ARMY, MARINE CORPS, NAVY, AIR FORCE

TAC RADIOS

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR TACTICAL RADIOS

ATP 6-02.72
MCRP 3-30B.3 [MCRP 3-40.3A]
NTTP 6-02.2
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MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES

FOREWORD

This multi-Service tactics, techniques, and procedures (MTTP) publication is a project of the Air Land Sea Application (ALSA) Center in accordance with the memorandum of agreement between the Headquarters of the Army, Marine Corps, Navy, and Air Force doctrine commanders directing ALSA to develop MTTP publications to meet the immediate needs of the warfighter.

This MTTP publication has been prepared by ALSA under our direction for implementation by our respective commands and for use by other commands as appropriate.

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PREFACE

1. Purpose

This publication provides a single source, consolidated reference on Tactical Radios. The intent of this publication is to provide tactical level operators and planners a comprehensive resource for planning, employing, creating, and operating radio networks in a Joint Service Environment.

Note: For the US Army, the term command and control was replaced with mission command. Mission command now encompasses the US Army's philosophy of command (still known as mission command) as well as the exercise of authority and direction to accomplish missions (formerly known as command and control).

2. Scope

This publication describes multi-Service tactics, techniques, and procedures (MTTP) for the tactical employment of tactical radios to support warfighters for training and operations across the range of military operations.

3. Applicability

This MTTP publication applies to commanders and their staffs that participate in the planning, employment, operations, and maintenance of tactical radio networks. This publication is unclassified with restricted distribution statement D, in accordance with Department of Defense Instruction 5230.24, *Distribution Statement on Technical Documents*, 23 August 2012, per table 5, "specific authority" directed in National Security

4. Implementation Plan

Participating Service command offices of primary responsibility will review this publication; validate the information; and, where appropriate, reference and incorporate it in Service manuals, regulations, and curricula as follows:

United States (US) Army. Upon approval and authentication, this publication incorporates the tactics, techniques, and procedures contained herein into the US Army Doctrine and Training Literature Program as directed by the Commander, US Army Training, and Doctrine Command. Distribution is in accordance with applicable directives listed on the authentication page.

US Marine Corps.[1] The US Marine Corps will incorporate the procedures in this publication in US Marine Corps doctrine publications as directed by the Deputy Commandant, Combat Development and Integration (DC, CD&I). Distribution is in accordance with the Marine Corps Publication Distribution System.

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[1] Marine Corps PCN: 144 000007 00

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5. User Information

a. US Army Combined Arms Center; Head Quarters Marine Corps, DC, CD&I; NWDC; Curtis E. LeMay Center for Doctrine Development and Education (LeMay Center); and Air Land Sea Application (ALSA) Center developed this publication with the joint participation of the approving Service commands. ALSA will review and update this publication as necessary.

b. This publication reflects current joint and Service doctrine, command and control organizations, facilities, personnel, responsibilities, and procedures. Changes in Service protocol, appropriately reflected in joint and Service publications, will be incorporated in revisions to this document.

c. We encourage recommended changes for improving this publication. Key your comments to the specific page and paragraph and provide a rationale for each recommendation. Send comments and recommendations directly to:

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SUMMARY OF CHANGES

ATP 6-02.72/MCRP 3-30B.3 /NTTP 6-02.2/AFTTP 3-2.18, *Multi-Service Tactics, Techniques, and Procedures for Tactical Radios*.

This revision provides a major rewrite of the document and includes the consolidation of the ATP 6-02.90/MCRP 3-403.3G/NTTP 6-02.9/AFTTP(I) 3-2.53, *Multi-Service Tactics, Techniques, and Procedures Ultrahigh Frequency Military Satellite Communications*.

Updates:

- Include a rewrite of chapter 1 to focus on general planning constraints, outlining key tasks required to synchronize tactical radio assets, networks, and services in a joint environment.
- Include the United States Army's use of high frequency, ultrahigh frequency, and very high frequency tactical radio networks.
- Equipment and nomenclature, to include deleting radios no longer in service and adding new radio systems accredited and employed since August 2013.

Deletes:

- School house material on high frequency, ionosphere propagation.
- Information of joint interoperability test command's (JITC's) approved radio list. For a detailed list, users are directed to visit the JITC Web site located at http://jitc.fhu.disa.mil/projects/ucdepot/index.aspx.
- Chapter V Multiband High Frequency. All multiband radio functions are now incorporated into frequency-band-specific chapters based on how they are used.

Adds:

- Condensed material from the rescinded the Multi-Service Tactics, Techniques, and Procedures (MTTP) for Ultrahigh Frequency Military Satellite Communications (published August 2013). Material was selected based on the scope of this MTTP.
- An overview of the Battlefield Airborne Communications Node platform including use, request for service, technical details and after-action reporting.

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TAC RADIOS

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR TACTICAL RADIOS

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EXECUTIVE SUMMARY

TAC RADIOS

Multi-Service Tactics, Techniques, and Procedures for Tactical Radios establishes tactics, techniques, and procedures for tactical radios and addresses their planning considerations, network establishment, and use in a joint environment.

Chapter I Overview and Planning Constraints

Chapter I provides unit level planner guidance on deploying tactical radio networks in a joint or multinational environment. This chapter outlines key tasks required to synchronize tactical radio assets, networks, and services.

Chapter II High Frequency Band

Chapter II provides an overview of high frequency (HF) wave theory. It also discusses how to create automatic link establishment with HF radios, and operating parameters.

Chapter III Very High Frequency Band

Chapter III provides an overview of very high frequency bands and discusses the effective operation of single-channel ground and airborne radio system and HAVE QUICK radios.

Chapter IV Ultrahigh Frequency Band

Chapter IV provides an overview of ultrahigh frequency bands, and discusses the enhanced position location reporting system radio and the application of Link 16 in a tactical environment.

Chapter V Battlefield Airborne Communications Node

Chapter V provides an overview of the Battlefield Airborne Communications Node system. It discusses how to request services, compatible equipment configurations and after action reporting.

Chapter VI Ultrahigh Frequency Military Satellite Communications Systems

Chapter VI provides a single-source consolidated reference for the tactical employment of ultrahigh frequency military satellite communications.

Appendix A Tactical Radio Planning Checklist

Appendix A provides a generic checklist that can be used in conducting initial planning efforts for activating and operating a radio network.

Appendix B Calculating Antenna Length

Appendix B provides charts which detail how to calculate the desired antenna length based on the frequency used for communications.

Appendix C Automatic Link Establishment Exclusion Band Listing

Appendix C provides a list of the internationally reserved exclusion bands.

Appendix D High Frequency-Automatic Link Establishment Communications Plan Example

Appendix D provides an example of a High Frequency-Automatic Link Establishment communications plan.

Appendix E High Frequency-Automatic Link Establishment Radio Programming Application Example

Appendix E provides systematic instructions on programming a radio for High Frequency-Automatic Link Establishment frequencies.

Appendix F Standard Frequency Action Format Example for Single-Channel Ground and Airborne Radio System

Appendix F provides a sample format for a standard frequency action request.

Appendix G HAVE QUICK Planning Actions

Appendix G provides a list of planning actions that occur when using HAVE QUICK radios.

Appendix H HAVE QUICK Technical Data

Appendix H explains word of the day, time of day, and network identification number importance as they apply to the HAVE QUICK radio network.

Appendix I HAVE QUICK Network Management Requirements

Appendix I provides the steps for managing a HAVE QUICK radio network.

Appendix J Equipment Nomenclature Matrix

Appendix J provides a list of radios, their capabilities, and interoperability information.

Appendix K Department of Defense Satellite Communications Priority and Precedence

Appendix K provides a detailed list of all satellite communications mission priorities and precedence's based on mission request criteria.

Appendix L Satellite Channel (Home Channel) Authorization

Appendix M is a list of currently authorized satellite channels (home channels) to include channel bandwidth, and upload and download frequencies.

Appendix M Electromagnetic Interference Checklists

Appendix N provides the user a checklist on how to document suspected electromagnetic interference based on signal signature and other characteristics of electromagnetic interference.

Appendix N Ultrahigh Frequency Satellite Communications Cut Sheet Examples

Appendix n contains an example of cut sheets used to record specific demand assigned multiple access and integrated waveform information.

Appendix O Ultrahigh Frequency Satellite Communications Table of Azimuths and Elevations

Appendix O provides a consolidated table to allow an ultrahigh frequency satellite communications terminal user to determine the parabolic antennas azimuth and elevation angles based on geographic locations.

Appendix P Demand Assigned Multiple Access Information Request Codes

Appendix P provides a planner with a detailed definition of ultrahigh frequency satellite communications demand assigned multiple access request codes.

Appendix Q Joint Tactical Radio System Enhanced Multi-Band Integrated Waveform Set Up

Appendix Q provides operators with an initial radio configurations for activating a joint tactical radio system on the enhanced multi-band interterm radio integrated waveform link.

Appendix R AN/PSC-5 C/D Integrated Waveform Set Up

Appendix R provides operators with an initial radio cut sheet outlining basic settings for establishing Ultrahigh Frequency Satellite Communications Integrated Waveform link with a PSC-5 C/D radio system.

Appendix S PRC-117F Integrated Waveform Set Up

Appendix S provides operators with an initial radio cut sheet outlining basic setting for establishing an ultrahigh frequency satellite communications integrated waveform link with a PRC-117F radio system.

Appendix T Joint Spectrum Interference Report Program

Appendix T provides a detailed for reporting electromagnetic interference using the joint spectrum interference report online.

Appendix U General Chairman of the Joint Chiefs of Staff Accepted Doctrinal Networks Relevant to Tactical Radio Operations

Appendix U describes common joint tactical radio network descriptions that operators can use to determine network use when reviewing joint planning documents.

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Chapter I
OVERVIEW AND PLANNING CONSTRAINTS

1. Overview

a. This publication provides the operational foundation for tactical radio network integration in support of joint operations. Planning and operating tactical radio networks in a joint or multinational environment require planners to integrate and synchronize tactical radio assets, networks, and services to enable command and control (C2). Because communications operating in a multi-Service environment are not standardized; tactical level planners, operators, and technicians often operate at a disadvantage. Additionally, with coalition partner forces, state, and non-state actors operating independent radio networks, the availability of operational frequencies may be small and congested.

b. This document describes tactics, techniques and procedures (TTP) for planning, installing, operating, and maintaining tactical radio networks across the high frequency (HF), very high frequency (VHF), and ultrahigh frequency (UHF) spectrums. The appendices to this publication contain operational checklists that can be used by tactical radio operators, expeditionary maintainers, or tactical joint planners tasked with integrating tactical radio resources in a joint operational environment.

2. Key Players

a. Communications Planner. For purposes of this publication, communications planner refers to an individual responsible for developing communications requirements and tactical plans in support of United States (US) Army or United States Marine Corps (USMC) battalion- (BN) level operations, US Air Force squadron-level operations, or US Navy or US Coast Guard O5-level commands operating in an environment with more than one Service or coalition partner. Communications planners focus on planning joint tactical radio integration and are referred to by various Service elements as the following:

(1) Transmission planners.

(2) Signal planners/noncommissioned officers.

(3) Frequency managers.

(4) Signal officers.

(5) US Air Force communications staff officers (A-6s), US Army or USMC component command, control, communications, and computer systems staff officers (G-6s), communication systems directorate of a joint staff (J-6).

(6) Spectrum managers.

(7) Communications chiefs.

(8) Electronics technicians.

(9) Communications technicians.

b. Terminal Operator (or Operator). For purposes of this publication, terminal operator refers to any individual who interacts (directly or indirectly) with a

communications terminal. Terminal operators tactically execute the plan developed by the communications planners and focus on operating the joint tactical radio equipment and networks.

c. Maintenance Technician (Maintainer or Technician). For purposes of this publication, maintenance technician refers to any individual who can activate, fix, or improve joint tactical radio network assets and networks. Maintenance technicians execute the plans developed by the communications planners and support the terminal operators by installing, troubleshooting and maintaining joint tactical radio equipment and networks.

3. Planning Considerations

a. Table 1 is a list of general planner- and operator-level considerations that apply to integrating joint tactical radios. The format in table 1 follows the joint communications planning annex format, but is not an all-inclusive list.

Table 1. Planning Considerations

Orientation/Situation
Mission. (Commander's mission, commander's intent, operational plan, operational order, special messaging from operational task chat for radios, planning constraints, 'commander's critical information requirements.)
Enemy. (Size, activity, location, unit, time, integrated waveform/command and control warfare capabilities, tactics, techniques and procedures.)
Terrain. (Geographic locations, asset availability restrictions, command enforced planning constraints, area studies results, landing rights, weather constraints, geographic area constraints.)
Troops. (Friendly forces assigned, in-general support, indirect support, higher, adjacent, host nation resources, friendly mobility requirements.)
Time Available. (D-Day, H-Hour, planning time available, satellite and special frequency lead times/availability.)
Additional Planning Factors to Consider. a. Voice, data, and tactical chat requirements. b. Doctrinal networks employed. c. Joint restricted frequency list. d. Existing communications-electronics operating instructions. e. Primary, secondary, and tertiary communications plans. f. Existing joint- and unit-specific standard operating procedures. g. Decision points. h. Signature management and operational security.

Table 1. Planning Considerations (Cont'd)
Installation Considerations
1. Joint, international, and host frequency clearance considerations.
2. Voice and data installation and setup plans.
3. Satellite access request, gateway access request, and satellite access authorization.
4. No later than and no earlier than start and stop times.
5. Color/button number combinations by mission.
6. Internet protocol radio subnet addressing schemes.
7. Frequency and guard charts (network control, guarding, and monitoring responsibilities).
Operational Considerations
1. Network management.
2. Primary, secondary, and tertiary communications networks.
3. Communications on the move/network on the move.
4. Unit standard operating procedures/operational tactical chat capabilities.
5. Joint call signs and pro-words use.
6. Joint unit interaction clearance procures.
Maintain, Assess, Improve, Response Considerations
1. Relationships with post, base, station, host, and unit.
2. Status of deployable replenishables (e.g., batteries, etc.)
3. Critical high demand, low density or moderate demand, high-fault-rate equipment.
4. Follow-on echelon plan.
5. Joint Spectrum Interference Resolution Report.
6. Electromagnetic interference response planned and options/information condition response options.
7. Joint spectrum interference resolution response coordination instructions.

b. In a joint environment, technicians and operators will be exposed to multiple planning processes when designing and installing joint tactical radio networks. Communications planners must understand joint, inter-Service, and coalition planning products because there is no established joint standard for planning and operating tactical-level radio networks. Appendix A, table 13 provides an overarching checklist to help ensure all radio frequency services and equipment assets are accounted for prior to mission start date. Figure 1 depicts the tactical level radio planning cycle, showing a basic process to use during initial planning efforts. It was adapted from *Joint Publication 6-0*,

Note: Submit all spectrum, frequency and satellite access requests in advance of the required date. Some requests require extended periods of time for approval. Additionally, prior to implementing any radio network, verify receipt of spectrum, frequency, and satellite access approvals.

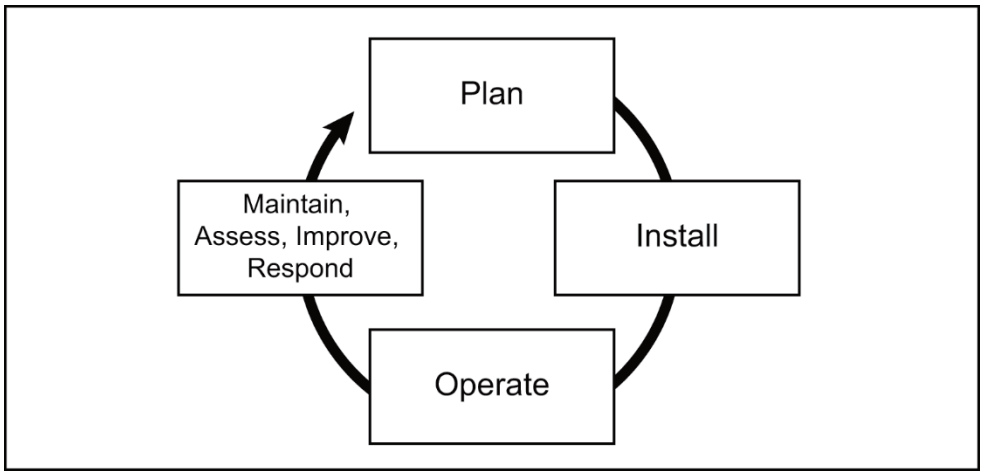

Figure 1. Tactical-Level Radio Planning Cycle

c. Joint Planning Environment. In joint environments the operation order (OPORD) Annex K serves as the key document for all tactical communicators and serves as source data for mission planning. The other relevant OPORD appendices and annexes follow.

(1) Annex K Appendix 2, Signals Intelligence to Annex B, Intelligence.

(2) Annex K Appendix 2, Communications to Annex N, Space Operations.

(3) Annex K Appendix 3, Information Warfare to Annex C, Operations.

(4) Annex K Appendices 3–5, Communications Planning, Satellite Communications (SATCOM) Planning and Frequency Management to Annex K, Communications.

(5) Annex K Appendix 8, C2 and Computers to Annex Q, Medical Service.

d. US Army and USMC Planning Environments. The US Army and USMC use Annex K, and its associated appendices and tabs, as a primary planning document. Tactical level frequencies and procedures will be listed in the signal operating instructions (SOI) (US Army) and automated communications electronic operating instructions (ACEOI) (USMC). This information will be articulated by a tactical network diagram, guard chart, and deconflicted using the joint restricted frequency list (JRFL). When operating with US Army or USMC controlled operational areas, tactical level planners, operators, and technicians must acquire these planning documents to identify key data and understand local processes and procedures. Guard Charts, a JRFL, and ACEOI can be found in appendices A and B of this publication.

e. US Air Force Planning Environments. US Air Force led or controlled planning environments use the OPORD Annex K, and associated appendices and tabs, as the primary planning document. The US Air Force amplifies and clarifies mission-specific planning guidance using special instructions (SPINS) to the air tasking order (ATO) to provide tactical radio planners and operators detailed mission-specific frequencies, rules and procedures, and unit identifying information required to operate in an air focused environment. Planners, technicians, and operators should consult SPINS Annex C, Operations and the JRFL, when in a joint environment led

by an air component commander. The final format of the SPINS will vary by command. The basic air planning and integration data contained inside all ATO SPINS mandated by the ATO format are in the following list. Planners, technicians, and operators must utilize these documents to plan, integrate, install, operate, and maintain tactical radio networks in an US Air Force controlled environment:

(1) ATO.

(a) Annex C, Operations to the ATO.

(b) Appendix 9, Information Warfare to Annex C, Operations to the ATO.

(c) Tab A, Electronic Warfare; and Tab B Tactical Deception (or Signature Management) to Appendix 9, Information Warfare to Annex C, Operations to the ATO.

(d) Appendix 10, Space Support to Annex C, Operations to the ATO.

(e) Appendix 11, General Remarks/SPINS Guidance to Annex C, Operations to the ATO.

(2) SPINS.

(a) Section A, Daily/Weekly SPINS Data (Color/number button combinations and frequencies) to Appendix 11.

(b) Section B, Communications SPINS.

(c) Section D, Command and Control Warfare SPINS.

(d) Section J, SOF SPINS.

(e) Section K, Space Support SPINS.

(f) Section N, Airspace Control Order SPINS.

f. US Navy and Coast Guard Environments. US Navy and Coast Guard led or controlled planning environments use the OPORD Annex K, and its associated appendices and tabs, as the primary planning document. The US Navy and Coast Guard amplify and clarify mission-specific planning guidance using fleet mission-specific messages called operation task (OPTASK) information operation (IO) and OPTASK electronic warfare (EW) to update surface tactical radio information and SPINS to aviation elements and the squadron's flying tactical missions.

g. Figure 2 summarizes the key planning products that tactical level radio planners, technicians, and operators should seek to support radio planning, integration, and operations.

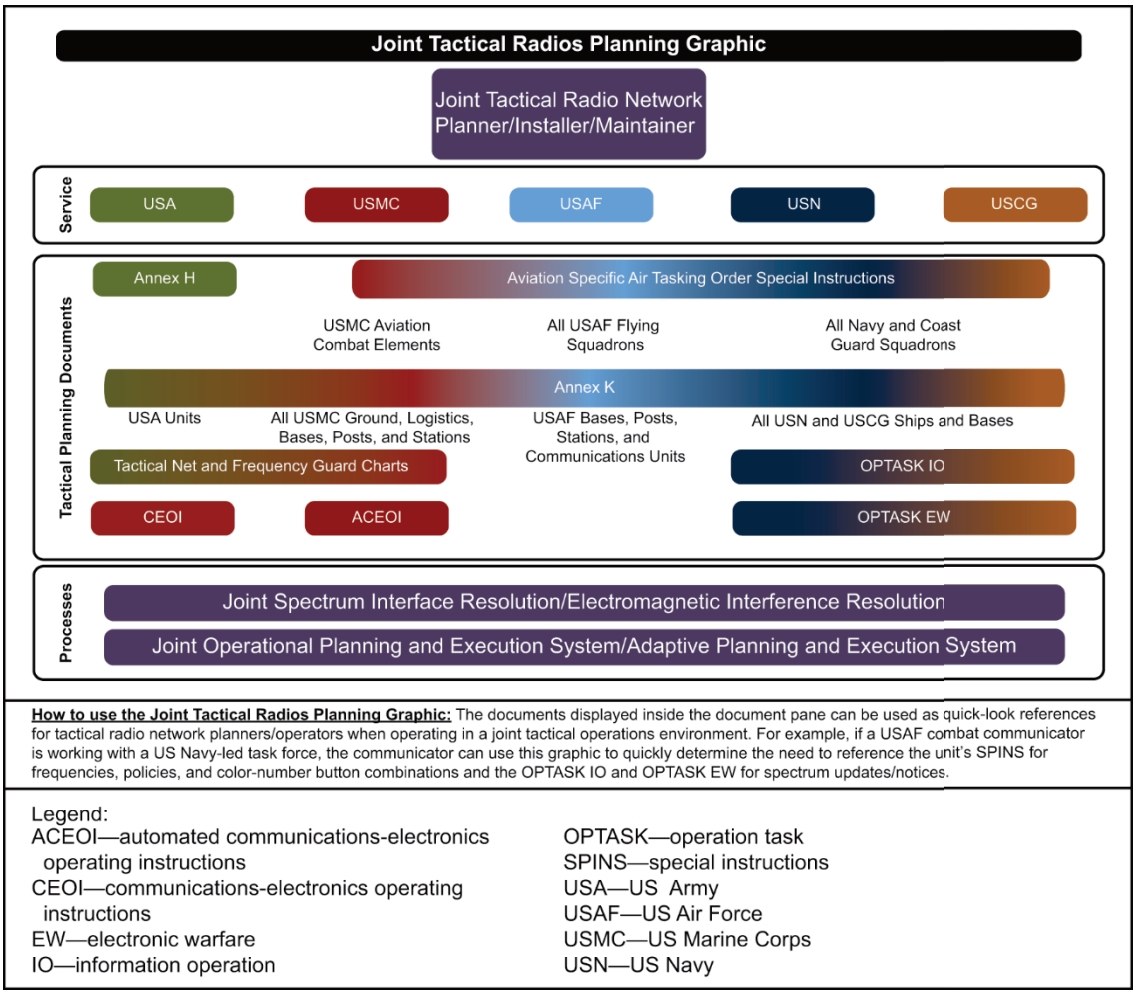

Figure 2. Joint Integration Planning Table

4. Electromagnetic Interference (EMI)

a. EMI is any electromagnetic disturbance, induced intentionally or unintentionally, that interrupts, obstructs, degrades, or limits the effective performance of electronic equipment. EMI can be caused by enemy, neutral, friendly, or natural sources. It must be resolved on a case-by-case basis. The goal is to resolve or mitigate EMI incidents at the lowest level within the command structure. The checklist in table 2 and the applicable checklists in appendix B provide basic reporting and response actions to identify and mitigate EMI.

Table 2. EMI Reporting Checklist		
Item	**Activity**	**Description**
1 ☐	Initiate log activity.	Make an initial log entry of the suspected problem. Log all pertinent activities and information. Include specific times of events, personnel/agencies contacted, and guidance/direction provided. Contact the local frequency manager for assistance.
2 ☐	Document initial characteristics.	Log initial perceptions of suspected EMI. What does it sound like? What does it look like? How often and when does it come up? Refer to Appendix B, EMI Signal Signature and Characterization Checklist.
3 ☐	Document the operational impact.	Log the specific impact to the circuit/network being affected by the EMI. Refer to Appendix B, EMI Operational Impact Checklist.
4 ☐	Verify terminal equipment integrity.	Ensure all terminals, and associated equipment, are properly installed and operating correctly. Execute available diagnostics checks. Refer to Appendix B, EMI Equipment Integrity Checklist.
5 ☐	Verify operational settings.	Verify operational settings of all equipment. Check for correct SAA assignments and parameters. Refer to Appendix B, EMI Operational Settings Checklist.
6 ☐	Verify the integrity of the immediate and local environments.	Verify the immediate surroundings and local environment are clear of potential electromagnetic interference or radio-frequency interference sources. Refer to Appendix B, EMI Immediate and Local Environment Integrity Checklist.
7 ☐	Determine the EMI locality.	Determine if the EMI is local (effects the downlink) or is a satellite EMI (effects the uplink). Refer to Appendix B Table 32: EMI Locality Checklist.
8 ☐	Note terrain and masking obstructions.	Indicate the type of terrain (e.g., flat, hilly, woodland, mountains, etc.). Identify any natural or man-made obstructions along the look angle, and significant obstructions adjacent to the look angle.
9 ☐	Check for space environmental/weather impact.	Determine if the natural weather or space environment is the cause of the EMI. Note the local weather conditions. Contact the US Air Force Space Weather Center (DSN 272-8070/commercial (402) 232-8070, or email space@afawa.af.mil) to determine the presence of solar radio bursts or noise storms, ionospheric scintillation, aurora activity, or solar flares. For solar radio EMI resolution, determine if the link line of sight is aligned with the sun and if the side lobes of the antenna intersect the sun's radio output. For ionospheric scintillation, determine if communications links intersect a region of ionospheric scintillation. Real-time and forecast space weather data and products may be obtained from US Air Force Space Weather Center reports addressing these natural EMI sources.
10 ☐	EMI resolved? If not, go to the next step.	Locally, document the anomaly and continue with the mission

Table 2 EMI Reporting Checklist (Cont'd)		
Item	**Activity**	**Description**
11 ☐	Coordinate with the supporting installation spectrum manager or regional satellite communications support center (RSSC) for ultrahigh (UHF) frequency satellite communications (SATCOM)	The installation spectrum manager or the RSSC should assist the user and inform the communications squadron. If the EMI is not resolved, provide an alternate, EMI free UHF SATCOM resource, if available. For UHF SATCOM, if not resolved, the RSSC and user should report the EMI into the Joint Spectrum Interference Report Online portal.
12 ☐	EMI issue resolved? If not, go to the next step.	Locally, document the anomaly and continue with the mission.
13 ☐	Coordinate with the installation spectrum manager or Global Narrowband Watch Office (GNWO) UHF SATCOM.	Advise the installation spectrum manager or GNWO of the EMI and request assistance in resolving the situation.
14 ☐	Advise management.	Advise the network manager, Service component or joint task force spectrum manager, as required.
Legend: DSN—Defense Switched Network EMI—electronic magnetic interference SAA—satellite access authorization SATCOM—satellite communications US—United States		

Chapter II
HIGH FREQUENCY BAND

1. Overview

a. HF describes the 1.6-30 megahertz (MHz) portion of the radio spectrum. HF radios provide tactical elements with standalone, terrain independent, robust communications, for line of sight (LOS) and beyond line of sight (BLOS), secure voice, and data communications. HF radios provide long distance, wide area, fixed or on-the-move, ground, and ground-to-air communications. HF radio, terrestrial BLOS, systems require understanding antenna design and capabilities to support local requirements. HF radios are simple, economic, portable, and versatile.

Note: Appendix C outlines the basic principles for calculating half-wave and long-wire HF antennas.

b. HF radio communications have the following characteristics.

(1) HF signals reflected off the ionosphere at high angles allow BLOS communications at distances up to 400 miles (643.7 kilometers). Reliable HF transmission requires a detailed analysis of the terrain and availability of appropriate frequencies.

(2) HF signals reflected off the ionosphere at low angles allow communications at distances over thousands of miles.

(3) HF signals do not require using SATCOM or retransmission (RETRANS) assets.

(4) HF systems are engineered to operate independent of intervening terrain or manmade obstructions.

c. HF radio performance factors include the following.

(1) The position of the sun in relation to transmitter and receiver stations.

(a) Low frequencies are optimal during times of darkness.

(b) High frequencies are optimal during times of sunlight.

(2) Season.

(a) Low frequencies are optimal during winter weather conditions.

(b) High frequencies are optimal during summer weather conditions.

(3) Solar activity.

(a) HF frequency band propagation is optimal during the solar maxima (maximum sunspot activity period).

(b) HF frequency band propagation is extremely limited during the solar minima (minimum sunspot activity period).

(4) Local electronic interference from manmade equipment can greatly reduce the available frequencies on an HF band.

Note: HF propagation changes daily. Select frequencies based on the type of network and distance between radios. When using these parameters, use a propagation program or table to determine which frequencies propagate best in specific conditions.

2. Typical HF Systems Employed By Joint Forces

a. Automatic Link Establishment (ALE).

(1) ALE functions on the principle of link quality analysis to automatically establish a communications link with one or multiple HF radio stations. ALE requires a specialized radio modem, the ALE adaptive controller. The ALE adaptive controller assesses and transmits a link quality factors analysis of the programmed frequencies on a regular, automated, or operator initiated basis. ALE controllers can be external modules or embedded in modern HF radio equipment.

(2) An ALE communications the link establishment breakdown is as follows.

(a) Each controller has a predetermined set of frequencies (propagated for conditions) programmed into memory channels.

(b) Each controller has a predetermined set of network call signs programmed into memory that include its own station network call sign, network call signs, group call signs, and individual call signs.

(c) When in listening mode, ALE receiver transmitters (RTs) log station call signs and associated frequencies, assigning a ranking score of the link quality on a per channel basis.

(d) When a station places a call, the ALE controller element attempts to link to the outstation using the data collected during ALE and sounding activities. If the sending ALE has not collected the outstation's data, the controller seeks the station and attempts to link a logical circuit between two stations on the network, enabling the users to communicate using all programmed channels.

(e) When the receiving station recognizes its address, it stops scanning and stays on that frequency. The two stations, automatically, conduct a "handshake" to confirm a link was established. Upon successful link establishment, the ALE controller ceases channel scanning and alerts the operator(s) that the system has established a connection and stations can exchange traffic.

(f) Upon completion of a link session, the ALE controllers send a link termination command and return to scanning mode and await further traffic. Built-in safeguards ensure ALE controllers return to the scan mode in case of a loss-of-contact condition.

(g) Modern ALE controllers can send short, orderwire digital messages known as automatic message displays, to members of the network. Messages can be sent to any or all members of the network or group. ALE controllers can contact individual stations by their call sign (i.e., all stations or any station or stations on the network or in the group). All calls make use of wildcard characters that substitute for individual call signs, such as @?@, All; and @@?, Any, null address calls used for systems maintenance and sent as @@@.

Note: Appendix D lists the frequency bands excluded from operational use due to international and safety allocations.

b. Third Generation (3G) ALE.

(1) The 3G HF ALE systems use scalable burst waveform signaling formats to transmit all control and data traffic signaling. Scalable burst waveforms define the signaling required to meet the distinctive requirements for the payload. Duration, time synchronization, acquisition, and demodulation performance are measured against the presence of electromagnetic noise, signal fading, and multiple path characteristics.

(2) The 3G HF ALE systems are designed to balance potentially conflicting objectives to maximize the usable link for the payload and minimize link establishment time. They use interleaving (mixing two or more digital signals) to minimize on-air time and link turnaround delay.

(3) The 3G HF ALE systems establish one-to-one and one-to-many (broadcast and multicast) links. They use a specialized carrier sense multiple access scheme to share calling channels and monitor traffic before use to avoid interference and collisions.

(4) Calling and traffic channels may share frequencies, but the system performance improves when using separate frequencies. Each calling channel is associated with one or more traffic channels that are close in frequency thereby capitalizing on similar propagation characteristics. Using associated control and traffic frequencies reduces the instances where the control and traffic frequencies are identical.

(5) The 3G HF ALE receivers continuously scan an assigned list of calling channels, listening for second generation or 3G calls. Second-generation ALE is asynchronous, and the calling station makes no assumption about when a destination station listens to any particular channel.

(6) The 3G HF ALE includes a similar asynchronous mode. Synchronous operation is likely to provide superior performance under conditions of moderate to high network load.

c. Wideband HF Fourth Generation (4G) ALE. The 4G ALE provides significantly higher data transfer rates than 3G ALE by using wideband HF technology. US Military Standard (MIL-STD)-1088-110C, Department of Defense Interface Standard: Interoperability and Performance Standards, appendix E defines a wideband HF data modem capabilities as support of bandwidth from 3 kilohertz (KHz)-24 KHz, in increments of 3 KHz allowing modem data rates from 75 bits per second (bps)-120 bps. Wider bandwidths increase system data rates and enable the use of transmission control protocol/internet protocol, tactical chat, email, file transfer, and Link 16 messaging. Wideband HF automatically selects bandwidth, frequency offset, and data rate during link establishment. Interference avoidance capabilities maximize link success.

d. Planning Considerations. Appendix E provides an HF-ALE communications plan example to use with the following considerations.

(1) HF ALE radios, operating in fixed frequency, linking protection, or electronic protection must operate in the cipher text (CT) mode, when possible.

(2) Equipment interoperability must be considered in network planning for HF ALE networks. US forces use MIL-STD-188-141, Interoperability and Performance Standards for Medium and High Frequency Radio Systems, HF ALE compatible radios, but coalition forces may not. Planners must verify interoperability between HF and HF ALE capable radios and allocate frequencies to support ALE and non-ALE HF radio networks, if required.

(3) The minimum size for an effective channel plan is four frequencies. As the number of frequencies in the channel plan decreases, the choices of link quality analysis may decrease.

(4) The optimum channel plan uses 10-12 frequencies. As the number of frequencies in the channel plan increases beyond the optimum of 10-12, the time required to conduct link quality analysis and establish links will increase.

(5) The following information pertains to HF ALE addressing and network allocations.

(a) Network allocations depend on the area of responsibility (AOR) and mission. The lead Service HF ALE network manager must contact the joint frequency management office or joint spectrum management element for approved frequency allocations assignments.

(b) The HF ALE network manager validates the master address list and network assignments prior to activation.

(c) The network manager generates the required channel plan, prints out a paper copy, prepares an electronic copy for issue and use, and creates channel plans needed for operations.

(d) The HF ALE network administrator coordinates HF ALE addressing in a joint environment. The HF ALE self-address consists of 3-15 characters, depending on system parameters. Using fewer characters in the address will optimize the speed of HF ALE operations. An effective technique is to use letter identifiers for the specific Service, as per table 3.

(e) Appendix F provides an example of how to program an HF- ALE radio systematically.

