satellite command and control system elements 2) Develop standards to achieve integrated satellite control systems compatibility	1) Meet approved interface and interoperability standards 2) Emphasize hardware and software functional commonality with other mission areas to increase multi-satellite support capabilities
Operability and Flexibility	3) Smooth transition from peace to war 4) Capable of being exercised in peacetime 5) Capable of sustaining essential operations at higher levels of conflict	3) Maximize operability consistent with wartighting operations plans and procedures 4) Be flexible and allow growth to accommodate new mission and surge support requirements without major modification of the capability
Capacity	6) Meet anticipated workload requirements at each level of conflict	5) Accommodate a mix of new and existing user and operator requirements
Reliability, Maintainability, and Availability	7) Integrated logistics support is a key factor	6) Become more economical to operate, maintain and logistically support
Command and Control (Reporting and Tasking)	8) Evolve toward integrated, interoperable system within the combatant command structure 9) Standard, survivable, secure links with wartighting forces/users 10) Direct mission related tasking of payloads, consistent with USSPACECOM concept of operations, in support of strategic and theater operations	7) Conform to existing operational command and control processes, procedures, and capabilities 8) Emphasize automation of these processes and procedures 9) Integrate resource scheduling and system status reporting 10) Be responsive to new support requests
Information Timeliness to the User		11) Facilitate distribution of timely and accurate mission information to wartighting forces and other users world-wide
Training	11) Conduct training and readiness activities in off-line environment preventing operational impact 12) Provide high fidelity scenarios	12) Minimize the complexity of systems operations and maintenance (O&M) and thereby reduce training timelines and required operator and maintainer skill levels 13) Maximize use of on-line decision making tools sufficient to minimize operator contingency training and operator retraining
Survivability and Endurability	13) Systems endurable as the forces supported 14) No single points of failure should cause loss of mission capability or support	14) Survivability and endurability must be sufficient to support assigned missions consistent with those mission requirements for satellite control across all war fighting environments

1.3.1 Key Requirements. The key requirements for the satellite control system involve the ability to execute TT&C functions and perform communications connectivity. Specifically, the key parameters are to reduce the operations manpower necessary to perform satellite contact functions at the Satellite Operations Center (SOC) and at the Remote Ground Facility (RGF), provide increased telemetry and commanding data rate capabilities, and to correspondingly reduce the operations manpower necessary to perform communications functions. (Table l-2). Requirements have been defined for each of these specific key parameters, variables determined, methodologies established, and preliminary analyses have been accomplished to provide thresholds and objectives. A complete list of requirements, including non-key parameters, is provided in Section 4.

SYSTEM REQUIREMENT	KEY PARAMETER	THRESHOLD	OBJECTIVE
EXECUTE			
NUMBER OF OPERATORS THE SATELLITE CENTER	YES	1 OPERATOR CONTACT	INTERVENTIO BY EXCEPTION
NUMBER OF OPERATORS THE REMOTE FACILITY"	YES	1 OPERATOR CONTACT	UNATTENDED OPERATIONS
TELEMETRY DATA	YES	20 MBPS	150 MBPS
COMMANDING DATA RATE*	YES	28.8 KBPS	100 KBPS
COMMUNICATIONS CONNECTIVITY			
NUMBER OF OPERATORS THE COMMUNICATIONS SEGMENT*	YES	1 OPERATOR CONTACT START OR STOP AND MONITOR 3 ON-GOING EVENTS	SAME

* DENOTES KEY PERFORMANCE

Table l-2. Key Requirements

1.3.1.1 Execute TT&C

1.3.1.1.1 SOC **Manpower. SOC** manpower is defined as the number of personnel in the satellite operations center required to perform telemetry, tracking, and commanding functions. **Variables.** The variables that affect this requirement are automation/user friendliness and cost. **Methodology.** Our approach is to leverage off existing commercial technologies and practices. Based on the Integrated Satellite Control Human Computer Interface Standard, a single operator should be able to manage and interpret up to four separate operations (computer displays). This means that for a typical in-procedure type of satellite contact, a single operator will be able to perform all required activities as shown in Figure 1- 1. Based on existing technology, we can achieve the decision support degree of automation without significant development effort as shown in Figure l-2. **Requirement.** The threshold requirement is that the satellite control system shall be designed so that one operator is capable of performing satellite contact functions (in-procedure). The objective requirement is manual intervention by exception.

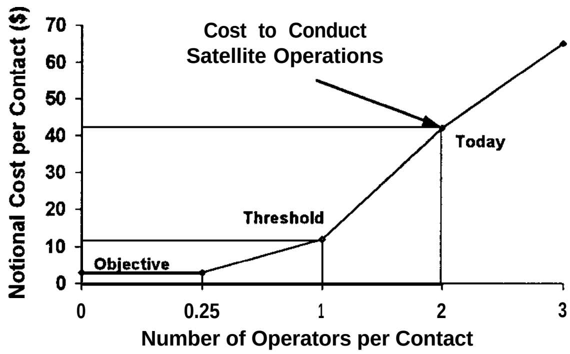

Figure l-l Number of SOC/RGF Operators per Contact

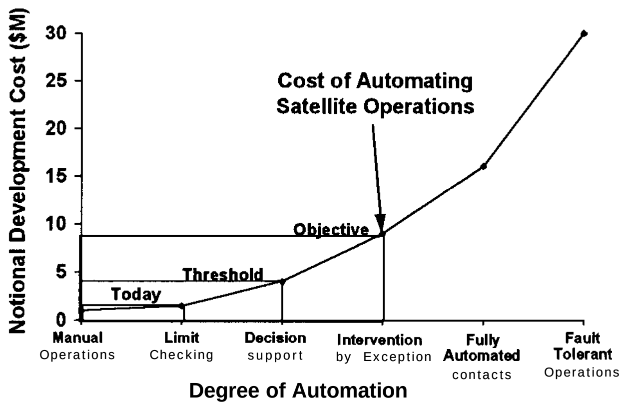

Figure l-2 Degree of SOC/RGF Automation Versus Cost

1.3.1.1.2 **RGF Manpower.** RGF manpower is defined as the number of personnel in the remote ground facility required to perform antenna operations in support of telemetry, tracking, and commanding functions. **Variables.** The variables that affect this requirement are automation/ user friendliness and cost. **Methodology.** Our approach is to leverage off existing commercial technologies and practices. Based on the Integrated Satellite Control Human Computer Interface Standard, a single operator should be able to manage and interpret up to four separate operations (computer displays). This means that for a typical in-procedure type of satellite contact, a single operator in the RGF will be able to perform all required RGF functions in support of TT&C as shown in Figure l-l. Based on existing technology, we can achieve the decision support degree of automation without significant development effort as shown in Figure 1-2. **Requirement.** The threshold requirement is that one operator is capable of performing necessary RGF antanna operations in support of single satellite contact functions. The objective requirement is unattended RGF operations.

1.3.1.1.3 **Telemetry Data Rate.** Telemetry data rate is defined as the quantity of SV platform and payload information which is downlinked as a function of time and measured in terms of bits per second (bps) which must be received (collected) by the satellite control system for subsequent handling. **Variables.** The variables that affect this requirement are link capacity, programmatic requirements and cost. **Methodology.** Telemetry data rate is driven by the individual satellite programs supported. Our approach evaluated programmatic needs in order to define the range of capabilities required to support the assigned satellite programs as shown in Figure 1-4. **Requirement.** The threshold requirement is that the satellite control system shall have the capability to relay telemetry data from supported SVs at rates up to 20 Mbps. The objective requirement is 150 Mbps.

- DMSP AND **SBIRS REQUIREMENTS DRIVE TT&C THRESHOLD DATA RATES**
  - **DMSP: 28.8 KBPS COMMANDING RATE**
  - **SBIRS: 20 MBPS MISSION DATA RELAY**
- **NPOESS DRIVES TT&C OBJECTIVE DATA RATES**
  - **100 KBPS COMMANDING RATE**
  - **150 MBPS COMBINED TELEMETRY/MISSION DATA RATE**

Figure l-3. SV Programmatic Requirements

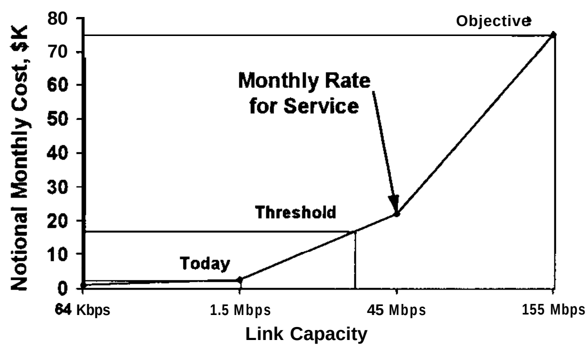

Figure l-4 Link Capacity

1.3.1.1.4 **Commanding Data Rate.** Command data rate is defined as the quantity of satellite control system or other ground-developed satellite tasking/control information, which must be uplinked to a SV as a function of time. These data are typically measured in bps. **Variables.** The variables that affect this requirement are link capacity, programmatic requirements and cost. **Methodology.** Commanding data rate is driven by the individual satellite programs supported. Our approach evaluated programmatic needs in order to define the range of capabilities required to support the assigned satellite programs. **Requirement.** The threshold requirement is that the satellite control system shall have the capability to command supported SVs at rates up to 28.8 Kbps. The objective requirement is 100 Kbps.

1.3.1.2 Perform Communications Connectivity

1.3.1.2.1 **Communications Manpower.** Communications manpower is defined as the number of personnel in the communications system required to perform communications initiation, control, and monitor functions for satellite control system users. **Variables.** The variables that affect this requirement are automation/user friendliness and cost as shown in Figure l-6 **Methodology.** Our approach is to leverage off existing commercial technologies and practices. Based on the Integrated Satellite Control Human Computer Interface Standard, a single operator should be able to manage and interpret up to four separate operations (computer displays). **Requirement.** This means that for a typical in-procedure type of satellite contact, a single communications system operator will be able to perform all required activities with manual intervention by exception as shown in Figure l-5. The threshold requirement is that the satellite control system shall be designed so that one communications system operator shall have the capability to initiate or terminate one communications event and perform end-to-end monitor and control for up to three additional on-going events.

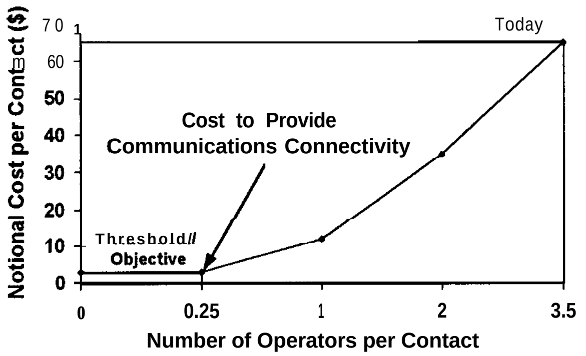

Figure l-5 Number of Communications Operators per Contact

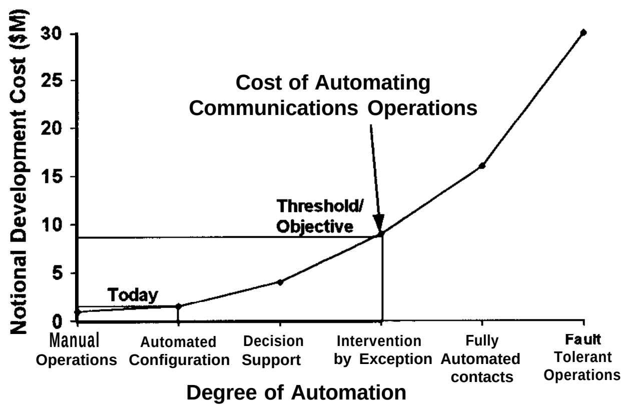

Figure l-6. Degree of Communications System Automation Versus Cost

1.3.2 Materiel Solutions

Non-materiel solutions, as described in the AFSPC MNS for Satellite Control, have been implemented but are not sufficient by themselves to correct identified deficiencies. Approaches to materiel solutions have been identified and evaluated as follows:

1.3.2.1 Leverage Existing Civil/Commercial/Foreign Svstems. Commercial satellite operations capabilities exist that may offer substantial technology and cost improvements over existing DoD and other agency satellite command and control capabilities. However, unacceptable constraints may exist. Considerations include the following:

a) Proprietary constraints;
b) Jeopardized responsiveness to National security needs;
c) Capacity shortfalls;
d) No single, existing system able to meet all DoD requirements;
e) Combining multiple existing systems presents prohibitively complex and expensive compatibility problems; and
f) Could lead to increased fragmented system management during stressed environments (e.g. loss of totality of control).

1.3.2.2 Block Changes. Improving future satellites' capabilities to self-monitor, tolerate failures (or self correct), and report health and mission performance status to ground satellite command and control capabilities should be considered at satellite block changes. This can reduce the volume (level) of ground-based satellite operation and operator intervention. Considerations related to block changes include the following:

a) Need to support on-orbit assets while block changes incrementally occur,
b) Some changes to ground system will still be needed to adapt to new satellite capabilities,
c) Establishing required capabilities based on only block changes increases implementation time and complexity to unacceptable levels, and
d) Block changes are typically not harmonized among satellite programs to provide synergistic effects.

1.3.2.3 New Svstems. A totally new integrated capability can be developed and acquired to provide support to current and future missions. A standardized, automated capability can reduce manning, training, and maintenance times, while increasing maintainability, operations support capacity, and operations and support cost savings. Automation should be considered for both the ground-based satellite command and control capability to simplify operator training/intervention and the mission satellites to reduce the need for frequent ground-based operator intervention. This new capability must also permit increased expandability to accommodate new mission requirements, interoperability, and interface with DoD and other agency satellite command and control capabilities. Considerations include the following:

a) Cost,
b) Schedule,
c) Performance and
d) Supportability.

1.3.2.4 Expand or Modify Existing Svstems. This alternative provides for incremental evolution of existing capabilities via improvements and modernization through which a more flexible, operable and maintainable satellite operations capability can be achieved. A standardized, more automated system can reduce manning, training and maintenance times, while increasing operations support capacity and overall cost savings for O&M. Automation can be applied to both existing ground-based satellite command and control capabilities and to satellites. Evolutionary acquisition to meet satellite system requirements allows a time-phased, requirements-based implementation of capabilities to ensure mission requirements are met in a fiscally constrained and responsive fashion. It permits taking advantage of opportunities in supported system programs as well as in harmonizing future block changes with a standard set of AFSCN support requirements. Because of inherent flexibilities in upgrading select portions of this complex system while minimizing risk to current operations, evolutionary modification to the AFSCN is considered the most viable approach.

1.4 Operational and Support Concepts

The satellite control system will continue to be operated and sustained in a manner that ensures all validated user requirements are met in an accurate and timely fashion. Table **l-2** lists users to be supported in 1998-2004 and the type of SOC or Network Service support, defined in Section 3.1, these users will require. Although support requirements have not been fully defined for all of the future Space Vehicles (SVs), known requirements have been considered in developing the operations and support concepts, identifying AFSCN shortcomings, and identifying upgrade requirements. The operations and support of the proposed system requires the participation of planners, developers, operators, maintainers, supporters and users to identify and implement concepts that will reduce overall costs. The operations and support concepts are documented in the 28 Oct 93 AFSPC Satellite Control CONOPS and summarized in the following paragraphs. The phrase “distributed, open system architecture” is used throughout this section as a generic phrase to conceptually describe the proposed capability. There is no intention through the use of these words to identify a specific design solution. The operations concept implements the Future Integrated TT&C Architecture Study (FITAS) recommended “plug and use” concept. This concept permits compatible users of the satellite control system to “plug” into selected RGFs and communications systems and “use” these resources for TT&C access without necessarily involving an AFSPC SOC. For AFSPC users the “plug and use” is accessed through SOCs at Falcon Air Force Base (FAFB), Onizuka Air Station (OAS), or other dedicated AFSPC centers. For non-AFSPC users the “plug and use” is accessed through their own operations centers, Mission Control Complexes (MCCs), or Test Support Complexes (TSCs). These services will be provided within the planned capabilities of the AFSCN. When needs exceed these capabilities, the requesting user may be required to compensate the network for cost of modification and any recurring cost of continued operation.

Table l-3. Programs Supported by the Satellite Control System in 1998-2004

Short Name	Program/System Name	SOC Support	Network Service
BALLISTICS	Ballistic Missiles		
BE	Brilliant Eyes Missions		
BMD	Ballistic Missile Defense Experiments		
BOOSTERS	Space Launch Boosters	X(TBD)	
DMSP	Defense Meteorological Satellite Program		
DSCS	Defense Satellite Communications system	X	X
DSP/SBIRS	Defense Support Program/Space Based Infrared System	X	X
FLTSATCOM	Fleet Satellite Communications System	X(TBD)	X
GFO	Geosat Follow-on		X
GPS	Global Positioning System	X	X
IUS	Inertial Upper Stage	X	X
Milstar	Milstar	X	X
MSTRS	Miniaturized Satellite Threat Reporting System		X
National	National Systems		X
NATO III/IV	North Atlantic Treaty Organization Satellites	X	X
NPOESS	National Polar Orbiting Environmental Satellite System	X	X
P9x	Space Test Experiment Missions		X
SKYNET IV	Skynet Communications Satellite	X	X
SMx	Support Mission Series (Classified Programs)		X
STS	Space Transportation System (Space Shuttle)	X(TBD)	X
UHF F/O	Ultrahigh Frequency Follow-On	X(TBD)	X

1.4.1 Operational Concept

The operational concept envisions operations performed through an integrated, interoperable system consisting of both space segment and ground segment elements. The space segment includes the SV platform (or bus) and the payload elements. The ground segment includes the space-ground interface, command and control, communications, scheduling, statusing, and development and training elements. This ORD addresses ground segment requirements. Space segment requirements will be addressed by SV Program ORDs. The ground segment will continue to encompass both multi-user resources (available to multiple space missions and users) and mission specific resources (uniquely required by individual space missions). Sharing of resources will be encouraged to maximize utilization rates, lower costs, reduce reliance on mission-specific resources, and provide flexibility in responding to user requirements. A dedicated dual node capability is not required for backup operations, however there will be the capability to perform selected satellite command and control operations from one or more possible alternate locations (to include possible mobile/transportable ground elements). The satellite control system will be able to provide continuous operations in peace, war, and all intermediate levels of conflict. Operational survivability will be commensurate with forces supported. The satellite control system operational concept is discussed below. Table l-3 relates the operational concept to the Capabilities and Characteristics of the proposed system.

The operational concept calls for evolution from today's satellite control capability to less manpower intensive, more highly automated, and more standardized configurations and operations designed with the goal of truly becoming the "Network of Choice" for both DoD and non-DoD satellite systems. The satellite control system operational concept (after activation of the capabilities required by this ORD) is based on satellite contact support planning, contact execution, and contact evaluation activities being performed automatically with the operator being notified of the actions taken unless there is a need for manual intervention. If a failure occurs during any phase of operations, the system automatically switches to other available resources and either notifies the operator of the action taken or prompts the operator with suggested actions through a decision support environment. The communications system linking the RGFs, control nodes, and satellite users will consist of both military and commercial non-dedicated, on-demand wide area network (WAN) transport services. These WAN services will be provided by the Defense Information Systems Agency (DISA) via the worldwide DISN. Unique communications requirements that cannot be immediately satisfied by DISN near-term will be presented to DISA for incorporation into DISN mid-term. Communications connectivity within the control nodes between SOCs will be through local area networks (LANs) and sub-networks. This connection should take less than two minutes for the most complex link. This notional operational concept for satellite control and communications forms the basis for the requirements in this ORD.