Table 3. Services Planning Flowchart Breakdown					
	Air Force	**Army**	**Coast Guard**	**Marine Corps**	**Navy**
Self-address	AFxxxx	Rxxxxx	xxxxCG	MCxxxx	NAxxxx
Example	AF0001	R00197	1034CG	MC-10	NA987
	FEMA	**NATO**	**SOF**	**Homeland**	**Other**
Self-address	FExxxx	NTxxxx	SFxxxx	HSxxxx	XXxxxx
Example	FE101	NT0297	SF4	HS1210	XX7345
Legend: FEMA—Federal Emergency Management Agency NATO—North Atlantic Treaty Organization SOF—special operations forces					

Note: In accordance with the Department of Defense (DOD), HF ALE concepts of operations, AF0005 through AF0009 are reserved for Mystic Star. Mystic Star is an HF, single-side-band communications system that provides HF communications for the President, Vice President, Cabinet members, and other senior government and military officials while aboard special mission aircraft.

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Chapter III
VERY HIGH FREQUENCY BAND

1. Overview

VHF describes the 30-300 MHz portion of the radio frequency (RF) spectrum. VHF signals propagate, principally, by LOS. VHF transmitters may be manpack, vehicular, or airframe-mounted units with power ranging from 0.25 watts in a manpack configuration to 120 watts in a multichannel, amplified system. Ground stations utilize VHF LOS for short range (approximately 25-50 miles, directly) or long-haul communications via LOS RETRANS. Uses include short-range, frequency modulation (FM), combat radio networks radar; radio navigation; ground-to-air communications; and wideband LOS multichannel systems.

2. VHF Antennas

VHF signal propagation characteristics differ greatly between the VHF-Low (30–90 MHz) and VHF-High (90–300 MHz) ranges. This inherent property requires planners, operators and technicians to carefully select an antenna based on available equipment and mission requirements. Some multiband transceivers have multiple VHF antenna ports to accommodate the VHF-Low and VHF-High frequency ranges.

a. The VHF-Low frequency range is optimized using large, omnidirectional whip or blade type, vertically polarized antennas designed for low takeoff angles. This configuration is preferred for vehicle mounted radio systems, designed for ground-to-ground communications links.

b. The VHF-High frequency range is optimized using small, omnidirectional biconical, and disconnect type horizontally polarized antennas for high takeoff angles. These antenna configurations are preferred for short-range, ground-to-air communications links.

c. Directional antennas, such as inverted V dipoles and log periodic, can communicate up to 100 miles across the entire VHF band.

3. Single Channel Ground and Airborne Radio System (SINCGARS)

SINCGARS capable transceivers can operate on all of the 2,320 VHF-Low frequencies between 30 and 87.975 MHz, in 25 KHz increments. SINCGARS are capable of transmitting analog voice and digital data up to 16 kilobits per second (Kbps) in either the antijam frequency hopping (FH) or single channel mode.

a. SINCGARS Operating Modes.

(1) Single channel mode uses manually entered frequencies and is neither capable of FH nor is it jam resistant.

(2) FH mode is jam resistant and requires loadsets which consist of hopsets, transmission security keys (TSKs), and network identification (ID). The operator may include lockout frequencies and integrated communications security (COMSEC).

(3) A hopset or lockout, is the set of frequencies on which a FH switches between multiple preprogramed radio networks. Hopsets are electronically loaded and stored in the radio.

(4) A TSK establishes a pseudo-random pattern for the frequencies.

(5) Network IDs establish the starting point within the pseudo-random pattern and are allocated to specific individual units.

(6) Time of day (TOD) synchronizes the FH network (FH net). Make every effort to maintain a standard TOD within the operating theater. Global Positioning System (GPS) timing is recommended.

b. Loadset Distribution (FH and COMSEC Data).

(1) A SINCGARS radio loadset consists of FH and COMSEC data. Only designated operators may transfer FH and COMSEC data between devices, transmit the data electronically, or send it using a combination of physical and electronic means. The lowest operational echelon will distribute and store loadsets consistent with the availability of fill devices, security arrangements, and operational needs.

(2) The controlling authority (CONAUTH) and joint task force (JTF) J-6 provide COMSEC and FH data to users. The CONAUTH provides only the amount necessary to satisfy operational requirements consistent with distribution capabilities. Organizations will deploy with the amount of data necessary to satisfy initial operational requirements consistent with distribution capabilities. Storing reserve loadsets at selected echelons facilitates for rapid distribution reduces risk, and minimizes the impact of a lost storage device in the forward area.

c. FH Mixed Network Operations. When operating with single-channel radios, a SINCGARS mixed-mode retransmission site or station can provide communications between a single channel station or network and an FH network without requiring all stations to operate in the vulnerable single-channel mode. To reduce the risk of being targeted by enemy direction-finding equipment, locate mixed-mode retransmission sites away from friendly positions.

d. SINCGARS Loadset Data.

(1) FH Variables. The J-6 spectrum manager is responsible for managing and generating multi-Service FH data. (See figure 3.)

(a) The J-6 spectrum manager generates the loadset. The Service component modifies unique loadsets at the corps or Service-equivalent level. To maximize FH effectiveness, loadsets should use the largest possible number of frequencies in the SINCGARS frequency range. This FH range, and the users' frequency requirements, determine the assignment of loadsets. After the spectrum manager generates loadsets, TSKs and network IDs are assigned. If a force's AOR or task organization changes, it is the responsibility of the higher headquarters to pass the required loadset to the moving unit.

(b) The larger the number of frequencies and wider the distribution across the SINCGARS frequency range, the better SINCGARS will perform when operating in FH mode. Loadset performance is a function of interference from friendly emitters, other electromagnetic sources, and the enemy's electronic attack capability.

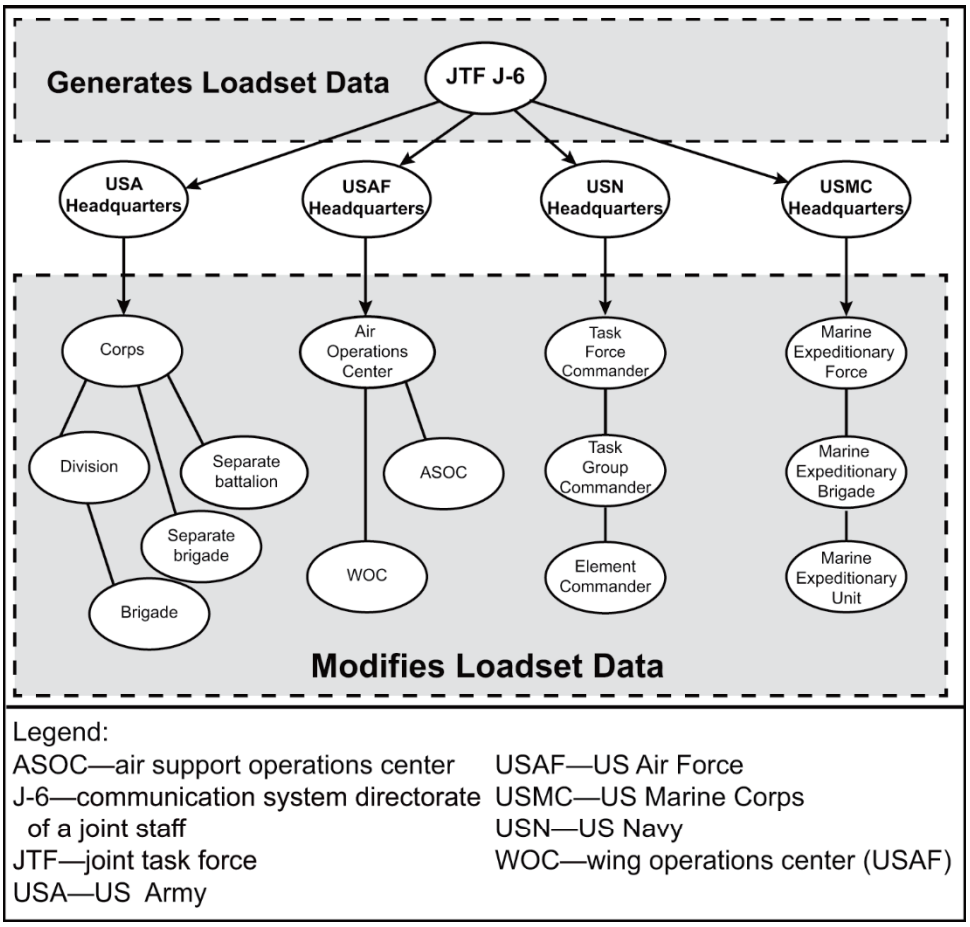


Figure 3. Echelons Capable of Generating Frequency Hopping Data

(c) SINCGARS radio can store all FH, COMSEC, and unique loadset data in each channel preset. The network control station (NCS) or station designated as frequency hopping-master (FH-M) should transmit on each FH network (FH-net) every four hours to keep all stations active on the network.

(2) Radio operators may manually enter the synchronization time into most SINCGARS-compatible radios using the keypad. Operators update the synchronization time by contacting the NCS (FH-M function), via a GPS receiver.

(3) SINCGARS radios require a two-digit Julian date. On Julian days from 100-365, radios that use a two digit Julian date by dropping the first digit (for example, day 100 becomes day 00).

(4) All SINCGARS radios, whether single channel or FH capable, operate in CT mode, when possible. SINCGARS radios use either integrated or external COMSEC devices. The joint force commander (JFC) designates the CONAUTH for all cryptographic network (cryptonet) operations while the J-6 provides staff

supervision. COMSEC variables include traffic encryption key (TEK) and key encryption key (KEK).

Note: Multi-Service components must submit a standard frequency action format (appendix G) for the RF needs of the organization, and any other special communications requirements to the J-6 spectrum manager. The frequency manager will validate the master network list and network group assignments prior to generation.

e. SINCGARS data distribution within Services and components.

(1) Army Forces (ARFOR). (See figure 4.) The US Army component CONAUTH receives and disseminates the FH and COMSEC variables to subordinate echelons. The CONAUTH is the commander of the organization or activity responsible for directing, establishing, operating, and managing the operational use and control of keying material assigned to the cryptonet. The commander may delegate CONAUTH responsibilities to a subordinate, in writing. The CONAUTH should be organizationally senior to cryptonet members, have the staff and expertise to perform essential management functions, and have the authority to ensure instructions are carried out. The CONAUTH may be at the theater, corps, or division level. Traditionally, the CONAUTH is at the theater level.

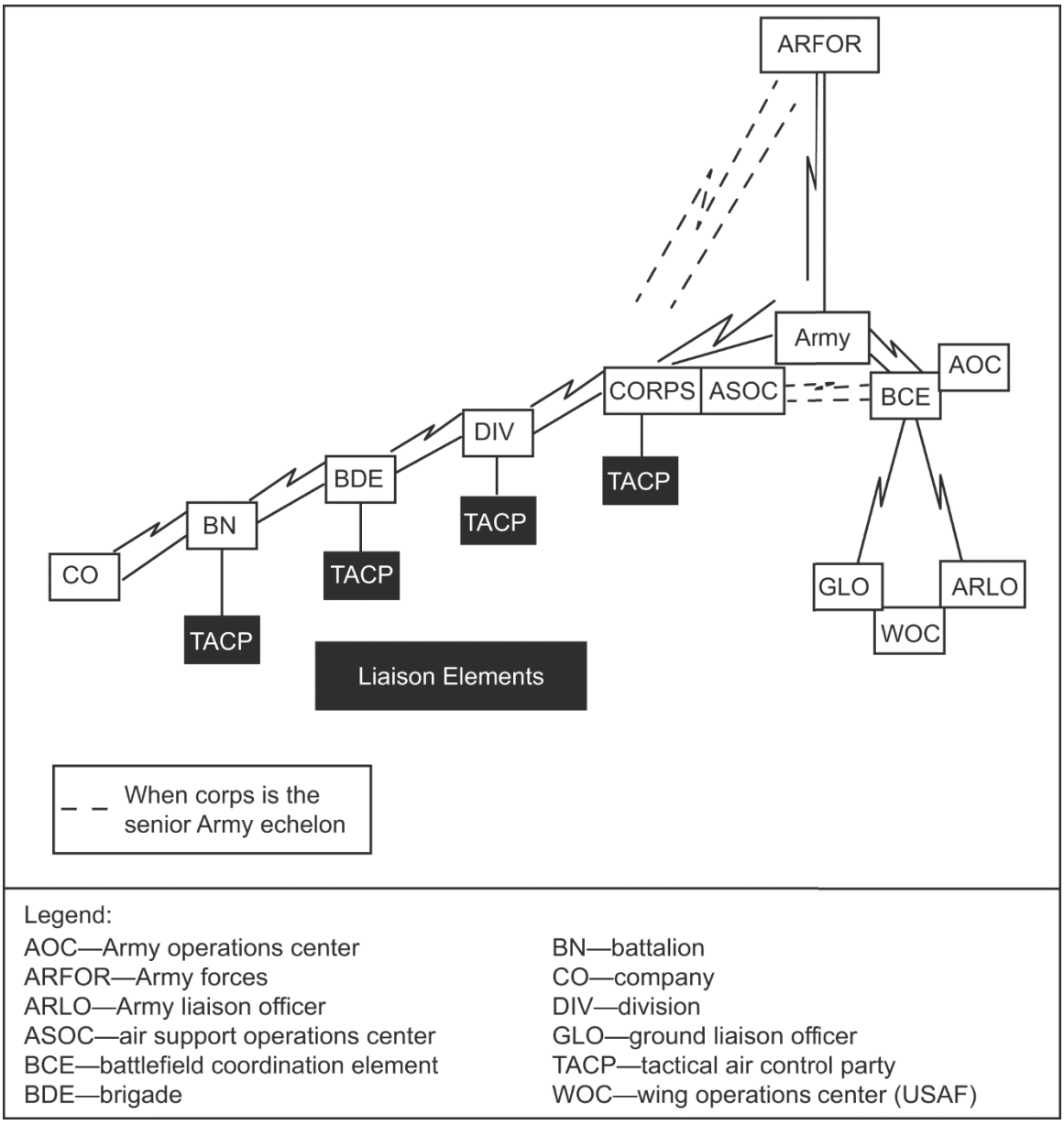


Figure 4. Loadset Data Distribution within US Army Units

(a) Corps and Division Levels. Corps and division network operations and security centers (NOSCs) monitor, manage, and ensure implementation of enterprise system management, network management, information dissemination management, and cybersecurity. The NOSC is the supporting regional cyber center and lead for operational procedures, and cybersecurity requirements within the chain of command. The NOSC orders and accounts for all forms of COMSEC material, including storing encrypted keys, performing key generation (corps TEK and KEK), and automatic key distribution. The NOSC generates SOI and FH variables to include corps-wide loadsets, network IDs, and TSKs.

(b) Corps. The corps component command, control, communications, and computer systems staff officer (G-6) is the principal staff officer for all matters

concerning communications, spectrum management operations, and networks. The corps G-6 has authority over the corps' information networks. The corps G-6 plans and directs all cybersecurity activities, vulnerabilities, and risk assessments with the intelligence officer (G-2), operations officer (G-3), information engagement officer (G-7), operational chain of command, and the regional cyber center. The corps G-6 employs an integrated NOSC to conduct Department of Defense information network (DODIN) operations for the corps. All corps signal elements coordinate with the NOSC when designing, operating, maintaining, and sustaining the corps' information network.

(c) Division. The division G-6 employs an integrated NOSC to conduct DODIN operations for the division. All division signal elements coordinate with the division NOSC when designing, building, configuring, securing, operating, maintaining, and sustaining the division's information network.

(d) US Army Contingency Planning.

- When US Army component staffs are tasked for a possible contingency operation, they begin planning and preparing simultaneously. Once the tasked units are identified, the assigned commanders must determine the specific resources needed.
- The J-6 spectrum manager is responsible for coordinating with higher-level spectrum managers to obtain approved frequency allocations.
- The joint automated communications-electronics operating instructions (CEOI) system manager is responsible for disseminating mission TSKs through the supporting forces. A separate message indicates specific TSK usage.
- The COMSEC account manager coordinates COMSEC key requirements and produces the COMSEC callout message to identify the specific keys for joint, ARFOR, corps, or division use. Subordinate units identify their network requirements, while the higher headquarters' G-6 compiles the master network list.
- Once the J-6 issues the approved frequency allocations, the G-6 generates the SOI for the ARFOR. The US Army joint automated CEOI system (JACS) managers issue the finalized list of tasked units and their associated networks to the J-6.
- Once the J-6 provides FH variables, the G-6 disseminates the FH variables to subordinate units. Each level prepares its individual loadsets.
- Receiving the COMSEC callout and TSK use messages completes the process. Prepared SOIs will be disseminated to subordinate units by secure electronic or physical means.

Note: SOI, COMSEC data, TSK, and network ID assignment do not occur below the division or separate brigade level. When authorized, brigades and separate battalions may generate TEKs to meet emergency requirements.

(2) Marine Corps Forces (MARFOR). (See figure 5.) The USMC uses JACS as the standard system for generating, distributing, and storing CEOI information at all levels of command. To employ the communications assets of the Marine air-ground task force (MAGTF) effectively, the spectrum manager uses the Systems Planning, Engineering, and Evaluation Device software to create accurate terrain analyses and wave propagation studies that allow for selecting optimum antenna sites. The USMC uses the AN/CYZ-10 automated network control device (ANCD) and AN/PYQ-10 simple key loader (SKL) to transfer, store, and fill SINCGARS TEK, KEK, and FH data. The ANCD/SKL uses JACS radio data system software to fill SINCGARS capable radios' single-channel radio electronic counter measure package (CSEP) to load the AN/ARC-210. Marine aircraft groups using the AN/ARC-210 radio are required to convert JACS loadset files into CSEP/ARC-210 data using the ARC-210 fill program (AFP) software. AFP allows entering HAVE QUICK (HQ) and single channel data for the ARC-210. AFP software has the same hardware requirements as JACS.

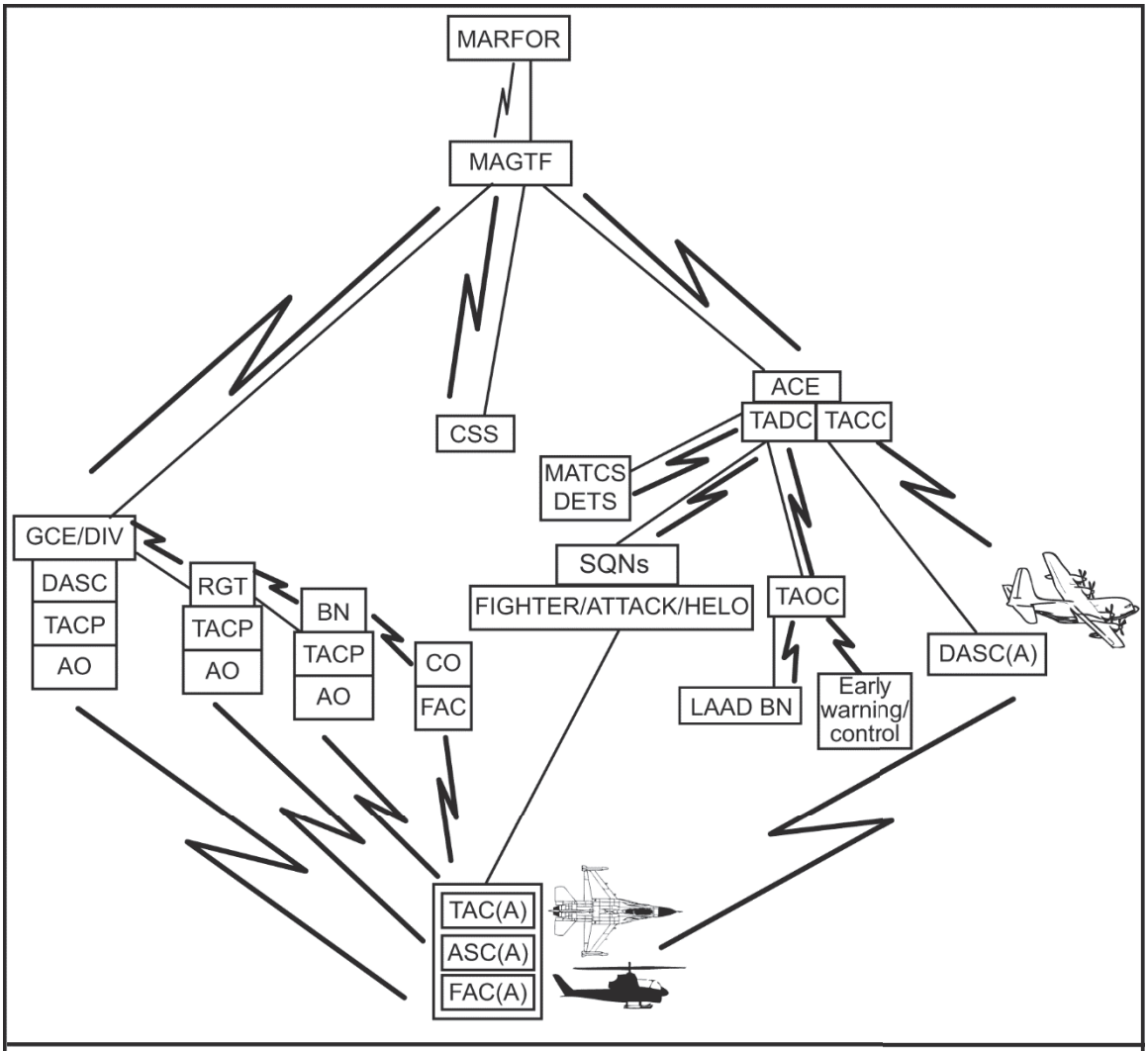
(a) Ashore.

- The MARFOR receives joint FH and COMSEC data from the JTF J-6 and provides the MAGTF command element (CE) the required frequency resources.
- The MAGTF CE generates MAGTF FH data, publishes COMSEC data, and allocates network IDs for all major subordinate commands and supporting units.
- The ground combat element (GCE) receives all joint and MAGTF FH data from the MAGTF CE. The GCE is capable of loadset generation down to the regimental level (implemented only when directed).
- The aviation combat element (ACE) receives all joint and MAGTF FH data from the MAGTF CE. The MAGTF CE provides special loadset files for the AN/ARC-210. The ACE is capable of loadset generation down to the group level.
- The MAGTF marine logistics group (MLG)/combat logistics regiment (CLR) receives all joint and MAGTF FH data from the MAGTF CE. The MLG/CLR can generate a loadset at the MLG/CLR headquarters.

(b) Afloat.

- MARFOR (naval forces (NAVFOR)) provide the MAGTF CE with required frequency resources and joint FH data.
- The MAGTF CE generates MAGTF FH data, publishes COMSEC data, and allocates network IDs for all major subordinate commands and supporting units.
- The GCE receives all joint and MAGTF FH data from the MAGTF CE. The GCE can generate loadsets down to the regimental level.
- The ACE receives all joint and MAGTF FH data from the MAGTF CE. It provides loadset files for AN/ARC-210 users. The ACE is capable of loadset generation down to the group level.

- The MLG/CLR receives all joint and MAGTF FH data from the MAGTF CE. The combat Service support can generate loadsets at the MLG/CLR headquarters.



Legend:

AO—action officer
ACE—aviation combat element
ASC(A)—assault support coordinator (airborne)
BN—battalion
CO—company
CSS—combat service support
DASC—direct air support center
DASC(A)—direct air support center (airborne)
DIV—division
FAC—forward air controller
FAC(A)—forward air controller (airborne)
GCE—ground combat element
LAAD—low altitude air defense
MARFOR—Marine Corps forces
MAGTF—Marine air-ground task force
MATCS—Marine air traffic control squadron
RGT—regiment
SQN—squadron
TAC(A)—tactical air coordinator (airborne)
TACC—tactical air command center (USMC)
TACP—tactical air control party
TADC—tactical air direction center
TAOC—tactical air operations center (USMC)

Figure 5. Loadset Data Distribution within USMC Units

(3) NAVFOR. Distribution of FH and COMSEC data within NAVFOR depends on the task organization. In an amphibious battle group scenario, the communications staff of the commander, amphibious task force (CATF) acts as the deconfliction point for FH and COMSEC data received from the MAGTF, elements of the amphibious task force, the composite warfare commander (CWC), the amphibious ready group (ARG) commander, and carrier strike group (CSG) commander. Figure 6 illustrates this bottom-up flow of data to the deconfliction point, and the top-down dissemination of deconflicted data to every SINCGARS equipped element in the operation. In a typical ARG/CSG scenario, the CWC/officer in tactical command (OTC) communications staff will act as the deconfliction point for FH and COMSEC data.

(a) The US Navy component CONAUTH receives and disseminates the FH and COMSEC data to subordinate echelons. Depending on the situation, the CONAUTH may be at either the CWC/OTC or the warfare commander level. Most often, the CONAUTH will be at the CWC level.

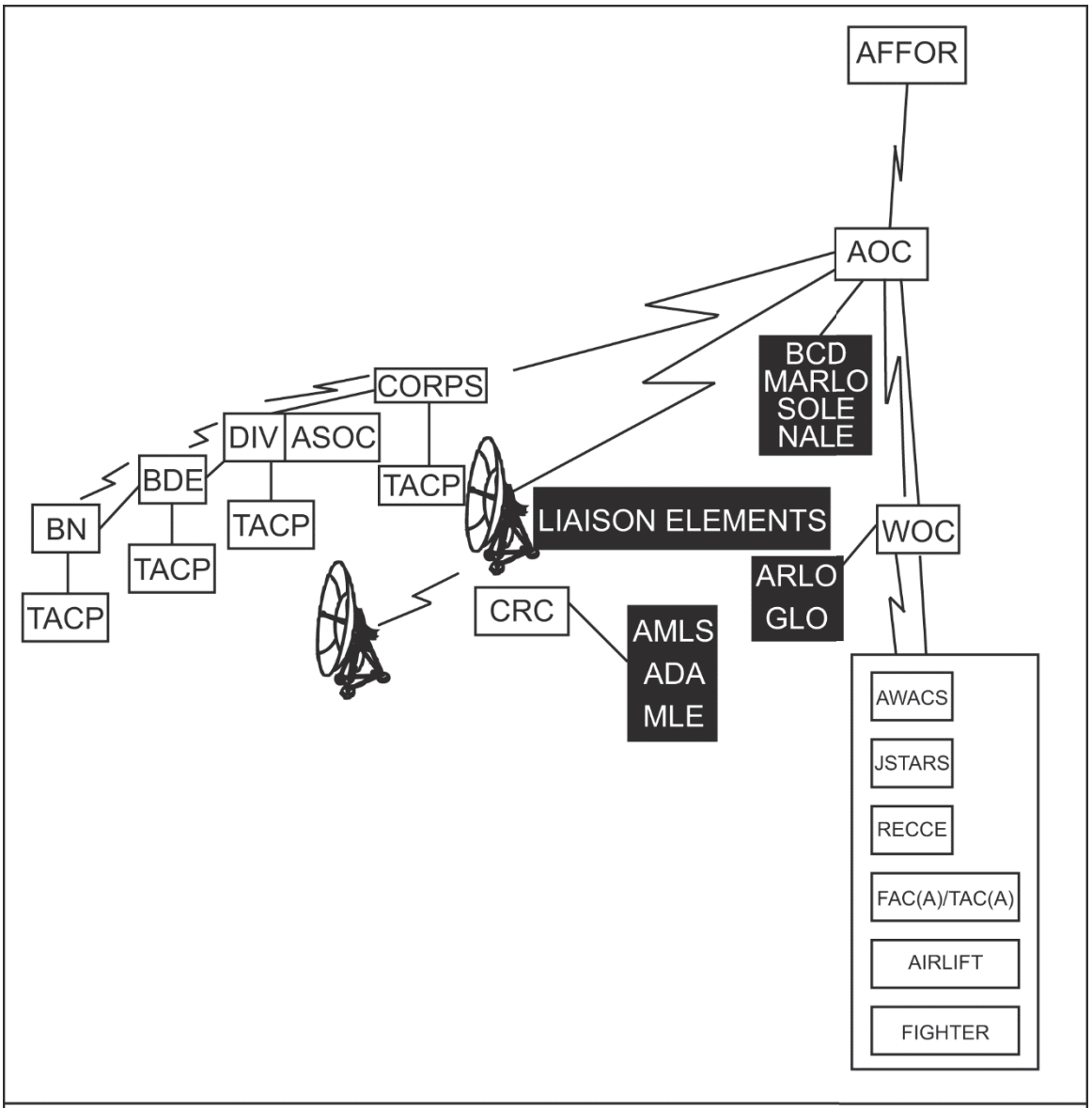
(b) CWC/OTC. The CWC/OTC communications staff will generate and disseminate the data, or delegate the responsibilities to subordinate warfare commanders. Specifically, the CWC/OTC communications staff can generate:

- OPTASK communications data.
- COMSEC data (battle group TEKs).
- FH data (battle group loadsets, network IDs, and battle group TSKs).

(c) Warfare Commanders. Warfare commanders will either use the data the CWC/OTC generates or, if authorized, generate their own FH and COMSEC data. The warfare commander has the equipment and capability to:

- Generate and merge OPTASK communications data.
- Generate COMSEC data (battle group TEKs).
- Generate FH data (network IDs and battle group TSKs).

(d) Assignment Generation. Generating TEKs, TSKs, and network ID assignments does not occur below the warfare commander level. When the warfare commander generates the data, the data is forwarded to the CWC/OTC or the CATF/NAVFOR for consolidation and deconfliction.



Legend:

ADA—air defense artillery
AFFOR—Air Force forces
AMLS—advanced medical life support
AOC—Army operations center
ARLO—Army liaison officer
ASOC—air support operations center
AWACS—Airborne Warning and Control System
BCD—battlefield coordination detachment
BDE—brigade
BN—battalion
CRC—control and reporting center
DIV—division
FAC(A)—forward air controller (airborne)
GLO—ground liaison officer
JSTARS—Joint Surveillance Target Attack Radar System
MARLO—Marine liaison officer
MLE—maritime law enforcement
NALE—naval and amphibious liaison element
RECCE—reconnaissance
SOLE—special operations liaison element
TAC(A)—tactical air coordinator (airborne)
TACP—tactical air control party
WOC—wing operations center (USAF)

Figure 6. Loadset Data Distribution within US Navy Forces

(4) US Air Force Forces. Figure 7 is an example of loadset data distribution within US Air Force units.

(a) Air Operations Center (AOC). The AOC is the operations control agency for the joint force air component. The AOC will provide overall management of SINCGARS network data for the US Air Force components using the US Air Force key data management system, and coordinate the SINCGARS network data with other Service components via the ATO. In this capacity, the AOC:

- Provides the joint force land component commander (JFLCC) communications staff with the total air component SINCGARS network requirements for close air support (CAS), combat search and rescue (CSAR), and joint suppression of enemy air defense.
- Receives initial and follow-on CEOI/SOI from the JFLCC (including the SINCGARS FH and associated COMSEC data) and distributes it to air component users (i.e., deployable radar, control and reporting center (CRC), MAGTF ACE, CSG, CWC/OTC, etc.).
- Provides guidance to US Air Force SINCGARS users regarding loading and employing SINCGARS networks.

(b) CRC. The CRC will develop and distribute loadsets for CRC and deployable radar SINCGARS assets.

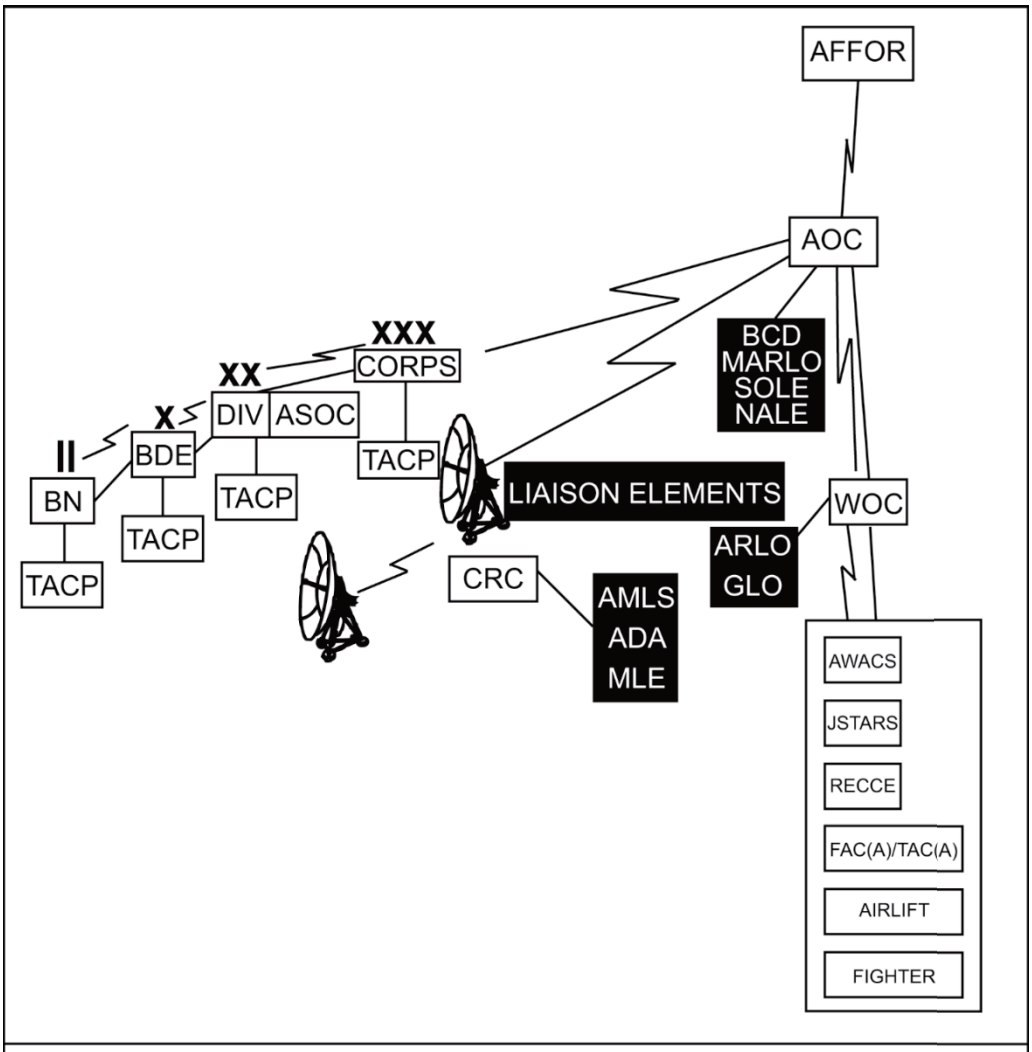
(c) Air Support Operations Center (ASOC). The ASOC is the corps' focal point for executing the US Air Force's air support mission in support of US Army ground forces. In this capacity, the ASOC:

- Coordinates with the US Army for ANCDs and SINCGARS data for all tactical air control party (TACP) SINCGARS radio assets. The US Army will provide SINCGARS CEOI/SOI to aligned TACP units.
- Ensures SINCGARS network requirements for immediate CAS are correctly specified. Immediate CAS will be conducted on a unique, specified standing radio network.