1.4.2 Support Concept

The satellite control system will be supported using Integrated Weapon System Management (IWSM). Under IWSM, the Air Force Materiel Command (AFMC) System Program Director (SPD) is responsible for "cradle-to-grave" support including integrated product development, life-cycle systems management, sustaining engineering, and integrated logistics.

Two levels of maintenance will be used, organizational and depot, while minimizing O&M cost. Organizational maintenance will perform preventive and corrective maintenance. Organizational maintenance should be integrated with operations (i.e., a combined operator and maintainer) wherever possible, especially for remote site or mobile/transportable systems, to reduce the number of personnel. Depot maintenance consists of those activities beyond the scope of organizational maintenance and may be performed either on-site or at the depot. System design should allow equipment maintenance by the personnel with the equivalent of 5-level technician experience. Equipment will maximize the use of built-in test (BIT) and automated fault detection-fault isolation (FD/FI) and fault correction (where feasible) capability to allow the identification of the appropriate LRU (cards, motors, etc.) to be removed, replaced and returned to the designated source for repair. Common equipment across programs will consolidate maintenance requirements, reduce the number of unique spares, and lower logistics support costs. The satellite control system will use integrated logistics support as defined in Section 5.

Table 1-4. Relationship of the Operational Concept to the Capabilities and Characteristics of the Proposed System

Capabilities and Characteristics	Proposed System	Operational Concept
Standardization and Interoperability	-Standard interfaces for all application systems and to all external users. --Standard human computer interfaces. --Minimum need for dedicated resources or payload specific configurations. --Mission Unique Equipment/Software (MUE)/ (MUS) for validated payload-specific processing. -Standard communications protocols and interfaces for voice, data, and video.	Standardized communications and data processing system access will be available to all users while maintaining security requirements. This will facilitate interoperability between ground segment elements and the space-to-ground links in order to provide for improved operations in any mission scenario.
Operability and Flexibility	--Automated mission planning. -Easily expandable and recontigurable communications capability. --Integrated, rule-based systems for common functions. --Secure system configuration to allow operations across all classification levels. --Distributed open computing environment to allow rapid operational changes. --Recontigurable software making maximum use of database changes vs hard coded software parameters	The system will be flexible enough to meet changes in tasking based on mission requirements. It will have the capability and flexibility to accommodate mission unique requirements and maintain a cost and operations effective baseline. It will implement a flexible communications connectivity architecture that is capable of supporting satellite control operations and mission data collection, processing, and dissemination throughout all levels of conflict.
Capacity	--Advanced capacity management planning ability. --Data rate easily variable based on user's needs. --Distributed, open computing environment for easily expandable data processing capability.	The system will have expandability (schedules, data rates, communications links, command and control, data processing and reduction) to accommodate validated mission requirements based on the AFSPC Mission Model.
Reliability, Maintainability, and Availability	--Expandable high-data-rate distributed workstation backbone, and broadband communications network. --Automated error detection and correction. --No mission impacting single-points of failure. --Modular, Line Replaceable Unit (LRU) based subsystems.	The satellite control capability will be available to all satellites assigned. The satellite control system will employ modular, easily maintainable, and highly reliable systems. Ground segment elements will be maintainable through the use of LRUs.
Command and Control (Reporting and Tasking)	--Distributed open computing environment with interface to existing external standard command and control systems for near realtime reporting, statusing, and tasking based on OPLAN requirements.	Automated reporting will be facilitated through standard interfaces with integrated status reporting systems. Mission status is transferred to and from the satellite control users or organizations requiring this information. Mission tasking is transferred to and from satellite control users or organizations requiring this information via standard interfaces.
Information Timeliness to the User	--Satisfy all requirements levied on the satellite control system by the OPLAN and user requirements documents.	Increased data processing capacity, high speed data processing, and rapid data dissemination will facilitate increased responsiveness to the user.
Training	--Direct connectivity between the satellite operations center and the satellite control simulation system.	Standard interfaces will be provided to interactive training systems designed to enhance training and certification of specified operations personnel.
Survivability and Endurability	--Architecture capable of operating in a mobile/transportable environment in support of wartighting missions.	The satellite control system will operate in support of United States forces, policies, strategies, and interests worldwide during peacetime, war, and all intermediate levels.

2. THREAT

The AFSCN is susceptible to three system specific threats: information collection threats, denial of service threats, and environmental threats. Within the first two threat categories, both internal (personnel granted access to satellite control systems) and external (personnel not granted access to the systems) sources are discussed. The internal threat, both to information collection and system denial, is the most significant threat. The primary security goals impacted by these threats include protection of military, political, economic or proprietary information from unauthorized disclosure; protection of system integrity; and protection from loss of system capability.

2.1 Operational Threat Environment

The following two documents identify specific threats that influence satellite control system requirements. In addition to these threat documents, National, DoD, and Air Force Space Policy provide threat related guidance.

2.1.1 <u>Space Threat Environment Description</u>

The hostile foreign threat is outlined and analyzed in the Space Systems Threat Environment Description (TED) (U), DST-2660F-727-93, 29 October 1993, produced by the National Air Intelligence Center, Air Intelligence Agency.

2.1.2 <u>Multi-Disciplinary Intelligence Threat Analysis</u>

The Air Force Office of Special Investigation (AFOSI) Multi-Disciplinary Intelligence (MDI) Threat Assessment - AFSCN (U) SECRET-NOFORN-WNINTEL; and the AFOSI MDI Threat Assessment - The Terrorist and Criminal Threat - AFSCN (U), SECRET-NOFORN-WNINTEL, provide additional threat information.

2.2 System Specific Threats

The United States Government recognizes that there is a destabilizing world situation causing increased and more uncertain threats to military systems. There is proliferation of weapons of mass destruction, increasing availability of weapons delivery systems within third-world nations, and increasing numbers of third world nations with nothing to lose and everything to gain by the conduct of terrorist activities. The potential threats to some, or all, current and future satellite control assets include nuclear attack; sabotage; terrorism; unconventional warfare; electronic warfare; biological, chemical, and conventional weapons; and espionage. Agents of foreign governments, terrorists, dissidents and radicals are a threat to satellite control facilities and operations. Overseas operations could also be threatened by local government policy changes, revolutions, coups, etc. The complexity of satellite control operations depends on both highly skilled personnel and critical computer processing. Malicious hardware and software damage by trusted insider personnel is a significant threat. Additionally, satellite control systems assets are susceptible to acts of nature. These threats are expected to continue for the forseeable future.

2.2.1 <u>Information Threat</u>

The AFOSI MDI Threat Assessment - AFSCN addresses the threat from unauthorized individuals gaining technical, economic, political or military information about space operations that could result in loss of national advantages in those areas. This information can be obtained through open sources of literature or through collection assets (internal or external, technical or human).

2.2.1.1 Internal Threat. The complexity of satellite control creates a dependency on experienced, knowledgeable personnel and critical communications - computer processing. The system is susceptible to information collection (human, electronic and mechanical) from intentional and unintentional acts by trusted agents with access to the system. The nature and severity of these threats vary from peacetime to general war.

2.2.1.2 External Threat. The satellite control system is also susceptible to unauthorized information collection by external agents (human, electronic, and mechanical). Foreign intelligence services and industrial espionage efforts acquire information from both operational activities and communication - computer activities that indicate sensitive, political, economic, technological, or proprietary information. Human intelligence (HUMINT) methods use personnel who observe, visit, or gain access to sensitive information or operations. Specific applicable collection methods are defined in Defense Intelligence Agency Regulation (DIAR) 55-3.

2.2.2 <u>Denial of Service Threat</u>

Denial of satellite control system capabilities can be accomplished by degrading the integrity and/or availability of communications - computer processing; by spoofing or jamming these systems; and by preventing the use of system facilities or components through intentional or unintentional damage, destruction or obstruction of these elements. Satellite control availability and integrity can be denied through both internal and external threat agents.

2.2.2.1 Internal Threat. Trusted individuals present the most significant denial of service threat. Those with authorized access to system hardware, software, computers, communications, utilities, tools, and essential facilities have the opportunity and ability to intentionally or unintentionally manipulate system operations and software development, and to damage critical components. Any authorized user could intentionally or unintentionally interrupt, degrade, or damage critical system elements.

2.2.2.2 External Threat. External threats stem from protesters; political, economic, or industrial agents; criminals; and, in periods of increased international tension or war, terrorist or paramilitary operations. They may use attack methods that include penetration and damage to restricted areas or antennae; interruption of communication links through signal spoofing or jamming; microwave attack; and use of chemical, biological, radiological, or conventional weapons. The physical security threat is defined in Air Force Instruction (AFI) 3 l-101 and the AFOSI MDI Threat Assessment - AFSCN.

2.2.3 Environmental Threat

The locations of satellite control system assets, Continental US (CONUS) and overseas, subject the system to environmental threats of many types. These include earthquakes, floods, thunderstorms, lightning, heavy snows, tropical storms, tornadoes, and corrosive sea spray and salt air. Satellite control communications links are susceptible to these environmental threats and numerous types of atmospheric and solar disturbances.

Various types of support activities may also create environmental hazards. Facility power outages; heating, ventilation, and air conditioning maintenance; and minor construction activities can cause power fluctuations, adverse temperature environments, air pollution, or other conditions that can impact continuity of system operations. Emergency situations in one module can impact other resources in the same building. Fire, toxic fumes from chemicals, or water from sprinkler systems or blocked drainage systems can lead to system outages.

2.3 Reactive Threat

The proposed system will provide greater flexibility, endurability, and availability through all levels of crisis and conflict. However, the reactive threat potential would increase proportionally to the increased direct applicability to the warfighter. If the satellite control system is perceived as a critical node in the information flow to the warfighter it becomes a bigger and better target.

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3. SHORTCOMINGS OF EXISTING SYSTEMS

This section begins with a brief overview of the current AFSCN. The general description of the existing system includes both the Multi-User and Dedicated elements of the AFSCN. Additional descriptive material can be found in the AFSCN Definition Document published by Headquarters AFSPC and in AFSCN system specifications. Note that the terminology used in this section is consistent with the Draft AFSCN Definition Document when describing the current system. Using this overview as a foundation, this section then identifies current AFSCN shortcomings as identified in the Satellite Control MAP and MNS.

3.1 General Description of Existing Systems

Air Force satellite command and control has evolved over a period of thirty years. What is now the AFSCN initially evolved as a system to test specific early RDT&E satellites and concepts. This system was transferred to AFSPC in 1987 and is continuing to evolve. It now routinely supports over 80 individual DoD and other assigned SVs by conducting over 120,000 contacts annually.

3.1.1 Communications

The current satellite control system is a geographically-dispersed collection of control nodes and RGFs, shown in Figure 3-l. The current network is characterized by centralized, fixed-location control nodes and fixed-location RGFs connected by fixed rate, point-to-point military and commercial communications links. The typical communication link data rate is up to 1.536 megabits per second (Mbps) from a single sided Remote Tracking Station (RTS) and 3.072 Mbps from dual-sided RTSs. The typical communication link data rate for dedicated RGFs is 2.4 kilobits per second (Kbps) to 2.66 Mbps. Uplink and downlink communications with supported SVs are accomplished over the Space-Ground Link Subsystem (SGLS) with the 1.76 to 1.84 Gigahertz (GHz) frequency band used for uplinking data and the 2.2 to 2.3 GHz band used for downlinking data. The AFSCN consists of multi-user and dedicated resources. Multi-user resources are shared to support multiple space systems while dedicated resources support only one system (e.g., GPS, DMSP, Milstar, etc.).

3.1.2 Operations Centers

The SOCs located at FAFB, Colorado, and at OAS, California, and MCCs and TSCs at OAS provide multi-user satellite control for the AFSCN. The Command and Control Segment (CCS) software used in these control centers is based on a centralized, mainframe-based processing architecture. Dedicated control centers at various dispersed locations perform payload and satellite control functions for DMSP, GPS, DSP, Milstar, and other space systems. The SOCs are able to provide varying degrees of backup or supplementary support on a program-specific basis to the dedicated control centers. Each SOC, MCC and dedicated control center is responsible for satellite control operations for the vehicles assigned to the center.

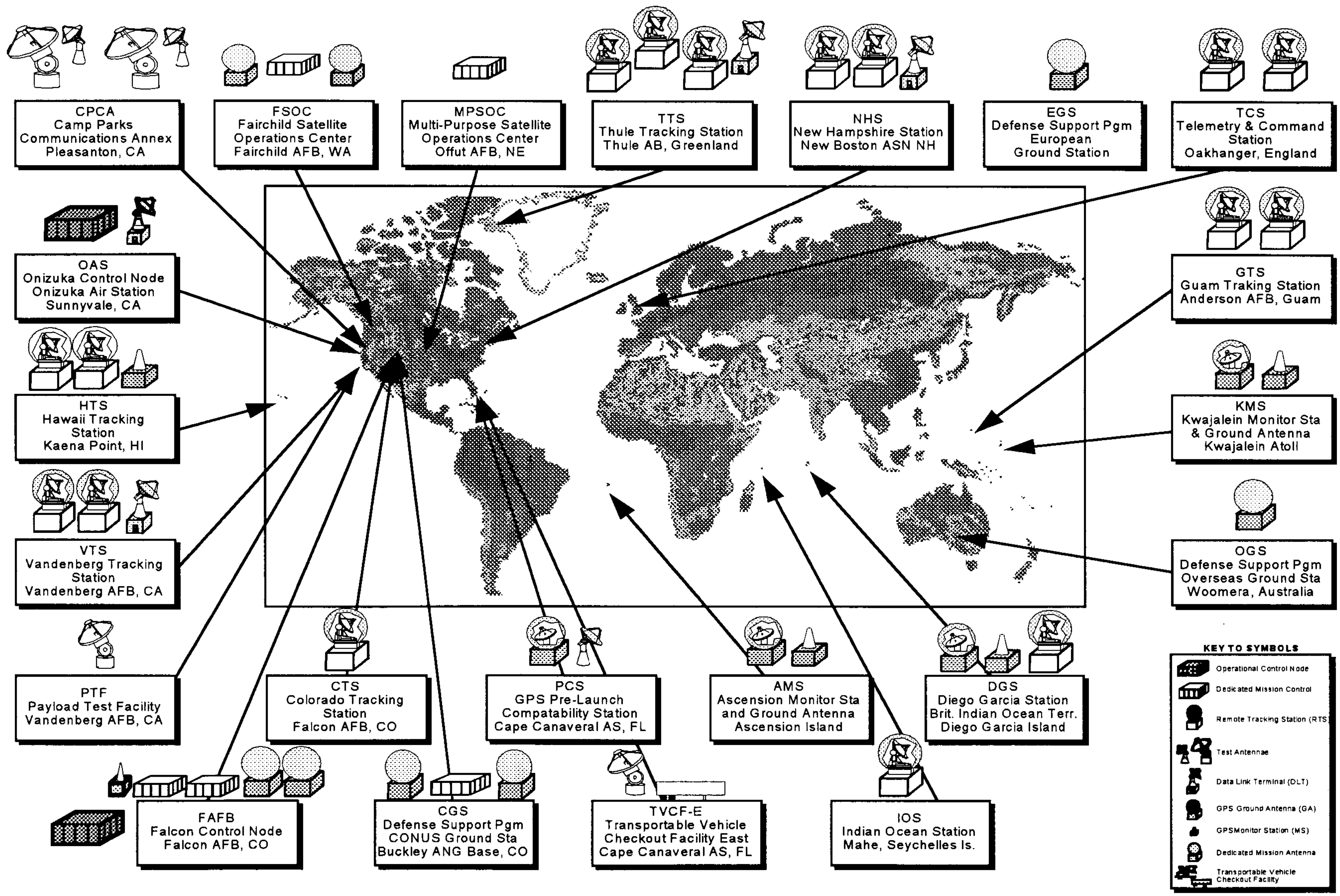

Figure 3-1. The Location of AFSCN Control Nodes and Remote Ground Facilities

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3.1.3 Antennas

There are nine AFSCN fixed-location RTSs with a total of sixteen separate antennas providing geographically dispersed TT&C capability. In addition, the AFSCN has four ground antennas and five monitor stations supporting the GPS program, two dedicated antennas supporting DMSP, additional assets supporting DSP and Milstar, and various SV checkout and calibration facilities. There are also two transportable tracking facilities: the Transportable Vehicle Checkout Facility and the Transportable Space Test and Evaluation Resource (a Materiel Command resource that can be scheduled for AFSCN usage).

3.1.4 Resource Control

AFSCN support is accomplished through the combined efforts of multi-user and dedicated resources. Resource Control Centers (RCCs) located at FAFB and OAS provide resource scheduling, configuration, and control for AFSCN multi-user resources, while dedicated resources are scheduled, configured and controlled through corresponding dedicated control centers. The 50th Space Wing Command Post at FAFB and the 750th Space Group Command Post (CP) at OAS gather and distribute network and SV status information and disseminate tasking from command and control authorities. Collecting and reporting AFSCN performance information is accomplished separately for multi-user and dedicated resources. Development and support of the AFSCN infrastructure is accomplished by multiple organizations within AFMC.

3.1.5 Operational Tasks

The three operational objectives of the satellite control mission, as defined in the Satellite Control MAP, are to support the satellite control system user, operate and sustain the assigned space assets, and operate and sustain the satellite control infrastructure. To accomplish these operational objectives, the Satellite Control MAP identified 15 operational tasks performed by the satellite control system. These tasks are listed in Table 3-l below. A description of each of these tasks is provided in the Glossary, Appendix E. For this ORD, the tasks are further divided into Network Service tasks and SOC tasks. The Network Service tasks support O&M of the RGFs, the communications system, and the scheduling system. The SOC tasks perform the position management; TT&C planning, control, and analysis; and anomaly resolution activities necessary to control SVs during launch, on-orbit operations, and end-of-life activities. Table **3-l** illustrates the allocation of the 15 MAP tasks to Network Service and SOC tasks. Note that of the 15 tasks, some are Network Service tasks only, some are SOC tasks only, and some are both Network Service and SOC tasks.

3.2 Existing System Shortcomings

The Satellite Control MAP describes how well the current system is able to perform the **15** operational tasks identified earlier in this section. The MAP assessment was made based on the ability of the current multi--use and dedicated resources to satisfy current and future mission requirements for the 25 year period of the MAP. The assessment used desired characteristics for the satellite control system, derived from the Satellite Control MNS, that included responsiveness,

Table 3-l. The 15 MAP Tasks are Allocated to Network Service and SOC Tasks

MAP Tasks	Network Service Tasks	SOC Tasks
1. Respond to User Requests	X	X
2. Disseminate Mission Data and Information	X	
3. Perform Operations Planning		X
4. Support Space Force Deployment		X
5. Execute TT&C	X	X
6. Provide Payload and Platform Evaluation		X
7. Provide SV Position and Orientation Management		X
8. Conduct SV Training		X
9. Isolate and Correct Ground Segment Problems	X	
10. Allocate/Control Resources	X	
11. Conduct Maintenance Operations	X	X
12. Conduct Network O&M Training	X	
13. Develop and Field New Capabilities	X	X
14. Perform System Analysis	X	X
15. Provide Communications Connectivity	X	

standardization, interoperability, operability, flexibility, capacity, reliability, maintainability, availability, dependability, survivability, endurability, affordability, and security. The assessment identified the following deficiencies: lack of flexibility for surge and change in user requirements; costly, complex, and non-interoperable command and control; susceptibility of communications links to interruption; limited capability to support existing and future radio frequency requirements; vulnerability of ground facilities to disruption; costly, complex, non-standard, and inflexible communications; limited ability for operational forces to request and receive data; lack of realistic, standardized training; high software sustainment costs for common as well as mission unique software; high O&M costs for remote facilities; unresponsive space force deployment; dependency on critical nodes for satellite control; and fragmented, non-standard logistics support.