(d) Wing Operations Center (WOC). The WOC executes the ATO as published by the AOC. Operations personnel of tasked units configure mission set data and link SINCGARS identifiers contained in the ATO to support the specified mission. The WOC:

- Develops procedures for integrating the construction of mission sets into the wing mission planning process using the Wing Command and Control System (WCCS) and the US Air Force key data management system.
- Develops and implements a SINCGARS standard loading scheme.
- Develops and implements procedures for transferring loadsets to the key data system ANCD at the squadron or unit level and for subsequently loading SINCGARS radios in specific aircraft assigned to the mission.

Note: The AOC will identify specific SINCGARS network data, TSKs, and COMSEC key identifiers, call signs, and call words for the CAS mission tasking in the ATO. In addition, the AOC will identify the SINCGARS data required by the CRC and the deployable radar. The SINCGARS FH data and communications identifiers will be transferred to the WOC via the WCCS.



Legend:
ADA—air defense artillery
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BN—battalion
CRC—control and reporting center
DIV—division
FAC(A)—forward air controller (airborne)
GLO—ground liaison officer
JSTARS—Joint Surveillance Target Attack Radar System
MARLO—Marine liaison officer
MLE—maritime law enforcement
NALE—naval and amphibious liaison element
RECCE—reconnaissance
SOLE—special operations liaison element
TAC(A)—tactical air coordinator (airborne)
TACP—tactical air control party
WOC—wing operations center (USAF)

Figure 7. Loadset Data Distribution within US Air Force Units

Chapter IV
ULTRAHIGH FREQUENCY BAND

1. Overview

UHF describes the 300 MHz-3,000 MHz portion of the RF spectrum. This frequency range can provide short-range and long-haul communications. In the UHF band, direct wave is used for transmissions from 15-100 miles. Communications are limited to a short distance beyond the horizon. Lack of static and fading in these bands makes LOS reception satisfactory. Directional antennas can focus the beam of RF energy, increasing the signal intensity over long distances. Directional antennas enable satellite transmissions over thousands of miles, depending on altitude, power, and configuration. UHF systems, that play an important role in network-centric warfare, are HQ, Link 16, enhanced position location report system (EPLRS), high capacity line of sight (HCLOS), and situational awareness data link (SADL). These systems provide the joint Service communities with ground-to-air, ship-to-shore, and multinational communications capabilities.

2. HQ

This section provides planning information on the employment of HQ jam-resistant radio systems to support a JTF. Appendix H provides an example of a HQ planning actions checklist.

a. Types of HQ radios. The HQ system refers to all HQ radios, including Basic HQ (sometimes called HQ I) and HQ II. The term HQ is used only in generic cases.

(1) HQ I refers to single-channel UHF radios modified to incorporate a slow frequency-hopping capability.

(2) HQ II refers to an upgraded HQ I system that incorporates improved FH and expanded hopsets.

(3) The second generation, anti-jam, tactical UHF radio for the North Atlantic Treaty Organization (NATO), SATURN, was developed by the US as HQ IIA SATURN and is the follow-on to HQ I/II. SATURN provides improved performance against jamming compared to the previous versions. SATURN employs fast frequency hopping within 225 MHz-400 MHz range providing improved anti-jamming capabilities over HQI/II. Digital modulation makes transmission much less vulnerable to interception and packets the information to avoid hopping interruption. SATURN voice quality is improved over HQ I/II and adds data transmission capability. SATURN-capable radios provide backwards capability with HQ I/II. US radio options include ARC-210 Generations 4, 5, and 6; ARC-231; and PRC-117G.

b. HQ Operational Prerequisites. The following parameters ensure netted HQ radios are interoperable. (Appendix I expands on these parameters).

(1) Word of the Day (WOD). WOD is a worldwide, 36-digit transmission security (TRANSEC) key inserted into a radio by an operator to establish a specified system hopping pattern, rate, and dwell time.

(2) Time of Day (TOD). TOD is a synchronizing signal derived from a stable timing source or designated master clock source. TOD may be acquired directly, over the air from GPS satellites, a timing source (such as the AN/ARC-204A (V2)), or a designated HQ radio used as a master clock. TOD can be inserted into the HQ radio through a hardware interface from a local timing source, such as an external GPS receiver. GPS is the most accurate sources. In the absence of GPS, the Airborne Warning and Control System (AWACS) or Joint Surveillance Target Attack Radar System (JSTARS) is the preferred choice within an operational area. If HQ communications begins to degrade due to time drift, perform a timing synchronization (Mickey) from the primary TOD source (beacon).

(3) Network Number Assignment. The network number assigns several radios, using the same WOD and TOD, to a network and establishes the hop set starting frequency. Assigning unique network numbers eliminates self-interference by guaranteeing interlaced operation among all of the available radio networks. Planners must determine how many radio networks are required in a theater and allocate resources according to the total available allotment. Assign network numbers for C2 platforms supporting multiple radio networks in a specified manner to maintain proper radio operation and frequency separation. Replicate network number assignments for other radio networks, based upon geographical separation, when requirements exceed allotment.

c. HQ Modes of Operation. All HQ radios provide standard, single frequency, UHF channel capabilities required for operations. This section outlines the differences between the active, antijam mode features between basic HQ I and HQ II.

(1) HQ I radio, active mode of operation provides the following capabilities.

(a) Slow FH.

(b) Three types of active mode networks (A-, B-, and sectionalized A-nets) and one type of training network (T-net).

- A-Nets A00.050-A99.950.
- T-Nets A00.000-A00.400.

(c) Only accommodates a single WOD.

(2) The HQ II radio, active mode of operation provides the following capabilities.

(a) It has a larger set of frequencies for increased jam resistance than the HQ I. A standard UHF HQ link in normal mode uses any one of 7,000 available UHF channels.

(b) It provides frequency management A-nets for NATO and non-NATO operations.

(c) There are three types of active mode networks (A-, B-, and sectionalized A-nets) and two types of T-net and frequency management training networks (FMT-net).

Note: When using FMT-nets, segment 20 of the WOD determines the hop rate (FH). The standard HQ segment 20 hop rate input is 300.350. For example, assigning 300.325 to segment 20 will make the system hop at a decreased rate. Using 300.375 will allow the system to hop at an increased rate.

(d) HQ II provides active mode conferencing through WOD insertion.

(e) The transceiver can accommodate up to six WOD.

Note: See appendix J for additional network management information.

d. HQ interoperability.

(1) Table 4 is a summary of interoperable HQ modes of operation and features. It shows technical interoperability potential only. To ensure interoperability, the configured transceivers must meet certain operational conditions. Any HQ radio can communicate with standard UHF radios. However, for this to occur, the HQ radios must be placed in the same operational mode.

(2) Table 4 also illustrates the backward compatibility for each succeeding generation of HQ radio.

Table 4. Summary of Interoperable HQ Operating Modes

Modes/Features	Capability	Radio		
		Standard UHF	Basic HQ	HQ II
Operating	UHF single channel	X	X	X
Modes	Guard channel			
	Basic HQ networks	X	X	X
	HQ II FMA-nets		X	X
	NATO/non-NATO			X
	FFH-nets			
	HQ FM-nets			X
Training Modes	Training-nets (5 frequencies) FMT-nets (16 frequencies) HQ FMT-nets (16 frequencies) FFH T-nets (40 frequencies)		X	X X
Operating Features	Conferencing Improved hopping algorithm multiple word-of-day storage/erase 20-watt output power		X	X X X

Note: X denotes interoperability.

Legend:
FFH—fast frequency hopping
FMA-net—frequency management A-nets
HQ—HAVE QUICK
NATO—North Atlantic Treaty Organization
T-net—training network
FM—frequency modulation
FMT-net—frequency management training networks
UHF—ultrahigh frequency

3. Tactical Digital Information Link-Joint (TADIL-J) (Link 16)

a. Overview.

(1) The TADIL-J (also known as Link 16) is a communication, navigation, and identification (ID) system supporting near real-time information exchange between tactical communications systems. The radio transmission and reception component of TADIL-J is the Joint Tactical Information Distribution System (JTIDS) or its successor, the Multifunction Information Distribution System (MIDS). High-capacity UHF, LOS, fast frequency hopping (FFH) data communications terminals provide secure, jam-resistant voice, and digital data exchange. JTIDS and MIDS terminals operate on the principal of time division multiple access (TDMA), where time slots are allocated among all TADIL-J network participants for data transmission and reception. TDMA provides the flexibility to design nodeless communications network architecture.

b. JTIDS.

(1) The JTIDS is a UHF terminal operating in the 960 to 1215 MHz frequency range. It is comprised of the Class 2M terminal, the JTIDS terminal controller, and the JTIDS antenna. JTIDS enables air defense artillery units to exchange mission-essential data in near real-time, with units performing joint air and missile defense.

(2) The JTIDS uses the 'DOD's tactical data link (TDL) to provide secure, jam-resistant, high capacity, interoperable voice, and data communications for tactical platforms and weapon systems.

(3) The JTIDS supports joint interoperability and attains situational awareness (SA) through integrating Link 16 messages, standards, and waveforms. JTIDS complements land and joint force objectives for airspace control by rapidly exchanging surveillance, ID, unit status, and engagement information. An in-theater joint data network provides the shared C2 data and targeting information.

(4) The JTIDS voice capability includes 2.4 Kbps encoded or unencoded modes, as well as 16 Kbps unencoded mode. AWACS can operate two JTIDS voice channels. JTIDS voice can be transmitted in CT or plain text (PT) depending on mission requirement and operational mode of the JTIDS terminal.

c. MIDS.

MIDS is a communications, navigation, and ID system intended to exchange C2 data among various weapons platforms. MIDS is the follow-on to the JTIDS terminal, providing improvements over the Class 2 family of terminals. MIDS is smaller and lighter than its predecessor, and can be installed in platforms that are limited in space and weight. MIDS-equipped platforms are fully compatible with all LINK 16 participants.

4. HCLOS

a. Overview.

(1) The GRC-245C HCLOS. This is a multi-channel radio designed, primarily, as the high-rate backbone transport for tactical networks interconnecting command, control, communications, computers, intelligence, surveillance, and reconnaissance elements. The AN/GRC-245 is one of the most spectrum-efficient radios available today with its 3.3 b/Hertz (Hz) efficiency.

(2) Tri-band Frequency and Range.

(a) Band 1: 225-400 MHZ; 256 Kbps to 16 Mbps greater than 50 kilometers (km).

(b) Band 3+: 1350-2690 MHz; 34 Mbps greater than 55 km.

(c) Band 4: 4400-5000 MHz; 256 Kbps greater than 40 km.

5. EPLRS

a. Overview.

(1) EPLRS is the US Army's mid-tier wireless tactical communications system for ground based data networking. The EPLRS system is extended into the air and sea domains by interfacing with the US Air Force's SADL, USMC's tactical data network (TDN), and US Navy's Amphibious Assault Direction System (AADS).

(2) EPLRS network is comprised of several radio terminals and one or more network controllers. This mesh architecture supports multiple concurrent communications channels and automatic relaying providing operators with transparent BLOS and site-to-site data link routing.

(3) EPLRS mobile networks are used by mission command systems and force battle command, brigade and below (FBCB2) host computers for SA and C2. The SADL integrates US Air Force CAS aircraft with the digitized battlefield via EPLRS. Its inherent position and status reporting provide an effective solution to air-to-ground combat ID.

(4) EPLRS top-level capabilities include voice and data communications, position location, and navigation services.

b. Planning. System planning and control require coordination between the functional users and the network service provider or NOSC. The four EPLRS planning elements include:

(1) Planning DODIN operations.

(2) Developing unit library data (i.e., a list of the participants/units; each requiring a military ID code entry into a database).

(3) Developing message library data, determining the types of messages to be exchanged among the users.

(4) Establishing need-line library data, determining user privileges to communicate with others.

c. Technical Descriptions and Characteristics. NCS and radio set (RS) are the two main components of EPLRS. They are explained in the following paragraphs.

(1) Network Control Station (NCS). The NCS contains tactical computers that enable automated technical control and centralized dynamic network management of EPLRS. The NCS is the primary technical control interface for all operators within the network. NCS software provides dynamic network monitoring and resource assignment that satisfies requirements for communications, navigation, ID data distribution, and position location.

(2) Radio Set (RS). The RS provides secure, jam-resistant, digital communications, and accurate position location capabilities. The RS accepts and implements NCS-issued commands and reports its status to the NCS. The RS consists of an RT, user readout device, and appropriate installation kit for ground, vehicle, and airframe implementation.

(a) EPLRS Lite (E-Lite). E-Lite equipment upgrade delivers a pocket-sized version of the EPLRS radio to the warfighter. The E-Lite system reduces the dismounted warfighter's equipment load by more than 20 pounds.

(b) EPLRS Network Manager. The EPLRS network manager is an equipment upgrade for the NCS. EPLRS network manager reduces the equipment's overall footprint and requires less maintenance and infrastructure than the NCS.

(c) Host Interfaces. EPLRS supports four types of host interfaces: the US Army data distribution system interface (ADDSI), MIL-STD-1553B, Aircraft Internal Time Division Command/Response Multiplex Data Bus, point-to-point (PTP) protocol, and Ethernet. Figure 8 shows host tactical system interfaces to an ADDSI RS and MIL-STD-1553B RS.

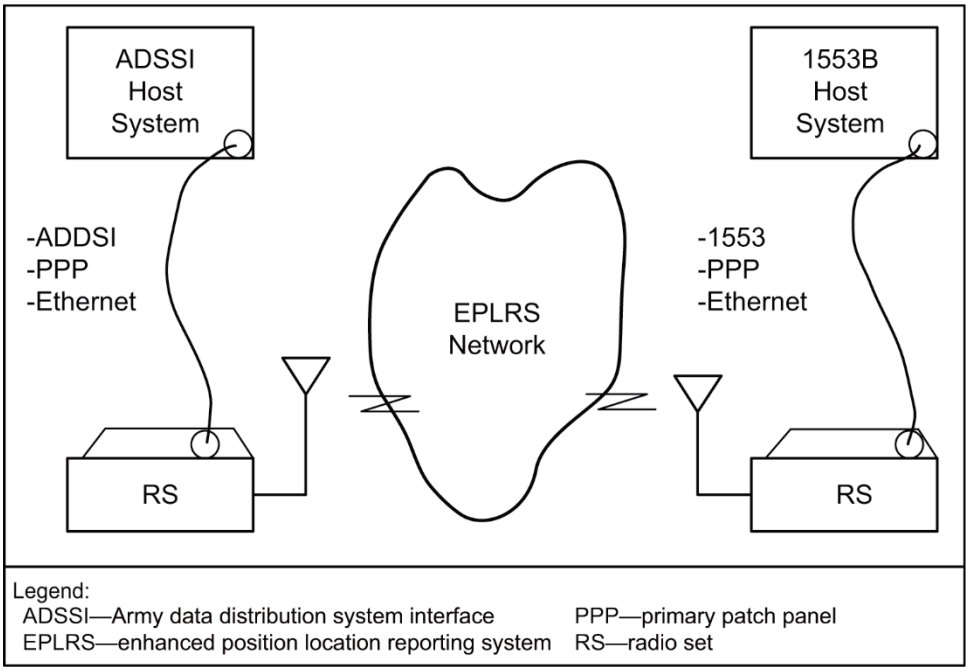


Figure 8. Host Tactical System Interfaces to an EPLRS

d. Joint Service EPLRS Applications.

(1) US Army. The US Army uses EPLRS to provide the communications backbone for the tactical internet for US Army FBCB2-equipped forces.

(a) The tactical internet is the physical communications network that provides the data backbone to support communications exchange and SA messages. The tactical internet forms two distinct information exchange layers, i.e., the upper tactical internet and the integrated tactical networking environment (ITNE). The upper tactical internet is composed of multichannel satellite systems and other warfighter information network-tactical systems. The ITNE comprises the networking environment that supports communications systems for the brigade and below, see figure 9.

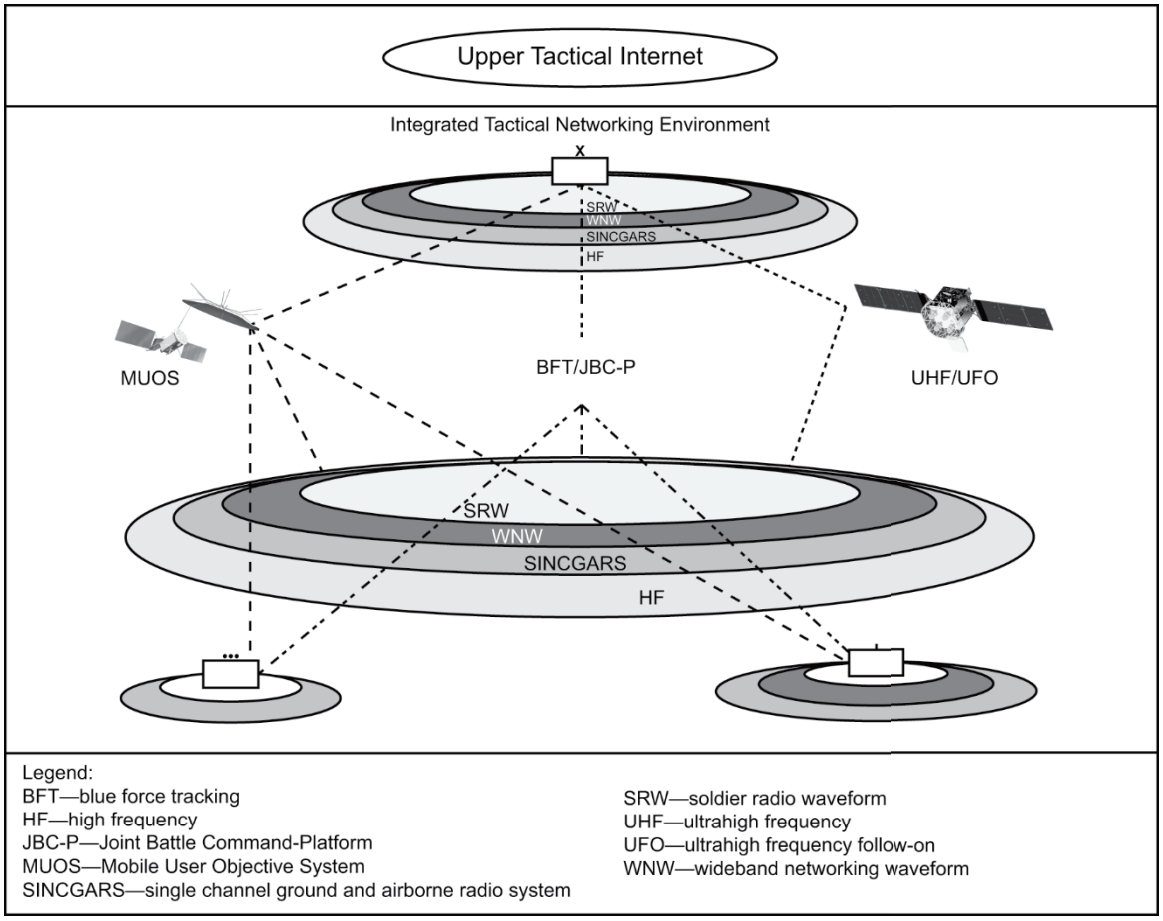


Figure 9. US Army Tactical Internet Brigade and Below Architecture

(b) At the brigade and battalion levels, use terrestrial and satellite based communications systems to create a picture of the battlespace.

- The FBCB2 provides the Soldier a terrestrial link on the battlefield increasing SA by automatically disseminating friendly force locations, reporting enemy locations, and presenting graphical representations of the commander's intent and scheme of maneuver throughout the AOR. Using EPLRS communications and position location features, FBCB2 integrates communications, weapon, and sensor systems to facilitate automated status, position, situation, and combat awareness reporting.
- The friendly force tracker (FFT) provides the Soldier a satellite-based tracking and communications system with a globally responsive and tailorable capability to identify and track friendly forces in assigned AORs, in near real time. The tracking system gives detailed information on friendly and enemy units up to a range of 5,000 miles. Operators can identify and share the common view with ground vehicles, rotary-wing aircraft, command posts, and command centers.

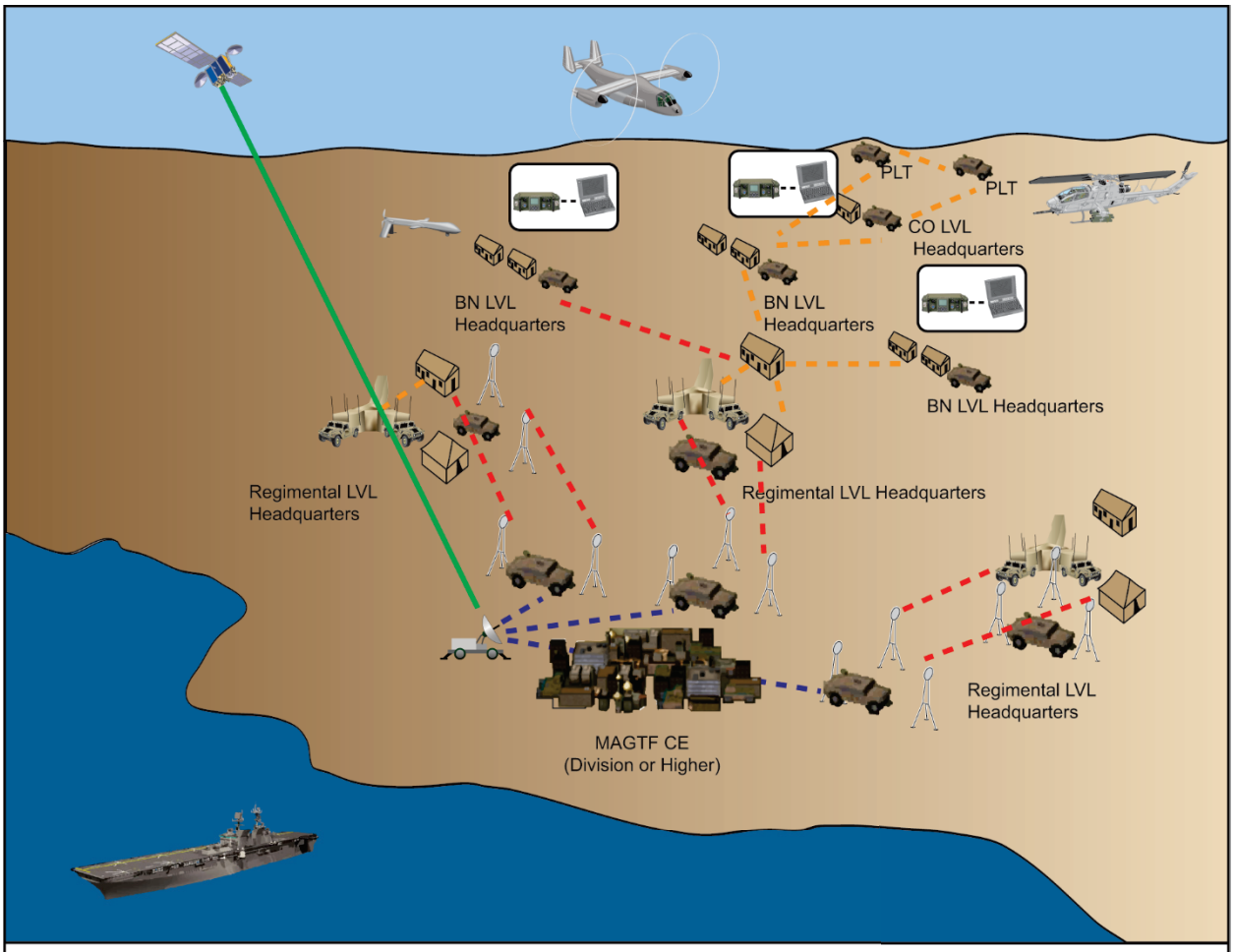
e. USMC. The USMC is replacing EPLRS with the Adaptive Network Wideband Waveform (ANW2) to provide radio transmission services including the TDN.

(1) The USMC's TDN architecture is designed as a communications network between MAGTF Headquarters and the Marine expeditionary force, expeditionary brigade, division, regiment, and battalions and subordinate company command levels. It enables mesh digital interoperable capabilities in Marine aviation units. The system's architecture can extend services to Marine Logistics Combat Element units and enable the digital interoperability concept for Marine ACE units. Figure 10 shows an example of a high level operational concept graphic highlighting how tactical data or radio transmissions networks are enabled using a variety of high-data-rate links and waveforms.''

(a) The TDN consists of commercial off-the-shelf (COTS) technologies, including Cisco routers and Microsoft servers, and integrates with approved end-user service delivery equipment (e.g., AN/PRC-117G) to create a wide-area network at regiment and battalion organizations.

(b) TDN employs a high data rate duplex architecture to extend the Combat Operations Center's Nonsecure Internet Protocol Router Network (NIPRNET) and SECRET Internet Protocol Router Network (SIPRNET) services through the radio link.

(c) ANW2 is a self-healing, robust, internet protocol (IP)-driven waveform that can support up to 30 radios within a subnet. The large number of radios that can be added to a subnet decreases the likelihood of single-point failure or data network outage. When working with USMC ground and logistics combat units (including field artillery and rocket batteries) coordinate with USMC S-6 communicators and consult a unit guard chart to determine IP programming ranges and radio network setup procedures inside the OPORD Annex K.



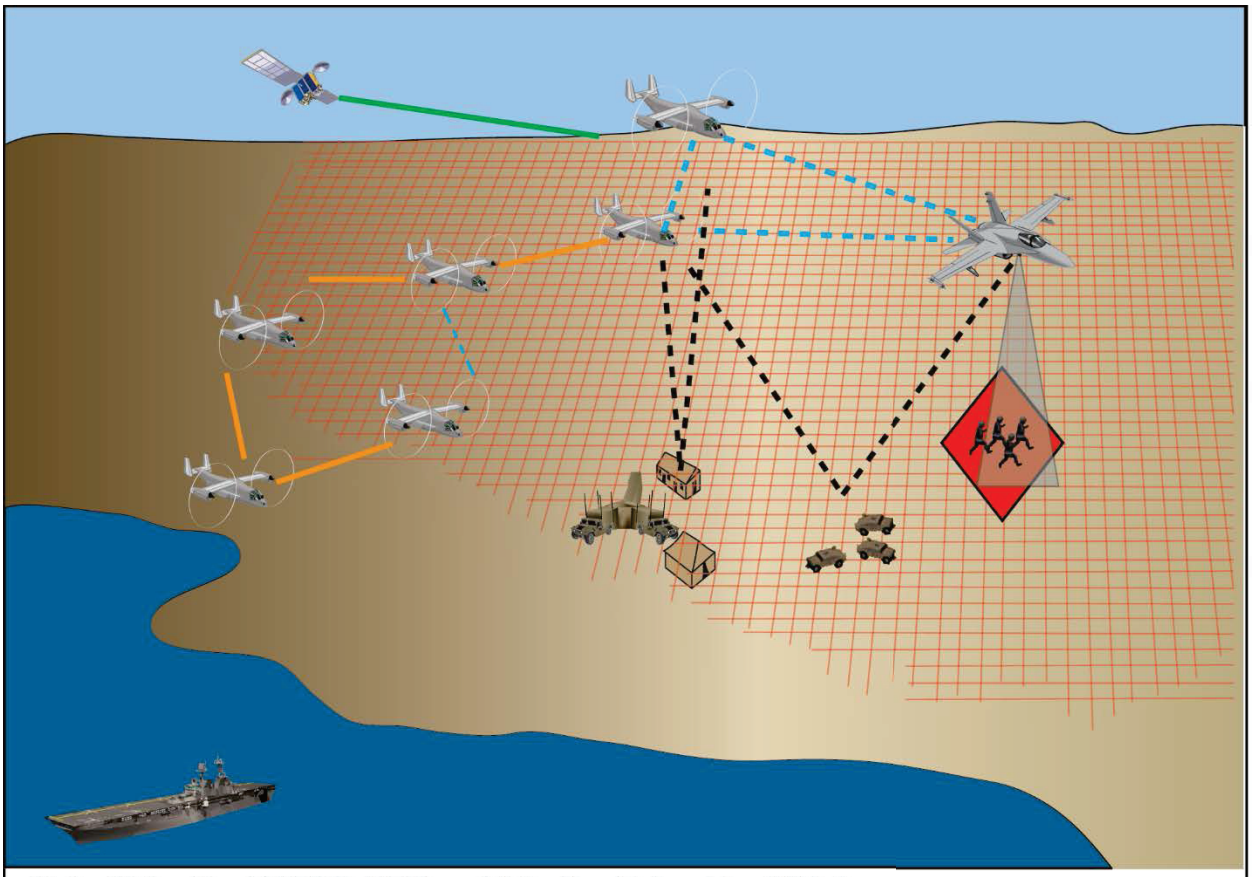
Note: Using the AN/PRC-117G and ANW2 (SRW capable waveform), the USMC extends cyber transmission services down to the platoon maneuver element level.

Legend:
ANW2—Adaptive Networking Wideband Waveform
BN—battalion
CE—command element
CO—company
LVL—level
MAGTF—Marine air-ground task force
PLT—platoon
SRW—soldier radio waveform
USMC—United States Marine Corps

Satellite Link
Wireless point-to-point link
ANW2 Link

Figure 10. USMC Tactical Data Network Application

(2) USMC aviation units employ ANW2's digital interoperability to link aircraft, Marine aviation command and control system, air defense, air control and operators on the mobile ad-hoc network. Figure 11 shows a high level operational concept graphic for a notional long-range raid mission using a meshed ANW2 network aboard the USMC variant MV-22 Ospreys to share data collected by fixed-wing assets conducting an intelligence, surveillance, and reconnaissance mission.



Note: Using the AN/PRC-117G and Adaptive Networking Wideband Waveform (soldier radio waveform capable waveform), the US Marine Corp extends cyber transmission services down to the platoon maneuver element level.

Adaptive Network Wideband Waveform Link
Satellite Link
Tactical Targeting Network Terminology Waveform Enabled Link
Voice Link

Figure 11. Talon Reach Long-Range Raid Using AN/PRC-117G

f. US Navy. The US Navy uses EPLRS in the AADS, AN/KSQ-1, to support communications and movement for the amphibious task force.

(1) The AADS, AN/KSQ-1, provides real-time information to the amphibious command ship, primary control ship (PCS), and the secondary control ship (SCS) on the position and movement of naval surface landing craft in the amphibious task force (ATF). The AN/KSQ-1 allows the amphibious command ship, PCS, and SCS to identify, track, communicate with, and control amphibious landing craft from launch through transit over-the-horizon, off-coast, and return while conducting maneuver warfare from the sea. Figure 12 shows an example of an amphibious assault direction.

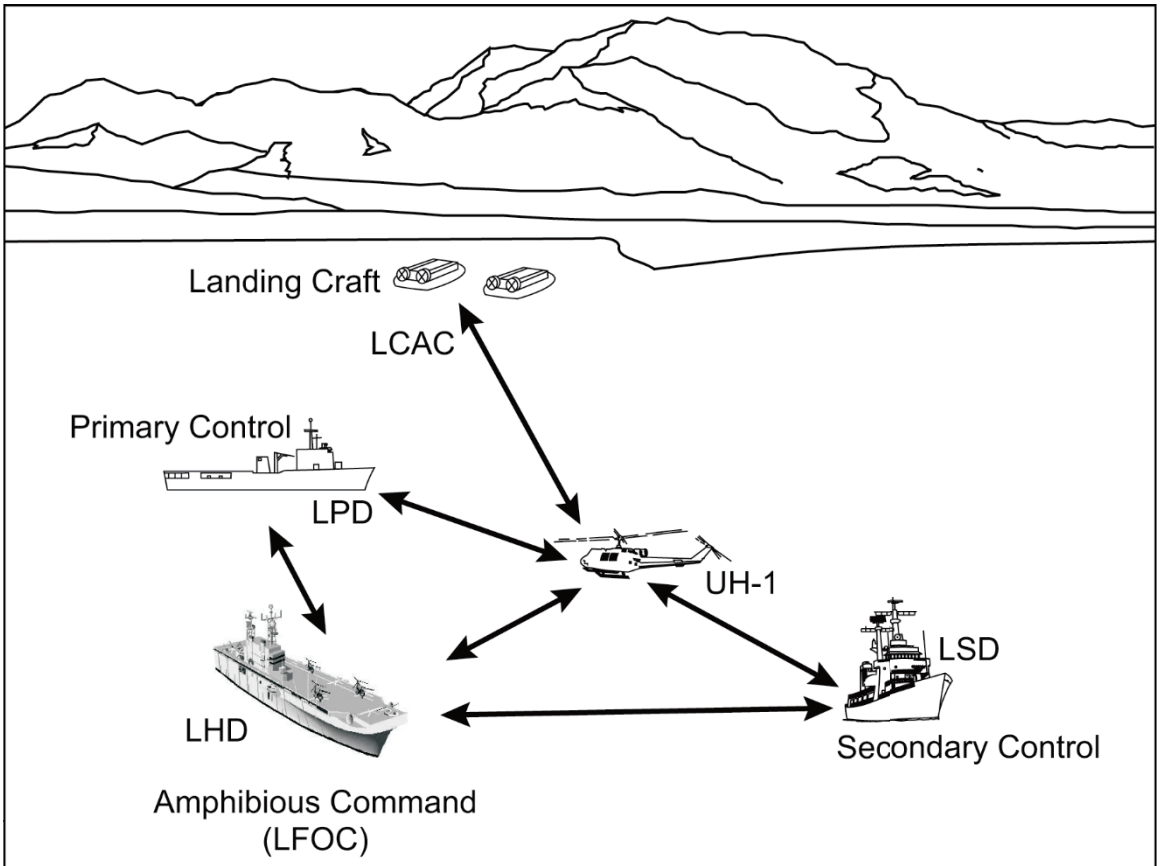
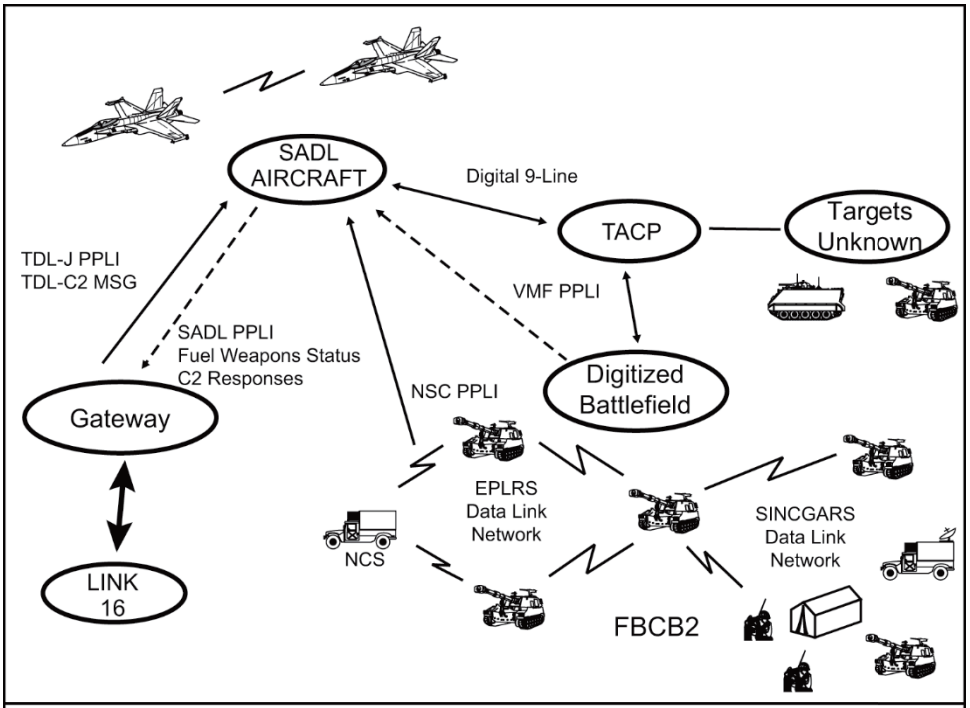


Figure 12. Amphibious Assault Direction

(2) EPLRS provides the jam-resistant and low probability of intercept communications links for exchanging preformatted text messages among members of the ATF up to 100 nautical miles. During the ship-to-shore phase of the amphibious assault, EPLRS radios installed in the landing force operations center will link the landing force commander with other USMC command elements ashore.

g. US Air Force. The US Air Force uses modified EPLRS radios for the SADL air-to-ground/ground-to-air data link with the EPLRS ground community in support of CAS and CSAR missions.

(1) SADL is the integration of an EPLRS radio, MIL-STD-1553B host interface, and aircraft avionics over the aircraft MIL-STD-1553B multiplex bus. It allows data from other SADL equipped fighters and ground EPLRS radios to be seen on cockpit displays. Figure 13 shows an example of a SADL network.



Legend:

C2—command and control
EPLRS—Enhanced Position Location Reporting System
FBCB2—Force Battle Command Brigade and Below
MSG—message
NCS—net control station
NSC—node site coordinator
PPLI—precise participant location and identification
SADL—situation awareness data link
SINCGARS—single-channel ground airborne radio system
TACP—tactical air control party
TDL—Tactical data link
VMF—variable message format

Figure 13. SA Data Link Network

(2) The SADL air-to-air network, consisting of two to sixteen members, is self-reliant. It functions independently of the presence or absence of a ground-based NCS. Network members share fighter positions, target positions, weapons data, and fuel statuses. Automated fighter-to-fighter relay and adaptive power control capabilities ensure connectivity and jam resistance, and provide a low probability of detection.

(3) In the air-to-ground mode, the pilot uses cockpit controls to synchronize the SADL radio with a ground division network. After synchronization, the fighter aircraft's SADL radio returns to sharing fighter-to-fighter data while recording SA from the tactical internet 's SA communications services. The ground NCS tracks the fighter using EPLRS and provides the fighter position and altitude to the ground forces. When the fighter begins an attack on a target, the pilot uses a switch on the control stick to provide the aircraft avionics with the five closest EPLRS positions. SADL provides the pilot SA and combat ID of EPLRS equipped personnel and units. Their positions show on heads-up and multifunction displays as Xs overlaid on the friendly positions. The pilot uses the proximity of EPLRS positions to the target area as factors in deciding whether to expend munitions.

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Chapter V
BATTLEFIELD AIRBORNE COMMUNICATIONS NODE (BACN)

1. Overview

a. BACN serves as an aerial communications retransmission hub, enabling voice and TDL extensions or bridging among geographically separated assets when services are restricted or unavailable.

b. The BACN system refers to the aircraft host platform (four Bombardier E-11As and three EQ-4B Global Hawk), aircraft communications relay payload, and the ground systems needed to control and configure the payload.

Note: Figure 14 provides a high-level operational overview of the BACN system.

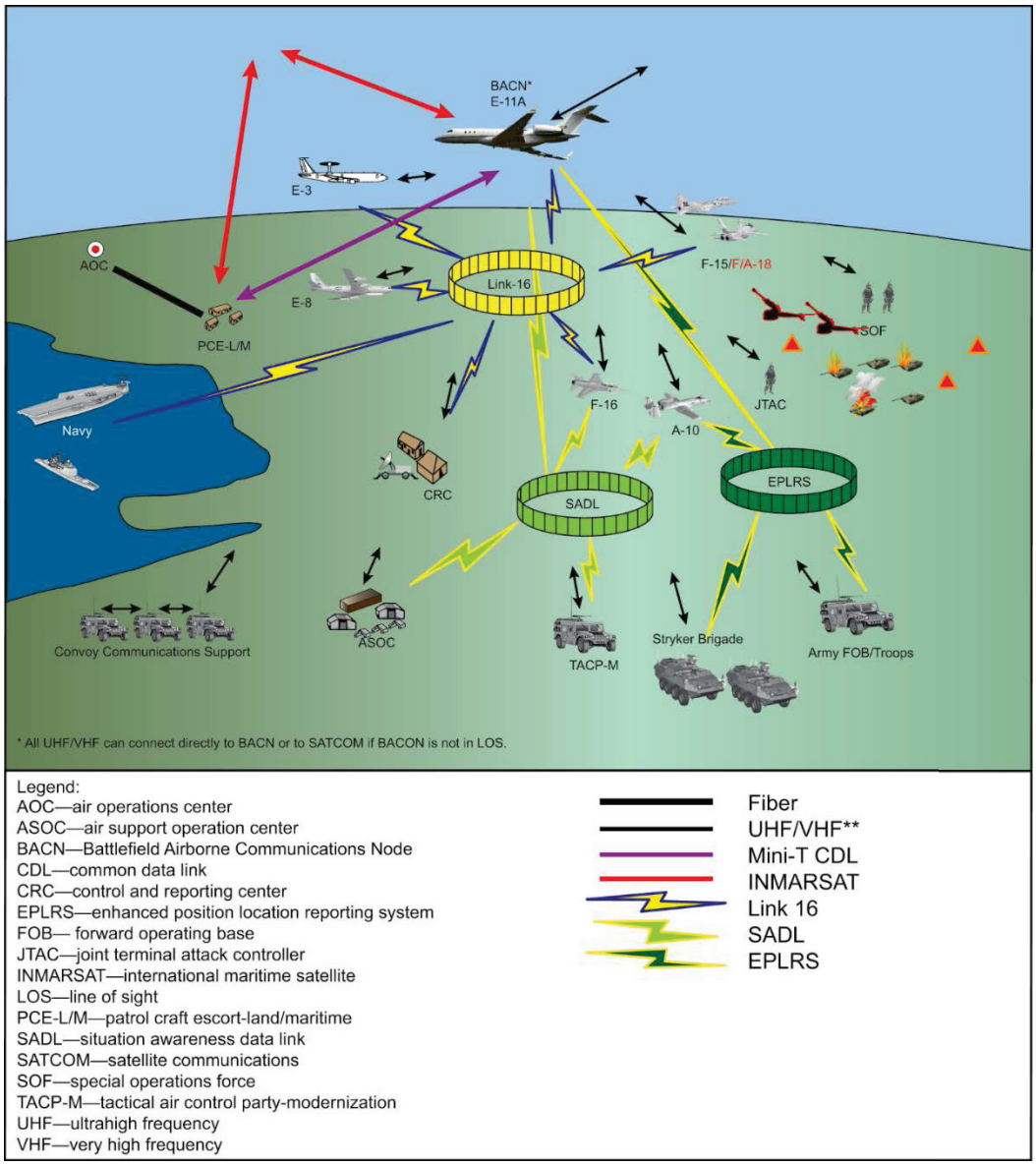


Figure 14. BACN Overview

2. Functions and Responsibilities

BACN provides a long endurance, airborne communications relay enabling BLOS tactical data exchange, reducing communications problems associated with incompatible systems, terrain, and LOS limitations.

a. BACN Capabilities.

(1) Voice bridging and extension.

(2) TDL bridging and extension.

b. BACN Airborne Payload (see figure 15).

(1) Nine ARC-210s v.4 UHF/VHF radios.

(2) One TDL system.

(3) Two MIDS LVT-4s (EQ-4Bs)/two MIDS LVT-2s (E-11As) terminals.

(4) Two EPLRS/SADL terminals.

(5) One INMARSAT (international maritime satellite) SATCOM.

(6) One Gateway/Airborne Executive Processor (AEP), which forwards, translates and bridges disparate networks.

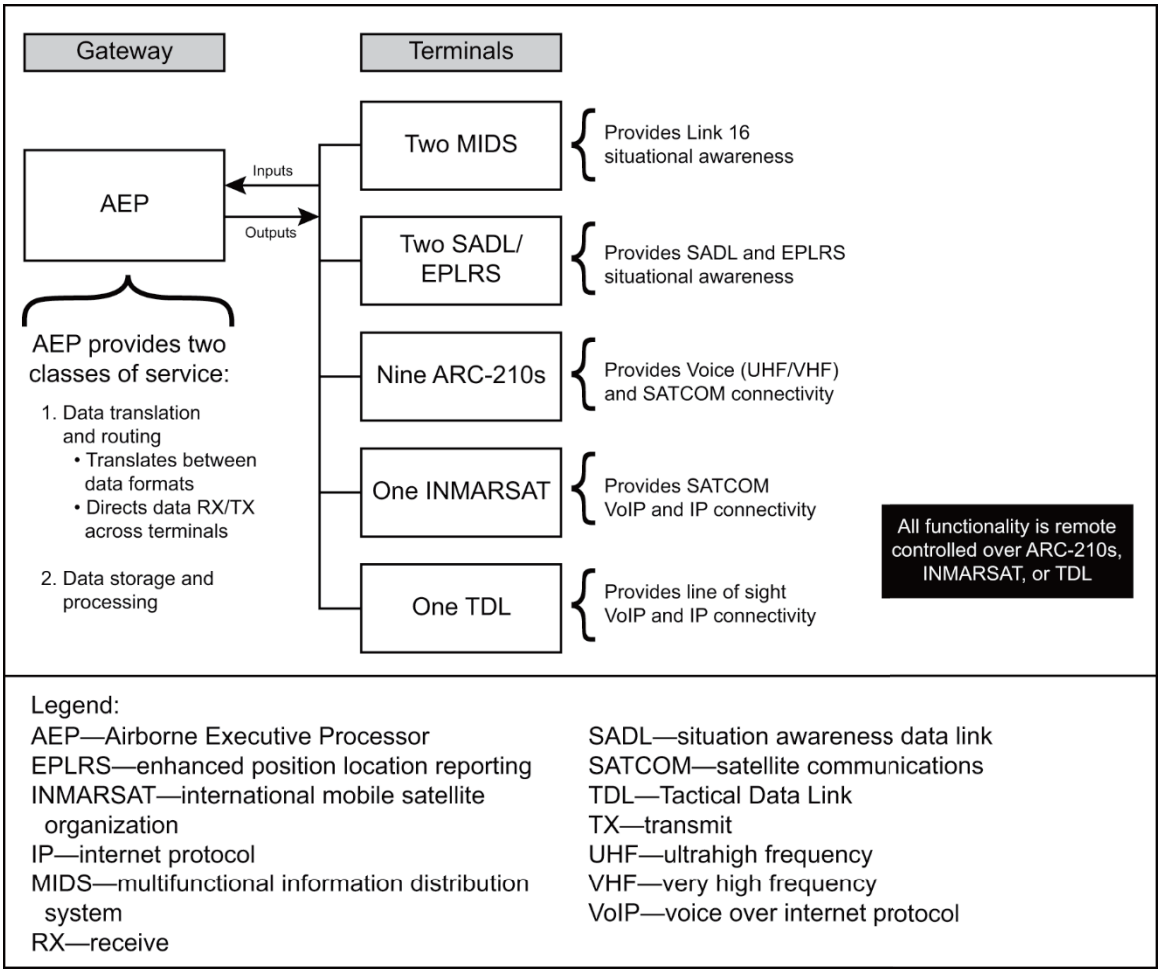


Figure 15. Battlefield Airborne Communications Payload

c. The BACN airborne payload communicates using:

(1) VHF/FM.

(2) UHF/amplitude modulation (AM).

(3) HQ I/II.

(4) SINCGARS.

(5) SADL.

(6) EPLRS.

(7) Link 16.

(8) INMARSAT Broadband Global Area Network.

(9) UHF demand assigned multiple access (DAMA) tactical SATCOM.

(10) TDL.

Note: BACN employs networking protocols over Joint Range Extension Application Protocol A and C to transport data using INMARSAT and TDL.

d. BACN Ground Support Systems.

(1) The Payload Control Element-Launch is BACN's local ground support system. It provides prelaunch support through preflight system checks, mission payload control, and mission status monitoring.

(2) The Payload Control Element-Mission is BACN's remote payload support system. It provides post-launch support through inflight system checks, mission payload control (dynamic frequency reconfiguration) and status monitoring.

3. Planning Considerations

a. Address the following questions when requesting BACN support through the joint tasking air strike request (JTAR), DD form 1972, as outlined in the theater SPINS.

(1) Will the request for BACN support be provided to ground or air assets?

(2) Where will support be provided in reference to established BACN orbits?

(3) What radio and link limitations are detrimental to your mission?

(4) What are the unit's limitations?

(5) What type of support is needed to accomplish the mission?

b. At a minimum, units should include the following details on all JTAR requests.

(1) Mission concept of operations.

(2) Mission impact and importance.

(3) Mission execution timeline (Zulu).

(4) Geographic location of supported units.

(5) Proposed communications plan, including specific frequencies to be bridged.

c. For requests more than 72 hours in advance, submit a JTAR through designated unit leadership channels to the Combined Air Operations Center (CAOC) BACN combat plans division liaison officer (LNO).

d. For support requests within the next 72 hours, submit a JTAR through designated unit leadership channels to the CAOC BACN combat operations division (COD) LNO. All JTARs will be prioritized in accordance with the combined force air component commander's (CFACC's) intent.

e. During mission execution, if issues develop with support provided and the requesting unit requires dynamic changes, contact the CAOC BACN COD LNO.

Note: Units requesting BACN support should use the mission planning considerations listed in table 5.

Table 5. Request For BACN Mission Support

Determine mission requirements.
Determine the geographic operational area.
Determine the terrain/range limitations.
Determine radio/link/crypto requirements.
Determine waveform use and align with BACN capabilities.
Complete and submit a JTAR (DD1972) through unit leadership channels up to the CAOC BACN CPD LNO.
Await approval of JTAR from the CAOC BACN CPD LNO.
Execute Mission.
Maintain contact with BACN Mission Coordinator for connectivity issues and dynamic re-tasking.
Post mission, debrief BACN mission coordinator; provide a complete MISREP.
Legend: JTAR—joint tasking air strike request CAOC—combined air operations center BACN—battlefield airborne communications node CPD—combat plans division LNO—liaison officer MISREP—mission report

4. Mission Capabilities and Employment Considerations

a. Voice Bridging and Extension. BACN provides up to four voice bridges using its nine ARC-210s for voice relay or extension between UHF and VHF frequencies. One radio is used for voice relay over SATCOM, providing a UHF to tactical satellite communications bridge. The E-11A can provide two separate SATCOM to UHF and VHF relay channels. The EQ-4B can provide one UHF SATCOM bridge. BACN also can connect UHF and VHF radios through its AEP, to its TDL system to relay voice over secure internet protocol voice.

b. TDL Bridging and Extension.

(1) BACN uses the AEP gateway to provide connectivity between the Link 16 and SADL networks to share the common tactical picture and data among J-series and variable message formats.

(2) BACN platforms can extend the Link 16, SADL, and EPLRS network. This provides a unified network facilitating data flow between different and geographically separated networks. This capability enables LOS and BLOS connections facilitating SA across an entire AOR.

(3) The airborne gateway planning must be accomplished with the joint interface control office (JICO) to ensure proper deconfliction between ground and airborne platforms performing gateway duties. Network waveform propagation characteristics and the mission operating area will determine where BACN platforms are located to support network data forwarding. To optimize LOS to the network users, BACN needs to be placed between the networks. Movement of the BACN orbits will be coordinated with control agencies, based on mission requirements.

Note: During orbit planning, terrain, user antenna location, and employment considerations, potentially, could affect low-altitude network users.

5. Post-Mission Analysis

All BACN missions are analyzed for mission effectiveness with results and findings collected through CAOC channels. Post-mission data is requested from the users, pilots, and operators during the mission debrief. This helps refine orbit locations and evaluate any problems that need to be addressed.

6. BACN Key Points of Contact

a. CAOC CPD BACN LNO. All JTARs will be forwarded, reviewed, and prioritized by the CAOC CPD BACN LNO for inclusion in the next day's ATO in accordance with CFACC intent.

b. CAOC COD BACN LNO. The CAOC CPD BACN LNO will monitor ATO execution. Any requests for BACN dynamic re-tasking will be coordinated with the CAOC COD BACN LNO.

c. BACN Mission Coordinator. The BACN mission coordinator is located in the payload control element-mission, responsible for technical operation of the payload control system, and directly responsible to the CAOC BACN LNOs. The BACN mission coordinator provides expertise in frequency management and voice bridging support/operations, while serving as the tactical data link subject matter expert to the LNOs.

d. United States Air Force Central Command (USAFCENT) BACN LNO. Any United States Central Command (USCENTCOM) requirements for the BACN system or aircraft will be coordinated through AFCENT for forwarding to ACC/A5, Directorate of Plans, Programs and Requirements.

e. ACC/A5JG. The ACC Fielded Gateways Branch manages requirements for the BACN system and aircraft.

Chapter VI
ULTRAHIGH FREQUENCY MILITARY SATELLITE COMMUNICATIONS (MILSATCOM) OVERVIEW

1. Introduction to UHF SATCOM

a. UHF MILSATCOM is the DOD's primary means of BLOS communications-on-the-move for tactical users. Its primary use is C2 by employing voice and data transmission. UHF MILSATCOM operates in the 225–400 MHz frequency range with narrowband MILSATCOM data rates of 64 Kbps and below. Legacy UHF SATCOM operates within 244–270 MHz with UHF uplink and downlink limited within the AOR. The next generation Mobile User Objective System (MUOS) Wideband Code Division Multiple Access (WCDMA) operates within 300–380 MHz, uses Ka uplink and is capable of global satellite relay communications.

b. SATCOM systems are comprised of three segments: space transport, ground, and user entry (radios/terminals).

(1) Space Transport. Satellite and satellite payload comprise space transport. Current satellite systems in operation are the legacy Fleet Satellite (FLTSAT), legacy UHF Follow-on (UFO), and MUOS. MUOS satellite payloads support 3G WCDMA and legacy MILSATCOM links. All MILSATCOM satellites can hosting 17 (each) 5 KHz and 21 (each) 5 KHz channels with a footprint between 65 degrees north and 65 degrees south latitudes. Figure 16 shows the UHF satellite locations currently used by the DOD.

(2) User Entry Segment. The user entry segment is comprised of all joint interoperability test command's (JITC's) certified radios accessing the MILSATCOM network. For the current and correct configuration approved for JITC certified terminals, users can access the JITC Web site at http://jitc.fhu.disa.mil/projects/ucdepot/index.aspx.

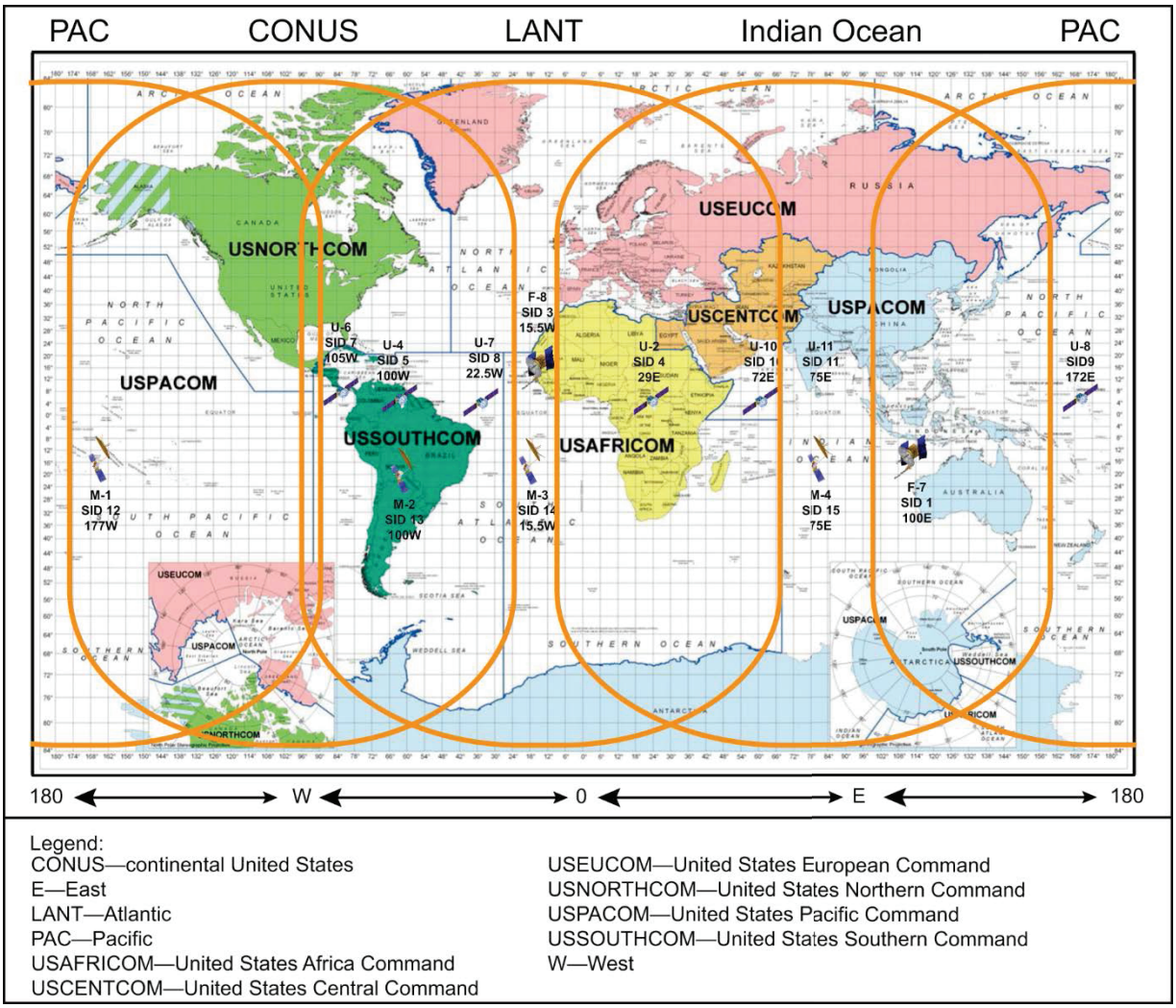


Figure 16. UHF Satellite Locations

(3) Ground Segment.

(a) The legacy ground segment consists of two parts, the signal control segment and the channel control segment. The signal control segment provides the satellite telemetry, tracking, and commanding for the Naval Satellite Operations Center. The channel control segment consists of the joint ultrahigh frequency military satellite communications network integrated (JMINI) Control System and integrated waveform control system (IWCS).

(b) Figure 17 depicts and explains each section of the MUOS ground segment. The ground segment is comprised of the ground transport segment, network management segment (NMS), ground infrastructure segment, and SCS.

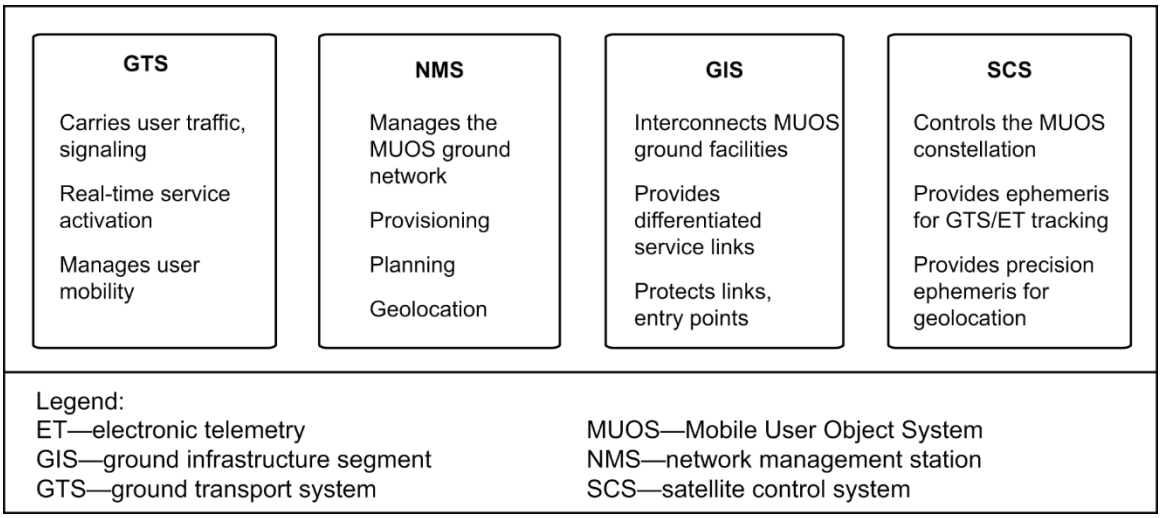


Figure 17. MUOS Ground Infrastructure

2. Limitations

UHF SATCOM operates on a narrowband spectrum and is limited to 64 Kbps and lower transmission rates. MUOS can support a maximum data transmission rate of 384 Kbps, but is limited to 64 Kbps per user. The legacy system's use of the narrowband spectrum makes it susceptible to a wide range of EMI. MUOS uses frequency masking and notching to increase UHF SATCOM WCDMA communications survivability against EMI conditions. MUOS's use of the Ka band for data transmission provides it low probability of intercept/low probability of detection.

3. Channel Control Systems.

Table 6 shows the four channel control sites that provide users access to legacy UHF SATCOM satellite channel resources.

Table 6. Channel Control Sites and AORs

Control Site	Location	AOR	
NCTAMS LANT	Norfolk, Virginia	CONUS	LANT
NCTS Naples	Capodichino, Italy	Indian Ocean	LANT
NCTAMS PAC	Wahiawa, Hawaii	PAC	CONUS
NCTS Guam	Finegayan, Guam	PAC	Indian Ocean

Note: NCTAMS PAC also hosts the MUOS Joint Enterprise Network Manager.

Legend:
AOR—Area of Responsibility
CONUS—continental United States
LANT—Atlantic
NCTAMS—Naval Computer and Telecommunications Area Master Station
NCTS—Naval Computer and Telecommunications Station
PAC—Pacific

4. Roles and Responsibilities.

a. This section covers the role and responsibilities for planners, terminal users, regional satellite communications support centers (RSSCs), the network management facility (NMF), and control sites. The NMF only supports the MUOS WCDMA operations.

b. The United States Strategic Command (USSTRATCOM) strategic instruction explains and expands roles and responsibilities regarding SATCOM.

c. Table 7 lists all the RSSC's and their AORs. The Global Narrowband Watch Office's (GNWO's) main tasks are UHF SATCOM global payload management, configuration management, and SA.

Table 7. RSSC and Responsibilities

RSSC	Phone	Email	Supports
RSSC West (Peterson AFB, Colorado Springs, Colorado)	312-692-4096 (DSN) 719-554-4096 (Commercial)	Usaf.peterson.afelm-cyber.mbx.rsscwest-narrowband@mail.smil.mil Usasmdcarstrat.rsscwest.narrowband@us.af.mil	Special Users, Strategic Warning/Intelligence, National and Strategic Force Direction, National Guard Bureau, NORAD, USNORTHCOM, USSTRATCOM, USTRANSCOM, DISA, Canada, and other authorized users as directed
RSSC East (MacDill AFB, Tampa Florida)	312-968-6840 (DSN) 813-828-6840 (Commercial)	Rssc-conus.narrowband@amc.af.smil.mil Rssc.conus@us.af.mill	USCENTCOM, USSOCOM, USSOUTHCOM, and Other authorized users as directed
RSSC Europe (Patch Barrack, Stuttgart, Germany)	314-434-5843 (DSN) 324-434-5843 (VoIP)	Usarmy.stuttgart.smdc.mbx.rssc-eur-narrowband@mail.mil Usarmy.stuttgart.smdc.mbx.rssc-eur-narrowband@smil.mail.mil	USAFRICOM, USEUCOM, Denmark, Italy, Luxembourg (includes Belgium), Netherlands, United Kingdom, and other authorized users as directed
RSSC Pacific (Wheeler Army Air Field, Hawaii)	315-456-0582 (DSN) 808-656-0582 (Commercial)	Usarmy.wheeler.smdc.mbx.rssc-pac@mail.smil.mil Usarmy.wheeler.smdc.mbx.rssc-pac@mail.mil	USPACOM, Australia, New Zealand, and Other authorized users as directed

Legend:
AFB—Air Force Base
DISA—Defense Information System Agency
DSN—Defense Switched Network
NORAD—North American Aerospace Defense Command
RSSC—regional satellite communications support center
USAFRICOM—United States Africa Command
USCENTCOM—United States Central Command
USEUCOM—United States European Command
USNORTHCOM—United States Northern Command
USPACOM—United States Pacific Command
USSTRATCOM—United States Strategic Command
USTRANSCOM—United States Transportation Command
USSOCOM—United States Special Operations Command
USSOUTHCOM—United States Southern Command
VoIP—voice over internet protocol

5. UHF SATCOM Access

a. Legacy UHF SATCOM. Legacy UHF SATCOM uses the FLTSAT, UFO and the MUOS legacy payload satellites.

(1) Demand assigned single access (DASA), commonly known as dedicated services, assigns all terminals operating on a network, one exclusively assigned uplink RF paired with one downlink frequency. Each station has a unique station identifier used to identify it to other station operators within the network. One station within the network is designated as a NCS to supervise and authenticate all ground terminals' entry and exit.

(2) Time division multiple access (TDMA) is mandated as the primary service by the Chairman Joint Chiefs of Staff Instruction (CJCSI) 6250.01A to maximize using limited channel resources.

(3) DASA provides one voice and data circuit on a single 5 KHz channel. The 25 KHz DAMA supports up to five 2.4 Kbps data or voice services per 25 KHz channel. The following are DAMA service types.

(a) Pre-assigned. Pre-assigned is a shared timeslot dedicated to one network. One set of users with a common or private guard network address has exclusive access to this timeslot.

(b) Ad Hoc. Ad hoc is a PTP, terminal base address (TBA)-to-TBA, TBA-to-common, or private guard network connection that establishes a private connection between two or more stations in one timeslot.

(c) Multiple Hop (M-HOP). M-HOP is a 5 KHz circuit that can be established between two radios physically located in two different satellite footprints. M-HOP provides data transmission outside a single satellite's LOS. The inherent data hopping signal delay can impair voice communication.

(4) Integrated Waveform (IW). IW serves as an interim capability prior to MUOS WCDMA fielding. IW improves the use of TDMA when compared to DAMA services.

b. MUOS WCDMA.

(1) MUOS is capable of worldwide communications services using commercial 3G Spectrally Adaptive Wideband Code Division Multiple Access (SA-WCDMA) cellular technology, modified for MILSATCOM. The MUOS ground infrastructure interfaces with the DODIN via DOD teleports, to provide access to the Defense Information System Network services to include; NIPRNET and SIPRNET.

(2) MUOS SA-WCDMA Interference Mitigation Techniques.

(a) These have lower power spectral density than a traditional narrowband waveform.

(b) The closed loop, power control system adjusts the power levels for ground and satellite transmitters. This enables the terminals to use the minimum power output necessary to maintain signal strength and quality of service.

(c) Using dynamic scanning and the adaptive notching algorithm, MUOS can detect the presence of terrestrial users in the uplink transmit channel and mask the MUOS waveform. Each carrier's composite mask consists of an operational mask, radio access node (RAN) mask, and local mask.

- The operational mask utilizes pre-determined fixed masks approved by international, national, and host nation policies. Because of the spectrally adaptive characteristics of MUOS, this type of notching should be kept to a minimum if not altogether avoided.
- The RAN mask is composed of two parts, the dynamic mask and supplemental mask. The dynamic mask RAN excision mask is determined within the ground terminal equipment. The supplemental mask is provided by NMS to each RAN.
- The local mask is a form of dynamic notching and automatic function of the satellite. The satellite scans the MUOS transmit channel to detect the presence of local UHF terrestrial users that could be impacted by the MUOS uplink transmissions. Once a terrestrial user is identified, the satellite masks the portions of the MUOS spectrum that could interfere.

(d) Once the frequency manager approves a frequency profile, it will be included in the terminal profile, and available for selection during terminal provisioning. An approved frequency profile is given a version number and is associated with a region set.

6. UHF SATCOM Management Tools

a. Joint Satellite Communications Management Planning System (JSMPS). The JSMPS is a SIPRNET-based, web-enabled SATCOM management and planning tool used to submit and receive MUOS terminal profiles and track, manage, and display critical DOD SATCOM data providing SA of SATCOM payloads. The JSMPS UHF application stores, processes, and provides access to extensive data regarding DOD use of UHF SATCOM. This includes constellations, platform configuration, frequency plans, frequency channelization, resource apportionment, resource allocation, scheduled usage, and user assignments. It also provides an automated and standardized up-channel reporting and tracking mechanism for documenting, resolving, and reporting EMI, and electronic attack events. The application is accessible via SIRPNET at: https://jsmps.jsme.stratcom.smil.mil.

b. Joint Integrated Satellite Communications Tool (JIST). The JIST is the SIPRNET, automated tool used to submit satellite access requests (SARs) and MUOS group requests to the RSSC via the user's authorizing command. The user is provided information on the progress of the SAR and issuing of the satellite access authorization (SAA). Submitting a gateway access request (GAR) and issuing a gateway access authorization (GAA) are not part of the JIST. GAR is submitted via email to the regional Defense Information Systems Agency contingency and exercise (CONEX) element. The CONEX works with the RSSC to process the GAR into a GAA. The requestor is informed of the GAA via email. JIST is accessible via: https://jist-jsme.stratcom.smil.mil/jist.

c. Joint Enterprise Network Management Tool. The Joint Enterprise Network Management Tool is the standard, online, SIPRNET-based application to provide information to the Mobile User Objective System capable terminals (MCTs). The online application is hosted by Naval Computer and Telecommunications Area Master Station (NCTAMS) Pacific (PAC), but can be ported onto a workstation or laptop to support deployed operations.

d. NCTAMS Daily 2301 Messages. NCTAMS Daily 2301 messages are published by NCTAMS LANT and NCTAMS PAC. The messages list all active UHF SATCOM services being provided by the control sites including the frequency pairs, appropriate keymat segments, and active and expiration dates.

(1) NCTAMS PAC: http://www.pr.cas.navy.smil.mil/navy/30/site.nsf/.

(2) NCTAMS LANT: http://www.fleetforces.navy.smil.mil/netwarcom/nctams/default.aspx.

7. Legacy Service Communications Planning

a. General. SAR must reach the servicing RSSC 30 days prior to the required date of the mission (see table 7). With the 30-day requirement, planners using JIST must submit the SAR through their validation authority 45 days prior to mission need. Table 8 is the comparison between DAMA and IW user guide when requesting legacy SATCOM channel resources. Use appendix K (which is a copy of the CJCSI 6250.01A appendix A to enclosure D) to determine the SATCOM priority and precedence.

b. The Need for SATCOM. During the planning process, establish the need for UHF SATCOM through accurate and defensible mission analysis including, the consideration of a signal intelligence risk assessment. Figure 18 depicts the standard communications planning cycle for determining if UHF SATCOM service is required.

c. Assess Force Structure Requirements.