The Satellite Control MNS documents the deficiencies of the existing system. The MNS identifies constraints such as manpower drawdowns, O&M reductions, and aging equipment; requirements of future satellites, such as mission data rates for weather satellites; as well as technological opportunities that necessitate changes to the existing satellite control system. The following paragraphs describe deficiencies of the existing system as documented in the Satellite Control MAP and MNS. Table 3-2 correlates these deficiencies to the 15 satellite control tasks.

3.2.1 Respond to User Reauests

The capability of the satellite control system to respond to user requests is critical. In the event of a crisis, war-fighters in the field must have confidence that Commander in Chief USSPACECOM will respond to their requests for specific satellite tasking. Currently, there are capabilities in place to respond to existing government agency users in a non-stressed environment. However, improvements could be attained with the incorporation of a standard interface for requesting data. The Satellite Control MNS recognizes that existing capabilities do not adequately meet requirements at stressed levels of conflict as, in general, they are less survivable than the satellites they support.

TABLE 3-2. Satellite Control Deficiencies to Tasks Correlation

Task / Deficiency	Task 1 Respond to User	Task 2 Disseminate Data	Task 3 Operations Planning	Task 4 Space Force Deployment	Task 5 Execute TT&C	Task 6 Payload & Platform Evaluation	Task 7 SV Position/ Orientation Mgmt	Task 8 Conduct SV Training
Lack Flexibility for Surge			X		X	X	X	
Costly Command and Control			X			X	X	
RF/Comm Susceptible to Interruption					X			
Limited Support for Future RF Reqmts					X			
Vulnerable Ground Facilities			X		X	X	X	
Costly Communications Systems		X						
Limited Operational Forces Access to Data	X	X						
Lack of Realistic Training				X				X
High O & M Costs for Remote Facilities					X			
Unresponsive Space Force Deployment	X			X				X
Dependent on Critical Nodes			X			X	X	
Fragmented, Non-standard Logistics								

TABLE 3-2. Satellite Control Deficiencies to Tasks Correlation (Continued)

Task / Deficiency	Task 9 Correct Ground Problems	Task 10 Allocate/ Control Resources	Task 11 Conduct Maintenance	Task 12 Conduct Network Training	Task 13 Field New Capabilities	Task 14 Perform System Analysis	Task 15 Provide Comm Connectivity
Lack Flexibility for Surge					X	X	X
Costly Command and Control	X	X	X		X	X	
RF/Comm Susceptible to Interruption							X
Limited Support for Future RF Reqmts					X		
Vulnerable Ground Facilities							X
Costly Communications Systems	X		X		X	X	X
Limited Operational Forces Access to Data							X
Lack of Realistic Training				X			
High O & M Costs for Remote Facilities			X				
Unresponsive Space Force Deployment							
Dependent on Critical Nodes							
Fragmented, Non-standard Logistics	X		X				X

3.2.2 Disseminate Mission Data and Information

Dissemination of mission data and information is a critical task. The war-fighter must receive mission data and other crucial information to understand the fighting scenario and plan accordingly. As the war-tighter becomes more aware of the data that is available he will demand more user friendly information at a faster rate. Due to this, the shortcomings that are expected with this task include: a) no direct routing of mission data, b) no timely dissemination of mission data, c) no well-defined interface for mobile users, d) unique mobile assets are required, and e) operators are not authorized to disseminate classified data.

3.2.3 Perform Operations Planning

Operations planning includes all satellite control operations preparation except for those required for launch readiness. The shortcomings associated with this task include: a) lack of standardization, b) inadequate capacity for future program support, c) costly and time consuming operations, d) no capabilities for mission planning, e) no rapid response to change, and f) vulnerable command and control facilities and dependence on critical nodes.

3.2.4 Support Space Force Deployment

In general, only shared satellite control systems can provide primary support for the launch and early orbit phases. An exception to this is DMSP, which provides primary support for launch and early orbit of its satellites through limited interoperability with selected shared resources. Some dedicated systems may provide backup support. The shortcomings that exist, or that are expected, include: a) limited support for quick reaction launches, b) large prelaunch preparation and launch operations staff, and c) no interoperability.

3.2.5 Execute Telemetry, Tracking. and Commanding

When planning for the future, there are shortcomings with TT&C that include: a) limited flexibility to support future requirements, b) vulnerability of SGLS to interruptions, c) vulnerability of overseas ground stations, d) danger of losing frequencies to civilian users, e) no interoperability between shared and dedicated systems, and f) high costs due to increasing number of remote ground systems. In addition, the present system lacks adequate standards for hardware, software, procedures, and interfaces among network resources, and with external satellite control systems (e.g., National Aeronautics and Space Administration [NASA], Naval Space Operations Center [NAVSOC], etc) to ensure interoperability and to provide backup support across programs and for all space missions.

3.2.6 Provide Payload and Platform Evaluation

Network workload for satellite supports requiring greater responsiveness will increase as satellite control continues to transition from a research and development environment to operations. In addition, less manpower will be available to perform the tasks because the O&M funding will be reduced to accommodate defense budget cuts. As this occurs, expected shortcomings will include time consuming operations, non-standardized data formats, vulnerable command and control facilities and dependence on critical nodes, and complicated anomaly resolution procedures.

3.2.7 Provide SV Position/Orientation Management

Shortcomings in the ability to perform SV position and orientation management include: a) unresponsive (time consuming) process, b) no standard, interoperable procedures, and c) vulnerable command and control facilities and dependence on critical nodes. Again, the transition from the research and development mode to the operations mode will increase the loading for satellite control. Consequently, responding to requirements for orbital adjustments may require additional manpower or automation not currently available.

3.2.8 Conduct SV Training

The ability to conduct SV training is constrained by shortcomings associated with the lengthy operator training program and the high skill levels required for routine tasks. The Satellite Control MNS recognizes that, due to the fragmentation of satellite operations, training programs exist for each type of satellite, each SOC, and each functional position. This results in multiple and lengthy training programs and a corresponding reduction in overall flexibility in supporting multi-satellite operations.

3.2.9 Isolate and Correct Ground Segment Problems

Satellite control has a limited capability to quickly isolate and correct ground segment problems due to the lack of automated fault isolation equipment and aged ground equipment.

3.2.10 Allocate/Control Resources

The current resource allocation/control capability will not meet future SV program requirements due to shortcomings caused by the manpower intensive aspect of this task and the lack of interoperability between allocation/control systems.

3.2.11 Conduct Maintenance Operations

There is currently little hardware and software standardization, expensive MUE requires costly maintenance, large maintenance crews are required, there are maintenance documentation problems, and commercial support is being lost for aging hardware.

3.2.12 Conduct Network O&M Training

Network O&M training is fragmented and requires lengthy timelines to meet today's requirements. This condition will worsen because reduced budgets will not tolerate the high costs of training. Expected shortcomings include increasing training expenses, increasingly archaic systems requiring additional training, and continuing need for considerable hands-on training.

3.2.13 Develop and Field New Capabilities

The shortcomings of this task are the time and expense of fielding new capabilities. The current architecture does not facilitate improvements to the system. Due to this, new or changing requirements are supported with the development of unique systems that are costly and complex.

3.2.14 Perform System Analysis

Multi-use satellite control systems require lengthy post-pass data retrieval and analysis, use non-standard data formats, and have no ability to assess overall end-to-end performance.

3.2.15 Provide Communications Connectivity

There are serious communications connectivity problems due to limited and complex communications routing, use of expensive leased communications lines, aging equipment, lack of standards, vulnerable links and ground facilities, limited capability to accommodate future program requirements, lack of quality data, and lack of adequate fault detection and correction. This situation is becoming worse due to the expense of dedicated circuits and aging equipment.

4. CAPABILITIES REQUIRED

This section identifies the required satellite control system performance parameters, logistics and readiness capabilities, and critical system characteristics. The capabilities required identify improvements to the multi-user elements, and lay the foundation to provide common services to the dedicated elements of DSP, DMSP, Milstar, and GPS, to ensure interoperability, commonality, and standardization. The performance capabilities described in the remainder of this section will result in a flexible, integrated satellite control system that is less costly and manpower intensive to operate and maintain (consistent with recent Congressional and DoD guidance to reduce O&M costs) and more easily modified to accommodate new missions. Note that the terminology used in this section is consistent with the hierarchy in which satellite command and control consists of space and ground segments, which in turn consist of elements and subsystems. Some requirements apply to specific users and programs supported by the AFSCN and do not necessarily impact all control nodes or remote ground facilities. The specifics of how and where to meet these requirements are appropriately defined in design specifications.

4.1 System Performance

In this section and in the RCM, a Threshold is the minimum acceptable operational value for a system capability or characteristic below which the utility of the system becomes questionable. An Objective is an operationally significant increment above the Threshold. There may not be an Objective value when an operationally significant increment above the Threshold is not identifiable or useful. A critical system characteristic is a type of characteristic that has historically been a design, cost, or risk driver. Key parameters describe those capabilities and characteristics so significant that failure to meet the Threshold is cause for the concept or system to be reevaluated or the program to be reassessed or terminated. Key parameters are to be extracted from this ORD and included in the Acquisition Program Baseline.

This section discusses performance capabilities required in terms of the Operational Tasks identified in the Satellite Control Mission Area Plan. In the remainder of Section 4, a number in brackets [X] ties the stated requirement to the RCM Parameter [X]. Requirements stated in the following sub-paragraphs will implement the FITAS recommended "plug and use" concept by permitting scheduled use of designated AFSCN resources by non-AFSPC users. Satellite control services provided under this concept include the core services of launch and early orbit, anomaly resolution, contingency support, TT&C, and access to the resource scheduling element, communications element, and selected RGF assets by non-AFSPC SOCs to perform satellite control functions independent of AFSPC SOCs.

4.1.1 <u>Respond to User Requests</u>

The satellite control system shall respond to requests made by operational military forces for data from the satellites operated by AFSPC. The satellite control system operates the platform and payload systems on-board the satellites in order to provide the required data in response to these requests. In addition, non-DoD users, such as US Government agencies, NASA, laboratories, universities, and foreign governments, require satellite data or operational control of satellites not operated by AFSPC. The satellite control system should permit the necessary connectivity in response to these non-DoD requests.

4.1.1.1 Payload Reconfiguration Planning. The satellite control system shall provide the capability for operators to plan (in-procedure) payload reconfiguration within a ten minute time period due to a user request [1]. Satellite control operators are frequently asked to respond to requests made by operational military forces (Theater Commanders) in need of data from various types of satellites that are operated by AFSPC. These requests can range from changes in operations or control of the platform or payload systems to requests for backup support for platform control. The required planning must be accomplished within 10 minutes of receiving a user request in order to maintain responsiveness to the warfighter. This time assumes an in-procedure operation that only needs specific data fields defined (such as a navigation upload operation or communications SV circuit reconfiguration).

4.1.1.2 Constellation Management. A constellation management capability shall be provided for all AFSPC SV programs [2]. The constellation management capability to be provided includes the ability to determine, predict, and periodically adjust the orbital parameters of SVs as needed to maintain relative position within the specific constellation. The satellite control system shall provide the capability for operators to perform constellation management, within 24 hours, in response to a users needs (e.g. fill in orbital coverage gap) [2]. This modeling capability to determine and predict SV orbital position, and the adjustments required to maintain the specified constellation coverage, shall be provided for each SV program where Satellite Control Authority resides within AFSPC. This capability supports the 28 Oct 93 AFSPC Satellite Control CONOPS requirement for the operations crews to maintain assigned satellite constellations according to planned schedules and vehicle requirements. This 24 hour time period is to perform necessary planning only (optimize coverage, determine propellant usage, calculate movement time, determine velocity change magnitude and direction of thrust) and does not reflect the variable time necessary to move the SV and fill the coverage gap. The Objective is to perform constellation planning within an eight hour period.

4.1.1.3 Immediate Schedule Addition. Immediate additions to the network support schedule shall be accomplished as soon as possible within ten minutes [3]. This 10 minute time period, from receipt of a schedule request to RGF service available, allows 5 minutes to work the network schedule options and resolve possible schedule conflicts and 5 minutes to turnaround the RGF, communications, and operations center equipment, perform prepass checks, and establish connectivity with the SV. The immediate schedule addition provides a responsive capability to any satellite control system user (either AFSPC or external) to accomplish non-nominal or emergency support requirements. This time period assumes that there is SV to RGF visibility and that the RGF is in a schedulable condition (currently operable or able to be recalled from preventive maintenance or other downtime).

4.1.2 Disseminate Mission Data and Other Information.

The satellite control system shall have the capability to process and transmit mission data through the satellite control node to the user, if required, provided it does not exceed planned satellite control system capabilities. In addition to sensor data, this data includes position and current status of mission satellites and satellite control assets and is provided directly from satellite control authorities to Commander In Chief USSPACECOM or other non-DoD users.

4.1.2.1 Disseminate Mission Data. The satellite control system shall be capable, as required, to disseminate processed mission data from a satellite control node to a command and control (C2) node within 60 seconds and disseminate unprocessed mission data within ten minutes of the end of an SV pass [4]. Timeliness, accuracy, data recipients and other aspects of mission data dissemination are defined on a program by program basis in individual SV requirements documents. Each space system's concept of operations uniquely determines the extent to which the satellite control system may monitor, receive, process, and/or distribute mission data.

4.1.2.2 Satellite Control System Status. Changes in satellite control system status shall be reported within two minutes from the time of detection of the change in status [5]. The intention is to achieve an automatic status reporting capability (to provide within two minutes a problem description, systems and subsystems effected, current status, and estimated time to return to operational status) to allow the user time to accomplish any replanning caused by satellite control system or SV problems.

4.1.3 Perform Operations Planning.

The satellite control system shall have the capability to perform all planning functions prior to a satellite contact including mission planning, defining contact objectives, generating commands, and performing contingency planning.

4.1.3.1 Operations Planning. The time required for a SOC to prepare the weekly network support request for an individual SV constellation shall be less than eight manhours per constellation [6]. The weekly network support schedule identifies all SV contact activities for the upcoming seven day period and translates the SV support requirements into near-term equipment utilization schedules for all elements of satellite control. Since manpower reductions are being mandated, the manpower intensive operations planning task must reduce manpower. This dictates that the time necessary to develop the SV schedule request, currently a time and resource intensive activity, must be reduced. The Objective is to prepare the weekly support request in less than one manhour.

4.1.4 Support Space Force Deployment.

The satellite control system shall support space force deployment to include pre-launch preparation (training, rehearsals, exercises), launch support, early orbit checkout, and positioning of space assets on-orbit (for support of regional users or requests for data of specific regions, movement of spares into operational positions, or repositioning for different coverage/visibility).

4.1.4.1 Launch Operations Preparation. The satellite control system shall be ready to support, after a launch call-up, satellite control operations 30 days prior to launch for the same SV type/family as previously supported by a SOC [7]. For a new SV type/family not previously supported, the satellite control system shall be ready to support, after launch call-up, operational simulations 180 days prior to launch [7]. This capability is needed to support the 28 Oct 93 AFSPC Satellite Control CONOPS requirement for SOC crews to conduct end-to-end compatibility testing to validate the software database; to conduct interactive or end-to-end rehearsals to simulate all pre-launch, launch, and early-orbit checkout procedures; and ensure proper information flow and communications configurations for these operations. These time periods supports launch on need scenarios required for operational support to warfighting forces.

4.1.5 Execute TT&C.

The satellite control system shall have the ability to receive telemetry (both mission data and health and status); collect and process azimuth and elevation pointing data, range and range rate data or other navigation information; and transmit the commands necessary to control payload mission activities and maintain the health and status of the satellite platform.

4.1.5.1 Number of Operators. This is a Key Parameter. The satellite control system shall be designed so that one SOC operator is able to perform satellite contact functions for a single satellite contact (in-procedure) and so that one operator per antenna can perform necessary RGF operations [8]. Where operations procedures dictate, increased manning may be required (e.g., launch support, anomaly resolution, orbit maneuvers). Reductions in personnel required to accomplish SOC and RGF functions are driven by anticipated budget reductions and can be achieved by providing the operators with automated, on-line, decision support tools to ease the operators workload. The Objective is for manual intervention by exception for SOC operations and for unattended RGF operations.

4.1.5.2 Capability to Receive and Process Tracking Data. The satellite control system shall have the capability to receive and process tracking data collected from ground-based and space-based tracking sources [9]. The objective is to eliminate dependence on single data sources.

4.1.5.3 Concurrent Events/Connectivity. The SOCs at the Falcon and/or Onizuka control node shall have the capability to conduct 29 concurrent events [10]. These SOC events include satellite contacts requiring telemetry, tracking, and commanding support; satellite contact and mission planning; postpass data analysis; contingency analysis; mission data transfer between the satellite control system and an external user; training and simulations; data playbacks from a RGF; and SOC system downtime or checkout. The satellite control system shall be sized to provide 40 concurrent antenna connectivities and 3 concurrent simulation events [10]. This requirement allows concurrent support from existing multi-user tracking stations, monitor stations/ground antennas, Navy Extremely High Frequency (EHF) and Super High Frequency (SHF) antennas, vehicle checkout facilities, mobile systems, Data Link Terminals, and Camp Parks Communications Annex, as shown in Appendix B. It also provides the capability to conduct launch support dress rehearsals and mission simulations. In addition to concurrent support, the network must also provide connectivity to each of the 50 antennas.

4.1.5.4 Telemetry Data Rate Capacity. This is a Key Parameter. The satellite control system shall have the capability to receive telemetry data from supported SVs at rates up to 20 Megabits per second (Mbps) [11]. This capacity parameter defines high end rates needed by programs such as SBIRS for interleaved focused area technical intelligence and TT&C (Network Service only). The Objective is to support future SVs, such as NPOESS, with potential data rates up to 150 Mbps (interleaved mission data and TT&C).

4.1.5.5 Command Data Rate Capacity. This is a Key Parameter. The satellite control system shall have the capability to transmit commands to SVs with a capacity to support single-pass software uploads. For low earth orbit programs such as DMSP Block 5D3, this capacity is defined by rates up to 28.8 Kbps [12]. The Objective is to support future SVs with potential command rates for single-pass software upload up to 100 Kbps.

4.1.5.6 Timing Accuracy. The satellite control system time source shall have a timing signal accurate to 10^{-7} seconds [13]. The timing accuracy is necessary to ensure compatibility within the satellite control system and among supported spacecraft and system users. All SV programs require an accurate time signal to synchronize on the telemetry waveform, precisely time tag telemetry data, and ensure time critical commands are executed at the correct time. The objective is to achieve timing signal accuracy of 10^{-9} , which is representative of GPS timing signal accuracy.

4.1.6 Provide Payload and Platform Evaluation.

The satellite control system shall have the ability to assess payload and platform systems and subsystems behavior, verify mission events during contacts, and conduct detailed performance analysis typically after an SV contact or pass is completed.