(1) Determine the mission's UHF SATCOM requirements in accordance with the planning guidance (i.e., OPTASKs, OPORD Annex K).

(2) Evaluate the network purpose and period, need to exchange information, geographic coverage, information, data rate, and the terminal equipment for all participants.

(3) Validate mission requirements against an established satellite database entry.

Table 8. DAMA versus IW			
Capabilities	**DAMA**	**IW**	**Remarks**
Voice Coder/ Decoder	LPC-10	MELP 2.4	MELP is the new standard. Much cleaner and clearer quality.
Services 25 KHz	Supports 5, 2.4 Kbps voice and data services per 25 KHz channel	Supports up to 17, 2.4 Kbps voice and data services per 25 KHz channel	
Services 5 KHz	Supports 1, 2.4 Kbps voice or data service per 5 KHz channel	Supports 3, 2.4 Kbps voice and data services per 5 KHz channel	
1.2 Kbps MELP Voice	Does not support it	Supports up to 32, 1.2 Kbps MELP voice services per 25 KHz channel	Only the PRC-117G, and PRC-152 and 152A are currently 1.2 MELP capable
3 dB Link	No	Yes	
Asynchronous Data Transfer	19.2 Kbps maximum using the entire 25 KHz channel	56 Kbps maximum per 25 KHz channel with excess resources to support 3, 2.4 Kbps voice services	32 Kbps transmission is the standard transmission rate for IW
Service Type(s) Supported	Preplanned pre-assigned; demand assigned	Preplanned, pre-assigned; preplanned, demand assigned; demand assigned	
Support Common Integrated Broadcast Support	No	Yes	IBS has transitioned to CIB
Modulation Technique	Phase-shift keying	CPM	CPM is more efficient enabling use of higher burst rates
Channel Control System	Obsolete, needs technology refresh	New; HBSS, Windows, and Assured Compliance Assessment Solution compliant	
Legend: CIB— Common Interactive Broadcast CPM—continuous phase modulation DAMA—demand assigned multiple access dB—decibel HBSS—Host Base Security Subsystem Kbps—kilobits per second KHz—kilohertz IBS—Integrated Broadcast Service IW—integrated waveform MELP—Mixed Excitation Linear Predictive			

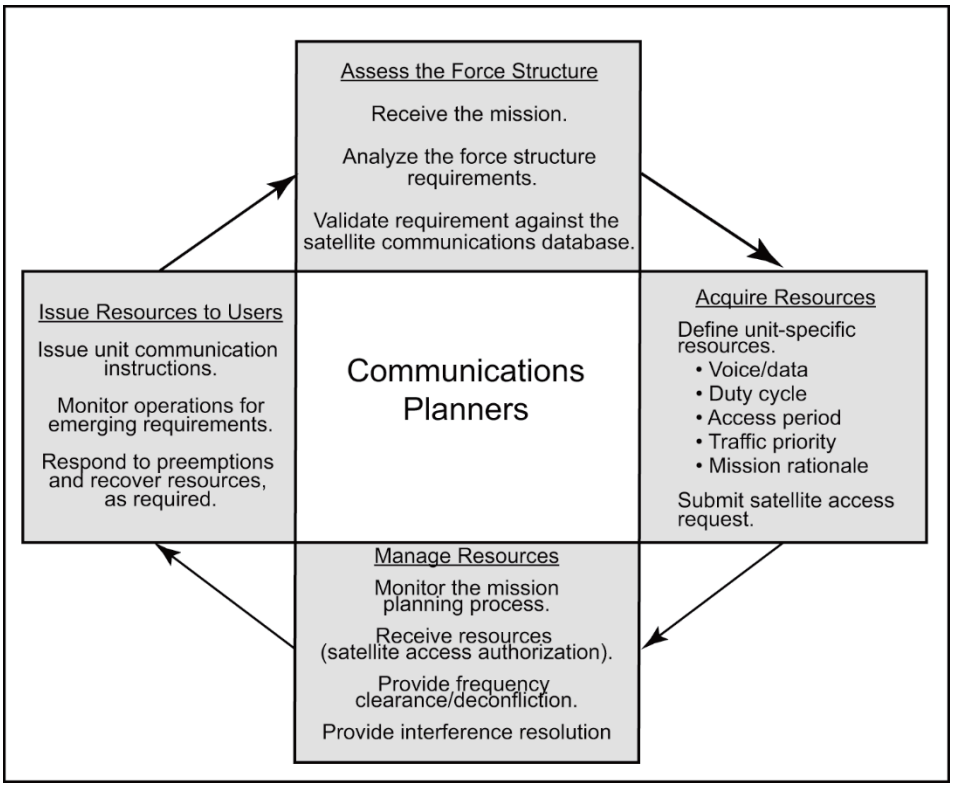


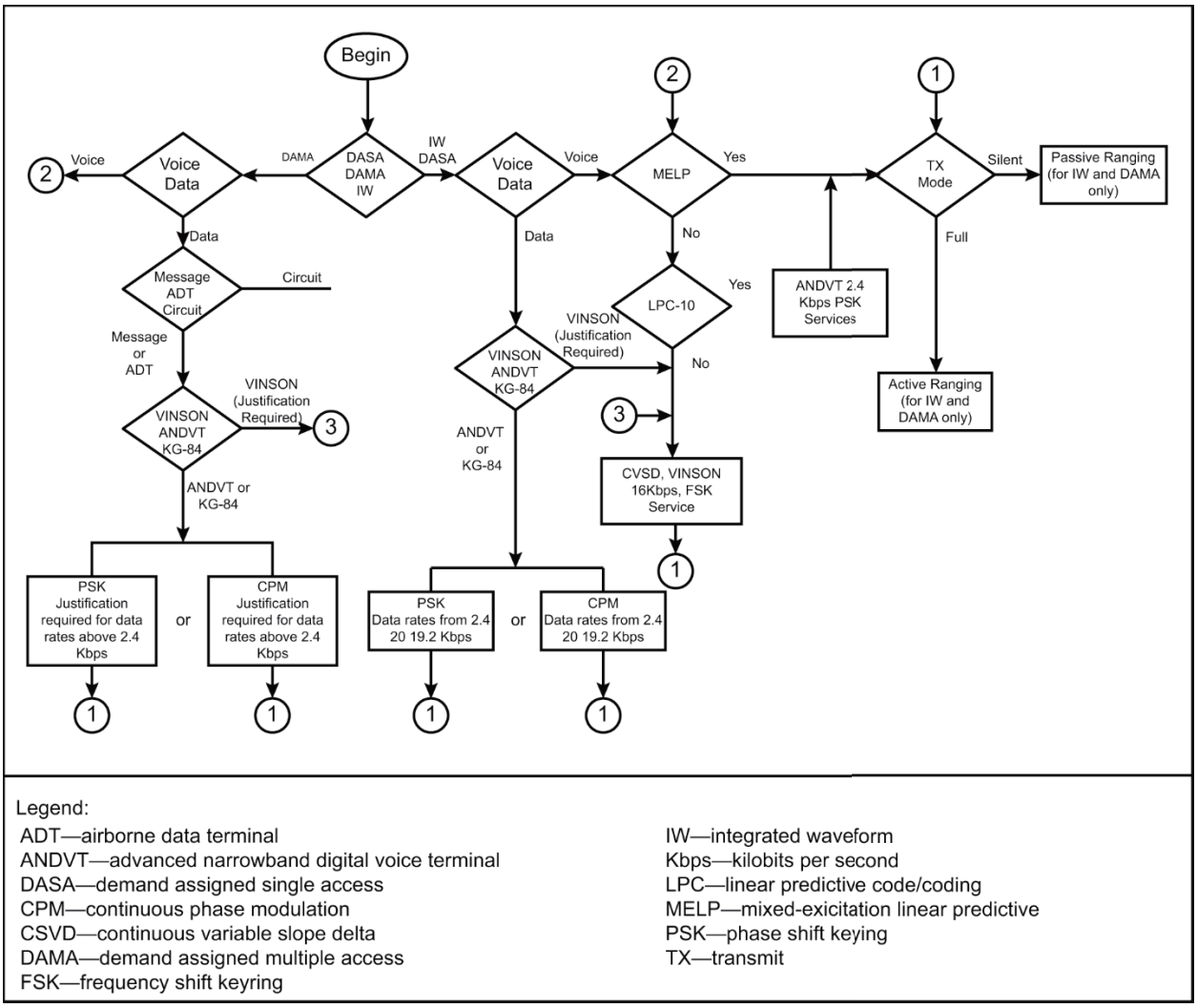
Figure 18. Communications Planning Cycle

d. Legacy UHF SATCOM. The CJCSI 6250.01A mandates the use of TDMA for all legacy users of unprocessed, narrowband transponders. Figure 19 depicts the user planning flowchart for requesting dedicated, DAMA, and IW service encryption standards.

(1) Advanced narrowband digital voice terminal (ANDVT) is used for voice and data communications encryption with data rates from 1.2 or 2.4 Kbps within the 5–25 KHz channels in IW, DAMA, or dedicated mode.

(2) KG-84 encryption is used for data communications encryption with data rates from 75 bps-56 Kbps. KG-84 encryption enables data input/output (I/O) rates up to 9.6 Kbps on 5 KHz dedicated channels and up to 56 Kbps on 25 KHz dedicated channels.

(3) VINSON VHF/UHF Wideband Tactical Secure Voice System Cryptographic Equipment encryption is used for voice and data communications encryption at 16 Kbps. It is used with 25 KHz channels, in IW, DAMA, or dedicated mode (with a 16 Kbps timeslot).



Legend:

ADT—airborne data terminal
ANDVT—advanced narrowband digital voice terminal
DASA—demand assigned single access
CPM—continuous phase modulation
CSVD—continuous variable slope delta
DAMA—demand assigned multiple access
FSK—frequency shift keyring
IW—integrated waveform
Kbps—kilobits per second
LPC—linear predictive code/coding
MELP—mixed-exicitation linear predictive
PSK—phase shift keying
TX—transmit

Figure 19. UHF SATCOM Legacy Services Planning Flowchart

e. Voice Coder/Decoder (VOCODER). The following paragraphs discuss three voice coder/decoders.

(1) Mixed Excitation Linear Predictive (MELP). The MELP is the secure voice standard and should be the first choice, if mission allows. The MELP uses ANDVT encryption and can be used for 5 KHz and 25 KHz channels in IW, DAMA, or dedicated mode.

(2) Linear Predictive Coding (LPC). The LPC provides the lowest voice quality of the three voice coder/decoders. The LPC operates at 2.4 Kbps using ANDVT encryption and can be used for 5 KHz and 25 KHz channels in IW, DAMA, or dedicated mode.

(3) Continuously Variable Slope Delta (CVSD). CVSD provides good voice quality, but requires a high bandwidth of 16 Kbps. CVSD uses VINSON VHF/UHF Wideband Tactical Secure Voice System Cryptographic Equipment encryption in IW, DAMA, or dedicated mode.

f. Data Rate Selection.

(1) KG-84 encryption accepts I/O data rates of: 75, 300, 600; 1,200, 2,400, 4,800; 6,000, 7,200, 8,000, and 9,600 bps; and 16, 19.2, 28.8, 32, 38.8, 48, and 56 Kbps.

(2) ANDVT encryption accepts I/O data rates of 1.2, 2.4, and 16 Kbps using VINSON encryption.

g. Data Mode.

(1) The data mode circuit service, assigns users a timeslot in each frame that accommodates fixed data rate transfers with relatively low throughput delays.

(2) Asynchronous data transfer provides IW users a specific channel and timeslot with an adaptive link layer protocol to establish flexible transmission burst parameters and allows user-to-user communications at a variable or fixed burst rate.

h. Modulations.

(1) Continuous phase modulation (CPM) is a phase-only modulation technique used for data transfer at various rates on 5- and 25-KHz channels.

(2) Frequency shift keying (FSK) is FM, discretely controlled by the transmitted information bits used with VINSON encryption.

(3) Phase shift keying (PSK) is a digital modulation scheme used for voice and data on 5- and 25-KHz channels with data rates from 75 bps-16 Kbps.

i. Ranging.

(1) Active Ranging. A terminal estimates its range to a satellite by transmitting and receiving its own burst.

(2) Passive Ranging. A terminal determines its range to a satellite by GPS data, satellite ephemeris data, or frame timing.

j. Access Period is a coordinated universal date-time group of start and stop access dates with specific periods of use per day.

k. Duty Cycle is the percentage of a 24-hour day the user requests circuit access.

(1) Low: 1–2 hour access per 24-hour period.

(2) Medium: 2–8 hour access per 24-hour period.

(3) High: 8 hours or more access per 24-hour period.

l. TBA. A TBA identifies the radio on the network and in the JMINI. DAMA capable terminals must have a valid, unique TBA assigned to operate in a TDMA network. For radios with more than one port, additional addresses are required and are listed as port addresses. The US Navy's Space and Naval Warfare Systems Command Atlantic assigns all TBAs and port addresses.

(a) A TBA is always assigned to port 1 of the terminal. Multiport terminals have a port address for each port above port 1.

(b) A TBA cannot be duplicated among terminals. The channel controller assigns different operating characteristics to the TBAs based on the terminal type.

(c) Input/output port address (IOPA) is similar to a telephone number and allows the terminal to initiate (dial) a data or voice service with another compatible terminal. Request an IOPA for every terminal port to ensure maximum flexibility and application. Table 9 indicates which IW functions need an IOPA. The IOPA assignment process is depicted in figure 20.

Table 9. IOPA IW Needs

Desired IW Function/Capability	IOPA	Number of additional IOPAs needed
Participation in a preplanned pre-assigned network	No	0
Participation in a preplanned network that has been activated on-demand by another user	No	0
Logging into the demand-assigned system to be discoverable to other users when they are seeking your participation in current or new services	Yes	0
Activating a preplanned network on-demand	Yes	0
Requesting another (logged-in) user joins the current network	Yes	1
Establishing an ad hoc point-to-point call	Yes	1
Establishing an ad hoc conference call	Yes	2–12

Legend:
IOPA—input/output port address IW—integrated waveform

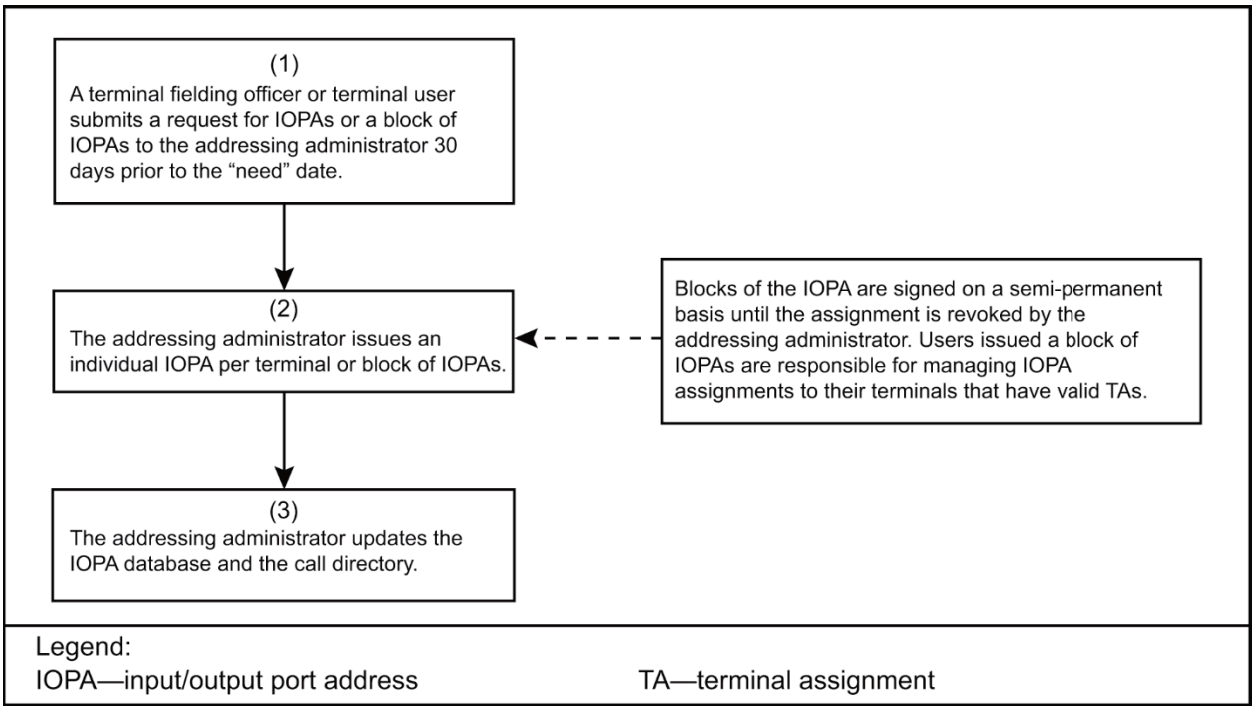


Figure 20. IOPA Assignment Flowchart

m. Network Type.

(1) Common Network (DAMA only) is a network guard address without a designated list of access-permitted terminals. Any terminal may participate if the network guard address is on the guard list and it uses the configuration code assigned to the address.

(2) Private Network (DAMA only) is a network guard address with a designated Z-access list of access-permitted terminals. This is the standard network for 5 KHz DAMA. A maximum of 64 TBAs are assigned to the network and designated in the SAR as participants. Any terminal can initiate the network for a call or service, and any service is available to the network. A 25 KHz DAMA private network is limited to 64 TBAs and must be listed in the SAR as participants.

8. MUOS WCDMA Service Planning

a. MUOS WCDMA provides three distinct services; PTP, group, and point to network (PTN).

(1) PTP Service. PTP provides a global IP-based, full-duplex terminal-to-terminal communications link. PTP communications are allocated on an ad hoc basis and do not require an operator to submit a SAR. PTP resource availability is established based on a terminal's precedence assigned during initial terminal provisioning. Defense Switched Network secure and unsecure calls are available with PTP service.

(2) Group Service. Group service is similar to legacy netted communications and require a SAR prior to mission start.

(3) PTN Service. PTN service is the standard MUOS configuration. It provides terminal access to DODIN services. PTN services require a SAR and GAR submission.

b. MUOS WCDMA Mission Planning and Provisioning.

(1) MUOS WCDMA allocations are dynamically managed in real time. A unit is required to submit provisioning and group requests 45 days prior to the mission start date. Figure 21 depicts the MUOS mission planning workflow, and figure 22 depicts the provisioning best practice workflow used to prepare the terminal for operations.

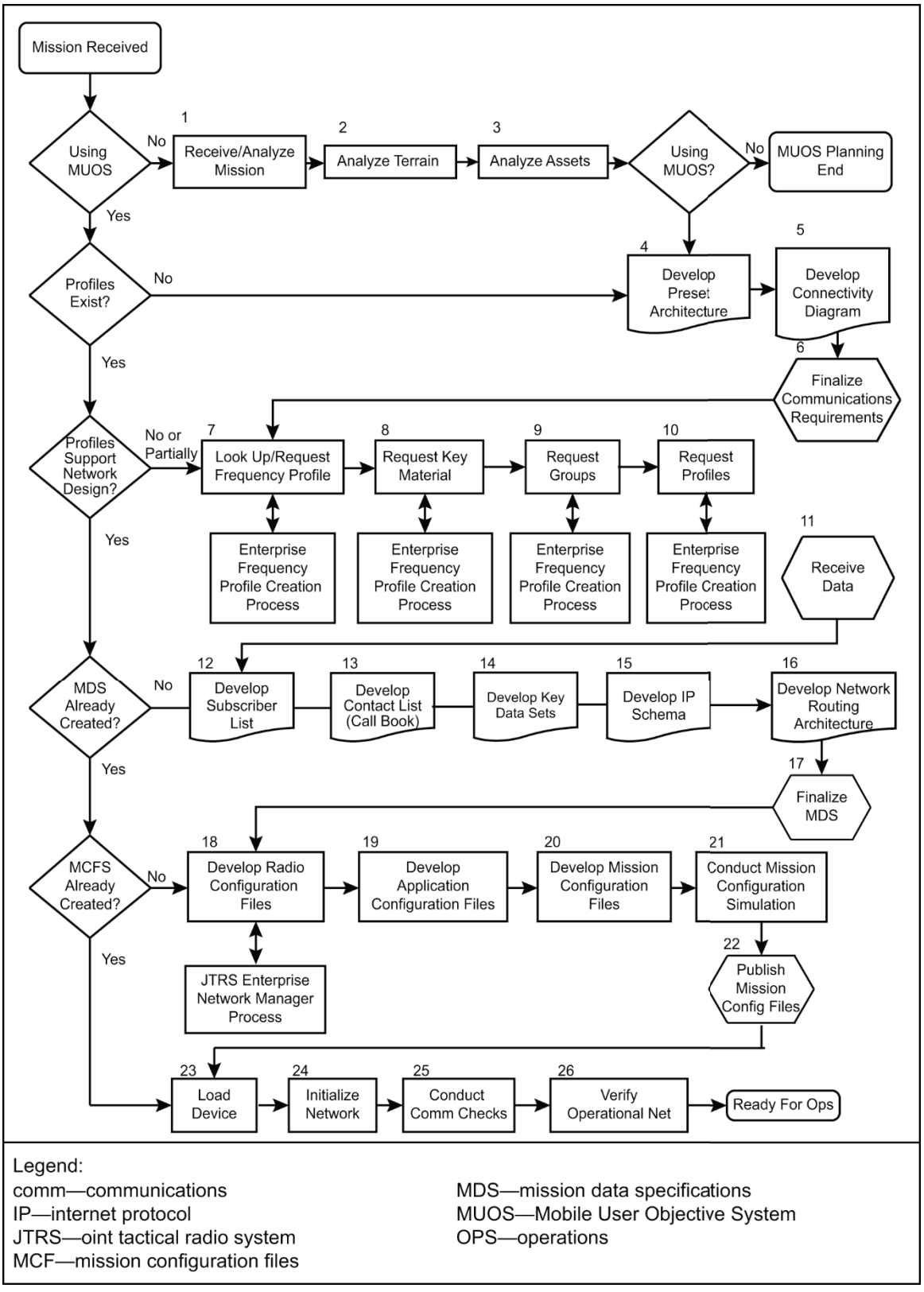
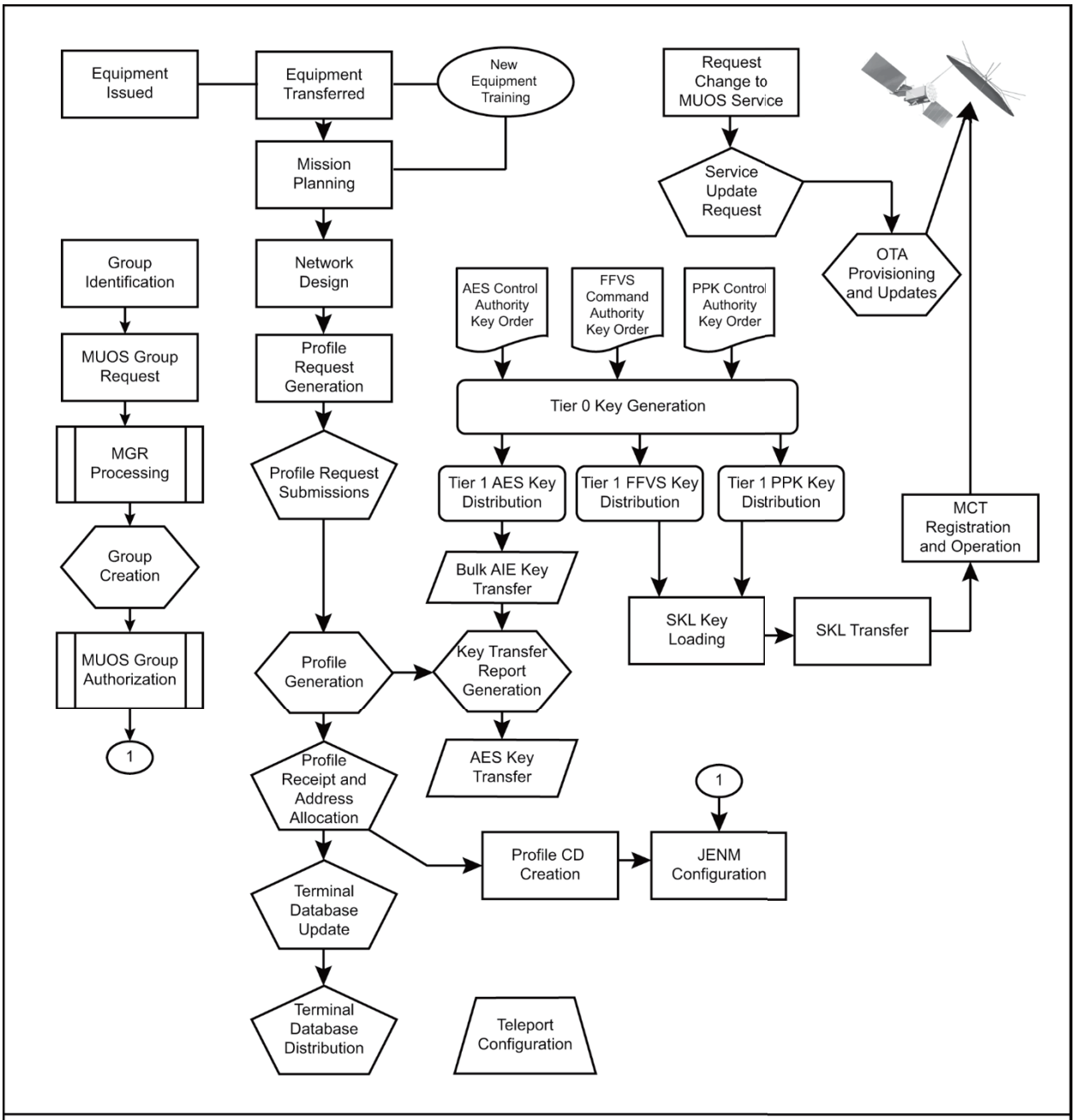


Figure 21. MUOS Mission Planning Workflow



Legend:
AES—advanced encryption standard
AIE—automated installation entry
CD—compact disc
JENM—joint enterprise network manager
MCT—mobile user objective system capable terminal
MGR—manager
MUOS—Mobile User Objective System
OTA—over the air
PPK—pre-placed key
SKL—Simple Key Loader

Figure 22. MUOS Provisioning Best Practice Flowchart

(2) Once a user activates a provisioned MCT and the FP ID number is assigned, the MCT is ready for operations.

(3) Peer-to-peer and PTN users can activate the terminal once the MCTs are provisioned and SAA is received.

Note: Figure 23, which shows the MUOS provisioning process, should be viewed with figure 22. Mission planners and units are responsible for Steps 1, 2, and 6.

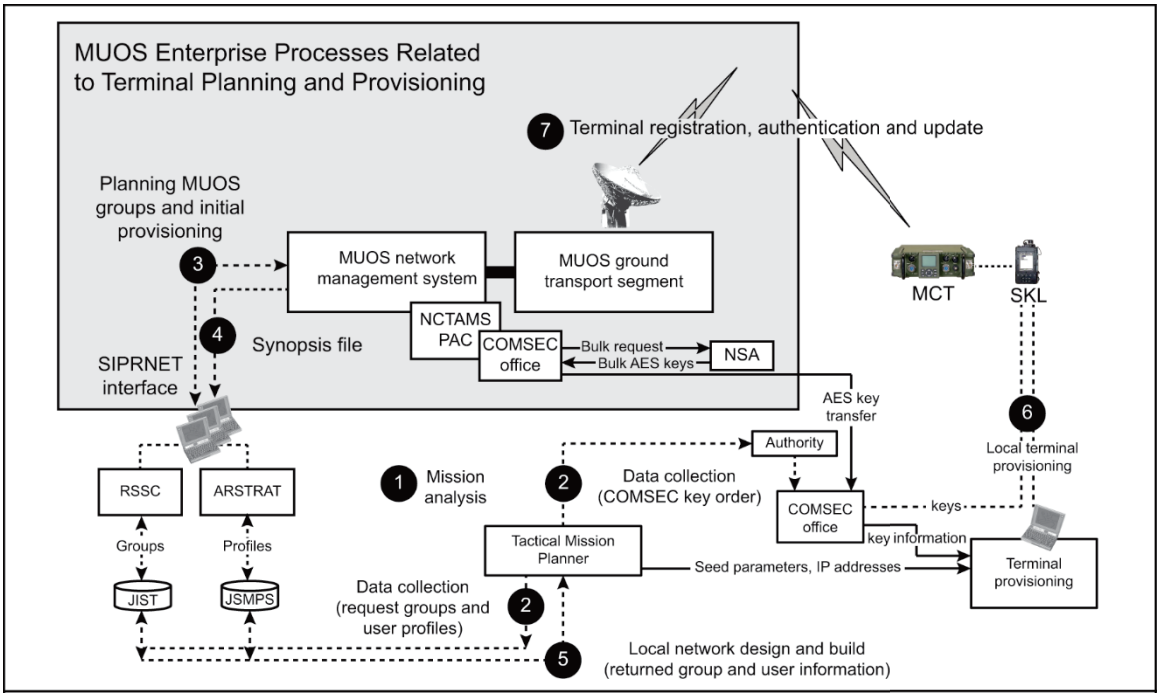


Figure 23. MUOS Provisioning Process

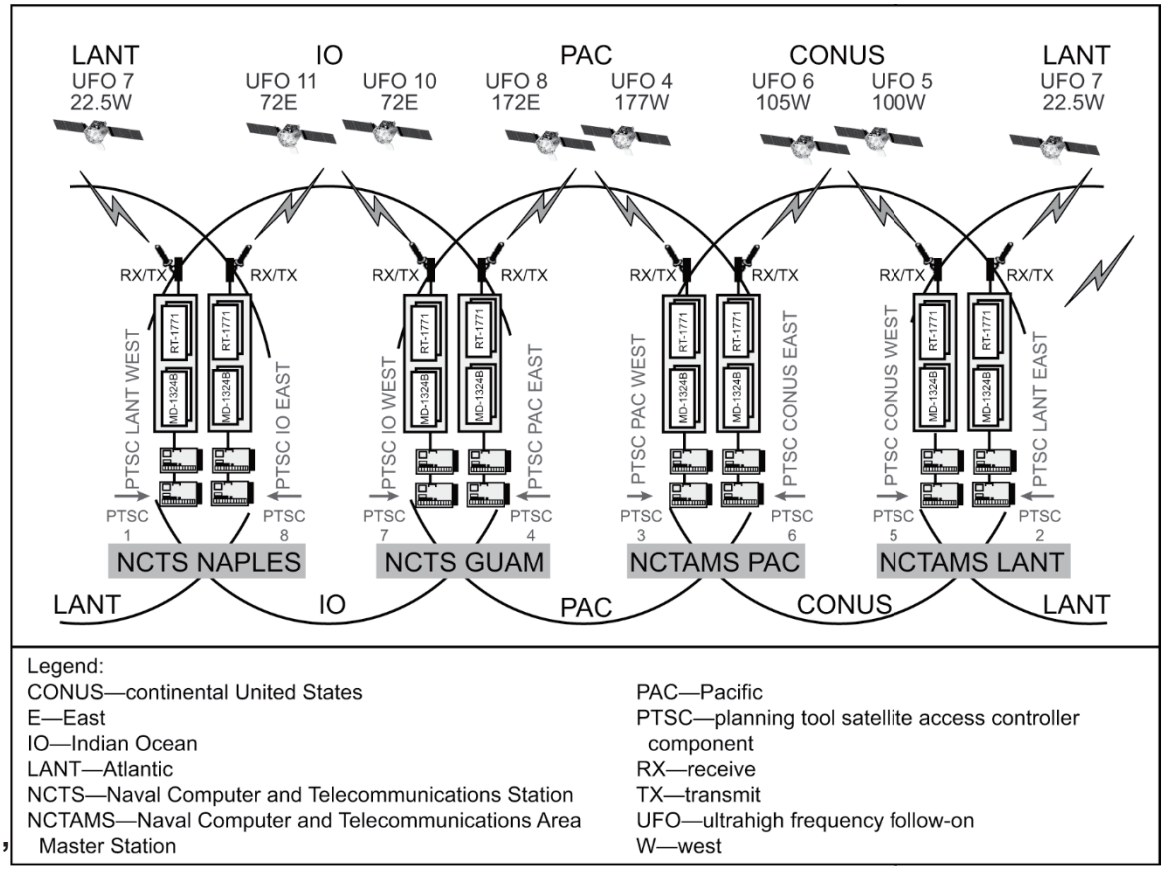
9. Order Wire (OW) Key Management

There are four satellite coverage areas, each with a unique OW key shared by IW and DAMA. Table 10 outlines the OW controller, footprint, and key position. The requesting activity must specify the coverage area for the OW key. The COMSEC custodian receives a message identifying the authorized weekly key segment.

Table 10. OW Key Positions at the Control Sites		
DAMA Controller	**Footprint**	**NCTAMS Key Position**
NCTAMS LANT	Continental United States	0 and 1
NCTS Naples, Italy	LANT Mediterranean	2 and 3
NCTAMS PAC	PAC	2 and 3
NCTAMS Guam	Indian Ocean	0 and 1
Legend: DAMA—demand assigned multiple access LANT—Atlantic NCTAMS—Naval Computer and Telecommunications Area Master Station NCTS—Naval Computer and Telecommunications Station PAC—Pacific		

10. Establishing a SATCOM Link

a. Calculate the antenna azimuth and elevation needed to establish a connection with the satellite identified in the SAA. Figure 24 lists the UHF SATCOM satellite orbital locations. Appendix L outlines how to calculate the antenna's azimuth and elevation based on the geographical locations of the ground terminal.



Legend:
CONUS—continental United States
E—East
IO—Indian Ocean
LANT—Atlantic
NCTS—Naval Computer and Telecommunications Station
NCTAMS—Naval Computer and Telecommunications Area Master Station
PAC—Pacific
PTSC—planning tool satellite access controller component
RX—receive
TX—transmit
UFO—ultrahigh frequency follow-on
W—west

Figure 24. IW Control Sites Locations and Satellites

b. To avoid cosite interference, maintain the maximum distance possible from other RF sources or antennas, based on the radio's power, antenna, and access type. Refer to table 11 for recommended antenna cosite separation (MUOS WCDMA does not have these limitations).

Table 11. Recommended Antenna Separation for Co-located Radios	
Power Output	**Recommended Antenna Separation**
50-watt vehicular amplifier adapter	100 feet
20 watts	50 feet
15 watts	40 feet
10 watts	30 feet
8 watts	15 feet

c. Confirm the following prior to activating any ground terminal.

(1) COMSEC and TRANSEC, are loaded in the proper key positions.

(2) The OW key and position are correct (check table 10).

(3) Programmed channel settings are correct.

(4) Home channel, frequency pair, uplink, and offset frequencies are accurate by using appendix M.

(5) Communications mode, normal, silent, or emission control is accurate.

d. Perform the following prior to activating and accessing a DAMA channel.