4.1.6.1 SV System Problem. The satellite control system shall have the capability to detect, isolate and notify the SOC operator of a discrete SV system problem. For an in-procedure anomaly, the system shall provide the SOC operator with recommended corrective action within one minute of detection of a problem [14]. For an out-of-procedure problem, the system shall recommend safing action to the SOC operator within TBD time after detection [14]. A discrete SV problem is characterized as a hard failure (i.e. a step function with the system either broken or not broken). Gradual degradation of a system with telemetry indicating performance slowly moving out of limits is not considered a discrete problem. This capability supports the Satellite Control MAP requirement for satellite control resources with the ability to assess payload and platform systems and subsystems behavior and verify mission events during contacts. Access to automated, on-line, decision support tools for telemetry processing, commanding, tracking, station-keeping, and status reporting will expedite notification to SV operations personnel when anomalous conditions are detected and help to avoid the loss of an SV during an anomaly.

4.1.7 Provide SV Position and Orientation Management.

The satellite control system shall have the ability to determine, predict, and periodically adjust the orbital parameters of individual SVs and maintain relative SV position within specified limits.

4.1.7.1 Orbit Maintenance. The satellite control system shall maintain the assigned SVs within orbit stationkeeping parameters at least 99% of the time [15]. Operations crews are required to maintain assigned satellite constellations according to planned schedules and vehicle requirements. Accurate orbit maintenance is critical to providing required operational support to the warfighting users. Accurate weather, navigation, communications, and warning depends on SVs positioned for accurate orbit placement. These accuracies drive the satellite control system to have the ability to maintain supported SVs within required stationkeeping parameters.

4.1.7.2 Orbit Update Generation. The satellite control system shall provide the capability for operators to generate an orbit update within 20 minutes after the completion of an SV contact [16]. Achieving this capability for a typical orbit update will allow a reduction in the number of orbit analyst personnel consistent with the current overall trend in the 50th Space Wing satellite operations to reduce satellite operations personnel. This capability will also improve the ability to acquire SVs during anomalous launch conditions by allowing the RGF antenna scan pattern to be updated prior to the first acquisition. The Objective is to accomplish an orbit update within five minutes after the completion of an SV contact.

4.1.8 Conduct SV Training.

The satellite control system shall have the ability to provide operations personnel with specific space vehicle familiarization training, readiness exercises and simulation activities in order to establish and maintain a high level of proficiency. Specific training requirements are described in Section 5, Integrated Logistics Support, and paragraph 5.3.2, Training and Training Support. There are no RCM parameters associated with performance of SV training.

4.1.9 Isolate and Correct Ground Segment Problems.

The satellite control system shall have the ability to rapidly isolate and correct ground system failures. This includes realtime FD/FI and the ability to correct through automatic reconfiguration using redundant paths and equipment.

4.1.9.1 Satellite Control Ground Segment Problems. The satellite control system shall have the ability to detect, isolate and report ground segment problems. The system shall have the capability to detect a problem and failover/reroute to an alternate system within one minute of occurrence [17]. Isolation and reporting of the problem shall be accomplished within two minutes of detection [17]. In order for a satellite contact to be scored as a success, at least 90% of the required telemetry and tracking data must be received and 100% of the required commands must be transmitted. During a typical ten minute pass (600 seconds), this means that no more than 10% of the data (60 seconds) can be lost. The Objective is for the satellite control system to automatically switch to a redundant system, isolate the problem to the appropriate level, respond to the operator, and report failover within one minute of problem occurrence.

4.1.10 Allocate/Control Resources.

The satellite control system shall have the ability to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control. This includes determination of visibility, availability (including deconfliction), operability and resolution of radio frequency interference, and coordination of non-flight activities.

4.1.10.1 Number of Scheduling Operators. The system shall be designed so that three operators per shift can perform scheduling operations [18]. Since manpower reductions are being mandated, the manpower intensive scheduling task must reduce manpower. This dictates that the time necessary to develop the RGF schedule request must be reduced. Scheduling operator workload is based on the need for one operator to work realtime additions, deletions, and conflict resolutions; one operator to prepare the 24 hour schedule for the next day activities; and one operator to prepare the planning schedule for the next week (7 day) activities. The Objective is to perform scheduling operations with one operator per shift.

4.1.10.2 Network Scheduling Capacity. In order to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control, the network scheduling system shall have the capability to schedule up to 800 events per day at up to 31 antennas [19]. In addition, up to 760 events shall be scheduled automatically [19]. Network events to be scheduled include satellite contacts, mission data transfer to an external user, training and simulations, data playbacks from an RGF, and system downtime or checkout. The satellite control system must schedule these events for Falcon and Onizuka control centers, the GPS control stations and ground antennas, Milstar operations centers, DMSP/NPOESS, DSP, Navy, NASA, classified users, and other external organizations. The Objective is to schedule 1000 events per day for all 50 satellite control system antennae and automatically schedule 950 of these events.

4.1.10.3 Network Configuration. The satellite control system shall have the capability to configure or reconfigure for each scheduled contact within less than five minutes [20]. This five minute time period includes time to turnaround the RGF, communications, and operations center equipment, perform prepass checks, and establish connectivity with the SV. The Objective is to have predesignated network configurations available for operational support on demand.

4.1.11 Conduct Maintenance Operations.

The satellite control system shall provide maintenance personnel with the ability to perform routine and periodic maintenance and logistics support to ensure dependability and availability of satellite control elements for operations. This includes monitoring equipment status and performing organizational and depot level maintenance. Specific maintenance requirements are described in Section 5, Integrated Logistics Support, and paragraph 5.1, Maintenance Planning. In addition, the dependability and availability aspects of maintenance operations are described later in this section in paragraph 4.2, Logistics and Readiness. Specific RMA values are TBD at this time [21] as discussed in paragraph 4.2.1, Reliability, Maintainability, and Availability.

4.1.12 Conduct Network O&M Training.

The satellite control system shall have the ability to provide O&M personnel with realistic training using a combination of formal classroom instruction, on-the-job training, and realistic hands-on simulation techniques. Specific training requirements are described in Section 5, Integrated Logistics Support, and paragraph 5.3.2, Training and Training Support. There are no RCM parameters associated with performance of network O&M training.

4.1.13 Develop and Field New Capabilities.

The satellite control system shall allow for continued evolution and development of new or enhanced capabilities. Fielding of new capabilities shall be done on a non-interference basis with operations and without large time delays between identification of the need and capability turn over for operations. There are no RCM parameters associated with developing and fielding new capabilities.

4.1.14 Perform System Analysis.

The satellite control system shall have the capability to evaluate overall system performance to include measuring end-to-end capacity, developing inputs for Reliability, Maintainability and Availability (RMA) studies, and performing long-term SV trend analysis. There shall be a capacity management capability to measure, evaluate and manage the current and projected capacity of RGF antennas, the communications systems, and the SOC systems. The capacity management tools and models will be used to evaluate the ability of the system to meet future mission model requirements, make recommendations for system upgrades, plan and implement SV supports using the satellite control system, and project requirements for system workarounds or new system capabilities. The Objective is to have a single, integrated capacity measurement, evaluation, and management system. There are no RCM parameters associated with performance of system analysis.

4.1.15 Perform Communications Connectivity.

The satellite control system shall provide reliable, secure communications links to transmit data between satellite control elements and between satellite control resources and all users. These communications links shall take full advantage of services provided by the DISA-operated DISN network. Full coordination with DISA will ensure complete interoperability with other DISA operated systems.

4.1.15.1 Number of Communications Operators. This is a Key Parameter. The satellite control system shall be designed so that one communications system operator shall have the capability to initiate or terminate one communications event and perform end-to-end monitor and control for up to three additional on-going events [22]. Since mandated manpower reductions will apply to all aspects of satellite control, communications operations must correspondingly reduce manpower. Communications operator workload is based on the ISC Human Computer Interface (HCI) Standard recommendation for up to four tiles/quadrants per display screen. Using this standard, one operator will have be able to monitor 3 on-going operations and initiate or terminate one additional event at a four tile/quadrant display screen.

4.1.15.2 Communications Performance. Communications performance is measured in errored seconds (ES) per day, severely errored seconds (SES) per day, and bit error rate (BER). The satellite control system communications performance shall attain an ES rate less than 215 errored seconds per day, an SES rate less than 35 severely errored seconds per day, and a BER of 10^{-8} [23]. An ES is any second in which one or more bits are in error or that contains error events as measured by the self monitoring system capability. These errors are found to include periods of error bursts, called SES, during which a large proportion of bits are in error. These SES periods occur well within the ES criteria so they consequently need another measure of performance. The values specified for ES and SES are current commercially advertised performance capabilities. The additional performance parameter, BER, is derived from current and future SV requirements.

4.2 Logistics and Readiness

The RMA parameters provide the framework to link the logistics and readiness of the satellite control system to the satellite control operational tasks and mission. Efforts are currently underway in AFSPC and the satellite control community to better state the definitions for standardized RMA and Dependability terminology. The next version of the ORD will incorporate these changes.

4.2.1 Reliability, Maintainability and Availability

The majority of satellite control system operations are routine activities such as SOH contacts, SOH analysis, or track and record supports for orbit maintenance. There is minimal impact to the SV mission if these planning, analysis or contact support activities fail. The activities are simply rescheduled or reaccomplished. The only time there may be an impact is when anomalies go undetected due to a SOH pass being skipped. Given the rarity of this type of event, the risk is extremely low. For the minority of operations that require high reliability (launch and early orbit support or thruster firings for SV maneuvering), the SV operations concepts generally call for an additional control node in shadow or an additional RGF in hot backup. This parallel string provides additional reliability over single string operations. Given the total consideration of risk, backup and interoperability, there are no current operational drivers for RMA. The optimum balance of reliability and maintenance is to achieve the lowest lifecycle cost. This balance will be determined during the cost benefit analysis. When the RMA that will provide the lowest possible cost is determined, the RMA values will be incorporated in the next ORD revision.

4.2.1.1 Reliability, Maintainability, and Availability Parameters. Mean Time Between Critical Failure (MTBCF) is the measure of system reliability. Critical failures occur when the system is rendered unable to perform an operational function during mission time. Mission time for AFSCN elements is 24 hours a day continuous, excluding maintenance events. Recall times will be applied to all maintenance events. Mean Time to Restore Function (MTTRF) is the measure of system maintainability. MTTRF is the elapsed time from critical failure occurrence to restoral of operational functionality. This time includes Administrative and Logistics Delay Times (ALDT).

4.3 Critical System Characteristics

Critical system characteristics for the satellite control system include electromagnetic compatibility and frequency spectrum assignment, and security.

4.3.1 Electromagnetic Compatibility and Frequency Spectrum Assignment

The satellite control system shall be capable of supporting the frequency requirements of SVs currently on orbit as well as those SVs currently in the design phase. The satellite control system will support future SVs compatible with established satellite control system standards. The multi-user element will continue to support SGLS for the forseeable future but support for future SVs may require use of other frequency spectrums, such as EHF, in the far term.

4.3.2 Security

The satellite control system shall be designed to protect against the security threats identified or defined in this document, the National Air Intelligence Center Space TED, and the AFOSI MDI Threat Assessment. System, personnel, information, physical, communications, emanation, and computer security measures shall provide a standardized and interoperable satellite control system secure operations capability.

4.3.2.1 System Security. An integrated, secure system able to assure mission capabilities during peacetime, war and intermediate levels of conflict with the ability to accommodate multiple security levels commensurate with the classification of the information being processed is a critical characteristic. The AFSCN currently supports a wide variety of users from unclassified

NASA missions to highly classified military space systems and allied nation space systems. Protection is currently provided through physical separation and isolation. The satellite control system design shall employ countermeasures and automatic security aids to enhance effectiveness. The security requirements of Air Force Policy Directive (AFPD) 33-2, Command, Control, Communications, and Computer (C4) Systems Security; and specialized communications computer security documents listed in Air Force Index 5 as supplemented by AFSPC shall be met.

4.3.2.2 Information Security. Information security shall consist of operational, computer, and communications security countermeasures and procedures for identifying, controlling, and protecting sensitive classified and unclassified information from unauthorized disclosure. Information concerning systems and programs shall be protected in accordance with (IAW) the AFSCN Security Classification Guide and individual SV program security classification guides. The satellite control system shall be capable of simultaneous operations at multiple classification levels from Unclassified to Secret with categories and handling restrictions. Where applicable, specifically defined systems shall be capable of protecting Top Secret Sensitive Compartmented Information (SCI) in accordance with appropriate security regulations and guidance.

4.3.2.3 Physical Security. Physical security countermeasures shall protect against system disablement or destruction, theft of system components, intrusion, espionage, sabotage, and vandalism. Standardized access control and perimeter intrusion detection systems shall provide common badging, control and training procedures. Physical security protection shall be IAW AFPD 31-4, Information Security and AFPD 31-1, Physical Security. Fixed and mobile control centers will be designated as a priority resource. The system shall be protected against physical threats that could result in loss of confidentiality, loss of integrity, or reduced system availability.

4.3.2.4 Communications Security. Communications security (COMSEC) and transmission security (TRANSEC) measures and procedures shall be established to ensure the confidentiality of data, protect the security of transmissions, and prevent unauthorized access to information transmitted on communications systems. The satellite control system shall operate in such a way as to preclude the compromise of classified information and to minimize the release of operational security (OPSEC) indicators. Cryptographic, authentication, and trusted computer systems shall be electronically keyed and provide standard communications processing capabilities for transmitting and processing all levels of classified information across the same equipment. All voice and data communications links processing classified and sensitive unclassified information and not carried on a protected distribution system shall be protected by National Security Agency approved COMSEC equipment. A single standard device with remote keying shall be provided for OPSEC. A single standard device capable of handling multiple algorithms shall be provided for COMSEC and TRANSEC. The Objective is to use a single standard device for OPSEC, COMSEC, and TRANSEC with remote keying and the ability to handle multiple algorithms. The COMSEC capability shall be compatible and interoperable with the USSPACECOM COMSEC system. Communications assets and encryption systems shall be designed to easily implement physical security. Measures will be established to ensure secure management of encryption keys and algorithms. Electronic Key Management systems shall be used, if available. Maintenance procedures will ensure communications system security integrity. Equipment used shall be supportable during at least a ten year satellite control system life cycle. Fail-secure capability shall be designed to ensure minimum compromise during communications system failure.

4.3.2.5 Emanations Security. Emissions security control shall be applied to all systems and facilities conducting electronic processing of sensitive information. This requirement applies to both communications equipment and facilities and to computer facilities. Any TEMPEST protection shall be based on site specific guidance while being consistent with AFI 33-203, Air Force TEMPEST Program, formerly the Air Force System Security Instruction (AFSSI) 7000, and shall be designed in compliance with TEMPEST requirements in the National COMSEC Information Memorandum (NACSIM) 5100 A and the guidelines of NACSIM 5104.

4.3.2.6 Computer Security. Computer systems shall be developed, designed, acquired, operated, and maintained as a secure computing capability as required by applicable DoD and Air Force security programs. The appropriate National Security Computer System (NSCS) class will be determined in accordance with Computer Security Center (CSC) Standard CSC-STD-003-85. A combination of system level protections and procedures shall limit personnel access to information based upon the class of information to which they are authorized access. A mechanism shall be in place to provide individual Identification and Authentication (I&A) for all users of satellite control systems. There shall be a mechanism to provide an audit trail such that security relevant actions can be traced to the responsible individual. Prior to Initial Operational Capability (IOC) all computer systems and communications networks will undergo end-to-end automated data processing equipment (ADPE) Security Test and Evaluation. Accreditation will be done IAW AFPD 33-2 and AFSPC supplement.

5. INTEGRATED LOGISTICS SUPPORT

Satellite control is in a continuous state of development in response to new and changing infrastructure and mission requirements. AFSPC and AFMC will, IAW the IWSM concept, include the following Integrated Logistics Support (ILS) requirements in the Integrated System Master Plan, when developed. Specific aspects of ILS implementation will be developed based on the Cost Benefit Analysis (CBA).

5.1 Maintenance Planning

Maintenance planning is the process conducted by AFSPC and AFMC to explore alternatives and to develop and document the maintenance concepts and requirements for the life of the satellite control system. Maintenance planning will provide input to the development of all the remaining logistics support elements.

5.1.1 Maintenance Concept

The maintenance concept for both hardware and software is two-level (organizational and depot) maintenance.

5.1.1.1 Hardware Maintenance. There will be two categories of organizational level hardware maintenance: on-equipment and off-equipment. Off-equipment includes visual inspection, removal and replacement of major subsystems and identified high-failure components, assembly of subsystems, and BIT. On-equipment includes visual inspection, maintenance, and BIT checks. The maintenance concept provides plans to sustain the satellite control system at the level of readiness to support operational requirements. The maintenance concept guides the formulation of maintenance design characteristics to achieve optimum balance between operational effectiveness and logistical support costs. Maintenance concept updates consider practical, low risk trade-off analyses of operational requirements and engineering designs. Hardware maintenance and materiel management will be handled IAW maintenance plans.

5.1.1.2 Software Maintenance. AFSPC will perform Level 1 and AFMC will perform Level 2 software maintenance as defined in the Memorandum of Agreement (MOA) between AFSPC and AFMC for Software Normalization, dated 16 Feb 93. A detailed explanation of each task is in the MOA.

5.1.1.2.1 Level 1 software maintenance encompasses the identification of operational requirements, validation of operational capabilities, certification of operational capabilities, control of the operational configuration, maintenance of database operational parameters, identification of problems, and restoral of operations.

5.1.1.2.2 Level 2 software maintenance encompasses fixing emergency problems; analyzing problems; maintaining network-level database items; developing technical solutions; designing, developing, and modifying software; certifying software modifications and releases; integrating systems; maintaining system integrity; distributing software releases; performing configuration management; improving technology; performing special studies; and maintaining software support services.

5.1.2 Maintenance Data Collection

The maintenance concept and maintenance plan are intended to support the satellite control system throughout its life-cycle. This will require incremental changes to the plan based on a strong maintenance data collection system. The maintenance data collection system for satellite control will use standard Air Force systems such as the Core Automated Maintenance System (CAMS) or the Reliability and Maintainability Information System (REMIS). These databases must tie into the Weapons Systems Management Information System to forecast force projection for operations and the operational concept as well as supportability concerns for the maintenance plan.

5.1.3 Emergency Maintenance

Maintenance support processes used in peacetime will meet required response times for support during wartime and crisis situations without change in process. Response time required for emergency fixes or other priority fixes shall be minimized consistent with prudent expenditure of funds. Software development and maintenance will be done off-line from the operational system.

5.1.4 Maintenance Personnel and Documentation

The best mix government or contractor maintenance capability is required for support of in-place equipment, future equipment and equipment modifications. The best mix will be determined as part of the CBA. Maintenance documentation will be kept current and be rapidly distributed to all network maintenance centers in order to provide complete and accurate information. Maintenance will be simplified through the use of FD/FI techniques and some degree of self-correction capability that permits rapid identification and correction of equipment problems.

5.2 Support Equipment

System design for maintainability will ensure maximum use of BIT and FD/FI equipment which employs self healing capabilities to the maximum extent practical. In addition, equipment will be designed/selected to be maintained and repaired using standard support equipment and tools to the maximum extent practical. Peculiar Support Equipment (PSE) will be held to the absolute minimum. Common Support Equipment (CSE) will be obtained from the Air Force to the maximum degree practical. AFMC will ensure all required support equipment is identified via the Support Equipment Recommendation Document (SERD) process. SERDs will include all CSE and PSE required for all levels of maintenance. Contractor format is acceptable provided it has all applicable LSA data to support the identified support equipment.

5.3 Human Systems Integration

Human Systems Integration (HSI) issues are addressed through the following six elements: manpower, personnel, training, safety, human engineering, and health hazards analysis. HSI considerations will be based on a review of the mission need, requirements of the previous system, and available information for existing analytical processes.

5.3.1 Manpower and Personnel

The user will determine operations, maintenance, and logistics support manning required, with the goal of minimizing manpower requirements. The fixed and mobile/transportable systems will normally be operated and maintained by in-service and contractor personnel and be capable of being operated and maintained by only in-service personnel in response to contingencies. Automation will be used to augment the manpower and reduce the skill levels required to operate, maintain, and configure operational systems. Operator functions for routine operations/maintenance will be integrated and combined where practical.

5.3.2 Training and Training Support

The SPD (SMC/CW) will work with AFSPC to address O&M training requirements via the formal training planning process. Training will be accomplished through a standardized training program, commensurate with the degree of standardization incorporated into satellite and infrastructure operations, with an appropriate mix of formal classroom instruction, computer aided training, on-the-job-training (OJT), and realistic hands-on simulation techniques. Training programs will accommodate a reduction in the required entry skill levels for the operators/maintainer concept, a reduction in the overall number of personnel required at each network location, and a reduction in the time necessary to train an individual for operations.

5.3.2.1 Training Concept. The AFSCN currently requires highly trained operators and maintainers, with specific training programs required to support all aspects of system operations. With the standardization requirements of this upgrade effort, and the associated requirement to reduce training, a new concept for training will be developed. This concept and training systems will be developed concurrent with the operational system development. Training will be developed to address all common satellite and network activities and minimize the need for element, space program, or SV specific training. Training will include the processes, procedures and techniques necessary for military personnel (including reserve forces if appropriate) to operate and support the system. Logistic support planning for training equipment and training device acquisition and installation is required. Training programs for operators will comply with AFSPC Instructional Systems Development requirements.

5.3.2.1.1 AFMC is responsible for the overall management of the initial training program development. A training system requirements analysis will be conducted in accordance with Air Force Pamphlet (AFP) 50-11 and Air Force Handbook (AFH) 36-2235, Volume 3. The analysis will examine the new system development impact on the traditional training scheme to determine what changes in training philosophy are required by the change in manning levels and skills. The analysis will also include consideration of available AFSPC training resources and existing simulators and will make a media recommendation.

5.3.2.1.2 AFSPC, working with AFMC, will define the training support required for the AFSCN and jointly develop the system training plan. AFSPC is responsible for chairing the Training Planning Team, and for planning and programming Type Two training (follow-on training). AFSPC is also responsible for Unit Qualification Training (UQT), recurring training, and OJT. Individual units will manage maintenance training, consisting of unit level OJT after Type One training (Special Contract Training).

5.3.2.1.3 Air Education and Training Command (AETC) provides formal Air Force Specialty Code training (Type Three) under AFCAT 36-2223. AETC will also establish and monitor Type One training as required. Type One training will meet requirements established through the Training Systems Requirements Analysis process as outlined in AFH 36-2235 and will be developed according to AFSPC formats and specifications. AETC will coordinate with AFSPC and AFMC to meet validated requirements. Upon completion of Type One training, AETC is responsible for developing and conducting Initial Qualification Training (IQT).

5.3.2.2 Training Requirements. Operations training requires an off-line (non-operational system) simulations capability to provide individual and team training (IQT, UQT, and recurring) and system exercises. The delivered training system(s) will be based on requirements for each course, however, full consideration will be given to maximum use of available AFSPC resources and simulations capabilities in order to avoid stove-pipe training solutions for individual programs. The training system will include concurrent configuration control with the operational system. Operational systems will also support on-line training concurrent with operations. That is, the total requirement encompasses both an off-line training simulation capability and the ability to train on the operational system.

5.3.3 Safety

Scientific and engineering principles will be applied during design and development to identify and reduce hazards associated with satellite control system operation and support with the objective of designing the safest possible system consistent with mission requirements and cost effectiveness. Personal safety is paramount in both installation and operation of any system. The following items need to be considered and the hazard minimized without sacrificing mission effectiveness: the location of the egress, emergency power-off, and any cords or lines; air handling to provide fresh air and heating and cooling to maintain personal comfort while still maintaining machine operating temperatures; and any underfloor routing of cables or other equipment must ensure floor stability and strength to prevent collapse under normal operations. Ergonomics for personnel who will operate equipment for long periods of time must consider comfort and adjustability of seating, wrist support, computer terminal readability, lighting, etc.

5.3.4 Human Factors Engineering

Human factors engineering will be applied during satellite control system design and development to achieve an effective man-machine interface and preclude system characteristics that require extensive cognitive, physical, or sensory skills; require complex manpower or training intensive tasks; or result in frequent or critical errors. The requirement is to be compliant with the ISC HCI Standard, Version 1.0, 1 Mar 94. Operator interfaces must be consistent and compatible with the system(s) in which they are to be used. They must be demonstrated to be maintainable with economic demands (same or less than compared to the system it replaces) on personnel resources, skills, training, and cost.

5.3.5 Health Hazard Constraints

Health hazards and safety issues identified from predecessor and similar system design, development and operation will be considered and lessons learned will be addressed during satellite control system design and development.

5.4 Computer Resources

New systems will be developed in accordance with an open systems environment to enhance the portability of applications between hardware suites and to facilitate interoperability with force-level systems; Air Force, Army and Navy standard systems; and other systems. A satellite control system Technical Reference Model (TRM), with tailoring and extensions from the DoD TRM, will be developed. It will provide a portfolio of standards to effect the interoperability and standardization required for the satellite control system mission. Use of standards will be consistent with 29 June 1994 Memorandum from the Secretary of Defense, Subject: Specifications and Standards -- A New Way of Doing Business. Data rights for software will be shown in the documentation. Existing DoD and COTS software will be used to the maximum extent feasible. Software documentation and source code that facilitate software maintenance will be delivered. During development, software will be protected from the introduction of malicious code (e.g., logic bombs, viruses). Software will be protected at the same level of sensitivity as its operational system(s). At IOC the software will have no known mission critical problems or anomalies and will adhere to program development standards. The software maturity matrix will be sufficient to support mission accomplishment.

5.4.1 Computer Resources Software Development

5.4.1.1 Code Development. New software should be developed in accordance with current DoD policy and using the best industry practices.

5.4.1.2 Code Sustainment. Software sustainment is a very costly activity. New systems shall be developed with one of the primary goals being a significant reduction in sustainment cost.

5.4.1.3 Databases. Databases will be designed so the user can change operational database contents without recompiling the software. All operator changeable data values will be in the database. Data elements and icons will be standardized within and between systems. Use of the Standard Query Language (SQL) will allow a common method for extracting data from a database. This enables different vendor's databases to provide identical outputs to applications software.

5.4.1.4 Systems

5.4.1.4.1 Maximum use will be made of COTS and reusable software. Software developed will be based on open industry-wide standards. Federal Information Processing Standards (FIPS) 158 and FIPS 127 apply. When COTS software is not available to satisfy requirements and unique software must be developed, that software must be written in the Ada programming language in accordance with DoD Directive 3405.1 and DoD Instruction 5000.2. For Ada, FIPS 119, American National Standards Institute (ANSI) Standard 1815a-1983, or International Standards Organization (ISO) Standard 8652-1987 may be used.

5.4.1.4.2 Software systems will be designed considering security, maintainability, correctness, robustness, extendibility, reusability, compatibility, efficiency, reliability, portability, testability, verifiability, integrity, understandability, and ease of use.

5.4.1.4.3 Applicable design documents will be included in the general documentation package. All developed code will be modular, with each module being a logical self contained, well documented unit.

5.4.1.4.4 The operational user interface will be graphical and comply with the ISC HCI Standard. The user interface will be standardized across the entire system/system of systems.

5.4.1.4.5 Software will be fully tested, corrected, and under strict configuration management when delivered. Test reports, test procedures, and test software will be delivered to the operational unit(s) for user conducted follow-on operational test and evaluation. Delivered software will not contain any code that does not satisfy validated requirements (dead code, trap doors, viruses, etc.).

5.4.1.5 Interfaces. Communications interfaces will use the Government Open Systems Interface Profile (GOSIP) for interfacing with other computer systems. FIPS 146 applies. Due to limited commercial availability, Transmission Control Protocol/Internet Protocol (TCP/IP) will be considered and is acceptable in place of GOSIP. TCP/IP will provide a standard method of transferring data (e.g., schedule requests and outage reports) between satellite control centers and network control elements.

5.4.1.6 Interoperability. Computer operating systems will be compliant with Portable Operating System Interface for Computing Environment (POSIX). FIPS 151 applies. Use of POSIX will allow a simple method for interacting between application software and the operating system in the satellite control system.

5.4.1.7 Documentation Needs. Documentation will be provided that describes how to install, operate, and maintain the software. Documentation will be sufficient enough to allow recompetition of the contract in the future.

5.4.1.8 Simulation Capability. A high-fidelity simulation system is required to emulate war gaming and the operational environment.

5.4.2 Computer Resources Support

The method of providing computer resources support will be developed by SMC/CW, with the participation of AFSPC.

5.5 Other Logistics Considerations

5.5.1 Logistics Support Analysis

A tailored logistics support analysis process will be used to tie all integrated logistics support elements into a viable Logistics Support Plan.

5.5.2 Supply Support

The satellite control system will be supported by the Air Force (AF) standard supply system. Spares utilization and accountability will be maintained via the standard base supply system. Location of system stocks will support the two level maintenance practice of remove and replace. Repair levels will be analyzed and recommended IAW a Repair Level Analysis conducted by AFMC as part of the Logistics Support Analysis process. The AFSPC standard is applied only at turnover (i.e. at turnover there will be 100% critical and 90% non-critical spares on site).

The satellite control system will reduce the number of unique pieces of equipment and associated spare parts. Maximum use of off-the-shelf software and standardized hardware will be incorporated into the network. The network will continue to incorporate equipment with minimal mean times to repair in order to assure the availability of critical services. The amount of PSE used to support maintenance will be reduced to the maximum extent feasible.

5.5.3 Technical Data

Technical data for the satellite control system will include program requirements documents and maintenance documents . The format for program requirements documents will be standardized using the Universal Documentation System. Maintenance documents for developed equipment will be standardized through the use of the Air Force Technical Order system. Automated, on-line techniques will be used to make these documents readily available to O&M personnel.

Technical orders will be accurate and current and include illustrated parts breakdown, parts listings, cabling diagrams and pin-outs, theory of operation, highlighted safety notices, and troubleshooting guides. Commercial documentation for COTS hardware and software will be supplemented with the above, if required, for the level of O&M being performed. Commercial manual supplements will be formatted IAW the Air Force Technical Order System.

5.5.4 Facilities and Land

The satellite control system will be installed within existing facilities and operate in the environmental conditions present in the supported units. Operational facilities will meet the security requirements for the protection of information stored or processed within that facility. AFSPC/SSO will review and approve all SCI facilities design, installation and upgrades.

5.5.5 Supporting Command Requirements

Supporting command requirements were identified by SMC/CW and include the specific items identified in the following paragraphs. Commercial Manual currency will be maintained via vendor subscription service.

5.5.5.1 Packaging, Handling, Storage and Transportation. Special packaging, handling, storage and transportation requirements will be identified as Contract Data requirements within acquisition and maintenance contracts. Special requirements will be identified only for non-stock listed equipment.

5.5.5.2 Level of Engineering Data and Data Rights. The acquisition agent requires level 3 engineering drawings on newly developed equipment. For COTS equipment, specification control drawings are required.

5.5.5.3 Depot and System Technical Orders. Technical Orders for newly developed items will be provided in accordance with Air Force Technical Order (AFTO) 00-5-1 and Technical Manual (TM) 86-01. The adequacy of commercial manuals to support the maintenance concept will be determined by Contractor Furnished Equipment Notices (CFENs).

5.5.5.4 Incorporation of Advanced Technology. Procedures for incorporating new technologies are defined in existing improvement and modernization policy.

5.5.5.5 Configuration Control Concept. Concepts will be in accordance with existing configuration control policy and procedures.

5.5.5.6 Sparing Strategies. The acquisition agent will acquire three years of initial spares, to include depot pipeline spares, with every acquisition effort. Leftover spares purchased in support of development and test may be used to fulfill initial spares requirements.

5.5.5.7 Sustaining Engineering. Sustaining engineering will be conducted in accordance with existing Air Force regulations and acquisition agency policies and procedures.

5.5.5.8 System Warranties and Guarantees. Initial commercial warranties for COTS equipment will be pursued when applicable. Warranties will be provided on equipment pieces as opposed to the systems as a whole.

5.5.5.9 Environmental Stress Screening. Environmental stress screening is required.

5.5.5.10 Data Collection and Analysis. Logistics Support Analysis Record Data Base, Bills of Material, and CAMS will be used to collect data for analysis and for determining future modification of requirements.

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6. INFRASTRUCTURE SUPPORT AND INTEROPERABILITY

6.1 Command, Control, Communications, and Intelligence

6.1.1 Command, Control, Communications, and Intelligence Integration

The satellite control system is designated as a Joint Interest system. Potential exists for support of other services and agencies. The satellite control system command and control will be integrated into the Command, Control, Communications, and Intelligence (C3I) infrastructure of the Unified and Specified (U&S) Command structure and should involve the exchange of voice, video, and electronic data products. All interfaces with the U&S Command C3I infrastructure will be protected to the level commensurate with the information processed. Specifically, the operational wings will interface with the USSPACECOM command structure via secure and protected interfaces between the 14th Air Force (14 AF), the Wing Command Post, and facilities designated as backup.

The operational wings will provide network status information, operational status of supported SVs, and progress reports to the 14 AF as required in response to command direction. The operational wings will receive requests for network or SV status and command directions from the 14 AF. Protected and secure data links will be the primary medium for exchange of information between the satellite control system and the 14 AF with secure voice communications providing additional communications connectivity. The operational wings will respond to information requests and command directives received from the 14 AF within the time frames established to support the Space Defense Command and Control System requirements. In addition, the satellite control system will maintain numerous interfaces with network users for the exchange of administrative and mission related data.

6.1.2 Frequency Spectrum Requirements

Satellite control is currently conducted primarily using S-band frequencies. S-band will continue to be used to maintain compatibility with SVs currently on orbit and those SVs currently in the design phase. However, the need for increased endurability, smaller equipment components, and the migration of new programs to the EHF band requires exploration of alternate frequencies in addition to S-band. In addition, encroachment into the S-band frequencies by international mobile communications interests and recommendations by the Electromagnetic Compatibility Analysis Center may also influence use of other frequency spectrums as a far term requirement. The satellite control system requires TT&C systems that are fully interoperable and compatible with these new requirements and standards. The FITAS recommended that the Joint Staff/J6 rewrite policy on MIL-STD 1582-C to restrict it's scope to TT&C only for survivable satellites and EHF operations.

6.1.3 Intelligence Requirements

Intelligence interfaces required for threat and warning information will be via the interface with the 14 AF.

6.2 Transportation and Basing

Transportation of satellite control system elements will require effective cargo and passenger movement via military and commercial modes to sites around the world. Transportable elements of the satellite control system will be compatible with on-road, air-transportable mobile/transportable operations and systems. Air Force policy is to procure safe, secure, and reliable commercial transportation services that meet requirements at the lowest overall cost. Use of available transportation will be determined per existing organizational authority.

Permanent basing locations of fixed assets is not expected to change appreciably. Current systems will continue to support both fixed and transportable assets. (See Figure 3-1 for a representation of fixed base locations.)

6.3 Standardization, Interoperability, and Commonality

The system design must adopt or develop guidance that enhances interoperability, promotes open systems, and achieves Weapon System Cost Reduction goals to reduce operating and sustaining costs by 20% from fiscal year 1998 levels by 2004. Specifically, the design must conform to guidance in the North American Aerospace Defense Command (NORAD)/ USSPACECOM Interoperability and Standardization Guidance Portfolio. The portfolio is the single point of reference for all standardization efforts affecting NORAD/USSPACECOM mission areas. Request for waiver must be coordinated with USSPACECOM/J4-J6.

6.3.1 Standardization of Common Functions

Standardization, interoperability, and commonality where feasible within the satellite control system will be used to increase responsiveness to user needs, optimize network flexibility, and reduce operating and maintenance costs. The satellite control system will perform satellite control operations through standardization of common functions (operations planning, SV position and orientation management, executing TT&C, disseminating mission data and other information, providing payload and platform evaluation, isolating and correcting ground segment problems, allocating and controlling resources, conducting maintenance, performing system analysis, and providing communications connectivity). The intent is to provide common capabilities on a single hardware/software suite with automated sharing of data between functions.

6.3.2 Interfaces and Protocols

Standard communications protocols, interfaces, data elements, and procedures will be used to promote connectivity with other satellite control networks (e.g. NASA and Navy) and external users. For each frequency spectrum used for TT&C, only standard formats will be used. Hardware, software, and interface standards for common functions will adhere to standards for Integrated Satellite Control Human Computer Interface; radio frequency; waveforms; modulation techniques and telemetry formats; timing formats; and astrodynamics. A single, standardized and integrated scheduling system will be capable of scheduling all satellite control system resources such as RGFs and communications equipment. A single frequency standard with output signals sufficiently accurate to meet telemetry, tracking, and time critical commanding requirements will provide the common system timing capability.

6.3.3 Specifications for Interfaces and Protocols

Specifications for interfaces and supported protocols will be developed and adopted jointly with other organizations (DoD, Government, commercial, and foreign), as feasible. Objectives are identified in the following paragraphs.

6.3.3.1 Architecture. Develop, maintain, and evolve an open systems architecture for all satellite control systems to ensure inter- and intra-mission interoperability, to reduce cost of ownership of existing systems, and to support cost avoidance initiatives in planned systems.

6.3.3.2 Acquisition. Monitor and direct design, acquisition, and maintenance of satellite control systems in a streamlined and cost effective manner.

6.3.3.3 Open Technical Standards. Establish and enforce a coherent set of open technical standards across missions and systems. This process ensures systems interoperability and applications portability will be consistent with the guidance developed and influenced by open systems environment activity within the DoD community.

6.3.3.4 Policy Compliance. Comply with DoD policy to adapt, when possible, to common or compatible operational, administrative, and logistics procedures; technical procedures and criteria; training; supplies, components, or equipment; software; data protocols; and interfaces.

6.4 Mapping, Charting, and Geodesy Support

Use of mobile systems will require surveys to select operational sites for mobile systems. The satellite control system should be interoperable with and standardized to the World Geodetic System 84 (WGS 84) as well as interoperable with current and future GPS grids.

6.5 Environmental Support

Facilities, equipment, and operations will comply with air and water quality requirements, and with hazardous, liquid, and solid waste disposal requirements. The wide variety of terrain (mountainous, heavily vegetated, coastal, etc.) encompasses many levels of environmental sensitivity subject to local and national restrictions. Some sites have the potential of being subjected to severe seismic activity, corrosive sea spray and salt air, thunderstorms, lightning, tornadoes, hurricanes (typhoons), fog, and temperature extremes.