(1) Confirm the channel type is 5 KHz or 25 KHz.

(2) Compare TBAs with assigned maximum precedence and network guard addresses. Refer to appendix N for a DAMA terminal setup example.

(3) Consult appendix O which defines all information request codes the user may receive through the terminal's OW.

e. Perform the following prior to activating and accessing IW channels.

(1) Confirm the channel type is 5 KHz or 25 KHz.

(2) Determine the service number and satellite identification (SATID).

(3) Confirm the terminal's IOPA.

(4) Confirm the voice mode and data rate.

(5) Consult appendix P for IW quick reference, setup instructions.

f. Consider the following compatibility issues.

(1) DAMA-IW Communications. IW services can be inserted into a DAMA channel. DAMA services cannot be inserted into an IW channel. DAMA-IW communication requirements must be specified on the SAR and established by the supporting RSSC.

(2) Voice Coder/Decoder Compatibility. MELP and LPC-10 are not compatible. A terminal using the LPC-10 cannot decrypt a MELP signal. A terminal using MELP can decrypt the LPC-10 signal.

Note: Current teleport equipment does not support IW M-HOP.

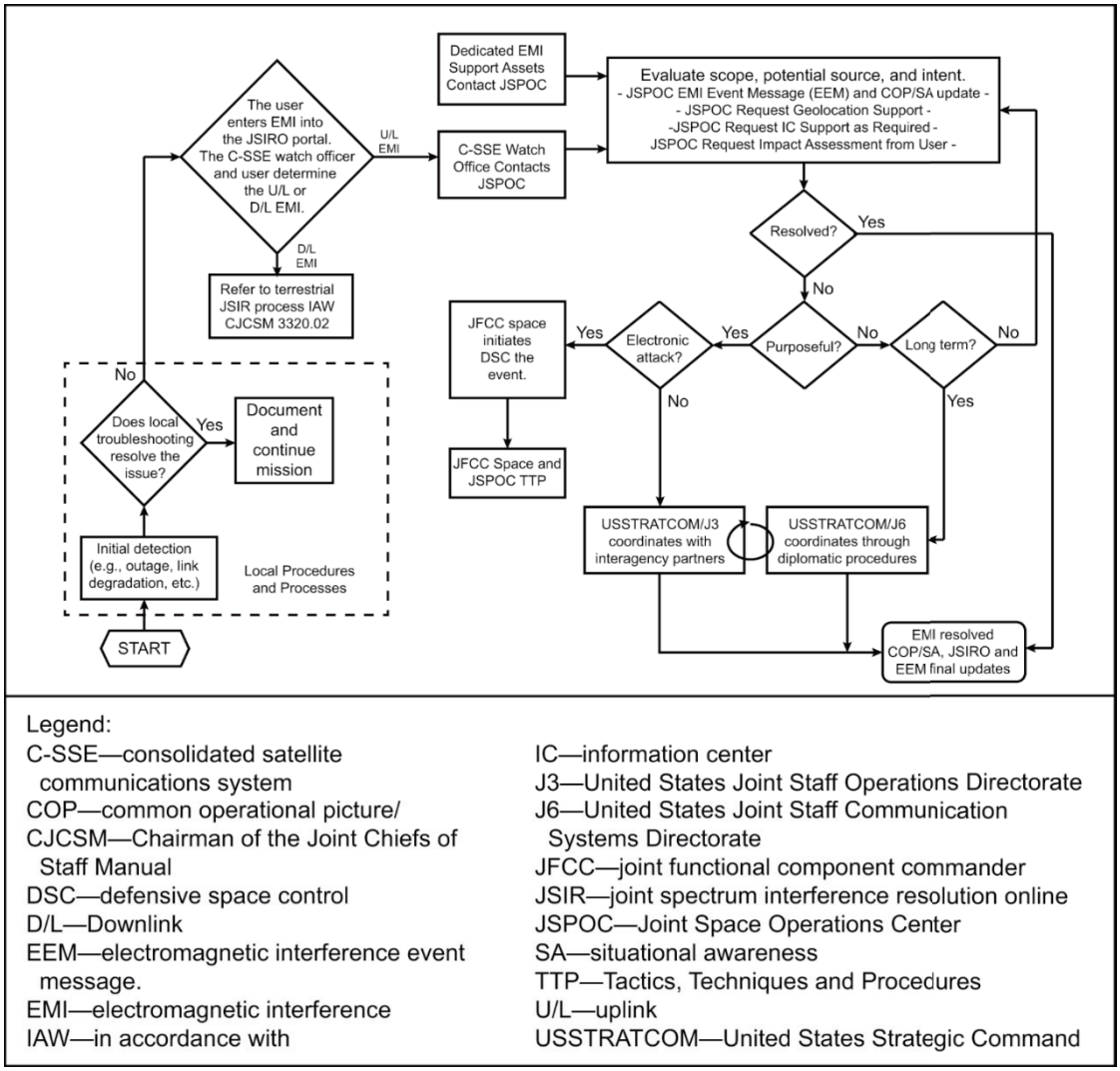
11. After Action Report

Each unit involved in a UHF SATCOM mission will submit an after action report to the RSSC upon mission completion. Units using UHF SATCOM systems must maintain a

master station log to document mission information and details critical to developing the after action report. At a minimum, the master station log must contain the activation date and time, deactivation date and time, reported problems, problem resolution descriptions, and the name or initials of the person making the entry. The after action report will provide RSSC resource managers information to analyze communication outages and trends.

12. EMI

This section defines local or regional processes, procedures, or organizational directives used to detect, characterize, geolocate, and resolve EMI or suspected EMI. All UHF SATCOM EMI resolution procedures are governed by the Chairman, Joint Chiefs of Staff Memorandum 3320.02, Joint Spectrum Interference Resolution (JSIR) Procedures. Figure 25 depicts the EMI Resolution Process as per US Strategic Command Strategic Instruction 714-4, *Consolidated Satellite Communications Management Policies and Procedures.*



Legend:

C-SSE—consolidated satellite communications system
COP—common operational picture/
CJCSM—Chairman of the Joint Chiefs of Staff Manual
DSC—defensive space control
D/L—Downlink
EEM—electromagnetic interference event message.
EMI—electromagnetic interference
IAW—in accordance with
IC—information center
J3—United States Joint Staff Operations Directorate
J6—United States Joint Staff Communication Systems Directorate
JFCC—joint functional component commander
JSIR—joint spectrum interference resolution online
JSPOC—Joint Space Operations Center
SA—situational awareness
TTP—Tactics, Techniques and Procedures
U/L—uplink
USSTRATCOM—United States Strategic Command

Figure 25. EMI Resolution Process

a. EMI Resolution Phases. EMI resolution consists of detection, ID, verification, characterization, geolocation, and resolution.

(1) Detection, ID, and Verification. A SATCOM link outage or impairment will trigger local troubleshooting and restoral procedures to rule out non-EMI causes (e.g., operator error, defective equipment, invalid frequency assignments, etc.) prior to reporting the EMI.

(2) Characterization. The operator must determine and gather data on the EMI spectral qualities (e.g., continuous wave, matched bandwidth, broadband noise, etc.).

(3) Geolocation. The operator must provide valid geolocation coordinates of the unwanted energy source. These coordinates will be assigned attributes and used to assist in determining signal intent.

(4) Resolution. Resolution actions may require frequency change, physical separation of interfering transmit and receive antennas, or other technical solutions. Resolution actions may restore communications, but not eliminate EMI sources.

b. MUOS EMI.

(1) MUOS masking and notching ('dynamic' or 'fixed') capabilities minimize the possible threat of EMI from ground-based sources. If operators experience denial of access to MUOS WCDMA services, they should conduct the following actions.

(a) Verify that provisioning request and requirements are valid.

(b) Verify the proper antenna user and its condition.

(c) Verify the COMSEC key is correct.

(d) Verify MUOS satellite availability with the MUOS help desk.

(e) If the operator experiences a denial of service or a suspected EMI beyond the masking and notching capability of the system, contact the MUOS help desk, servicing RSSC, and chain of command. The help desk, GNWO, and Joint Functional Component Command for Space (JFCC-SPACE) are responsible for outage resolution processes.

(2) For legacy narrowband EMI, follow the appropriate checklists in appendix B.

c. See table 12 for UHF SATCOM points of contacts.

Table 12. UHF SATCOM Key Points of Contact

Name	Position	Agency	Phone Numbers		Email Address
			Commercial	DSN	
MUOS Help Desk	Tier 1 Help Desk	USASMDC or ARSTRAT	719-554-2171 or 855-SATC0M1		
Level 1 JMINI and IW Control Sites Consolidated Call Center	JMINI or IW Control Sites Help Desk	SPAWAR Atlantic	877-477-2927 843-218-5550	588-5550	ssc-chischelpdesk.fct@navy.mil
JCMO	OW Key Ordering	JCMO	813-828-2461	968-2461	JCMO@JCSE.smil.mil

Table 12 UHF SATCOM Key Points of Contact (Cont'd)					
Name	Position	Agency	Phone Numbers		Email Address
GNWO	UHF SATCOM issues	USSMDC or ARSTRAT	855-728-2061	312-692-1382	usarmy.peterson.smdc.mbx.uhf-c-sse@mail.smil.mil usarmy.peterson.smdc.mbx.uhf-c-sse@mail.mil
NNWC	Legacy SSE for UFO and FLTSAT TDMA controllers' user representative	US Navy or FCC	757-203-0166	668-0166	cipriano.deluna@navy.smil.mil cipriano.deluna@navy.mil
CONUS					
RSSC West	SAR, SAA, GAR, GAA, or SATCOM issue	USASMDC or ARSTRAT	719-554-4096	312-692-4096	usaf.peterson.afelm-cyber-mbx.rsscwest-narrowban@mail.smil.mil usasmdcarstrat.rsscwest.narrowband@us.af.mil
NCTAMS LANT	UHF control site (LANT or CONUS)	US Navy or FCC	757-443-2124/ 9001	312-564-2124	nctamslant.ftoccour.fct@navy.smil.mil nctamslant.ftoccour.fct@navy.mil
Pacific					
RSSC East	SAR, SAA, GAR, GAA, or SATCOM issues	USASMDC or ARSTRAT	813-828-6840	968-6840	rss.conus@us.af.mil
RSSC East	TBA, or IOPA manager	SPAWAR Atlantic	843-218-6620	588-6620	N/A
			Commercial	DSN	
Europe					
RSSC EUR	SAR, SAA, GAR, GAA, or SATCOM issues	USASMDC or ARSTRAT	49-711-907120. 5843/5711 314-434-5843 (VoIP)	314-434-5843/5711	usarmy.stuttgart.smdc.mbx.rssc-eur-narrowband@mail.smil.mil usarmy.stuttgart.smdc.mbx.rssc-eur-narrowband@mail.mil
NCTS Naples	UHF Control Site (LANT or Indian Ocean)	US Navy or FCC		314-626-6057	jftocwo@eu.navy.mil jftocwo@eu.navy.smil.mil
NCTAMS PAC	UHF Control Site (CONUS or PAC)	US Navy or FCC	808-653-5326	315-453-5377/ 0090	Jftocwo.nctp.fct@navy.smil.mil Jftocjws.nctp.fct@navy.smil.mil
NCTS Guam	UHF Control Site (PAC or Indian Ocean)	US Navy or FCC	671-355-5104/ 5513	315-355-5513/5375	m-gu-nctsgutechcontrol-gs@fe.navy.smil.mil m-gu-nctswowatchstanders@fe.navy.mil
RSSC PAC	SAR, SAA, GAR, GAA, or SATCOM issues	USASMDC or ARSTRAT	808-656-0582/ 4700	315-456-0582/ 4700	usarmy.wheeler.smdc.mbx.rssc-pac@mail.smil.mil usarmy.wheeler.smdc.mbx.rssc-pac@mail.mil

Table 12 UHF SATCOM Key Points of Contact (Cont'd)				
Name	Position	Agency	Phone Numbers	Email Address

Legend:
ARSTRAT—Army Strategic Command
CONUS—continental United States
DSN—Defense Switched Network
EUR—Europe
FCC—Federal Communications Commission
FLTSAT—fleet satellite
GAA—Gateway Access Authorization
GAR—Gateway Access Request
GNWO—Global Narrowband Watch Office
IOPA—input/output port address
IW—integrated waveform
JCMO—Joint Communications Security Management Office
JMINI— joint ultrahigh frequency military satellite communications network integrated
LANT—Atlantic
MUOS—Mobile User Objective System
NCTAMS—Naval Computer and Telecommunications Area Master Station
NCTS—Naval Computer and Telecommunications Station
NNWC—Naval Network Warfare Command
OW—order wire
PAC—Pacific
RSSC—Regional Space Support Center
SAA—satellite access authorization
SATCOM—satellite communications
SAR—satellite access request
SPAWAR—Space and Naval Warfare Systems Command
SSE—satellite communications system expert
TBA—terminal base address
TDMA—time division multiple access
UFO—ultrahigh frequency follow-on
UHF—ultrahigh frequency
US—United States
USSMDC—United States Space and Missile Defense Command
USASMDC—United States Army Space and Missile Defense Command
VoIP—voice over internet protocol

Appendix A
TACTICAL RADIO PLANNING CHECKLIST

Table 13 provides communication planners an overarching checklist to ensure all radio frequency services and equipment assets are accounted for prior to deployment.

Table 13. Tactical Radio Planning Checklist		
Mission		
1.	Obtain all required mission planning documents.	
		Where are the main communications planning documents? That is, ☐ Annex H (US Army), ☐ Annex K (USN, USMC, and USAF), ☐ OPTASK IO (USN and SCG), ☐ OPTASK EW (USN and USCG), ☐ ATO SPINS (USAF and USN primarily, but any unit with flying squadrons).
		Where are the ACEOIs, SOIs, and guard charts (USMC or US Army) or frequency charts (USN, USCG, or civilian other government departments and agencies?
		Do we have an ☐ OPTASK Chat or ☐ OPTASK IO network control station?
		Does the frequency manager have a published JRFL or signals of interest targeting or deconfliction plan?
		Does the commander have any decision points that will shift the tactical radio priorities? (That is, when a unit reaches a certain objective in the mission the circuit priorities change on the guard chart or frequency chart.)
		Does the commander have primary, secondary, and tertiary communication mode preferences? That is, does the commander prefer tactical chat over capable radios or FFTs over voice circuits?
		Does the commander have special communications retransmission requirements that need repeater broadcast over single-channel radio frequencies?
		What are the local, host, post, base, and station SOPs?
		Is the required crypto is available and accessible?
2.	Identify all of the tactical radio commander's mission requirements.	
		Are there any planning constraints or restraints? (For example, Is there an inability to use dedicated SATCOM or VHF in the vicinity of certain cities.)
		What is the CCIR)? Does the commander need to be alerted if a specific radio network is unavailable?
		What are the commander's communication information exchange requirements? That is, does the commander want voice, data and tactical chat running simultaneously?

Table 13. Tactical Radio Planning Checklist (Cont'd)		
3.	Identify all critical resources, mission essential assets, and capabilities available.	
		What are the commander's voice circuit requirements?
		What are the commander's low data rate SCR requirements?
		What are the command's tactical chat over SCR requirements?
		What are the commander's mission essential circuits?
		What are the commander's mobility requirements?
		Has the unit obtained host, nation, base, post, and satellite landing rights?
		Does the unit have satellite landing rights?
Enemy		
1.	What are the enemy's primary operating frequencies?	
		Does the enemy have information warfare, EW, or command and control warfare capabilities? (If so, list them on the communications planning estimate.)
		What is the enemy's most likely course of action? Does the enemy intend on using neutral and friendly coalition networks to conduct or coordinate operations?
		What are the enemy's signal collection and SIGINT capabilities?
		What is the enemy's most dangerous course of action? Does the enemy plan to use EW equipment to jam friendly assets, creating a degraded or denied operational environment?
		Can the enemy employ nuclear forces or resources?
		Based on the enemy's MLCOA and MDCOA, do friendly forces need to be concerned about signature management or OPSEC?
Terrain and Weather		
1.	Terrain Considerations.	
		Are there any terrain or geographic constraints that will degrade tactical radio implementation?
		Are there any area studies or site surveys that can provide data for tactical radio planning? For example, site survey geological position results that can impact tactical radio implementation.
		Does the enemy control or manage any key transmissions terrain? For example, control of high ground areas for antenna positions.
		Are there any host nation, post areas, or named areas of interest that will disrupt or degrade the use of tactical radio frequencies?
2.	Weather Considerations.	
		Has unit personnel checked USAF space weather forecasts to anticipate weather impacts to tactical radio operations?

Table 13. Tactical Radio Notional Planning Checklist (Cont'd)		
		Have unit personnel checked the weather and sea state forecasts to determine if they will impact ship–to-shore operations in an amphibious environment?
		What unit has the main effort?
		What units will provide the supporting efforts?
		What are the commander's communication circuit priorities?
		What critical applications, doctrinal networks or high priority missions broadcast over the tactical radio networks? For example, are they fighter air direction, tactical air direction, or naval surface fires?
		Can equipment withstand forecasted worst case weather (high winds, rain, cold, etc.)?
		Are there any CJCS supporting communications units such the JCSE in the area with special capabilities to be leveraged or integrated?
		Are own-unit personnel replacing a unit already in place that has established procedures?
		Are own-unit personnel establishing a transition network that another unit will assume?
		What are the capabilities (in terms of equipment and training) of the units in the area? ☐ HF, ☐ HF (ALE), ☐ VHF, ☐ MBITRs, ☐ UHF (only), ☐ UHF (multiband), ☐ UHF SATCOM/dedicated, ☐ UHF SATCOM/DAMA, ☐ UHF SATCOM/IW, ☐ UHF SATCOM/WCMDA (MUOS)
		Are there host nation capabilities to be integrated into the tactical radio plan or accounted for?
Time Available		
		How much time exists in calendar and duty days between today and mission start date?
		Do own-unit personnel have to pass orders and guidance to subordinate units to plan for tactical radio resources?
		Do own-unit personnel have enough lead time for accessing, or access to satellite resources? ☐ SAR? ☐ GAR? ☐ SAA?
Installing Tactical Radio Networks		
		Have own-unit personnel added joint, international, and host nation frequencies to the JRFL?

Table 13. Tactical Radio Planning Checklist (Cont'd)		
		Have own-unit personnel established voice and data installation plans that comply with the network diagrams inside the: ☐ Annex H (US Army), ☐ Annexes K and N ☐ (USMC, USN, USCG, USAF, and joint planning documents), ☐ OPTASK IO/OPTASK EW (USN and USCG) and ☐ SPINS (USAF, USN, and USCG)?
		Have own-unit personnel received the ☐ SAR, ☐ GAR and ☐ SAA?
		Do own-unit personnel have ☐ NLT and ☐ NET start and stop times?
		Do own-unit personnel have correct color/button number combinations, by mission, from the SPINS?
		Have the IP radio subnet addressing schemes been developed?
		Have the frequency and guard charts been updated? Is the unit assuming or monitoring ☐ network control, ☐ guarding, and ☐ monitoring responsibilities?
		Has the unit submitted SAR/GAR for ☐ DAMA, ☐ Dedicated, ☐ IW and ☐ WCMDA (MUOS Capable) services?
Operating the Tactical Radio Network		
		Are network management and network control relationships established in accordance with the event guard chart or SPINS?
		Have primary, secondary, and tertiary communications networks been established?
		Have we set up the COTMNOTM network links?
		Do the unit personnel have access to SOPs/OPTASK Chat notices?
		Are unit call-signs and signal operating instructions on hand in accordance with joint call signs and prowords use?
		Are there any joint clearance procedures?
Maintaining, Improving and Responding to Network Challenges Operating in D2CEs		
		Are there maintenance or support relationships with existing post, base, stations, host, and units?
		Has a deployable bench stock/replenishables account been created?
		Are critical high demand, low density, or moderate demand, high-fault-rate equipment on order?
		Has a follow-on echelon plan for tactical radio units been established?
		Have the JSIR and beaconing report templates been created? Has a unit been identified for JSIR and beaconing report handoff?
		Have EMI reporting procedures been established?
		Does the unit have access to the JSIR response coordination instructions and relevant reporting points of contact?
		Has the unit established a plan for operating in D2CEs?

Legend:
ACEOI—automated communications-electronics operating instructions
ALE—automatic link establishment
ATO—air tasking order
MDCOA—most dangerous course of action

Table 13. Tactical Radio Planning Checklist (Cont'd)	
CJCS—Chairman of the Joint Chiefs of Staff	MLCOA—most likely course of action
CCIR—commander's critical information requirement	MUOS—Mobile User Objective System
COTM—communications on the move	NLT—no later than
D2CE—degraded and denied communications environment	NOTM—network on the move
DAMA—demand access multiple access	OPSEC—operations security
DISA—Defense Information System Agency	OPTASK—operation task
EMI—electromagnetic interference	SAA—satellite access authorization
EW—electronic warfare	SAR—satellite access request
FFT—friendly force tracker	SATCOM—satellite communications
GAR—gateway access request	SCR—system change request
HF—high frequency	SIGINT—signals intelligence
IO—information operations	SOI—signal of interest
IP—internet protocol	SOP—standard operating procedures
IW—integrated waveform	SPINS—special instructions
JCSE—joint communications support element	US—United States
JRFL—joint restricted frequency list	USAF—United States Air Force
JSIR—joint spectrum interference resolution	USCG—United States Coast Guard
MBITR—multiband inter/intra team radio	USMC—United States Marine Corps
	USN—United States Navy
	UHF—ultrahigh frequency
	VHF—very high frequency
	WCMDA—Wideband Code Division Multiple Access

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Appendix B
ELECTROMAGNETIC INTERFERENCE (EMI) CHECKLISTS

1. EMI Signal Signature and Characterization Checklist

When EMI is suspected of conflicting with authorized satellite communications (SATCOM) services and resources, make every to document the suspected signal's signature and other characteristics. For deployed SATCOM users, this may be complicated by the absence of adequate spectrum analyzers or monitoring equipment. If adequate equipment is unavailable, the operator should check with the local communications support unit to determine if it has equipment available to assist in the effort. Many local and regional support agencies (control stations, battle management centers, joint communications security monitoring activity (JCMA), etc.) are equipped to assist with characterization activities. If no support is available, the operator must document the interfering signal by using the following checklist (table 14).

Table 14. EMI Signal Signature and Characterization Checklist

Item	Activity	Questions/Comments	Description
1 ☐	Log initial perceptions.	What do they look like? (This assumes monitoring equipment is used.)	Spike, broadband, side lobe, spread-spectrum, elevated noise floor level, clear or encrypted, comb, swept-frequency, pulsed or hopped, etc. Recognized modulation? Recognized crypto signature? Recognized as steady or stuck in receive key?
		What do they sound like?	Static; pop; hiss; crackle; high-pitched tone; single tone; wavering tone; distinct multiple tones; click; hum; whine; garbled or intelligible voice; noise; etc.
2 ☐	Log measured characteristics.	(Assumes monitoring equipment is used.)	Center frequency, bandwidth, amplitude, modulation, encrypted, etc.
3 ☐	Log the duty cycle.	What is its frequency?	Constant signal or key, cyclical (note time intervals), periodic, random, intermittent, pulse duration and repetition rate (for pulsed signals), hop duration and rate (for hopping signals), start and stop frequencies, direction, and sweep rate (for swept signals), etc.
4 ☐	Log time frames.	When does EMI transmit?	Start and stop dates and times. Continuous?
5 ☐	Record observations.	(Assumes recording devices are available)	Make an audio recording. Take pictures of displays. Make a soft copy recording of displays. Perform an electronic screen capture. Print out displays.
6 ☐	Determine (speculate) intent.	Was EMI accidental or intentional?	Is there recognized or unrecognized signal/modulation? Is there an appearance of blue-on-blue interference? Does the EMI follow if user frequency/channel/transponder is changed? Is there a suspected pirated resource (unauthorized use by US/coalition force)? Does EMI increase in power if the transmitted SATCOM signal is increased?

Legend:
EMI—electromagnetic interference
SATCOM—satellite communications
US—United States

2. EMI Operational Impact Checklist

The severity of EMI may vary from negligible to loss of service. The operator must document the EMI event. The operational impact is based on the severity of the EMI and the relative priority, precedence, or importance of the service being impacted. Operational impact may be subjective. Table 15 is a checklist that will assist in determining and documenting the operational impact of suspected EMI.

Table 15. EMI Operational Impact Checklist

Item	Activity	Questions/Comments	Description
1 ☐	Identify the impacted user/ service/network.	Identify, specifically, who is impacted.	Log/document the user, service, and network impacted by the EMI. Log ID and names and designations. Log names/IDs/designations of directly impacted terminals , or members of the impacted service/network. Log assigned priority and service precedence. Identify the owning organization and POC, exercise, operation, or activity name, tasking combatant command or JTF and POC.
2 ☐	Identify the type of service impacted.	Specifics about the type of signal being impacted.	Voice or data? Data rate? Modulation mode? Burst rate? Code rate? Encryption?
3 ☐	Identify the impacted satellite resource.	Specifics about the impacted satellite resource.	Identify the impacted satellite system, satellite, channel number, channel frequency (uplink and downlink), and transponder. If it is a UHF DAMA channel, identify the frame format and time slot used, and DC circuit number (if known).
4 ☐	Identify the extent of the impact.	Is the service degraded or unusable? What percent is degraded?	Quantify the extent of the impact. For voice service, is the service usable, degraded (noisy), or unusable? For data, what is the experienced parity or BER impact? Is the circuit usable for voice but unusable for data? Does the signal follow if frequencies/channels are changed? What percent of the time is the EMI experienced? When the EMI is in effect, what percent of degradation is experienced? (Percentages are subjective determinations unless otherwise noted.)
5 ☐	Identify impacted terminals' characteristics.	Specifics about impacted SATCOM terminals.	Single or multiple terminals impacted? Terminals types and configurations? Are radio, modem, antenna, encryption devices used? Antenna size and polarity? Is the radio remote controlled from the antenna? How far?

Legend:
BER—bit error rate
DAMA—demand assigned multiple access
DC—direct current
EMI—electromagnetic interference
ID—identified
JTF—joint task force
POC—point of contact
SATCOM—satellite communications
UHF—ultrahigh frequency

3. EMI Equipment Integrity Checklist

Terminals experiencing malfunctions exhibit symptoms similar to EMI events. Every effort must be made to verify the physical and operational integrity of the terminal and any associated equipment connected to, or operating with, the impacted terminal. Use the checklist in table 16 to assist in determining the operational integrity of the terminal and associated equipment.

Table 16. EMI Equipment Integrity Checklist

Item	Activity	Description
1 ☐	Check connectors and plugs.	Verify all connectors and plugs are properly fastened and secured.
2 ☐	Check racks and panels.	Verify all equipment racks and panels are properly installed.
3 ☐	Check power.	Verify the correct power is being applied to each terminal component.
4 ☐	Check interlocks.	Verify all interlocks are properly engaged.
5 ☐	Check cables and shielding.	Check all cables and shielding for kinks, frayed areas, and other visible signs of stress, fatigue, or shorting.
6 ☐	Check antenna.	Verify antenna cables are in good condition. Verify the antenna is pointed correctly (peaked on the beacon). Verify the antenna is not coated with hail, ice, sleet, slush, or snow.
7 ☐	Check unused ports.	Verify all unused ports are properly terminated.
8 ☐	Perform bit, byte, or BER test, as required.	Perform, or have maintenance personnel perform, any bit, byte, BER, or other diagnostic tests available.
9 ☐	Check for maintenance.	Verify there are no ongoing terminal maintenance activities.
10 ☐	Check test equipment.	Verify all test equipment (e.g., oscillators, sweep or pulse generators, etc.) is turned off.
11 ☐	Verify correct operation.	Check for SRK or stuck-in key condition. Verify, or have maintenance personnel verify, proper terminal operation.
12 ☐	Verify receive quality indicators.	Compare normal indicators with current indicators, including RSL, Eb/No, BER, margin, buffer fill, etc. Abnormalities (increased RSL and decreased Eb/No or sync loss) indicate EMI or an equipment malfunction.

Legend:
BER—bit error rate
Eb/No—energy bit to noise power SRK—steady receive key
RSL—Receive Signal Level

4. EMI Operational Settings Checklist

Terminals operating with incorrect equipment settings may experience problems similar to an EMI event. Table 17 is a checklist used to assist in determining the operational integrity of the terminal and associated equipment.

Table 17. EMI Operational Settings Checklist

Item	Activity	Description
1 ☐	Check satellite resource assignments.	Verify the following resource assignments: Satellite Channel or Frequency Antenna
2 ☐	Check terminal resource assignments.	Verify the following terminal assignments: Frame format, time slot Power levels Ports Terminal image Antenna look angle (azimuth, elevation, or polarization)
3 ☐	Check network/service assignments.	Verify the type of network or service and all associated operating parameters: Network or service name and ID Voice or data Modulation mode Data rate, burst rate Encoding, interleaving Encryption type Applied protocols
4 ☐	Check COMSEC/TRANSEC equipment and assignments.	Verify the following: Encryption device compatibility encryption device strapping/settings The correct KEYMAT The crypto period The correct TRANSEC key The COMSEC/TRANSEC keys are correct and properly loaded. The proper operation of the encryption device.
5 ☐	Check other baseband devices.	Verify settings are correct on the following: Embedded encryption devices Data processing/distribution devices

Legend:
crypto—cryptographic
ID—identification
KEYMAT—keying material
TRANSEC—transmission security
COMSEC—communications security

5. EMI Immediate and Local Environment Integrity Checklist

A malfunction of collocated RF-generating equipment in the immediate area may cause EMI. The operator must verify the integrity of the environment surrounding the SATCOM terminal and antenna and consult with the local frequency manager regarding the possible presence of other RF devices. Use table 18 to assist in verifying the integrity of the local environment.

Table 18. EMI Immediate and Local Environment Integrity Checklist

Item	Activity	Description
1 ☐	Check SATCOM support equipment.	Examine the following SATCOM support equipment for proper operation and configuration, and ensure there are no RF emanations: power generators, heaters, air conditioning units.
2 ☐	Check other equipment.	Check all other equipment in proximity to the SATCOM terminal and antenna for proper configuration and operation, and ensure there are no RF emanations: test equipment, welders, electric motors, vehicles, thermostatically-controlled devices.
3 ☐	Check for construction and maintenance.	Check for any ongoing construction or maintenance in the immediate vicinity of the SATCOM terminal and antenna. Examine associated power generation and construction equipment for proper configuration and operation, and for no RF emanations.
4 ☐	Check for other RF devices.	Check for the presence of other RF equipment capable of radio, sonar, radar, privately owned radar detectors, hospital diagnostic equipment (e.g., x-ray, CT, CAT, MRI, NMRI), or microwave transmission. Verify the availability and authorization with local frequency managers.
5 ☐	Check for transient RF generation equipment.	Examine the immediate area for the presence of adjacent, mobile, or tactical communications platforms or terminals; such as mobile vans, tactical antennas on vehicles, C2 vehicles, or other SATCOM terminals.
6 ☐	Consult with a local frequency manager. Check for local EMI-RFI sources.	Request assistance from local a frequency manager. Examine the local area for potential sources of electromagnetic emanations; such as: microwave or cellular towers, fixed or mobile communications vans or shelters, radar transmitters, airborne or mobile reconnaissance, electronic intelligence, C2 platforms or vehicles, ongoing local exercises, deployments, testing, or training.

Legend:
C2—command and control
CAT—computed axial tomography
CT—computed tomography
EMI—electromagnetic interference
MRI—magnetic resonance imaging
NMRI—nuclear magnetic resonance imaging
RF—radio frequency
RFI—radio frequency interference
SATCOM—satellite communications

6. EMI Locality Checklist

EMI may impact one or all terminals participating in a network. EMI that impacts a single terminal, or several closely situated terminals, is interfering with the satellite downlink and is identified as local interference. Satellite EMI occurs on the uplink frequency/channel/transponder and hits the satellite. All terminals participating in the service/network supported by that specific frequency/channel/ transponder experience EMI received by the satellite and retransmitted on the downlink. Considerably different resources may be used to isolate and locate downlink versus uplink EMI source. Use the table 19 checklist to assist in determining and documenting whether the suspected EMI is on the downlink or uplink.

Table 19. EMI Locality Checklist

Item	Activity	Questions/Comments	Description
1 ☐	Identify all impacted terminals.	Which terminals are impacted by the EMI?	Poll/query all network/Service member terminals. Determine which may be experiencing the EMI. Use radio checks, orderwire, TELECOM, FAX, e-mail, etc. to make contact. If unable to contact other terminals, notify the appropriate RSSC immediately.
2 ☐	Identify impacted terminal locations.	Where are the impacted terminals located?	Identify and document the specific location of each terminal experiencing the EMI. Include latitude, longitude, and altitude. If it is a mobile or tactical terminal, include the approximate range of mobility. When possible, use GPS to obtain locations.
3 ☐	Determine terminal proximity.	Are impacted terminals close to each other?	Are all impacted terminals situated within 100–150 miles?
4 ☐	Determine if it is local or uplink EMI.	Is the satellite impacted?	Only one impacted terminal equals local EMI. Multiple (but not all) terminals probably equal local EMI. All Service/network member terminals impacted, but close to each other equals may be local or uplink EMI. All terminals impacted but not close to each other equals uplink EMI.
5 ☐	Determine the line-of-sight impact.	What happens to EMI if there is a change to the terminal antenna azimuth and elevation?	If possible, vary antenna azimuth and elevation. Note the effect on the EMI. If the antenna is moved out of line-of-sight of the satellite and EMI is still visible, the EMI is probably local. (This assumes the operator can move the antenna and has signal monitoring equipment.)
6 ☐	Attempt local EMI direction finding.	For a suspected local EMI, what is the effect of terminal antenna azimuth and elevation changes?	If EMI intensity changes when the antenna azimuth and elevation is changed, change the azimuth and elevation to maximize EMI intensity. The resulting azimuth shows the approximate direction of the EMI source from own terminal. If multiple terminals are impacted within a local area, have each terminal operator perform the same check. The resulting headings can be used to, roughly, triangulate the position of the EMI source. This is a rudimentary direction finding capability. This does not apply whether or not the suspected EMI is satellite (uplink) EMI.

Table 19 EMI Locality Checklist (Cont'd)
Legend: EMI—electromagnetic interference FAX—facsimile GPS—Global Positioning System RSSC—regional space support center TELECOM—telecommunications

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Appendix C
CALCULATING ANTENNA LENGTH

An antenna's length must be considered by physical and electrically measured length. The two are never the same. The reduced velocity of the electromagnetic wave inside the antenna, combined with the terminal capacitive effect, make the antenna seem longer when measured electrically then when measured physically. The contributing factors are the ratio of the diameter and length of the antenna combined with the capacitive effect of terminal equipment (e.g., insulators, clamps, etc.) used to support the antenna.

a. To calculate physical length for a half-wave antenna, use a correction of 0.95 for frequencies between 3 and 50 MHz, see table 20.