Supported SVs will have the ability to operate with minimal disruption due to space environmental conditions. The satellite control system will have the capability to predict and respond to conditions caused by plasma effects on spacecraft charging, trapped radiation, solar particle events, upper earth atmosphere drag effects, and the environmental results of orbital debris.

7. FORCE STRUCTURE

The current AFSCN force structure consists of those physical resources at the geographic locations depicted in Figure 3-1 and the manpower included in the current Unit Manning Documents. Satellite control will tend to become an integrated capability through the use of multi-mission resources, deletion of dedicated facilities, and consolidation of DoD capabilities. The number and location of RGFs is not expected to change in the near term, however the AFSPC goal is to reduce the dependence on overseas ground stations.

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8. SCHEDULE CONSIDERATIONS

As the current AFSCN evolves to an integrated satellite control capability, with an architecture that responds to new and changing satellite mission requirements, it will remain in a continued state of development that is accomplished in parallel with, and without impact to, on-going satellite operations. The development, acquisition, and deployment of new capabilities is driven by future user support requirements and the timing of planned satellite block changes. IOC for each new capability will be achieved when all required threshold values have been achieved for that capability, demonstrated through an appropriate test program, and made available for operational use by any SV requiring the new capability. Full Operational Capability (FOC) for each new capability will be achieved when all necessary training, staffing, and maintenance support systems are in place. Based on windows of opportunity caused by the timing of these block changes, new capabilities for the satellite control system proposed by this ORD shall be completed incrementally with an IOC by 2000 and an FOC not later than 2004. Specific requirement need dates that are different from the year 2000 are identified in the statement of the requirement.

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APPENDIX A

REQUIREMENTS CORRELATION MATRIX

PART I

The RCM delineates the required system capabilities and characteristics and is an extension of Chapter 4 -- Capabilities Required -- in the body of the ORD. The system capabilities and characteristics, thresholds, and objectives in the RCM agree with the expanded text in Chapter 4. Under the ORD I column heading is a description of the threshold (a minimum acceptable operational value for a system capability or characteristic below which the utility of the system becomes questionable) and objective (an operationally significant increment above the threshold) values for the future system. In this RCM, an asterisk (*) indicates an item to be placed in the Acquisition Program Baseline (APB) as a key parameter (those capabilities and characteristics so significant that failure to meet the threshold is cause for the concept or system to be reevaluated or the program to be reassessed or terminated).

SATELLITE CONTROL
REQUIREMENTS CORRELATION MATRIX
PART I

SYSTEM CAPABILITIES AND CHARACTERISTICS	KEY PERFORMANCE PARAMETER	ORD I/II Thresholds	ORD I/II Objectives
Respond to User Requests (Network Service and SOC Tasks)			
[1] Time to plan (in-procedure) payload reconfiguration due to user request (4.1.1.1)	No	≤ 10 minutes	
[2] Constellation Management: (4.1.1.2) a) Constellation Management Capability b) Time to perform constellation planning in response to user needs to fill an orbital coverage gap	a) No b) No	a) For all AFSPC SV programs b) ≤ 24 hours	b) ≤ 8 hours
[3] Time to accomplish an immediate schedule addition (From user tasking receipt to RGF service available) (4.1.1.3)	No	≤ 10 minutes	
Disseminate Mission Data and Other Information (Network Service Task)			
[4] Time to disseminate Mission Data: (4.1.2.1) a) Processed b) Unprocessed	a) No b) No	a) ≤ 60 seconds to command and control node b) ≤ 10 minutes following end of pass	
[5] Time to report changes in satellite control system status (From change detection to notification) (4.1.2.2)	No	≤ 2 minutes	
Perform Operations Planning (SOC Task)			
[6] Time required for SOC to prepare network support request for 1 SV constellation per week (4.1.3.1)	No	≤ 8 manhours/SV constellation	≤ 1 manhour/SV constellation
Support Space Force Deployment (SOC Task)			
[7] Launch operations preparation time: (4.1.4.1) a) Ready to support, after launch call-up, satellite control operations for the same SV type/family b) Ready to support, after launch call-up, satellite control operations for a new SV type/family	a) No b) No	a) ≥ 30 days prior to launch b) ≥ 180 days prior to launch	

SYSTEM CAPABILITIES AND CHARACTERISTICS	KEY PERFORMANCE PARAMETER	ORD I/II	
		Thresholds	Objectives
Execute TT&C (Network Service and SOC Tasks)			
[8] Number of operators to perform satellite contact functions: (4.1.5.1) a) SOC (SOC Task) b) RGF (Network Service Task)	a) Yes b) Yes	a) Capability for 1 operator/single satellite contact (in-procedure) b) Capability for 1 operator/antenna	a) Capability for manual intervention by exception b) Capability for unattended antenna operations
[9] Capability to receive and process tracking data (4.1.5.2) (SOC Task)	No	Both ground-based and space-based tracking sources	Eliminate dependence on single tracking data source
[10] Number of concurrent events/connectivity: (4.1.5.3) a) SOC events at Falcon and/or Onizuka node (SOC Task) b) Antenna connectivities (Network Service Task)	a) No b) No	a) 29 b) 40 realtime and 3 simulation events	
[11] Telemetry Data Rate Capacity (4.1.5.4) (Network Service Task)	Yes	20 Mbps	150 Mbps
[12] Command Data Rate Capacity (4.1.5.5) (Network Service Task)	Yes	Single-pass command upload for low earth orbit SVs such as DMSP 5D3	Single-pass command upload for future SVs up to and including 100 Kbps
[13] Timing accuracy (4.1.5.6) (Network Service Task)	No	10^{-7} seconds	10^{-9} seconds
Provide Payload and Platform Evaluation (SOC Task)			
[14] Time to detect, isolate and notify SOC operator of a discrete SV problem: (4.1.6.1) a) In-procedure anomaly b) Out-of-procedure anomaly	a) No b) No	a) ≤ 1 minute after detection recommend corrective actions b) ≤ TBD time after detection recommend safing action	
Provide SV Position and Orientation Management (SOC Task)			
[15] Maintain SV within stationkeeping parameters (4.1.7.1)	No	≥ 99% of the time	
[16] Time to generate an orbit update (4.1.7.2)	No	≤ 20 minutes after contact end	≤ 5 minutes after contact end

SYSTEM CAPABILITIES AND CHARACTERISTICS	KEY PERFORMANCE PARAMETER	ORD I/II Thresholds	ORD I/II Objectives
Isolate and Correct Ground Segment Problems (Network Service Task)			
[17] Time to detect, isolate and report satellite control ground segment problems: (4.1.9.1) a) Detect and failover/reroute b) Isolate and report	a) No b) No	a) ≤ 1 minute of occurrence b) ≤ 2 minute of detection	Switch, isolate, respond and report ≤ 1 minute of occurrence
Allocate/Control Resources (Network Service Task)			
[18] Number of operators to perform scheduling functions (4.1.10.1)	No	Capability for 3 operators/shift	Capability for 1 operator/shift
[19] Network scheduling: (4.1.10.2) a) Number of events to be scheduled b) Number of events to be scheduled automatically	a) No b) No	a) ≥ 800 events/day at up to 31 antennae b) ≥ 760 events scheduled per day	a) ≥ 1000 events/day at up to 50 antennae b) ≥ 950 events scheduled per day at up to 50 antennae
[20] Time to accomplish network configuration for a scheduled contact (4.1.10.3)	No	< 5 minutes	Predesignated network configurations available on demand
Conduct Maintenance Operations (Network Service and SOC Tasks)			
[21] RMA: (4.1.11 and 4.2.1) (Network Service and SOC Tasks) a) MTBCF b) MTTRF	a) No b) No	a) TBD b) TBD	a) TBD b) TBD
Provide Communications Connectivity (Network Service Task)			
[22] Number of operators to perform communications functions (4.1.15.1)	Yes	Capability for 1 operator to initiate or terminate 1 event and monitor up to 3 additional on-going events	
[23] Performance: (4.1.15.2) a) Errored seconds/day b) Severely errored seconds/day c) Bit Error Rate for commanding (end-to-end)	a) No b) No c) No	a) ≤ 215 b) ≤ 38 c) Average 10^{-8}	

APPENDIX B

REQUIREMENTS CORRELATION MATRIX

PART II

(SUPPORTING RATIONALE FOR SYSTEM CAPABILITIES AND CHARACTERISTICS)

1. Respond to User Requests. (Parameters 1, 2 and 3) The Satellite Control MAP requires the satellite control system to respond to requests made by operational military forces for data from the satellites operated by AFSPC. In addition, non-DoD users, such as US Government agencies, NASA, laboratories, universities, and foreign governments, require satellite data or operational control of satellites not operated by AFSPC. The satellite control system operates the platform and payload systems on-board the satellites in order to provide the required data in response to these requests.

(Parameter 1) Payload Reconfiguration Planning. The Satellite Control MAP requires the satellite control system to respond to requests made by operational military forces (Theater CINCs) in need of data from various types of satellites that are operated by AFSPC. The MAP also requires the system to respond to requests from non-DoD users. Support can range from operations and control of the platform and payload systems on board the satellites to backup support for platform control. The 28 Oct 93 AFSPC Satellite Control CONOPS identifies the need to effectively and efficiently control space systems and to distribute space system information in support of Unified and Specified CINC warfighting requirements as well as the Mission Areas of other designated space systems and users. Payload reconfiguration planning must be accomplished within 10 minutes of receiving a user request in order to maintain responsiveness to the warfighter. In order to restore a GPS SV to operational status in response to a users needs, the navigation upload commands must be prepared and be ready to transmit to the SV within a ten minute period. To accommodate a users request for a new Milstar communications circuit assignment, the reconfiguration message must be ready for transmission within ten minutes. The Air Force Satellite Communications System requires the capability to generate a command message and transmit the command message at the next possible support to satisfy mission requirements and window of opportunity timelines. The ten minute time period assumes an in-procedure operation that only needs specific data fields defined. The specified time is consistent with the timeline for an immediate schedule addition (Parameter 3) and provides the capability to have the planning completed to support the immediate add.

(Parameter 2) Constellation Management. The Satellite Control MAP, the 28 Oct 93 AFSPC Satellite Control CONOPS, and the Memorandum of Agreement between AFSPC and AFMC on Roles and Missions for Spacelift and Satellite Control call for the network ability to perform constellation management for each SV program where Satellite Control Authority resides with the operational command. In addition, the Satellite Control MAP requires the ability to determine, predict, and periodically adjust the orbital parameters of individual SVs and maintain relative SV position within specified limits. AFSPC MNS 002-94 requires the system to perform orbit maintenance for national, military, civil, allied, commercial, and research, development and test satellites and their associated payloads. The 28 Oct 93 AFSPC Satellite Control CONOPS requires the operations crews to maintain assigned satellite constellations according to planned schedules and vehicle requirements. This parameter provides the capability to maintain and/or achieve the configuration and position required by individual AFSPC SVs, or SV constellations, to accomplish the specified mission objectives. It satisfies the planning timeline requirement, coordinated with 14th Air Force, to perform analysis for OPLAN execution. An example would be to enable rapid response to a request for constant GPS three dimensional coverage over a specified area of interest. The time period is to perform necessary planning only (optimize coverage, determine propellant usage, calculate movement time, determine velocity change magnitude and direction of thrust) and does not reflect the variable time necessary to move the SV and fill the coverage gap. The Objective is to accomplish this planning within eight hours.

(Parameters 3) Immediate Schedule Addition. The Satellite Control MAP requires the system to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control. AFSPC MNS 002-94 requires a system that allows for increased operational autonomy and that supports consolidation of independent operational elements. The 28 Oct 93 AFSPC Satellite Control CONOPS requires, to the greatest extent practical, a scheduling element that will be automated and integrated to automatically configure and test the other elements of the ground segment. This requirement provides a responsive capability to any satellite control system user (either AFSPC or external) to accomplish non-nominal or emergency support requirements. The 10 minute time period to accomplish an immediate schedule addition is based on the mission timeline of a low-altitude SV and provides 5 minutes to work the network schedule options and resolve possible schedule conflicts and 5 minutes to turnaround the RGF, communications, and operations center equipment, perform prepass checks, and establish connectivity with the SV. This time period assumes that there is SV to RGF visibility and that the RGF is in a schedulable condition (currently operable or able to be recalled from preventive maintenance or other downtime).

2. Disseminate Mission Data and Other Information. (Parameters 4 and 5) The Satellite Control MAP requires the capability to process and transmit mission data through the satellite control node to the user as required. In addition to sensor data, this information includes position and current status of mission satellites and satellite control assets and is provided directly from satellite control authorities to CINCSPACE or other non-DoD users.

(Parameters 4) Disseminate Mission Data. Mission data may be disseminated either directly from the satellite or through the satellite control node. The Satellite Control MAP recognizes that dissemination of mission data and information is a critical task and that as the warfighter becomes more aware of the data that is available he will demand more user friendly information at a faster rate. AFSPC MNS 002-94 requires a system that facilitates the distribution of timely and accurate mission information to warfighting forces and other users world-wide while being responsive to new support requests. The 28 Oct 93 AFSPC Satellite Control CONOPS requires the satellite control system to distribute space system information in support of Unified and Specified CINC warfighting requirements as well as the mission areas of other designated space systems and users. Each space system's concept of operations uniquely determines the extent to which the satellite control system may monitor, receive, process, and/or distribute mission data. For example, GPS navigation data is provided directly to the warfighter through the use of receivers uniquely designed for the air, land, or sea mission being supported. Weather data from the DMSP system, however, is received either directly by the warfighter through tactical terminals or indirectly after dissemination to Air Force Global Weather Center. Tactical warning data is received by the warfighter after mission unique processing. The 60 second time to distribute processed data is driven by the need to report events of interest to appropriate command and control authorities within the specified period. The ten minute time to disseminate unprocessed data after the end of an SV pass is a DMSP mission requirement.

(Parameter 5) Satellite Control System Status. The Satellite Control MAP requires that the current status and position of mission satellites, and status of satellite control assets be provided directly from satellite control authorities to CINCSPACE or other non-DoD users. AFSPC MNS 002-94 requires the satellite control system to conform to existing operational command and control processes, procedures, and capabilities; emphasize automation of these processes and procedures; and integrate resource scheduling and system status reporting. The 28 Oct 93 AFSPC Satellite Control CONOPS requires an integrated status reporting system to provide automated reporting from the ground segment elements and the space segment elements. Human interaction will be limited to providing proper follow-up responses to status changes and/or performing exercise or real-world tasking scenarios. AFSPC Regulation 55-2 requires that changes in status of operational systems be reported as soon as possible after detection of a change in status. The intention is to achieve an automatic status reporting capability (to provide within two minutes a problem description, systems and subsystems effected, current status, and estimated time to return to operational status) to allow the user time to accomplish replanning caused by satellite control system or SV problems.

3. Perform Operations Planning. (Parameter 6) The Satellite Control MAP requires the capability to perform all planning functions accomplished prior to a satellite contact including mission planning, defining contact objectives, generating commands, and performing contingency planning.

(Parameter 6) Operations Planning. The Satellite Control MAP recognizes that operations planning is a costly and time consuming activity. The MAP requires the satellite control system to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control. The 28 Oct 93 AFSPC Satellite Control CONOPS recognizes that mission planning determines future activities required to support individual SVs. The CONOPS requires planning interfaces to the scheduling element and command and control element for generation of individual satellite support schedules. Mission planning is currently manpower intensive in regards to SV scheduling. Since manpower reductions mandated by Air Force Chief of Staff in the weapon system cost reduction initiative will apply across the board, mission planning must correspondingly reduce manpower. This dictates that the time necessary to develop the RGF schedule request must be reduced. Based upon anticipated manning levels, analysis shows that the time needed to prepare network support schedule requests for the RGFs, currently done via the Program Action Plan (PAP) for the common use system, must not exceed eight manhours per SV constellation/week. The Objective is to accomplish this planning within one manhour.

4. Support Space Force Deployment. (Parameter 7) The Satellite Control MAP requires support to space force deployment to include pre-launch preparation (training, rehearsals, exercises), launch support, early orbit checkout, and positioning of space assets on-orbit (for support of regional users or requests for data of specific regions, movement of spares into operational positions, or repositioning for different coverage/visibility).

(Parameter 7) Launch Operations Preparation. AFSPC MNS 002-94 requires maximized operability consistent with operations plans and flexibility to accommodate "surge" support requirements. The 28 Oct 93 AFSPC Satellite Control CONOPS requires the satellite operations center crews to conduct end-to-end compatibility testing to validate the software database; to conduct interactive or end-to-end rehearsals to simulate all pre-launch, launch, and early-orbit checkout procedures; and ensure proper information flow and communications configurations for these operations prior to committing to launch. To accomplish these functions, the satellite operators and the satellite control system must have the capability to copy, modify, assemble, install and test SV operations databases received from the satellite program office and/or the SV manufacturer on the operational flight computer systems and accomplish other necessary preparation activities to be ready for satellite control operations after launch call-up. For launch call-up for the same SV type/family that has been previously supported by the SOC, the satellite control system must be ready to support satellite control operations at least 30 days prior to the scheduled launch. For launch call-up for a new SV type/family that has not been previously supported by the SOC, the satellite control system must be ready to support satellite control operations at least 180 days prior to the scheduled launch. These time periods supports launch on need scenarios required for operational support to warfighting forces.

5. Execute TT&C. (Parameters 8 through 13) The Satellite Control MAP requires the ability to receive telemetry (both mission data and health and status); collect and process azimuth and elevation pointing data, range and range rate data or other navigation information; and transmit the commands necessary to control payload mission activities and maintain the health and status of the satellite platform.

(Parameter 8) Number of Operators. This is a Key Parameter. The Satellite Control MAP, CONOPS, and MNS requires the following: minimize O&M cost, reduce number of military personnel, reduce skill level, reduce training time, incorporate technology advances, manage satellite anomalies by exception. For a typical, in-procedure support, a reduction of the on-console personnel to one operator must be achieved by any new system. This is consistent with the current trend in 50th Space Wing satellite operations to use a single controller for routine state-of-health passes. The reduction in personnel is also consistent with current available technology and commercial practices. Where operations procedures dictate, increased manning may be required (e.g., launch support, anomaly resolution, orbit maneuvers). Operator workload for the RGF is based on the current Automated Remote Tracking Station (ARTS) concept requiring one ARTS operator at each ARTS antenna. The Objective for SOC operations is to accomplish contact supports with manual intervention by exception. The Objective for the RGF is unattended operations.

(Parameter 9) Tracking Data Sources. The 28 Oct 93 AFSPC Satellite Control CONOPS requires a system able to conduct satellite operations without the need for numerous TT&C sites throughout the world. Current satellite tracking relies on ground-based observations for orbit determination. The USCINCSPACE vision for future satellite control operations includes reducing the current dependence on overseas ground stations. As future vehicles incorporate space-based navigation (e.g. GPS), orbital analysis must be capable of receiving and processing data from space-based sources as well as from conventional ground-based sources. The Objective is to eliminate dependence on a single tracking data source.

(Parameter 10) Concurrent Events/Connectivity. The 28 Oct 93 AFSPC Satellite Control CONOPS requires a capability to perform the main tasks of the satellite control mission identified in the MNS for all assigned satellite programs in the Mission Model. Part A of this parameter represents the typical maximum number of concurrent SOC events that will occur concurrently. These SOC events include satellite contacts requiring TT&C support, satellite contact and mission planning, postpass data analysis, contingency analysis, mission data transfer between the satellite control system and an external user, training and simulations, data playbacks from an RGF, and SOC system downtime or checkout. The number of concurrent SOC events is derived by adding typical regularly observed maximums as shown in the following table.