Table 20. Half-wave Antenna Length Calculation

Desired Length		Equation		Solution
Antenna length (meters)	=	$\frac{150 \times 0.95}{\text{Frequency in MHz}}$	=	$\frac{142.50}{\text{Frequency in MHz}}$
Antenna length (feet)	=	$\frac{492 \times 0.95}{\text{Frequency in MHz}}$	=	$\frac{468}{\text{Frequency in MHz}}$

Note: This table was derived from Chapter 10 of Army Tactical Publication 6-02.53, *Techniques for Tactical Radio Operations*.

Legend:
MHz—megahertz

b. The length of a long-wire antenna (one wavelength or longer) for harmonic operation is calculated by using the following formula, where N = number of half-wavelengths in the total length of the antenna, see table 21.

Table 21. Long-wire Antenna Length Calculation

Length (meters)	=	$\frac{150 (N - 0.05)}{\text{Frequency in MHz}}$
Length (feet)	=	$\frac{492 (N - 0.05)}{\text{Frequency in MHz}}$

Notes:
1. This table was derived from Army Tactical Publication 6-02.53, *Techniques for Tactical Radio Operations*.
2. N equals the number of half-wave lengths in the total length of the antenna.

Legend:
MHz—megahertz

Note: For more information for antenna techniques refer to ATP 6-02.53, Chapter 10.

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Appendix D
AUTOMATIC LINK ESTABLISHMENT EXCLUSION BAND LISTING

The following frequencies in table 22 are reserved for specific purposes and should never be used in an automatic link establishment network.

Table 22. Automatic Link Establishment Exclusion Band Listing
Any frequency not assigned
2182 kilohertz (KHz)—International distress standard voice
2187.5 KHz—International distress digital selective calling
3023 KHz—Search and rescue
4125 KHz—Distress and safety
4207.5 KHz—International distress digital selective calling
4209.5 KHz—Navigational Telex (NAVTEX) (safety)
5680 KHz—Search and rescue
6215 KHz—Search and rescue
6312 KHz—International distress digital selective calling
8291 KHz—Distress and safety
8414.5 KHz—International distress digital selective calling
12290 KHz—Distress and safety
12577 KHz—International distress digital selective calling
16420 KHz—Distress and safety
16804.5 KHz—International distress digital selective calling
2500 KHz—Worldwide time signal
5000 KHz—Worldwide time signal
10000 KHz—Worldwide time signal
15000 KHz—Worldwide time signal
20000 KHz—Worldwide time signal

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Appendix E
HIGH FREQUENCY-AUTOMATIC LINK ESTABLISHMENT COMMUNICATIONS PLAN EXAMPLE

Table 23 highlights key data required to program an automatic link establishment (ALE) radio prior to activating or joining an ALE link.

Table 23. Example of a Communications Plan

Channel Matrix								
Channel	**Channel group**	**Frequency**	**Mode**	**AGC**	**COMSEC**	**Band-width**	**Power (in Watts)**	**RX only**
01	01	03545	USB	Medium	KY-99	3.0	20	No
02	01	03729	USB	Medium	KY-99	3.0	20	No
03	01	04580	USB	Medium	KY-99	3.0	20	No
04	01	06100	USB	Medium	KY-99	3.0	20	No
05	01	09580	USB	Medium	KY-99	3.0	20	No
06	01	101180	USB	Medium	KY-99	3.0	20	No
07	01	125000	USB	Medium	KY-99	3.0	20	No
08	01	164900	USB	Medium	KY-99	3.0	20	No
09	01	169970	USB	Medium	KY-99	3.0	20	No
10	01	183950	USB	Medium	KY-99	3.0	20	No

Legend:
AGC—automatic gain control
COMSEC—communications security
RX—receive
USB—upper side band

Table 24 provides an example of a cut-sheet for assigning radio address per station active on an ALE network.

Table 24. Radio Address Assignment by Station Name

Address Matrix	
Station Name	**Address**
JFC	Jfc001
NAVFOR	Na0987
ARFOR	R00197
MARFOR	Mc0100
AFFOR	AF001
SOF	SOF054
USCG	CG1034
NET	JTF NET

Legend:
AFFOR—Air Force forces
ARFOR—Army forces
JFC—joint force commander
JTF—joint task force
MARFOR—Marine forces
NAVFOR—Naval forces
NET—network
SOF—special operations forces
USCG—United States Coast Guard

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Appendix F
HIGH FREQUENCY, AUTOMATIC LINK ESTABLISHMENT (ALE) RADIO PROGRAMMING APPLICATION EXAMPLE

1. Third Generation (3G) Utility Functions

a. To enter 3G mode, press the number 3 key or mode key on the keypad menu until 3G appears on the display, then press [ENT].

b. The utility and test functions in 3G mode are the same as in other modes with the exception of the 3G-specific utilities.

c. From the preset screen (top right), press [OPT] to display the options menu.

d. Press [◄] or [►] until 3G is highlighted; then press [ENT].

2. The 3G, 3G+: Link Quality Analysis (LQA)

a. Press [◄] or [►] until LQA is highlighted; then press [ENT].

b. The LQA may be EXCHANGE or SOUND, and function the same as under ALE mode. Select EXCHANGE or SOUND and press [ENT].

c. The radio must be in SYNC for LQA to function. Use the p and q arrows to select exchange destinations.

d. When LQA is completed, press [◄] or [►] until SCORES is highlighted; then press [ENT].

e. Select an individual address and press [ENT].

3. The 3G, 3G+: Time of Day (TOD)

a. The receive/transmit (R/T) TOD can be manually set when synchronization from a TOD server or Global Positioning System (GPS) is unavailable.

b. From the preset screen, press [OPT] to display the Options Menu. Press [◄] or [►] until 3G is highlighted; then press [ENT].

c. Press [◄] or [►] until TOD is highlighted; then press [ENT].

d. Enter the correct TOD in 24-hour format; then press [ENT].

e. Enter the correct date; then press [ENT].

f. Press [OPT] to return to the Preset screen.

4. The 3G, 3G+: TOD Role

a. The R/T TOD role defines from where TOD sync will be derived and the role of this station.

b. From the preset screen, press [OPT] to display the Options Menu. Press [◄] or [►] until 3G is highlighted; then press [ENT].

c. Press [◄] or [►] until TODROLE is highlighted; then press [ENT].

d. Use [p] or [▼] to select the TOD server station name; then press [ENT].

e. Use [p] or [▼] to select the TOD role for this station; then press [ENT].Choices are base and outstation.

f. Press [OPT] to return to the Preset screen

5. **The 3G, 3G+: View List of Linked Radios**

a. The LINKED menu displays the addresses of the other linked radios.

b. From the preset screen, press [OPT] to display the Options Menu. Press [◄] or [►] until 3G is highlighted; then press [ENT].

c. Press [◄] or [►] until LINKED is highlighted; then press [ENT].

d. Use [p] and [q] keys to scroll through the list of addresses of linked radios.

6. **The 3G Operation**

a. a. Press the [MODE] button to scroll through the available operating modes.

b. Choices are: FIX, ALE, HOP, 3G and 3G+.

c. Press [MODE] until 3G is displayed.

d. Press [ENT] to select 3G mode.

e. If AUTOTUNE was not selected during programming, the R/T will indicate the need for tuning. Press [OPT], select RETUNE; then press [ENT].

f. The radio will begin scanning when 3G mode is selected. The displayed channel number will change as the radio scans through the list of 3G channels.

g. Press [↻] to momentarily display the channel screen.

h. The display will return to the preset screen after a few seconds.

i. Press [CALL] to display the CALL TYPE menu. The choices are: MANUAL, AUTOMATIC, SYNC REQUEST, and BEST. Scroll to AUTOMATIC; then press [ENT]. The ADDRESS TYPE menu is then displayed.

j. Select the desired ADDRESS TYPE; then press [ENT].

k. Scroll through the list of addresses to find the desired address. Press [ENT].

l. The radio will begin transmitting a call to the selected address.

m. After the call has been transmitted, the radio will wait for a response.

n. When a response has been received, the radio will indicate that it is LINKED.

o. Press [CLR] to return to the preset screen.

p. While linked, press [CLR] from the preset screen.

q. The radio will display the TERMINATE LINK menu.

r. To terminate the link, scroll to YES; then press [ENT].

s. The radio will begin transmitting a link termination message.

t. Place an ALE Call in 3G+

u. An individual call is used to establish communications (a connection) between two stations. An individual call may be placed to any programmed individual address.

v. Press [CALL] to display the CALL TYPE menu choices (i.e., 3G MANUAL, 3G AUTOMATIC, 3G BEST, 3G BROADCAST SYNC, 3G BDCAST SYNC- ALL, 3G SEND GPS REPORT, ALE MANUAL, and ALE AUTOMATIC).

w. Use the p and q keys to scroll through the options. Select ALE AUTOMATIC; then press [ENT]. ALE AUTOMATIC allows the radio to attempt the call on all channels in the channel group according to LQA scores or from the highest to the lowest frequency, if no LQA score data exists.

x. If ALE MANUAL is selected, the channel to be used also will be operator selected. The ALE call will be attempted on this channel and if the called station is not reachable, the call ends.

y. The ADDRESS TYPE menu is then displayed. Using the p and q keys, select the desired address type (INDIVIDUAL, NET, ANY, ALL); then press [ENT].

z. Use the p and q keys to select the desired address; then press [ENT].

aa. The R/T will begin transmitting to the selected address. After the call, the R/T will wait for the response.

bb. When a response has been received, the R/T will indicate LINKED on the liquid crystal display (LCD). The radio will then make available the programmed system preset items programmed to the linked self-address.

7. ALE: Program/Operation

a. Channel Group:

(1) Press [PGM] button.
(2) Press the [◄] or [►] arrow until MODE is highlighted.
(3) Press the [ENT] button.
(4) Press the [◄] or [►] arrow until ALE is highlighted.
(5) Press the [ENT] button.
(6) Press the [◄] or [►] arrow until CHAN_GROUP is highlighted.
(7) Press the [ENT] button.
(8) ADD is highlighted.
(9) Press the [ENT] button.
(10) Enter channel group number 002–49.
(11) Press the [ENT] button.
(12) ADD is highlighted.

Note: Operators should see PGM-MODE-ALE-CHAN_GROUP and the channel group being altered in the far right corner of the radio.

(13) Press the [ENT] button.

(14) Enter the channel preset numbers that each operator programmed earlier (for example 01 [ENT], 02 [ENT], 03 [ENT], and 04 [ENT]).

(15) Press the [CLR] button.

(16) Press the [▲] or [▼] arrow until REVIEW is highlighted.

(17) Press the [ENT] button.

(18) Press the [▲] to view all previously entered channel presets (For example, if four channel presets are entered, press the [▲] arrow four times to view all channel presets).

(19) Press the [CLR] button three times.

(20) CHAN_GROUP is highlighted.

Note: Operators have now finished programming the channel group. Follow steps 6 through 18 to create additional channel groups.

b. Self-Address. The following steps explain programming the ALE self-address. Continuing from the CHAN_GROUP screen execute the following steps.

(1) Press the [◄] or [►] arrow until ADDRESS is highlighted.

(2) Press the [ENT] button.

(3) Press the [◄] or [►] arrow until SELF is highlighted.

(4) Press the [ENT] button.

(5) ADD is highlighted.

(6) Press the [ENT] button.

(7) Type in the desired one- to three-character self-address (for example, RT1).

Note: Additional self-addresses may be up to 15 characters long. Up to 20 self-addresses can be programmed. By entering more than three characters, the operator will increase the signaling time on the radio.

(8) Press the [ENT] button.

(9) Enter CHANNEL GROUP 00–49.

(10) Press the [ENT] button.

(11) SELF is highlighted.

Note: Operators have completed programming of the self-address. To enter an additional self-address, follow steps 3 through 11.

c. Individual Address.

(1) Press the [▲] or [▼] arrow until INDIVIDUAL is highlighted.

(2) Press the [ENT] button.

(3) ADD is highlighted.

(4) Press the [ENT] button.

(5) Type in the desired one- to three-character individual address (for example, RT2).

(6) Press the [ENT] button.

(7) Enter CHANNEL GROUP, the previously programmed default is 00.

(8) Press the [ENT] button.

(9) ASSOC SELF will default to the previously entered self-address.

Note: If there is more than one self-address, ensure each operator chooses the correct one for the channel group with which he or she is working

(10) Press the [ENT] button.

(11) INDIVIDUAL is highlighted.

Note: Now, each operator has the knowledge to program an individual address. Follow steps 1 through 10 to create additional addresses.

d. Net Address. After step 10, follow these steps to program the network address.

(1) Press the [▲] or [▼] arrow until NET is highlighted.

(2) Press the [ENT] button.

(3) ADD is highlighted.

(4) Press the [ENT] button.

(5) Enter the desired name for the network address (for example, CMD1).

Note: The address may be up to 15 characters long with up to 20 programmable network addresses

(6) Press the [ENT] button.

(7) Enter the appropriate CHANNEL GROUP. The default will be 00.

(8) Press the [ENT] button.

(9) ASSOC SELF will default to the previously entered self-address.

(10) Press the [ENT] button.

(11) ADD is highlighted.

(12) Press the [ENT] button.

Note: Ensure to enter the network members in the same order (for example, RT1, RT2, RT3, etc.).

(13) Press the [CLR] button five times.

(14) The NET is highlighted.

(15) Press the [ENT] button.

Note: The MAX TUNE TIME default is 15 SECONDS with options of 0–60 seconds. Leave this option as the default setting.

(16) Press the [ENT] button.

(17) LINK TIMEOUT is set to OFF

Note: If operators press the [▲] once, ON is highlighted. By pressing [ENT] button, operators must enter a numeric value 0–60 minutes. This allows the radio to reestablish a call if no message traffic is sent in the minute the value is entered.

(18) Press the [ENT] button.

(19) LINK TO ANY CALLS is defaulted to ON.

(20) Press the [▲] or [▼] arrow until OFF is highlighted.

(21) Press the [ENT] button.

(22) LINK TO ALL CALLS is defaulted to ON.

(23) Press the [▲] or [▼] arrow until OFF is highlighted.

(24) Press the [ENT] button.

(25) AMD OPERATION is DISABLED.

(26) Press the [▲] or [▼] arrow until ENABLED is highlighted.

(27) Press the [ENT] button.

(28) SCAN RATE is deflated to ASYNC.

(29) Press the [ENT] button.

(30) LINK PROTECT LEVEL defaults to 0. The options are 0 and 1; do not change the default option.

(31) Press the [ENT] button.

(32) LINK PROTECT KEY is defaulted to 000000000000000. Leave this option set as the default.

(33) Press the [ENT] button.

8. ALE Configuration

a. CONFIG ALE:

(1) After executing step 33, press the [CLR] button once.

(2) Press the [◄] or [►] arrow until CHAN_GROUP is highlighted.

(3) Press the [◄] or [►] arrow until CONFIG is highlighted.

(4) Press the [ENT] button.

(5) MAX SCAN CHANNELS should be set to the maximum number of channel presets in each channel group. Enter the number of channel presets from 001–100 (default is 100).

(6) Press the [ENT] button.

(7) Listen before transmit defaults to OFF.

(8) Press the [▲] or [▼] arrow until ON is highlighted.

(9) Press the [ENT] button.

(10) Key to call should be set to OFF.

b. ALE Call Setup.

(1) To call one member of the network (individual), Press “1” CALL BUTTON>AUTOMATIC>INDIVIDUAL>1BD (or desired station).

(2) The ALE will perform a link establishment attempt automatically by starting from the highest channel number in the list until there is a successful link establishment. Once the link is established, normal push-to-talk communications can resume. If MANUAL is chosen, the operator must choose which channel in the channel group to use.

9. How to Tear/Clear Down a Connected ALE Link

Press the [CLR] key, and [ENT] to terminate the link.

10. How to Perform a Network Call (Every Member in the Network is Called)

a. PRESS “1” CALL>AUTOMATIC>NET.

b. The network call will begin to set up. The procedure will wait for an answer from all members before completing the final part of the link set up and allowing push-to-talk communications to commence. Now, the initiating station can relay a message to all members at the same time.

c. Tear down the link by following the same actions as in previous steps. (If any station made a mistake with any of the programming, it will not be able to be part of the network call.)

11. Automatic Message Display (AMD)

a. AMD messages are not encrypted and are not secure unless the low probability of intercept setting is enabled in every radio on the network. Ten messages may be prepared in advance to send when ready. Messages are limited to no more than 90 letters or numbers. Older messages are lost if more than ten are received.

(1) To create an AMD message (which takes the radio off line), press PGM number “8”>MODE>ALE>AMD>TX-MSG.

(2) Use the “6” and “9” buttons to scroll through the transmit (TX) message options (EDIT, REVIEW, DELETE). Select EDIT to write a message; then press [ENT]. Press the “6” and “9” buttons to scroll to an empty TX message; then press [ENT]. Then type in a message to send.

(3) To send an AMD message (this does not take the radio off line), press “7” OPT>ALE>TX_MSG. Then, choose AUTOMATIC/MANUAL for channel selection then the individual station to receive the message.

b. To read an AMD message, press “7” OPT>ALE>RX_MSG

Note: If the operator is not on the radio when the AMD message is received by the radio, the letter M will appear on the liquid crystal display (LCD) screen. Read the message as described in paragraph 12, steps a through d.

---

(1) Press the [CLR] key. To restart the ALE network scanning, press the [CLR] key.

(2) RADIO STEPS LQA EXCHANGE.

(3) Press the “7” button.

(4) Select ALE.

(5) Press [ENT].

(6) Select EXCHANGE.

(7) Press [ENT].

(8) Select EXCHANGE TYPE (Individual/Network).

(9) Press [ENT].

(10) Select Individual/Network Address.

(11) Press [ENT].

12. View LQA Exchange Scores

a. Press the “7” button.

b. Select ALE.

c. Press [ENT].

d. Select scores.

e. Press [ENT].

f. Scroll through addresses using UP and DOWN arrows.

g. Scroll through Scores using UP and DOWN arrows.

13. Making an ALE Call

a. Press the “1” button.

b. Select Automatic.

c. Press [ENT].

d. Select Individual.

e. Press [ENT].

f. Select the desired Address.

g. Press [ENT].

h. Once connected, “LINKED to…” will be displayed and five short beeps will be heard. A link icon will display in the right corner.

Appendix G
A STANDARD FREQUENCY ACTION FORMAT EXAMPLE FOR A SINGLE-CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINCGARS)

Prior to master network list and network group assignments, multi-Service components must submit a standard frequency action format for the radio frequency needs of the organization, and any other special communications requirements to the J-6, Command. Control, Communications and Computers/Cyber's spectrum manager. Table 25 is an example of a standard frequency action format for the SINCGARS.

Table 25. Standard Frequency Action Format Example for SINCGARS

Minimum Format Items

005. Security Classification (UE)
010. Type of Action (T) = Training
110. Frequencies: type and quantity (M30-M88) number needed
113. Station Class (ML) for ground
114. Emission Designator (25K00F1E)
115. Transmitter Power (in watts) (W18)
140. Required Date (YYYYMMDD)
141. Expiration Date (YYYYMMDD)
200. Agency
203. Bureau
204. Command (Unit)
207. Operating Unit
300. Transmitter Location, State
301. Transmitter Antenna Location
303. Antenna Coordinates
340. Transmitter Equipment Nomenclature
343. Transmitter Equipment Allocation Status
400. Receiver Location, State
401. Receiver Antenna Location
403. Antenna Coordinates
440. Receiver Equipment Nomenclature
443. Receiver Equipment Allocation Status
502. Description of Requirement
803. Requester Data (name, telephone number, and e-mail)
005. U
010. T
110. M30-M88 (300)
113. FB/FA/MLR/ML/MA
114. 36K00F3E

Table 25. Standard Frequency Action Format Example for SINCGARS (Cont'd)
115. W35 140. 010430 141. 010530 200. US ARMY 204. UNIT INFORMATION (SMD) 207. UNIT INFORMATION (RS) 300. CA 301. FT IRWIN 340. G, AN/VRC-89 343. 4167/6 400. FT IRWIN 440. G, AN/VRC-89 443. 4167/6 502. REQUIRED FOR COMMAND AND CONTROL DURING ROTATION 803. POC: SGT John Doe, 123-4567, 123-45681, john.doe@somewhere.army.mil

Appendix H
HAVE QUICK PLANNING ACTIONS

Table 26 provides an example of a HAVE QUICK planning actions checklist in advance, just prior, and during an operation.

Table 26. HAVE QUICK Planning Actions

Planning Action	Unified Command	Service Component Joint Task Force 1 or 2	Operating Unit
In Advance of the Operation			
Identify the following for each operation or contingency plan: Probable HQ participants and their platforms. HQ participants who must operate together (group them into networks). Include network diagrams in the Communication Annex (Annex K) to the operation or contingency plan. HQ systems that will be used in each networks. (Identify platforms with multiple HQ systems operating in two or more networks.)	X	X	X
Establish a mode of operation for each networks. It should be the most advanced mode supported by every HQ radio in the network. Annotate each HQ network diagram with the appropriate mode.	X		
Verify: All Services obtain the WOD from the National Security Agency, through COMSEC channels. The CONAUTH for HQ WOD is the Joint COMSEC Management Office (MacDill Air Force Base, Florida 33621-5504); message address: JOINT COMSEC MANAGEMENT OFFICE MACDILL AFB FL; phone: DSN: 968-2461), commercial: 813-828-2461. Whether the HQ systems in the network are wired to permit securing the system. If so, identify the networks that will be secure, the number of different VINSON VHF/UHF Wideband Tactical Secure Voice System Cryptographic Equipment key lists required, and the CONAUTH for the key lists. Publish this information in Annex K.	X		
Requisition WOD and VINSON keying material through the Joint Staff Inter-theater COMSEC package manager or Service chain of command.	X		X
Define procedures for extracting WOD and VINSON keys at the operating unit level.		X	X
Identify the time-based stations available, including those that will accompany operation participants and those already in theater.	X	X	X
Generate a map overlay for Annex K that shows locations of all time-based stations, based on expected disposition of forces.		X	
Select specific time-based stations as the primary and alternate time sources for each participant. The time-based station map overlay in Annex K will be useful in selecting sources for participants without organic time-based stations.		X	
Assign primary, secondary, and (if possible) tertiary channel frequencies to each network for OTA single-time distribution. These frequencies also can be used for network administration and control. Publish this information in the CEOI.	X		

Table 26. HAVE QUICK Planning Actions (Cont'd)			
Planning Action	**Unified Command**	**Service Component Joint Task Force 1 or 2**	**Operating Unit**
Establish and coordinate procedures for obtaining time updates from the primary or alternate source as required due to communication degradation. When sources for other than OTA distribution become available, include procedures for using them. Publish this information in the unit's standard operating procedures.		X	X
Determine how units will receive their timing updates and what hardware and electronic methods will be used. Consider using silent methods.			X
Establish leap-second compensation and WOD changeover procedures. Identify which HQ systems are capable of using the secure mode. Publish this information in the joint CEOI.	X		
Assign network numbers to each joint network. Use an assignment scheme that maximizes frequency separation among geographically adjacent networks, particularly those whose stations share the same platform. Publish this information in the joint CEOI.	X		
Issue the remaining network numbers to Service components for subsequent reassignment to single Service networks. Retain an appropriate quantity (5 percent) of network numbers to be issued during the operation should interference problems arise. Publish this information in Annex K.	X		
Assign network numbers to single-Service network.		X	X
Update plans periodically, to reflect changes in participants, HQ systems, timing sources, etc.	X	X	X
Just Prior to the Operation			
Confirm who is participating and their HQ systems. Confirm whether these HQ systems are wired to permit secure communications. Change network modes of operation as required. Use reserve numbers where possible. Maximize frequency separation for adjacent networks while minimizing changes to network numbers previously assigned. Update CEOI with new assignments and distribute the information to operating units.	X	X	X
Confirm the availability of designated WOD and VINSON keying material. Shortages should be identified early in the planning stage.	X	X	X
Confirm operational readiness of time-based stations. Designate replacement time sources for those not ready. Conduct operator reviews of procedures for the WOD changeover, TOD acquisition, network number insertion, use of single-channel backup frequencies, etc.	X	X	X
Conduct operator reviews of procedures for WOD changeover, TOD acquisition, network number insertion, use of single-channel backup frequencies, etc.			X
During the Operation			
Issue WOD and VINSON keying material. Assign network numbers to unplanned participants.	X	X	
Reassign network numbers, as necessary, to deconflict frequencies.	X	X	
Employ emergency self-start procedures when a TOD update is required but no source is available. A self-started network has a unique time reference, and no station can enter it (other than those in the network when it is self-started). Therefore, find a time source and update the TOD as soon as possible.		X	X
Track information about HQ that would be appropriate for a lessons learned report.	X	X	X

Table 26. HAVE QUICK Planning Actions (Cont'd)
Legend: AFB—Air Force Base CEOI—communications-electronics operating instructions COMSEC—communications security CONAUTH—controlling authority DSN—Defense Switched Network HQ—HAVE QUICK OTA—over-the-air TOD—time of day WOD—work of the day

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Appendix I
HAVE QUICK (HQ) TECHNICAL DATA

1. Word of the Day (WOD)

a. General. The WOD is a 36-digit transmission security code inserted into the radio by an operator. It is stored in the radio and programs the system with the hopping pattern, hopping rate, and conferencing selection. The National Security Agency produces and distributes WOD through communications security (COMSEC) channels. There are two COMSEC types being use, based on geographic location: KAL-9200 and KAL-269.

(1) The KAL-9200, HQ Worldwide Electronic Counter-Countermeasures Settings, is used outside the continental United States (CONUS), as defined by the Joint Communications Security (COMSEC) Management Office, MacDill Air Force Base, Florida. All combat units should order this item. Due to potential interference with Federal Aviation Administration safety of flight functions, do not use KAL-9200 within line-of-sight of CONUS facilities.

(2) The KAL-269 (CONUS WOD) is used in CONUS, as defined by the Joint COMSEC Management Office.

b. Ordering and Reproducing the WOD.

(1) Order WOD canisters through the supporting COMSEC custodian. Units must store and maintain sufficient WOD materials for their operations. WOD materials are not required for system checkout or maintenance.

(2) The KAL-9200 is distributed in the quantities needed to support units equipped with HQ radios. The Joint COMSEC Management Office is the controlling authority (CONAUTH) for KAL-9200.

(3) The following policies apply to reproducing the KAL-9200 WOD segment.

(a) Only HQ users with flying missions may reproduce it locally by a method authorized for classified material. Limit quantities to the minimum mission requirement.

(b) Forward requests for local reproduction from non-flying units through COMSEC channels to the CONAUTH. Requests must explain why the unit cannot meet WOD requirements with a small number of canisters.

(c) Control original extracted WOD segments according to Service COMSEC directives.

(d) Special control procedures, such as hand receipts and copy counts, are not required for reproduced copies of the daily extracted WOD segment. Treat the current and next day's segments as unclassified. Control the complete canister as CONFIDENTIAL material, according to Service directives.

(4) The following policies apply to distributing, reproducing, and using KAL-269 WOD segments:

(a) The KAL-269 is distributed through COMSEC channels. After reaching the unit level, treat the KAL-269 in accordance with Service regulations.

(b) Reproduce KAL-269 at the unit level (as necessary).

c. WOD Dissemination. The WOD is issued to users, one segment (day) at a time. It is changed periodically, normally once a day. The WOD may be issued as current plus following day. The segment in use always has a date that matches the current Zulu date. Operators who anticipate mission requirements exceeding one day must take the next day's WOD. Some users may require the entire canister. The AN/PYQ-10 simple key loader can load multiple WOD (MWOD) information.

2. Time of Day (TOD)

a. General. HQ radios require accurate timing systems and a precise time reference, TOD, to maintain synchronization while frequency hopping (FH) in the active mode of operation. Timing systems integral to the HQ radios provide frequency and timing requirements for standard and FH radio operation. Coordinated Universal Time (UTC) serves as the precise time reference used to initialize and align all HQ radio timing systems. HQ timing source alignment and accuracy ensures users operation will be synchronized within their networks and precludes interference with, and by, other HQ networks.

(1) HQ radio timing systems are configured with temperature controlled, quartz crystal oscillators. Operational experience proves frequent TOD updates improve HQ communications reliability.

(2) The TOD reference signal used to initialize and synchronize all HQ radio operation is provided as UTC and is either transmitted to, or manually inserted into, the radio. TOD is transmitted to a radio either by another HQ radio over-the-air (OTA) or through an electrical bus or interface from an external TOD reference source.

b. TOD Sources. Initializing and updating TOD for HQ radio may be obtained from a variety of sources, including the following.

(1) The primary TOD distribution source needs to be from a single, master radio frequency (RF) source. Global Positioning System (GPS) satellites serve as the primary master RF sources. The method of updating a HQ radio with TOD may be dictated by the HQ platform capability or based upon mission expediency.

(2) Airborne Early Warning and Control System (AWACS)/Joint Surveillance Target Attack Radar System (JSTARS)/Rivet Joint. In the absence of a GPS, the AWACS, JSTARS, or Rivet Joint aircraft is the choice for TOD in an operational area using the AN/ARC-204A(V)2. These aircraft are equipped with GPS receivers and rubidium oscillators and can provide accurate TOD OTA to any HQ radio (in the absence of GPS) up to 30 days. Time signal sets also can be received from a forward or rear tactical air control facility utilizing the AN/TRC-187, which can serve as a primary TOD source. The AN/TRC-187 contains a GPS receiver, HQ radio, and other interfaced circuitry to support the transmitting and receiving TOD data. In addition, the AN/TRC-187 can receive accurate time from another time signal set via telephone lines. It can pass TOD OTA to any HQ radio.

Note: In some instances it may be more practical for a land-based unit such as a control and reporting center or sector air operations center, to act as the TOD source since the

land based units in theater usually operate around the clock, as opposed to airborne platforms which have limited on-station time.

c. GPS. GPS receivers are installed or affiliated with most ships, aircraft, tactical air control system shelters, vehicles, and manpack units. Deploying GPS receivers with an HQ TOD output interface has established it as a means of initializing and updating HQ radios with TOD. GPS is the most accurate source because it contains cesium beam and rubidium oscillators from which output signals are constantly monitored and refer to the United States Naval Observatory UTC.

Note: Many radios equipped with GPS TOD receivers have no way to indicate if a valid TOD was received via GPS other than to operations check it with another collocated radio. (There is no audible tone as with a TOD OTA transfer.)

(1) HQ Radios. Operators can use HQ radios that have recently received a TOD update from a single master RF source. The time will be most accurate immediately after the radio has received the update.

(2) Emergency Time Start. Use emergency time start as a last resort if no UTC source is available. If synchronization is lost and an accurate timing source is not available, users within a network may synchronize themselves. One HQ radio can self-generate an arbitrary TOD and then act as a master clock to synchronize all other radios on the network. Other radios, with the proper TOD, will not be able to communicate with the self-started network in the active mode, and networks with different TOD may experience mutual interference if they are within range. Make every effort to acquire TOD from GPS, AWACS, JSTARS, Rivet Joint, or HQ radios before using the emergency activation procedure.

d. TOD and Day of Month (DOM). In addition to requiring TOD, HQ II radios also require the current DOM so the correct MWOD segment can be loaded from internal memory to initialize the radio for operation. Users can acquire DOM information in a time update from a HQ II radio loaded with the current DOM or enter it manually.

(1) If this date information is not available, the user can enter the current DOM manually and then self-start the radio's clock.

(2) For HQ II radios to transmit DOM after an emergency self-activation, enter the DOM before the TOD, or only the TOD will be transmitted. There is no manual input for day of year. Only when the original TOD is received from GPS can a radio receive day of year.

e. TOD Procedural Considerations.

(1) TOD Initialization. Although the principal way of initializing and updating HQ radios will be by a single master RF source, there are additional facilities/terminals available to provide TOD. The appropriate initialization method depends on the tactical environment. There are planning considerations to remember when selecting TOD initialization methods; Three are as follows.

(a) Operators must receive an initial TOD in the normal mode, on a single ultrahigh frequency. When operating in the active mode, operators can only receive TOD updates from radios operating in the same network.

(b) Designation of alternate frequencies and beacon sources for transmitting initial and updated TOD to network members is another important consideration. Without an alternate, enemy jamming of the primary frequency can cripple an HQ network by disrupting time synchronization. If the primary time source fails, two-way transfer of TOD responsibilities to an alternate source must occur.

(c) In case of RF beacon frequency loss, all platforms will revert to individual platform GPS until an alternate RF beacon is established.

(2) Leap Second.

(a) Leap Second Planning. Twice a year, at midnight UTC (on 31 December and 30 June) the UTC advances or delays by one second. Leap seconds are used only when required to compensate for variations in the Earth's rotation rate and to keep UTC aligned with astronomical time.

(b) The Leap-Second Rollback Problem. At midnight, when a leap second occurs, a network composed of radios relying on different sources of time (i.e., GPS and non-GPS) have the potential of being non-interoperable after a leap second event if the radios are commanded to receive a new TOD. Since HQ II radios do not have the provision for manual input of an expected leap second or for automatic rollback at the designated time, operators must ensure the following measures are performed.

- A leap second occurrence is identified several months prior to its occurrence. The operational procedure for HQ II radios is to require all active units, operating through midnight, to accept a new TOD message from an identified GPS-based timing source.
- GPS automatically corrects for the leap second and continuously provides accurate UTC to GPS-equipped radios. Most aircraft are equipped with GPS receivers to synchronize their HQ radios with UTC. It is the responsibility of the platform, operator, or pilot to initiate this sequence.
- Units that do not have GPS receivers will continue to operate on time that has not been corrected for the leap second. TOD reinitialization of non-GPS-clocked radios by a GPS-clocked radio is required to begin operation with time that has been corrected for the leap second.

3. NETWORK ID Number

The three-digit network identification number is manually entered into the radio similar to the manual assignment of a single frequency. The number assigns the network type and group on which a radio network will operate. Also, the network number provides an offset in the hopping sequence upon which radios in that network will initiate their hop sequence. Network number assignments are made by planners based upon the number of networks accommodated by WOD in a geographical region. Operators may apply network number replication when sufficient geographical separation permits.

Appendix J
HAVE QUICK (HQ) NETWORK (NET) MANAGEMENT REQUIREMENTS

1. General

a. Net number, word of the day (WOD), and time of day (TOD) settings separate users into distinct networks.

b. Net number prefixes are always “A”.

c. Net numbers are in the form XX.XYY (prefixed by A or B) where Xs range from 0 to 9 and YY is chosen from the set (00, 25, 50, or 75).

2. Basic HQ I NETs

a. Net Types. The four types of active mode operations available in basic HQ are:

b. A-nets.

c. Sectionalized A-nets.

d. B-nets.

e. T-nets.

(1) T-nets. Training exercises in the active mode use T-nets, which do not expose the system’s full jam-resistance capability. The T-net frequencies form part of the training WOD that is loaded into preset channels 15 through 19. The final element, 300.0YY is loaded into preset channel 20, where YY is the hop rate 00, 25, 50, or 75. For each complete T-net WOD, five independent non-interfering T-nets are available. The assigned network numbers are A00.0 through A00.4.

(2) Only systems with the same training WOD, TOD, and network numbers entered in the same preset channels 15 through 20, will be able to communicate in active mode.