TYPICAL MAXIMUM CONCURRENT SOC EVENTS

Location	**Typical Maximums**
Falcon AFB and Onizuka AFB	16
GPS GAs	4
GPS MSs	5
Milstar	1
Navy	3
	Total 29

Part B represents the network sizing to provide concurrent support from existing common user tracking stations, monitor stations/ground antennas, Navy EHF and SHF antennas, vehicle checkout facilities, mobile systems, Data Link Terminals, and Camp Parks Communications Annex plus support mission simulations to include maneuvers and maneuver handovers. In addition to concurrent support, the network must also provide connectivity to each of the 50 antennas. Rationale for concurrent antenna connectivities is provided in the table on the following page.

CONCURRENT ANTENNA CONNECTIVITIES RATIONALE

ANTENNAS	TYPICAL CONCURRENT USE
16 Common User RTSs	Support at 16 of 16 RTSs
2 Vehicle Checkout Facilities (VCF)	Support at 1 of 2 VCFs
4 Camp Parks Communications Annex	Support at 1 of 4 CPCA
5 Navy EHF/SHF Antennas	Support at 3 of 5 Navy
4 Ground Antennas (GA)	Support at 4 of 4 GAs
31 Antennas (Total common use)	**Support at 25 of 31 concurrently (Typical)**
5 Monitor Stations (MS)	Support at 5 of 5 MS
4 DSP Antennas	Support at 4 of 4 DSP
1 MILSTAR MCE	Support at 1 of 1 MILSTAR
4 Data Link Terminals (DLT)	Support at 3 of 4 DLTs
3 Mobiles (DSP)	Support at 0 of 3 Mobiles
2 NPOESS Antennas	Support at 2 of 2 NPOESS
19 Antennas (Total dedicated use)	**Support at 15 of 19 concurrently (Typical)**
50 Antennas (Total)	**Support at 40 of 50 antennas concurrently (Typical)**
SIMULATIONS	**TYPE SUPPORT**
3 Simulation Events	For 1 Launch - Primary and Backup Stations Plus a Hot Handoff

(Parameter 11) Telemetry Data Rate Capacity. This is a Key Parameter. AFSPC MNS 002-94 requires changes to the current system caused by requirements of future satellites, such as data rates for weather satellites. The 28 Oct 93 AFSPC Satellite Control CONOPS requires the satellite control system to have the capacity, capability, and flexibility to accommodate mission unique requirements (schedules, communications links and data rates) yet also maintain a cost and operationally effective baseline. High end rates are needed by programs such as SBIRS for focused area technical intelligence. The Objective is to support future SVs, such as NPOESS, with potential data rates up to 150 Mbps (interleaved mission data and TT&C).

(Parameter 12) Command Data Rate Capacity. This is a Key Parameter. Command data rate requirements are driven by the same MNS and CONOPS rationale as the telemetry data rate requirements (Parameter 11). This capacity parameter defines single pass software upload capability for low earth orbit programs such as DMSP Block 5D3. The Objective is to support future SVs with potential command rates (single pass software upload) to 100 Kbps.

(Parameter 13) Timing Accuracy. AFSPC MNS 002-94 requires that future satellite operations eliminate redundant mission unique resources whenever common systems can satisfy mission needs and reduce life cycle costs. The MNS also requires that new capabilities meet the requirements of standards under development by the DoD and other agencies. The objective reflects the accuracy of the GPS system, which is becoming the defacto standard.

6. Provide Payload and Platform Evaluation. (Parameter 14) The Satellite Control MAP requires satellite control resources with the ability to assess payload and platform systems and subsystems behavior, verify mission events during contacts, and conduct detailed performance analysis typically after an SV contact or pass is completed.

(Parameter 14) SV System Problem. The 28 Oct 93 AFSPC Satellite Control CONOPS requires automated telemetry processing, commanding, tracking, station-keeping, and status reporting for routine support to non- or semi-autonomous SVs as well as notification to personnel when anomalous conditions are detected. The satellite control system must automatically detect, isolate and notify the SOC operator of a discrete SV problem and recommend corrective actions for an in-procedure anomaly within one minute of problem detection. For out-of-procedure anomalies, the system must recommend safing actions within TBD time of detection of the discrete SV problem. A discrete SV problem is characterized as a hard failure (i.e. a step function with the system either broken or not broken). Gradual degradation of a system with telemetry indicating performance slowly moving out of limits is not considered a discrete problem. This requirement is driven by the need to safe the vehicle during the same contact in which the problem was discovered. After the vehicle is safed more detailed analysis can be accomplished and further corrective action taken as required.

7. Provide SV Position and Orientation Management. (Parameters 15 and 16) The Satellite Control MAP requires the ability to determine, predict, and periodically adjust the orbital parameters of individual SVs and maintain relative SV position within specified limits.

(Parameter 15) Orbit Maintenance. AFSPC MNS 002-94 requires the system to perform orbit maintenance for national, military, civil, allied, commercial, and research, development and test satellites and their associated payloads. The 28 Oct 93 AFSPC Satellite Control CONOPS requires the operations crews to maintain assigned satellite constellations according to planned schedules and vehicle requirements. Accurate orbit maintenance is critical to providing required operational support to the warfighting users. GPS navigation accuracy for the soldier in the field, Navy ships, and aircraft pilots depends on visibility with a specified number of GPS SVs and the phasing of these SVs within the total constellation. Tactical users of DMSP weather information depend on knowing when the DMSP SVs will be visible over their location for data readouts. Pointing accuracy for spot beam communications antennae is dependent on precise knowledge of orbit position. These accuracies drive the satellite control system to have the ability to maintain supported SVs within required stationkeeping parameters 99% of the time.

(Parameter 16) Orbit Update Generation. Orbit update requirements are driven by the same MNS and CONOPS rationale as the orbit maintenance requirements (Parameter 13). For a typical orbit update, a reduction in the number of the orbit analyst personnel and the time required to perform the update must be achieved by any new system. This is consistent with the current trend in 50th Space Wing satellite operations to reduce satellite operations personnel. The reduction in the time required to generate an orbit update is consistent with available technology and will assist in reducing operations personnel. Less common events, such as Launch and Early Orbit (LEO) supports and contingency operations replanning may require additional manpower or time to determine or predict orbital parameters. This requirement also provides the capability to generate and distribute orbital element sets necessary to acquire SVs during anomalous launch conditions. Using actual booster engine burn data allows the RGF tracking antenna scan pattern to be updated to enable first acquisition. The Objective is to generate these updates within 5 minutes.

8. Isolate and Correct Ground Segment Problems. (Parameter 17) The Satellite Control MAP requires satellite control resources with the ability to rapidly isolate and correct ground segment failures. This includes realtime fault detection and isolation and the ability to correct through automatic reconfiguration using redundant paths and equipment.

(Parameter 17) Satellite Control Ground Segment Problems. The 28 Oct 93 AFSPC Satellite Control CONOPS requires redundancy, fault detection and fault isolation capabilities, and auto-failover capabilities built into individual equipment items. In order to provide at least 90% of the required telemetry and tracking data and 100% of the commanding data during a ten minute pass (600 seconds) with no more than a 10% data loss (60 seconds of data), the satellite control system must automatically detect a ground segment problem and failover/reroute to a redundant system or component within one minute of problem detection. This time period also allows for crypto equipment failures that require time for switchover and resynchronization of the crypto boxes. Within two minutes of detection the system must isolate the problem to a specific system or component and initiate problem resolution activities such as notification to maintenance within two minutes of detection. The Objective is to switch to redundant equipment, isolate the problem, respond and report within one minute of problem occurrence.

9. Allocate/Control Resources. (Parameters 18, 19 and 20) The Satellite Control MAP requires the ability to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control. This includes determination of visibility, availability (including deconfliction), operability and resolution of radio frequency interference, and coordination of non-flight activities.

(Parameter 18) Number of Scheduling Operators. The Satellite Control MAP, CONOPS, and MNS requires the following: minimize O&M cost, reduce number of military personnel, reduce skill level, reduce training time, incorporate technology advances, manage satellite anomalies by exception. Since manpower reductions mandated by Air Force Chief of Staff in the weapon system cost reduction initiative will apply across the board, network scheduling must correspondingly reduce manpower. This dictates that the time necessary to develop the RGF schedule request must be reduced. Scheduling operator workload is based on the need for one operator to work realtime additions, deletions, and conflict resolutions; one operator to prepare the 24 hour schedule for the next day activities; and one operator to prepare the planning schedule for the next week (7 day) activities. The Objective is to accomplish the scheduling functions with one operator per shift.

(Parameter 19) Network Scheduling Capacity. AFSPC MNS 002-94 requires a system that allows for increased operational autonomy and that supports consolidation of independent operational elements. The 28 Oct 93 AFSPC Satellite Control CONOPS requires, to the greatest extent practical, a scheduling element that will be automated and integrated to automatically configure and test the other elements of the ground segment. The application of current expert system and decision support technologies and use of commercial scheduling system capabilities are directly applicable to improving satellite control scheduling. Network events to be scheduled include satellite contacts, mission data transfer between the satellite control system and an external user, training and simulations, data playbacks from a RGF, and system downtime or checkout. The satellite control system must schedule these events for Falcon and Onizuka control centers, the GPS control stations and ground antennas, Milstar operations centers, DMSP/National Polar Orbiting Environmental Satellite System (NPOESS), DSP, Navy, NASA, classified users, and other external organizations. 800 events (500 common user events plus 300 events from dedicated centers) is a typical loading from these centers. Up to 760 events must be automatically scheduled to minimize the required scheduling manpower. The Objective is to schedule 1000 events per day for all 50 satellite control system antennae and automatically schedule 950 of these events.

(Parameter 20) Network Configuration. Network configuration requirements are driven by the same MNS and CONOPS rationale as the scheduling capacity requirements (Parameter 19). The 5 minute time period to accomplish network configuration for a scheduled SV support includes time to turnaround the RGF, communications, and operations center equipment, perform prepass checks, and establish connectivity with the SV. Increased loading on the satellite control system, based on missions identified in the AFSPC National Mission Model, indicate that efficiencies are needed to accommodate the anticipated increased workload. 50th Space Wing loading studies indicate that each 5 minute reduction in reconfiguration time (currently 10 to 15 minutes) is equivalent to the addition of one Remote Tracking Station. The Objective is to have predesignated network configurations available to satellite control personnel for use on demand.

10. Conduct Maintenance Operations. (Parameter 21) The Satellite Control MAP requires that maintenance personnel have the ability to perform routine and periodic maintenance and logistics support to ensure dependability and availability of satellite control elements for operations. This includes monitoring equipment status and performing organizational and depot level maintenance.

(Parameter 21) Reliability, Maintainability and Availability. Given the total consideration of risk, backup and interoperability, there are no critical operational drivers for RMA. The optimum balance of reliability and maintenance is to achieve the lowest lifecycle cost within acceptable risk. This balance will be determined during the cost benefit analysis. When the RMA providing the lowest possible cost and acceptable operational risk, and considering incorporation of current commercial practices, is determined, those RMA values will be incorporated in the next ORD revision. The majority of satellite control system operations are routine activities such as state-of-health contacts and analysis or track and record supports for orbit maintenance. For the minority of operations that require high reliability (launch and early orbit support or thruster firings for SV maneuvering), the SV operations concepts generally call for an additional control node in shadow or an additional RGF in hot backup. This parallel string provides additional reliability over single string operations.

11. Perform Communications Connectivity. (Parameters 22 and 23) The Satellite Control MAP requires reliable, secure communications links to transmit data between satellite control elements and between satellite control resources and all users.

(Parameter 22) Number of Communications Operators. This is a Key Parameter. The Satellite Control MAP, CONOPS, and MNS requires the following: minimize O&M cost, reduce number of military personnel, reduce skill level, reduce training time, incorporate technology advances, manage satellite anomalies by exception. Since manpower reductions mandated by Air Force Chief of Staff in the weapon system cost reduction initiative will apply across the board, communications operations must correspondingly reduce manpower. The communications operator workload is based on the Integrated Satellite Control Human Computer Interface Standard recommendation for up to four tiles/quadrants per display screen. Using this standard, one operator will have be able to monitor 3 on-going operations and initiate or terminate one additional event at a four tile/quadrant display screen.

(Parameter 23) Communications Performance. Currently available communications connectivity, which provides for the transmission of voice or data, uses measures of performance and availability known as Errored Seconds (ES) per time period and Severely Errored Seconds (SES) per time period. These measures are considered more appropriate for future upgrades than those currently in use as they are directly attributable to the new systems and capabilities that will be commercially delivered. An ES is any second in which one or more bits are in error or that contains error events as measured by the self monitoring system capability. These errors are found to include periods of error bursts, called SES, during which a large proportion of bits are in error. These SES periods occur well within the ES criteria so they consequently need another measure of performance. The values specified for ES and SES are current commercially advertised performance capabilities. The additional performance parameter, Bit Error Rate, is derived from current and future SV requirements.

APPENDIX C

REQUIREMENTS CORRELATION MATRIX

PART III

Rationale and Needs/Requirements Change Sheet

This Appendix provides the rationale for changes in system characteristics, performance, and supporting parameters between successive reissues of the ORD. It shows the evolutionary process of refining characteristics, capabilities, and threshold and objective values. Since this is the first issue of the ORD for Satellite Control, RCM Part III is not required.

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APPENDIX D

LIST OF ACRONYMS AND ABBREVIATIONS

14 AF	14th Air Force
AB	Air Base
ADPE	Automated Data Processing Equipment
AETC	Air Education and Training Command
AF	Air Force
AFB	Air Force Base
AFCAT	Air Force Catalog
AFI	Air Force Instruction
AFMC	Air Force Materiel Command
AFOSI	Air Force Office of Special Investigation
AFH	Air Force Handbook
AFP	Air Force Pamphlet
AFPD	Air Force Policy Directive
AFR	Air Force Regulation
AFS	Air Force Station
AFSCN	Air Force Satellite Control Network
AFSPC	Air Force Space Command
AFSSI	Air Force System Security Instruction
AFTO	Air Force Technical Order
ALDT	Administrative and Logistics Delay Time
AMS	Ascension Monitor Station
ANG	Air National Guard
ANSI	American National Standards Institute
APB	Acquisition Program Baseline
ASAF (Space)	Assistant Secretary of the Air Force (Space)
Aust.	Australia
BALLISTICS	Ballistic Missiles
BE	Brilliant Eyes
BER	Bit Error Rate
BIT	Built-in Test
BMD	Ballistic Missile Defense
BOOSTERS	Space Launch Boosters
bps	Bits per Second

C2	Command and Control
C3	Command, Control and Communications
C3I	Command, Control, Communications, and Intelligence
C4	Command, Control, Communications and Computer
CA	California
CALS	Continuous Acquisition and Life Cycle Support
CAMS	Core Automated Maintenance System
CBA	Cost Benefit Analysis
CCS	Command and Control Segment
CFEN	Contractor Furnished Equipment Notices
CO	Colorado
COCOM	Combatant Command
COMSEC	Communications Security
CONOPS	Concept of Operations
CONUS	Continental United States
COTS	Commercial Off The Shelf
CP	Command Post
CPCA	Camp Parks Communications Annex
CRS	Command Readout Station
CSC	Computer Security Center
CSE	Common Support Equipment
CSOC	Consolidated Space Operations Center
CTS	Colorado Tracking Station
DCS	Defense Communications System
DGS	Diego Garcia Tracking Station
DIAM	Defense Intelligence Agency Manual
DIAR	Defense Intelligence Agency Regulation
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DLT	Data Link Terminal
DMSP	Defense Meteorological Satellite Program
Do	Operational Dependability
DoD	Department of Defense
DSCS	Defense Satellite Communications System
DSIS	DCS Satellite Control Facility Interface System
DSP	Defense Support Program
ECCM	Electronic Counter-Countermeasures
EHF	Extremely High Frequency
ES	Errored Seconds
exp	Exponential Function

FAFB	Falcon Air Force Base
FD	Fault Detection
FI	Fault Isolation
FIPS	Federal Information Processing Standard
FITAS	Future Integrated TT&C Architecture Study
FL	Florida
FLTSATCOM	Fleet Satellite Communications System
FOC	Full Operational Capability
FSOC	Fairchild Satellite Operations Center
GA	Ground Antenna
Gbps	Gigabits per second
GAO	Government Accounting Office
GFO	Geosat Follow-on
GHz	Gigahertz
GOSIP	Government Open Systems Interface Profile
GOTS	Government-Off-The-Shelf
GPALS	Global Protection Against Limited Strike
GPS	Global Positioning System
GTS	Guam Tracking Station
HCI	Human Computer Interface
HI	Hawaii
HOI	Headquarters Operating Instruction
HQ	Headquarters
HSI	Human Systems Integration
HTS	Hawaii Tracking Station
HUMINT	Human Intelligence
I&A	Indication and Authentication
IAW	In Accordance With
ILS	Integrated Logistics Support
IOC	Initial Operational Capability
IOS	Indian Ocean Tracking Station
IQT	Initial Qualification Training
Is.	Island
ISC	Integrated Satellite Control
ISO	International Standards Organization
IUS	Inertial Upper Stage
IWSM	Integrated Weapons System Management
JCS	Joint Chiefs of Staff
Kbps	Kilo Bits per Second
KMS	Kwajalein Monitor Station

LAN	Local Area Network
LRU	Line Replaceable Unit
MAP	Mission Area Plan
Mbps	Mega Bits per Second
MCC	Mission Control Complex
MDC	Maintenance Data Collection
MDI	Multi-Disciplinary Intelligence
ME	Mission Effectiveness
MIL-HDBK	Military Handbook
MILSATCOM	Military Satellite Communications
MMD	Maximum Critical Mission Duration
MNS	Mission Need Statement
MOA	Memorandum of Agreement
MPSOC	Multi-Purpose Space Operations Complex
MR	Mission Reliability
MROC	Multi-command Required Operational Capability
MS	Monitor Station
MSTRS	Miniaturized Satellite Threat Reporting System
MTBCF	Mission Time Between Critical Failures
MTTRF	Mean Time to Restore Function
MUE	Mission Unique Equipment
MUS	Mission Unique Software
N/A	Not Applicable
NACSIM	National COMSEC Memorandum
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVSOC	Naval Space Operations Center
NE	Nebraska
NH	New Hampshire
NHS	New Hampshire Tracking Station
NOFORN	No Foreign Dissemination
NORAD	North American Aerospace Defense Command
NPOESS	National Polar Orbiting Environmental Satellite System
NSCS	National Security Computer System
O&M	Operations and Maintenance
O&S	Operations and Sustainment
OAS	Onizuka Air Station
OJT	On-the-Job Training
OPLAN	Operations Plan
OPSEC	Operations Security
ORD	Operational Requirements Document

P9x	Space Test Experiment Program
PE	Program Element
PSE	Peculiar Support Equipment
Pt.	Point
PTF	Payload Test Facility
PMD	Program Management Directive
POSIX	Portable Operating System Interface for Computing Environment
PRD	Program Requirements Document
PSP	Program Support Plan
RCC	Resource Control Center
RCM	Requirements Correlation Matrix
RDT&E	Research, Development, Test and Evaluation
REMIS	Reliability and Maintainability Information System
RF	Radio Frequency
RGF	Remote Ground Facility
RMA	Reliability, Maintainability, and Availability
RTS	Remote Tracking Station
SAF	Secretary of the Air Force
SBIR	Space Based Infrared System
SCA	Satellite Control Architecture
SCI	Sensitive Compartmented Information
SCSS	Satellite Control Simulation System
SDLS	Satellite Data Link Standard
SERD	Support Equipment Recommendation Document
SES	Severely Errored Seconds
SGLS	Space-Ground Link Subsystem
SHF	Super High Frequency
SKYNET	Skynet Communications Satellite
SMC	Space and Missile Systems Center
SMx	Support Mission Series
SOC	Satellite Operations Center
SOH	State of Health
SON	Statement of Operational Need
SORD	System Operational Requirements Document
SPD	System Program Director
SQL	Standard Query Language
STS	Space Transportation System
SV	Space Vehicle

TBD	To Be Determined
TBS	To Be Supplied
TCP/IP	Transmission Control Protocol/Internet Protocol
TCS	Telemetry and Command Station
TED	Threat Environment Description
Terr.	Territory
TM	Technical Manual
TRANSEC	Transmission Security
TRM	Technical Reference Model
TSC	Test Support Complex
TT&C	Tracking, Telemetry, and Commanding
TTS	Thule Tracking Station
TVCF-E	Transportable Vehicle Checkout Facility - East
U	Unclassified
U&S	Unified and Specified
UHF F/O	Ultrahigh Frequency Follow-On
UQT	Unit Qualification Training
US	United States
USAF	United States Air Force
USSPACECOM	United States Space Command
VTS	Vandenberg Tracking Station
WA	Washington
WAN	Wide Area Network
WGS 84	World Geodetic System 1984
WNINTEL	Warning Notice Intelligence Sources and Methods Involved

APPENDIX E

GLOSSARY OF TERMS

ALLOCATE AND CONTROL RESOURCES - A Mission Area Plan Operational Task. Satellite control resources must be able to translate SV support requirements into near-term equipment utilization schedules for all elements of satellite control. This includes determination of visibility, availability (including deconfliction), operability and resolution of radio frequency interference, and coordination of non-flight activities. (MAP)

AUTOMATED SYSTEM - The technique of operating and controlling the satellite control system through a combination of computer and telecommunications resources that collect, record, process, store, communicate, retrieve and display information to minimize manual intervention.

AUTONOMOUS - Independent, self-contained satellite design features used to reduce dependency on AFSCN ground systems.

CAPACITY - Capacity is the number of SVs that can be accommodated by the network. Accommodated in this sense means providing the required levels of planning, TT&C, communications throughput, computer performance, and mission support. Capacity is determined by such factors as mission task loading, number of antennas available at the required location, communication link bandwidth, mission length and complexity, etc. (AFSCN Capacity Management Plan)

CAPACITY MANAGEMENT - The process of assuring that the services provided by the AFSCN, and the resources that support those services, are sufficient to meet the requirements for those services and resources. The capacity management process measures, evaluates and manages the current and projected capacity of antennas, SOCs, communications, and the end-to-end network. (AFSCN Capacity Management Plan)

COMMAND AND CONTROL (Reporting and Tasking) - Command and control is the exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. For this ORD, command and control functions consist of both tasking and reporting activities. (JCS Pub 1)

COMMERCIAL OFF-THE-SHELF - A product (hardware, software, test equipment, etc.) developed and produced for general use having applicability to, and use for, the satellite control system without major modification or change.

COMMONALITY - A quality that applies to materiel or systems possessing like and inter-changeable characteristics enabling each to be utilized, or operated and maintained, by personnel trained on the others without additional specialized training. (JCS Pub 1)

COMMON FUNCTION - A function that is shared by different SV missions or accomplished by other satellite control networks to support different SV missions. For the satellite control system, common functions are operations planning, SV position and orientation management, executing TT&C, disseminating mission data and other information, providing payload and platform evaluation, isolating and correcting ground segment problems, allocating and controlling resources, conducting maintenance, performing system analysis, and providing communications connectivity.

COMMUNICATIONS EVENT - A communications event is a communications related activity that provides connectivity between a remote ground facility and a satellite operations center for a realtime contact, simulation, playback or other data transfer in support of the satellite control mission.

CONDUCT MAINTENANCE OPERATIONS - A Mission Area Plan Operational Task. Satellite control personnel must be able to perform routine and periodic maintenance and logistics support to ensure dependability and availability of satellite control elements for operations. This includes monitoring equipment status and performing organizational and depot level maintenance. (MAP)

CONDUCT NETWORK OPERATIONS AND MAINTENANCE TRAINING - A Mission Area Plan Operational Task. Satellite control personnel must be provided with realistic training for operators and maintainers using a combination of formal classroom instruction, on-the-job training, and realistic hands-on simulation techniques. (MAP)

CONDUCT SPACE VEHICLE TRAINING - A Mission Area Plan Operational Task. Satellite control personnel must be provided with specific SV familiarization training, readiness exercises and simulation activities in order to establish and maintain a high level of proficiency. (MAP)

CONNECTIVITY (NETWORK) - The topological description of the satellite control system that specifies the interconnection of the nodes in the network in terms of circuit parameters such as location, termination and quantity.

CONSTELLATION MANAGEMENT - The capability to maintain and/or achieve the configuration and position required by individual AFSPC SVs, or SV constellations, to accomplish the specified mission objectives.

CONTACT - The time period when connectivity is established between an RGF and an SV under the control of a satellite operations center for the purpose of conducting a satellite command plan. Typically, the SV is acquired and tracked by the RGF antenna, the SV telemetry data is received, and appropriate commands are transmitted to the SV. Concurrently, the operations center processes and evaluates the telemetry data and verifies the SV state-of-health and status of user or mission data (if applicable). The contact ends when the contact objectives are met and tracking is terminated or when the SV is no longer visible to the RGF. An SV support is typically conducted in three phases: pre-pass, pass (or contact), and post-pass. The pass or contact can be either an actual connectivity with an SV or a simulated event using a vehicle simulator.

CRITICAL FAILURE - Critical failures occur when the system is rendered unable to perform an operational function during mission time.

CRITICAL SYSTEM CHARACTERISTIC - A special category of characteristics such as transportability, interoperability, ECCM, etc., which are historically design, cost and risk drivers and require early identification for cost/performance tradeoffs. (AFI 10-601)

DEDICATED NETWORK/RESOURCE - A network/resource used for space system support by a single program (e.g., FSOC, MPSOC, Ground Antennas, etc. are current dedicated resources).

DEVELOP AND FIELD NEW CAPABILITIES - A Mission Area Plan Operational Task. This task includes the ability to program, plan and budget for continued evolution of the satellite control system through development of new or enhanced capabilities. Fielding new capabilities must be done on a non-interference basis with operations without large delays between identification of the need and turnover to operations. (MAP)

DISSEMINATE MISSION DATA AND OTHER INFORMATION - A Mission Area Plan Operational Task. This task involves formatting and transmitting data for the user. Mission data may be either transmitted directly from the satellite or through the satellite control node after data processing is performed as required. Information includes position and current status of mission satellites and satellite control assets and is provided directly from satellite control authorities to CINCSPACE or other non-DoD users. (MAP)

ELEMENT - Subset of the ground or space segment within the AFSCN (e.g. Communications, scheduling, payload, space-to-ground interface, etc). (CONOPS)

ENDURABILITY - The degree to which the mission can continue to be sustained without impairment despite partial loss or graceful degradation of resources.

ERRORED SECONDS - An Errored Second is any second in which one or more communications data bits are in error or that contains error events as measured by the self monitoring system capability. (Data Communications Technical Reference)

EXECUTE TELEMETRY, TRACKING AND COMMANDING - A Mission Area Plan Operational Task. Satellite control resources must be able to receive telemetry (both mission data and health and status); collect and process azimuth and elevation pointing data, range and range rate data or other navigation information; and transmit the commands necessary to control payload mission activities and maintain the health and status of the satellite system. (MAP)

FAULT TOLERANT - A condition of the satellite control system that allows the system to stay in operation to finish a mission when a device, component or element fails to perform in the required manner, e.g., short circuit, broken wire, etc..

FLEXIBILITY - The property of a system that allows changes and adjustments to satisfy differing requirements. For the AFSCN, standard interfaces could be a property that allows system changes to be made to more easily satisfy new user requirements.

FORMAT - A predetermined arrangement of electronic data characters, fields, files and other information related to a specific function or process.

GOVERNMENT OFF-THE-SHELF - A product (hardware, software, test equipment, etc.) developed and produced for government use having applicability to, and use for, the satellite control system without major modification or change.

HIGH FIDELITY - For training purposes, high fidelity means capable of providing an operationally useful simulation of the space environment (aerodynamic force modeling, radiation data, message routing, environment data, radio frequency, thermal, power, and field-of-view elements), the space vehicle (simulation control, model processing, telemetry generator, and simulation model set elements), the network (ground station, communications, and radio frequency environment elements), and the control complex (resource control and mission control workstations, data routing, and resource control and mission control real-time and planning elements). (SCSS SON)

IN-PROCEDURE - Satellite control operations and functions for which routine or corrective actions have been predefined and documented.

INTEGRATED - A combination of separate satellite control system elements to provide an interrelated whole with complete interconnection and interoperation. The Satellite Control Mission Area Plan provides an example: "dedicated integration of the command and control element consists of several projects that will integrate (combine) both shared and dedicated resources by expanding the open system architecture provided by ASC. For example, this could be done by duplicating the ASC system in the existing dedicated operations centers or by providing a payload subnet as part of the shared ASC systems." In addition, "Dedicated Integration for the SGIE (Space Ground Interface Element) consists of several projects that will integrate (combine) the shared and dedicated resources through elimination, consolidation and interoperability. This may be an upgrade or expansion of RF Upgrade." (MAP)

INTERFACE - A boundary or point common to two or more similar or dissimilar command and control systems, sub-systems, or other entities against which or at which necessary information flow takes place. (JCS Pub 1)

INTEROPERABILITY - The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The capability to exchange information or services directly between Air Force satellite control system users. The degree of interoperability should be defined when referring to specific cases. (JCS Pub 1)

INTERVENTION BY EXCEPTION - A feature of the satellite control system that requires manual interruption of the automated system only because of failure or the need for manual input to the system.

ISOLATE AND CORRECT GROUND SEGMENT PROBLEMS - A Mission Area Plan Operational Task. Satellite control resources must be able to rapidly isolate and correct ground segment system failures. This includes real time FD/FI and the ability to correct through automatic reconfiguration using redundant paths and equipment. (MAP)

KEY PARAMETER - A capability or characteristic of the satellite control system so significant that failure to meet the threshold is cause for a satellite control system mission to be reassessed or terminated. (AFI 10-601)

LAUNCH ON NEED - Contingency launches and early orbit support conducted when the world situation is such that a replenishment SV is required to be launched, checked out, and declared fully operational using an accelerated launch schedule in order to support a U&S or theater CINC's operations.

MAINTAINABILITY - A measure of the ease with which maintenance of a satellite control system functional unit (hardware or software) can be performed in accordance with prescribed requirements. It is a characteristic of design and installation that is expressed as the probability that an item will be retained in or restored to a specified condition within a given period of time, when the maintenance is performed in accordance with prescribed procedures and resources. (AFI 10-602)

MAIN TASKS - The main tasks of the satellite control mission, identified in the Satellite Control Mission Need Statement (1 Aug 94), are:

> a) satellite control including planning; orbit maintenance; Telemetry, Tracking, and Commanding (TT&C); factory and pre-launch checkout; launch-to-orbit; early-orbit checkout; on-orbit state-of-health monitoring and maintenance; and end-of-life disposition
> b) support mission data processing and dissemination to warfighting forces and other users. (Satellite Control MNS)

MANUAL INTERVENTION - The performance of a function without computer assistance.

MEAN TIME BETWEEN CRITICAL FAILURE - Mean Time Between Critical Failure is the measure of system reliability. Critical failures occur when the system is rendered unable to perform an operational function during mission time.

MEAN TIME TO RESTORE FUNCTION - Mean Time to Restore Function is the measure of system maintainability. MTTRF is the elapsed time from critical failure occurrence to restoral of operational functionality. This time includes Administrative and Logistics Delay Times.

MISSION MODEL - The HQ AFSPC developed, Assistant Secretary of the Air Force (Space) approved document that identifies firm, probable, and potential future space missions.

MISSION TIME - For the AFSCN is 24 hours a day continuous, excluding maintenance events.

MISSION UNIQUE EQUIPMENT - Non Multi-user equipment that supports functions of a specific SV program.

MULTI-USER - Capable of supporting more than one satellite program with a standard equipment suite.

NETWORK SERVICE TASKS - Tasks performed to support O&M of the RGFs, communications system, and the Network Control System. Specific Service Tasks are identified in Table 3-1 in the ORD text.

OBJECTIVE - An operationally significant increment above the threshold. A value beyond the threshold that could potentially have a measurable, beneficial impact on capability or operations and support above that provided by the threshold value. (AFI 10-601)

OPERABILITY - The degree to which a system is capable of being used.

OUT OF PROCEDURE - Satellite control operations and functions for which routine or corrective actions are not predefined or documented.

PERFORM OPERATIONAL PLANNING - A Mission Area Plan Operational Task. This includes all planning functions done prior to satellite contact and operations (except for launch preparation and resource scheduling). This task typically includes mission planning, defining contact objectives, command generation, and contingency planning. (MAP)

PERFORM SYSTEM ANALYSIS - A Mission Area Plan Operational Task. This task is performed concurrent with readiness, employment, deployment, and sustainment operations and evaluates the overall performance of the satellite control system and also the space vehicle platform and payload during recovery. This task measures end-to-end capacity, and provides input for reliability, maintainability, and availability studies for satellite control elements as well as long term trend analysis for space vehicles. (MAP)

PROVIDE COMMUNICATIONS CONNECTIVITY - A Mission Area Plan Operational Task. Satellite control resources must provide reliable, secure communications links to transmit data between satellite control elements and between satellite control resources and all users. (MAP)

PROVIDE PLATFORM AND PAYLOAD EVALUATION - A Mission Area Plan Operational Task. Satellite control resources must be able to assess payload and platform systems and subsystems behavior, verify mission events during contacts, and conduct detailed performance analysis typically after the space vehicle contact or pass is completed. (MAP)

PROVIDE SPACE VEHICLE POSITION AND ORIENTATION MANAGEMENT - A Mission Area Plan Operational Task. Satellite control resources must be able to determine, predict, and periodically adjust the orbital parameters of individual SVs and maintain relative SV position within specified limits. (MAP)

REMOTE GROUND FACILITY - A satellite control system facility remotely located from a control center that provides the satellite to ground interface for tracking, telemetry, and commanding. The satellite control system RGFs consist of the 16 RTS antennas at nine locations, numerous program dedicated antennas, and various checkout facilities.

REMOTE TRACKING STATION - A satellite control system facility, under the real-time control of a satellite control system SOC, MCC, or TSC that provides S-band tracking, telemetry, and commanding and mission data retrieval services for designated space vehicles. There are currently 16 RTS antennas at nine geographically dispersed locations.

RESPOND TO USER REQUEST - A Mission Area Plan Operational Task. There are two types of user requests. The first request is made by operational military forces in need of data from various types of satellites that are operated by AFSPC. Requests from operational forces are typically made to CINCSPACE. These requests are then provided as tasking to satellite control authorities. Satellite control authorities respond to this tasking through operation and control of the platform and payload systems on board the satellites. The second type of satellite control request comes from non-DoD users, such as US government agencies, NASA, laboratories, universities, and foreign governments. These requests are for satellite data and/or operational control of satellites not operated by AFSPC. Requests for data are made directly from the outside agency to the Operations Center within the SOC with primary responsibility for the specific satellites. Operational support can vary from complete responsibility for platform and payload operations to backup for platform control. (MAP)

RESPONSIVENESS - A measure of the amount of time that elapses between generation of an inquiry and the receipt of a response.

SEVERELY ERRORED SECONDS - Errored Seconds (ES) include periods of error bursts, called Severely Errored Seconds (SES), during which a large proportion of bits are in error. These SES periods occur well within the ES criteria so they use the SES measure of performance. (Data Communications Technical Reference)

SIDE - A single antenna, associated equipment string, and communications at an RTS location.

SIMULATION - Modeling and/or emulation of specified mission resources or operations.

SITE - One or more antennas, associated equipment string, and communications at an RTS location or at a Remote Ground Facility.

SOC TASKS - Tasks performed in the SOC for all AFSPC SVs to accomplish position management; TT&C planning, control, and analysis; and anomaly resolution activities necessary to control SVs during launch, on-orbit operations, and end-of-life activities. Specific SOC Tasks are identified in Table 3-1 in the ORD text.

STANDARDIZATION - The process by which the Department of Defense achieves the closest practicable cooperation among the Services and Defense Agencies for the most efficient use of research, development, and production resources, and agrees to adopt, on the broadest possible basis, the use of common or compatible operational, administrative, technical and logistic procedures; common, compatible, or interchangeable supplies, components, weapons, or equipment; or common or compatible tactical doctrine with corresponding organizational compatibility. (JCS Pub 1)

SUPPORT - A term used to describe the three phases of operations (pre-pass, pass (or contact), and post-pass) when the RGF, communications system, and satellite operations center are preparing for an SV contact, conducting an SV contact, or terminating an SV contact. Support includes transmitting any necessary pre-pass data to the RGF or receiving post-pass telemetry or mission data playbacks from the RGF. The support can be associated with either an actual connectivity with an SV or with a simulated event using a vehicle simulator.

SUPPORT SPACE FORCE DEPLOYMENT - A Mission Area Plan Operational Task. Includes pre-launch preparation (training, rehearsals, exercises), launch support, early orbit checkout, and positioning of space assets on-orbit (for support of regional users or requests for data of specific regions, movement of spares into operational positions, or repositioning for different coverage or visibility. (MAP)

SURVIVABILITY - Capability of a system to accomplish its mission in the face of an unnatural (manmade) hostile, scenario dependent environment. Survivability may be achieved by avoidance, hardness, proliferation, or restoration (or a combination). A measure of the ability of a space system to perform its intended function after being exposed to a stressing environment created by an enemy or hostile agent. (AFI 10-601)

SYSTEM - Comprises all of the components within the AFSCN required to support a SV mission. Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. (JCS Pub 1)

SYSTEM CAPABILITIES - Measures of performance such as availability, reliability, survivability, etc. for the satellite control system to accomplish its mission. (AFI 10-601)

SYSTEM CHARACTERISTICS - Satellite control system design features such as capacity, maintainability, interoperability, etc., needed to accomplish the satellite control system mission. (AFI 10-601)

THRESHOLD (ORD) - A minimum acceptable operational value for a system capability or characteristic below which the utility of the system becomes questionable. A minimum acceptable operational value for a system capability or characteristic which, in the users judgment, is necessary to provide an operational capability that will satisfy the mission need. (AFI 10-601)

VULNERABILITY - Degree of risk, defenselessness, or weakness that places resources in jeopardy. The characteristic of a system which causes it to suffer a definite degradation (incapacity to perform the designated mission) as a result of having been subjected to a certain level of effects in an unnatural (manmade) hostile environment. (JCS Pub 1)

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APPENDIX F

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