3. HQ II NETWORKS

Net types. HQ II has all of the basic HQ networks and adds the ability to load frequency management A-nets FMA-nets and FMT-nets.

a. FMA-nets. FMA-nets are divided into two groups: North Atlantic Treaty Organization (NATO) nets and non-NATO networks. Each group has 1,000 networks, divided into 50-net blocks, and arranged to guarantee minimum frequency separation. They have equal jam resistance and should allow the communications planner to minimize interference when several HQ II radios are operated on a single platform. NATO networks are reserved for exclusive use in NATO countries. The network numbers are in the form AXX.XYY. The XX.X designates the network number (00.0 through 99.9). The YY designates the frequency table entry.

(1) The “00” selects a basic HQ net, sectionalized A-net, or B-net.

(2) The “25” selects a HQ II NATO net.

(3) The “50” selects a HQ II non-NATO net.

b. FMT-nets.

Note: There is no guaranteed frequency separation between different modes of operation (i.e., single channel and A-nets, sectored A-nets and A-nets, etc.). Do not assign two radios on a platform network from the same block. Doing so will defeat the frequency separation scheme and result in interference.

(1) HQ II provides 16 FMT-nets in addition to basic HQ T-nets. The 16 FMT-nets should not be operated at the same time unless the selected frequencies between the two modes are widely separated to minimize interference with command and control. The FMT-nets are numbered A00.025 through A01.525 and do not repeat. The user must select all six characters in the network designator, and set the last two digits at 25. Each of the 16 FMT-nets use the same set of 16 frequencies. The 16 authorized training frequencies shown in table 27, are loaded into the radio's permanent memory and are reloaded only if the authorized training frequencies change. The list of 16 frequencies guarantees the 4 MHz minimum separation.

(2) The frequencies in the first column are approved for use exclusively within continental United States (CONUS) FMT-nets. These frequencies are in the order suggested for use throughout CONUS by all HQ-equipped radios. In other theaters, major commands are responsible for obtaining approved frequencies. The T- net numbers for HQ II are the same as in the basic HQ system, except six digits are read instead of four. The T-nets are numbered A00.000 through A00.400. The last two digits must be 00.

Note: To use the FMT-nets, the entire training WOD is not required. Loading only channel 20, training WOD (300.0XX); channel 14, effective day of WOD (3XX.000); and channel 01, and current day (3XX.000) elements will enable use of the 16 FMT-nets (A0X.X25). This allows rapidly reloading the WOD to expedite use for training or when a complete WOD reload is not practical. There are two sets of T-nets available in HQ II FMT-nets; the T-nets are not interoperable.

Table 27. HQ II Frequency Modulation T-Net Frequencies (Megahertz)							
Net	Location						
	Continental United States Alaska Hawaii Korea	Japan	Guam (within 12 nautical miles)	Norway France Portugal Greece Estonia Latvia Lithuania	Italy Spain Belgium Netherlands Luxembourg Turkey	Denmark United Kingdom Germany Slovenia Slovak Republic Romania Bulgaria	Czech Republic Hungary Poland Iceland Albania Croatia
20	235.050	314.700	235.050	261.050	252.925	252.725	525.100
19	225.150	322.700	289.050	379.325	374.425	374.125	373.800
18	252.925	326.300	293.550	269.350	264.550	265.875	257.400
17	239.950	369.700	298.650	316.550	308.550	315.875	310.000
16	271.950	381.100	303.275	291.250	283.875	284.950	280.325
15	267.850	314.675	308.750	359.350	344.925	357.150	355.675
14	262.450	322.675	314.450	338.950	337.025	342.575	344.525
13	257.250	326.275	235.050	373.875	357.325	363.275	363.700
12	314.450	369.675	314.450	399.450	386.800	387.850	399.775
11	308.750	381.075	308.750	386.550	379.725	379.225	378.025
10	303.275	381.100	303.275	306.500	292.425	292.200	291.175
9	298.650	369.700	298.650	310.900	300.725	298.575	298.275
8	293.550	322.700	293.550	253.000	245.725	248.275	246.775
7	289.050	326.300	289.050	328.400	312.925	336.025	335.475
6	284.150	314.675	235.050	241.450	235.100	240.875	240.525
5	279.750	322.675	314.450	283.850	270.175	270.025	267.325

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Appendix K
DEPARTMENT OF DEFENSE (DOD) SATELLITE COMMUNICATIONS PRIORITY AND PRECEDENCE

Use table 28 to determine the SATCOM priority during service request process.

Table 28. DOD Satellite Communications Priority Table

Priority User	Category
Priority 1	Strategic order (essential to national survival).
1A	System control/orderwire.
1B	Executive support.
1B1	Presidential support.
1B2	Secretary of Defense support.
1B3	Secretary of State/envoy and emissary support/diplomatic negotiations.
1C	Strategic and threat warning/intelligence.
1D	National and strategic nuclear force direction requirements.
1E	Secretary of Defense directed combatant command emergency operations authority (other than executive support).
Priority 2	Tasked plan execution (operational, contingency, or functional plan).
2A	CJCS support, exclusively, relates to the support provided to the CJCS and Vice CJCS in the execution of their duties as senior military advisors to the Secretary of Defense.
2B	Combatant commander operations relate, exclusively, to the efforts required of the combatant command, in peace and war, to facilitate executing the functional or geographic mission. These include combat Service support.
2C	JTF or CTF operations direct task force communications. These do not include task force components' internal communications.
2D	Component operations (theater forces) communications internal to a component, including components that are task force participants.
2E	Tactical warning and intelligence related to sensors, personnel, and associated support that collect and disseminate time-sensitive intelligence to US combatants.
Priority 3	Essential operational support (operations not associated with an OPLAN, CONPLAN, FUNCPLAN).
3A	Humanitarian support/defense support of civil authorities' response to peacetime crises, disasters, and national special security events.
3B	Combatant commander operations are operations not directly related to executing a tasked plan, but essential for operational support.
3C	JTF CTF operations and JTF and CTF communications not directly related to executing a tasked plan, but essential for operational support. This does not include internal component communications.

Table 28. DOD Satellite Communications Priority Table (Cont'd)	
Priority User	**Category**
3D	Component operations internal component communications, including task force participants, not directly related to executing a tasked plan, but essential for operational support.
3E	Intelligence and weather intelligence information gathering, threat identification, and weather collection activities that are not directly associated with a higher priority activity.
3F	Diplomatic post support. Routine communications support to US diplomatic facilities and personnel overseas.
3G	Space vehicle support. Relates to launch and recovery support to space vehicles.
3H	EMI activity resolution. EMI will be assigned the priority of the mission affected or 3H, whichever is higher.
3I	Logistics supports the routine transit and processing of DOD materiel.
Priority 4	Training.
4A	CJCS directed exercise.
4B	Pre-deployment exercise/training (45 days out) reserved for forces to exercise and train priority 1, 2, or 3 requirements within 45 days of an operational deployment.
4C	Combatant command sponsored, specific training tasks associated with supported and supporting commands; imminent follow-on deployment or operations in support of homeland security/defense.
4D	Major commands: US Air Force and US Army Echelon 2 sponsored training performed in the name of the Service's major command.
4E	Joint forces training (multiple categories) forces engaged in sanctioned joint training.
4F	Unit sponsored unit level training.
Priority 5	VIP support.
5A	Service Secretaries.
5B	Service Chiefs.
5C	Combatant command travel.
5D	Other travel.
Priority 6	RDT&E and general.
6A	EMI activity testing/resolution.
6B	DOD-sponsored testing.
6C	DOD-sponsored demonstrations.
6D	DOD administrative support.

Table 28. DOD Satellite Communications Priority Table (Cont'd)	
Priority User	**Category**
6E	DOD quality of life initiatives.
Priority 7	Miscellaneous.
7A	DOD support to law enforcement (non-JTF support).
7B	Civil non-federal agency support.
7C	Non-US support as approved by the authorized organization.
7D	Other.
Legend: CJCS—Chairman Joint Chiefs of Staff CTF—coalition task force DOD—Department of Defense EMI—electromagnetic interference JTF—joint task force RDT&E—research, development, test and evaluation US—United States VIP—very important person	

Use table 29 to determine the SATCOM precedence during service request process.

Table 29. DOD Satellite Communications Precedence Category Table	
Precedence	**Category**
Flash	Reserved for combat operations.
Immediate	Reserved for life, limb, or eyesight impact and critical operations.
Priority	Reserved for operations involving space support, space control, diplomatic support, and logistics.
Routine	All modes of operations/training not listed.
Flash Override	Not a precedence level but rather an authority and means to override all other traffic. Reserved for national command authority.

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Appendix L
ULTRAHIGH FREQUENCY (UHF) SATELLITE COMMUNICATIONS TABLES OF AZIMUTHS AND ELEVATIONS

1. Azimuths

a. Figure 26 shows quadrants for UHF azimuths and elevations. Use tables 30-33 to extract the azimuth difference between the location of a satellite and receiver (user). To do this, determine which quadrant contains the satellite. Each quadrant has its own table for determining the correct azimuth to the satellite (i.e., tables 32 through 35 represent quadrants I through IV, respectively). The quadrant divisions are the equator and satellite meridian.

b. For example, if the satellite is located at 105o west longitude and the receiver is located in San Diego, California at 33o north latitude and 117o west longitude (rounded numbers), which is contained in quadrant IV; that would place the receiver 33o above the equator and 12o west (117-105 = 12) of the satellite.

c. Select the table of quadrants for quadrant IV (table 35) and locate the closest values to 12o in the first column. These are 10.0 and 15.0. Look across the top row, and locate 30.0 and 35.0 (because 33o is not represented in the table). Where the column and row values intersect on the table are values 160.6, 162.9, 151.8, and 155.0. Add these values and divide the sum by 4 (the number of values) to obtain the average (157.57). The azimuth is rounded up to 158o.

Figure 26. Quadrants for UHF Tables of Azimuths and Elevations

Table 30. Table of Azimuth, Quadrant I

	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
5.0	225.1	206.7	198.7	194.3	191.7	189.9	188.7	187.8	187.1	186.5	186.1	185.8	185.5	185.3	185.2	185.1	185.0
10.0	243.7	225.4	214.3	207.3	202.6	199.4	197.1	195.3	194.0	193.0	192.1	191.5	191.0	190.6	190.3	190.2	190.0
15.0	252.0	237.1	226.0	218.1	212.4	208.2	205.0	202.6	200.8	199.3	198.1	197.2	196.5	195.9	195.5	195.2	195.1
20.0	256.5	244.5	234.6	226.8	220.7	216.1	212.4	209.5	207.2	205.4	204.0	202.8	201.9	201.2	200.6	200.3	200.1
25.0	259.4	249.6	241.0	233.7	227.8	223.0	219.1	216.0	213.4	211.3	209.7	208.3	207.2	206.4	205.8	205.3	205.1
30.0	261.4	253.3	245.9	239.4	233.8	229.1	225.2	221.9	219.2	217.0	215.2	213.7	212.5	211.6	210.9	210.4	210.1
35.0	262.9	256.1	249.7	244.0	238.9	234.5	230.7	227.4	224.7	222.4	220.5	219.0	217.7	216.7	215.9	215.4	215.1
40.0	264.1	258.3	252.9	247.8	243.3	239.2	235.6	232.5	229.9	227.6	225.7	224.1	222.8	221.8	221.0	220.4	220.1
45.0	265.0	260.1	255.5	251.1	247.1	243.4	240.2	237.3	234.7	232.5	230.7	229.1	227.8	226.8	226.0	225.4	225.1
50.0	265.8	261.7	257.7	254.0	250.5	247.2	244.3	241.7	239.3	237.3	235.5	234.0	232.7	231.7	231.0	230.4	230.1
55.0	266.5	263.1	259.7	256.5	253.5	250.7	248.1	245.8	243.7	241.8	240.2	238.8	237.6	236.7	235.9	235.4	235.1
60.0	267.1	264.3	261.5	258.8	256.3	253.9	251.7	249.6	247.8	246.1	244.7	243.4	242.4	241.5	240.9	240.4	240.1
65.0	267.7	265.4	263.1	260.9	258.9	256.9	255.0	253.3	251.8	250.3	249.1	248.0	247.1	246.3	245.8	245.3	245.1
70.0	268.2	266.4	264.6	262.9	261.3	259.7	258.2	256.8	255.6	254.4	253.4	252.5	251.7	251.1	250.6	250.3	250.1
75.0	268.7	267.3	266.0	264.8	263.5	262.4	261.3	260.2	259.3	258.4	257.6	256.9	256.4	255.9	255.5	255.2	255.1
80.0	269.1	268.2	267.4	266.5	265.7	265.0	264.2	263.5	262.9	262.3	261.8	261.3	260.9	260.6	260.3	260.1	260.0
85.0	269.6	269.1	268.7	268.3	267.9	267.5	267.1	266.8	266.5	266.2	265.9	265.7	265.5	265.3	265.2	265.1	265.0

Table 31. Table of Azimuth, Quadrant II

	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
5.0	314.9	333.3	341.3	345.7	348.3	350.1	351.3	352.2	352.9	353.5	353.9	354.2	354.5	354.7	354.8	354.9	355.0
10.0	296.3	314.6	325.7	332.7	337.4	340.6	342.9	344.7	346.0	347.0	347.9	348.5	349.0	349.4	349.7	349.8	350.0
15.0	288.0	302.9	314.0	321.9	327.6	331.8	335.0	337.4	339.2	340.7	341.9	342.8	343.5	344.1	344.5	344.8	344.9
20.0	283.5	295.5	305.4	313.2	319.3	323.9	327.6	330.5	332.8	334.6	336.0	337.2	338.1	338.8	339.4	339.7	339.9
25.0	280.6	290.4	299.0	306.3	312.2	317.0	320.9	324.0	326.6	328.7	330.3	331.7	332.8	333.6	334.2	334.7	334.9
30.0	278.6	286.7	294.1	300.6	306.2	310.9	314.8	318.1	320.8	323.0	324.8	326.3	327.5	328.4	329.1	329.6	329.9
35.0	277.1	283.9	290.3	296.0	301.1	305.5	309.3	312.6	315.3	317.6	319.5	321.0	322.3	323.3	324.1	324.6	324.9
40.0	275.9	281.7	287.1	292.2	296.7	300.8	304.4	307.5	310.1	312.4	314.3	315.9	317.2	318.2	319.0	319.6	319.9
45.0	275.0	279.9	284.5	288.9	292.9	296.6	299.8	302.7	305.3	307.5	309.3	310.9	312.2	313.2	314.0	314.6	314.9
50.0	274.2	278.3	282.3	286.0	289.5	292.8	295.7	298.3	300.7	302.7	304.5	306.0	307.3	308.3	309.0	309.6	309.9
55.0	273.5	276.9	280.3	283.5	286.5	289.3	291.9	294.2	296.3	298.2	299.8	301.2	302.4	303.3	304.1	304.6	304.9
60.0	272.9	275.7	278.5	281.2	283.7	286.1	288.3	290.4	292.2	293.9	295.3	296.6	297.6	298.5	299.1	299.6	299.9
65.0	272.3	274.6	276.9	279.1	281.1	283.1	285.0	286.7	288.2	289.7	290.9	292.0	292.9	293.7	294.2	294.7	294.9
70.0	271.8	273.6	275.4	277.1	278.7	280.3	281.8	283.2	284.4	285.6	286.6	287.5	288.3	288.9	289.4	289.7	289.9
75.0	271.3	272.7	274.0	275.2	276.5	277.6	278.7	279.8	280.7	281.6	282.4	283.1	283.6	284.1	284.5	284.8	284.9
80.0	270.9	271.8	272.6	273.5	274.3	275.0	275.8	276.5	277.1	277.7	278.2	278.7	279.1	279.4	279.7	279.9	280.0
85.0	270.4	270.9	271.3	271.7	272.1	272.5	272.9	273.2	273.5	273.8	274.1	274.3	274.5	274.7	274.8	274.9	275.0

Table 32. Table of Azimuth, Quadrant III

	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
5.0	45.1	26.7	18.7	14.3	11.7	9.9	8.7	7.8	7.1	6.5	6.1	5.8	5.5	5.3	5.2	5.1	5.0
10.0	63.7	45.4	34.3	27.3	22.6	19.4	17.1	15.3	14.0	13.0	12.1	11.5	11.0	10.6	10.3	10.2	10.0
15.0	72.0	57.1	46.0	38.1	32.4	28.2	25.0	22.6	20.8	19.3	18.1	17.2	16.5	15.9	15.5	15.2	15.1
20.0	76.5	64.5	54.6	46.8	40.7	36.1	32.4	29.5	27.2	25.4	24.0	22.8	21.9	21.2	20.6	20.3	20.1
25.0	79.4	69.6	61.0	53.7	47.8	43.0	39.1	36.0	33.4	31.3	29.7	28.3	27.2	26.4	25.8	25.3	25.1
30.0	81.4	73.3	65.9	59.4	53.8	49.1	45.2	41.9	39.2	37.0	35.2	33.7	32.5	31.6	30.9	30.4	30.1
35.0	82.9	76.1	69.7	64.0	58.9	54.5	50.7	47.4	44.7	42.4	40.5	39.0	37.7	36.7	35.9	35.4	35.1
40.0	84.1	78.3	72.9	67.8	63.3	59.2	55.6	52.5	49.9	47.6	45.7	44.1	42.8	41.8	41.0	40.4	40.1
45.0	85.0	80.1	75.5	71.1	67.1	63.4	60.2	57.3	54.7	52.5	50.7	49.1	47.8	46.8	46.0	45.4	45.1
50.0	85.8	81.7	77.7	74.0	70.5	67.2	64.3	61.7	59.3	57.3	55.5	54.0	52.7	51.7	51.0	50.4	50.1
55.0	86.5	83.1	79.7	76.5	73.5	70.7	68.1	65.8	63.7	61.8	60.2	58.8	57.6	56.7	55.9	55.4	55.1
60.0	87.1	84.3	81.5	78.8	76.3	73.9	71.7	69.6	67.8	66.1	64.7	63.4	62.4	61.5	60.9	60.4	60.1
65.0	87.7	85.4	83.1	80.9	78.9	76.9	75.0	73.3	71.8	70.3	69.1	68.0	67.1	66.3	65.8	65.3	65.1
70.0	88.2	86.4	84.6	82.9	81.3	79.7	78.2	76.8	75.6	74.4	73.4	72.5	71.7	71.1	70.6	70.3	70.1
75.0	88.7	87.3	86.0	84.8	83.5	82.4	81.3	80.2	79.3	78.4	77.6	76.9	76.4	75.9	75.5	75.2	75.1
80.0	89.1	88.2	87.4	86.5	85.7	85.0	84.2	83.5	82.9	82.3	81.8	81.3	80.9	80.6	80.3	80.1	80.0
85.0	89.6	89.1	88.7	88.3	87.9	87.5	87.1	86.8	86.5	86.2	85.9	85.7	85.5	85.3	85.2	85.1	85.0

Table 33. Table of Azimuth, Quadrant IV

	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
5.0	134.9	153.3	161.3	165.7	168.3	170.1	171.3	172.2	172.9	173.5	173.9	174.2	174.5	174.7	174.8	174.9	175.0
10.0	116.3	134.6	145.7	152.7	157.4	160.6	162.9	164.7	166.0	167.0	167.9	168.5	169.0	169.4	169.7	169.8	170.0
15.0	108.0	122.9	134.0	141.9	147.6	151.8	155.0	157.4	159.2	160.7	161.9	162.8	163.5	164.1	164.5	164.8	164.9
20.0	103.5	115.5	125.4	133.2	139.3	143.9	147.6	150.5	152.8	154.6	156.0	157.2	158.1	158.8	159.4	159.7	159.9
25.0	100.6	110.4	119.0	126.3	132.2	137.0	140.9	144.0	146.6	148.7	150.3	151.7	152.8	153.6	154.2	154.7	154.9
30.0	98.6	106.7	114.1	120.6	126.2	130.9	134.8	138.1	140.8	143.0	144.8	146.3	147.5	148.4	149.1	149.6	149.9
35.0	97.1	103.9	110.3	116.0	121.1	125.5	129.3	132.6	135.3	137.6	139.5	141.0	142.3	143.3	144.1	144.6	144.9
40.0	95.9	101.7	107.1	112.2	116.7	120.8	124.4	127.5	130.1	132.4	134.3	135.9	137.2	138.2	139.0	139.6	139.9
45.0	95.0	99.9	104.5	108.9	112.9	116.6	119.8	122.7	125.3	127.5	129.3	130.9	132.2	133.2	134.0	134.6	134.9
50.0	94.2	98.3	102.3	106.0	109.5	112.8	115.7	118.3	120.7	122.7	124.5	126.0	127.3	128.3	129.0	129.6	129.9
55.0	93.5	96.9	100.3	103.5	106.5	109.3	111.9	114.2	116.3	118.2	119.8	121.2	122.4	123.3	124.1	124.6	124.9
60.0	92.9	95.7	98.5	101.2	103.7	106.1	108.3	110.4	112.2	113.9	115.3	116.6	117.6	118.5	119.1	119.6	119.9
65.0	92.3	94.6	96.9	99.1	101.1	103.1	105.0	106.7	108.2	109.7	110.9	112.0	112.9	113.7	114.2	114.7	114.9
70.0	91.8	93.6	95.4	97.1	98.7	100.3	101.8	103.2	104.4	105.6	106.6	107.5	108.3	108.9	109.4	109.7	109.9
75.0	91.3	92.7	94.0	95.2	96.5	97.6	98.7	99.8	100.7	101.6	102.4	103.1	103.6	104.1	104.5	104.8	104.9
80.0	90.9	91.8	92.6	93.5	94.3	95.0	95.8	96.5	97.1	97.7	98.2	98.7	99.1	99.4	99.7	99.9	100.0
85.0	90.4	90.9	91.3	91.7	92.1	92.5	92.9	93.2	93.5	93.8	94.1	94.3	94.5	94.7	94.8	94.9	95.0

2. Elevations

a. Use table 34 to extract the elevation difference between the location of the satellite and receiver's (user's). For example, the satellite is located at 105º west longitude and the receiver is located 33º north latitude and 117º west longitude. That would place the receiver 33º above the equator and 12º degrees west (117-105 = 12) of the satellite.

b. Select the values 10 and 15 on the first numerical column of table 36 (because 12 is not represented in this table). Look across the top, numerical row and locate the 30 and 35 (because 33º is not represented in this table).. The numbers where these values intersect are 53, 48, 51, and 46. Add these values then divide the sum by 4 (the number of values) to obtain their average. The elevation is 49.5º.

c. Elevations less that 10º make acquiring a satellite difficult.

Table 34. Table of Elevations

Degrees of Longitude East/West of Satellite	Degrees of Latitude North/South of Satellite																
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**
5	82	77	71	66	60	55	49	43	38	33	27	22	17	11	6	1	-4
10	77	73	69	64	59	53	48	43	37	32	27	21	16	11	6	1	-4
15	71	69	65	61	56	51	46	41	36	31	26	21	16	11	6	1	-4
20	66	64	61	57	53	49	44	39	35	30	25	20	15	10	5	1	-4
25	60	59	56	53	50	46	41	37	33	28	23	19	14	10	5	0	-4
30	55	53	51	49	46	42	38	34	30	26	22	17	13	9	4	0	-4
35	49	48	46	44	41	38	35	31	28	24	20	16	12	8	4	0	-5
40	43	43	41	39	37	34	31	28	25	21	18	14	10	7	3	-1	-5
45	38	37	36	35	33	30	28	25	22	19	16	12	9	5	2	-2	-5
50	33	32	31	30	28	26	24	21	19	16	13	10	7	4	1	-2	-5
55	27	27	26	25	23	22	20	18	16	13	11	8	5	3	0	-3	-6
60	22	21	21	20	19	17	16	14	12	10	8	6	4	1	-1	-4	-6
65	17	16	16	15	14	13	12	10	9	7	5	4	2	0	-2	-4	-7
70	11	11	11	10	10	9	8	7	5	4	3	1	0	-2	-4	-5	-7
75	6	6	6	5	5	4	4	3	2	1	0	-1	-2	-4	-5	-6	-7
80	1	1	1	1	0	0	0	-1	-2	-2	-3	-4	-4	-5	-6	-7	-8
85	-4	-4	-4	-4	-4	-4	-5	-5	-5	-5	-6	-6	-7	-7	-7	-8	-8

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Appendix M
SATELLITE CHANNEL (HOME CHANNEL) AUTHORIZATION

Table 35 provides a list of currently authorized satellite channels (home channels) to include channel bandwidth, and upload and download frequencies.

Table 35. Satellite Channel (Home Channel) Authorization

Channel Number	Uplink Frequency (Megahertz)	Downlink Frequency (Megahertz)	Channel Bandwidth
1	SHF	250.350	Not Applicable (N/A)
2	SHF	250.400	N/A
3	SHF	250.450	N/A
4	SHF	250.500	N/A
5	SHF	250.550	N/A
6	SHF	250.600	N/A
7	SHF	250.650	N/A
8	SHF	250.700	N/A
9	292.850	251.850	25 kilohertz (KHz)
10	292.950	251.950	25 KHz
11	293.050	252.050	25 KHz
12	293.150	252.150	25 KHz
13	294.550	253.550	25 KHz
14	294.650	253.650	25 KHz
15	294.750	253.750	25 KHz
16	294.850	253.850	25 KHz
17	296.250	255.250	25 KHz
18	296.350	255.350	25 KHz
19	296.450	255.450	25 KHz
20	296.550	255.550	25 KHz
21	297.850	256.850	25 KHz
22	297.950	256.950	25 KHz
23	298.050	257.050	25 KHz
24	298.150	257.150	25 KHz
25	299.350	258.350	25 KHz
26	299.450	258.450	25 KHz
27	299.550	258.550	25 KHz
28	299.650	258.650	25 KHz
29	306.250	265.250	25 KHz
30	306.350	265.350	25 KHz
31	306.450	265.450	25 KHz
32	306.550	265.550	25 KHz
33	307.750	266.750	25 KHz
34	307.850	266.850	25 KHz
35	307.950	266.950	25 KHz
36	308.050	267.050	25 KHz

Table 35. Satellite Channel (Home Channel) Authorization (Cont'd)			
Channel Number	**Uplink Frequency (Megahertz)**	**Downlink Frequency (Megahertz)**	**Channel Bandwidth**
37	309.150	268.150	25 KHz
38	309.250	268.250	25 KHz
39	309.350	268.350	25 KHz
40	309.450	268.450	25 KHz
41	310.650	269.650	25 KHz
42	310.750	269.750	25 KHz
43	310.850	269.850	25 KHz
44	310.950	269.950	25 KHz
45	293.950	260.350	25 KHz
46	293.975	260.375	25 KHz
47	294.000	260.400	25 KHz
48	294.025	260.425	25 KHz
49	294.050	260.450	25 KHz
50	294.075	260.475	25 KHz
51	294.100	260.500	25 KHz
52	294.125	260.525	25 KHz
53	294.150	260.550	25 KHz
54	294.175	260.575	25 KHz
55	294.200	260.600	25 KHz
56	294.225	260.625	25 KHz
57	294.250	260.650	25 KHz
58	294.275	260.675	25 KHz
59	294.300	260.700	25 KHz
60	294.325	260.725	25 KHz
61	294.350	260.750	25 KHz
62	294.375	260.775	25 KHz
63	294.400	260.800	25 KHz
64	294.425	260.825	25 KHz
65	294.450	260.850	25 KHz
66	295.050	261.450	25 KHz
67	295.075	261.475	25 KHz
68	295.100	261.500	25 KHz
69	295.125	261.525	25 KHz
70	295.150	261.550	25 KHz
71	295.175	261.575	25 KHz
72	295.200	261.600	25 KHz
73	295.225	261.625	25 KHz
74	295.250	261.650	25 KHz
75	295.275	261.675	25 KHz
76	295.300	261.700	25 KHz
77	295.325	261.725	25 KHz

Table 35. Satellite Channel (Home Channel) Authorization (Cont'd)			
Channel Number	**Uplink Frequency (Megahertz)**	**Downlink Frequency (Megahertz)**	**Channel Bandwidth**
78	295.350	261.750	25 KHz
79	295.375	261.775	25 KHz
80	295.400	261.800	25 KHz
81	295.425	261.825	25 KHz
82	295.450	261.850	25 KHz
83	295.475	261.875	25 KHz
84	295.500	261.900	25 KHz
85	295.525	261.925	25 KHz
86	295.550	261.950	25 KHz
87	295.650	262.050	25 KHz
88	295.675	262.075	25 KHz
89	295.700	262.100	25 KHz
90	295.725	262.125	25 KHz
91	295.750	262.150	25 KHz
92	295.775	262.175	25 KHz
93	295.800	262.200	25 KHz
94	295.825	262.225	25 KHz
95	295.850	262.250	25 KHz
96	295.875	262.275	25 KHz
97	295.900	262.300	25 KHz
98	295.925	262.325	25 KHz
99	295.950	262.350	25 KHz
100	295.975	262.375	25 KHz
101	296.000	262.400	25 KHz
102	296.025	262.425	25 KHz
103	296.050	262.450	25 KHz
104	296.075	262.475	25 KHz
105	296.100	262.500	25 KHz
106	296.125	262.525	25 KHz
107	296.150	262.550	25 KHz
108	297.150	263.550	25 KHz
109	297.175	263.575	25 KHz
110	297.200	263.600	25 KHz
111	297.225	263.625	25 KHz
112	297.250	263.650	25 KHz
113	297.275	263.675	25 KHz
114	297.300	263.700	25 KHz
115	297.325	263.725	25 KHz
116	297.350	263.750	25 KHz
117	297.375	263.775	25 KHz
118	297.400	263.800	25 KHz

Table 35. Satellite Channel (Home Channel) Authorization (Cont'd)			
Channel Number	**Uplink Frequency (Megahertz)**	**Downlink Frequency (Megahertz)**	**Channel Bandwidth**
119	297.425	263.825	25 KHz
120	297.450	263.850	25 KHz
121	297.475	263.875	25 KHz
122	297.500	263.900	25 KHz
123	297.525	263.925	25 KHz
124	297.550	263.950	25 KHz
125	297.575	263.975	25 KHz
126	297.600	264.000	25 KHz
127	297.625	264.025	25 KHz
128	297.650	264.050	25 KHz
129	302.445	248.845	5 KHz
130	302.450	248.850	5 KHz
131	302.455	248.855	5 KHz
132	302.465	248.865	5 KHz
133	302.475	248.875	5 KHz
134	302.485	248.885	5 KHz
135	302.495	248.895	5 KHz
136	302.500	248.900	5 KHz
137	302.505	248.905	5 KHz
138	302.515	248.915	5 KHz
139	302.525	248.925	5 KHz
140	302.535	248.935	5 KHz
141	302.545	248.945	5 KHz
142	302.550	248.950	5 KHz
143	302.555	248.955	5 KHz
144	302.565	248.965	5 KHz
145	302.575	248.975	5 KHz
146	302.585	248.985	5 KHz
147	302.595	248.995	5 KHz
148	302.600	249.000	5 KHz
149	302.605	249.005	5 KHz
150	302.615	249.015	5 KHz
151	302.625	249.025	5 KHz
152	302.635	249.035	5 KHz
153	302.645	249.045	5 KHz
154	302.650	249.050	5 KHz
155	302.655	249.055	5 KHz
156	302.665	249.065	5 KHz
157	302.675	249.075	5 KHz
158	302.685	249.085	5 KHz
159	302.695	249.095	5 KHz

Table 35. Satellite Channel (Home Channel) Authorization (Cont'd)			
Channel Number	**Uplink Frequency (Megahertz)**	**Downlink Frequency (Megahertz)**	**Channel Bandwidth**
160	302.700	249.100	5 KHz
161	302.705	249.105	5 KHz
162	302.715	249.115	5 KHz
163	302.725	249.125	5 KHz
164	302.735	249.135	5 KHz
165	302.745	249.145	5 KHz
166	302.750	249.150	5 KHz
167	302.755	249.155	5 KHz
168	302.765	249.165	5 KHz
169	302.775	249.175	5 KHz
170	302.785	249.185	5 KHz
171	302.795	249.195	5 KHz
172	302.800	249.200	5 KHz
173	302.805	249.205	5 KHz
174	302.815	249.215	5 KHz
175	302.825	249.225	5 KHz
176	302.835	249.235	5 KHz
177	302.845	249.245	5 KHz
178	302.850	249.250	5 KHz
179	302.855	249.255	5 KHz
180	302.865	249.265	5 KHz
181	302.875	249.275	5 KHz
182	302.885	249.285	5 KHz
183	302.895	249.295	5 KHz
184	302.900	249.300	5 KHz
185	302.905	249.305	5 KHz
186	302.915	249.315	5 KHz
187	302.925	249.325	5 KHz
188	302.935	249.335	5 KHz
189	302.945	249.345	5 KHz
190	302.950	249.350	5 KHz
191	302.955	249.355	5 KHz
192	307.750	254.150	25 KHz
193	311.150	257.550	25 KHz
194	316.955	243.855	5 KHz
195	316.960	243.860	5 KHz
196	316.975	243.875	5 KHz
197	317.000	243.900	5 KHz
198	317.010	243.910	5 KHz
199	317.015	243.915	5 KHz
200	317.025	243.925	5 KHz

Table 35. Satellite Channel (Home Channel) Authorization (Cont'd)			
Channel Number	**Uplink Frequency (Megahertz)**	**Downlink Frequency (Megahertz)**	**Channel Bandwidth**
201	317.035	243.935	5 KHz
202	317.045	243.945	5 KHz
203	317.055	243.955	5 KHz
204	317.065	243.965	5 KHz
205	317.075	243.975	5 KHz
206	317.085	243.985	5 KHz
207	317.090	243.990	5 KHz
208	317.095	243.995	5 KHz
209	317.100	244.000	5 KHz
210	317.105	244.005	5 KHz
211	317.110	244.010	5 KHz
212	317.115	244.015	5 KHz
213	317.125	244.025	5 KHz
214	317.135	244.035	5 KHz
215	317.145	244.045	5 KHz
216	317.155	244.055	5 KHz
217	317.165	244.065	5 KHz
218	317.175	244.075	5 KHz
219	317.185	244.085	5 KHz
220	317.190	244.090	5 KHz
221	317.195	244.095	5 KHz
222	317.200	244.100	5 KHz
223	317.205	244.105	5 KHz
224	317.210	244.110	5 KHz
225	317.215	244.115	5 KHz
226	317.225	244.125	5 KHz
227	317.235	244.135	5 KHz
228	317.245	244.145	5 KHz
229	317.255	244.155	5 KHz
230	317.265	244.165	5 KHz
231	317.275	244.175	5 KHz
232	317.285	244.185	5 KHz
233	317.290	244.190	5 KHz
234	317.295	244.195	5 KHz
235	317.300	244.200	5 KHz
236	317.305	244.205	5 KHz
237	317.310	244.210	5 KHz
238	317.315	244.215	5 KHz
239	317.325	244.225	5 KHz

Appendix N
ULTRAHIGH FREQUENCY (UHF) SATELLITE COMMUNICATIONS (SATCOM) CUT SHEET EXAMPLES

Tables 36, 37, and 38 are examples of cut sheets. Each unit may have developed cut sheets for their unit or mission.

Table 36. DAMA SATCOM Cut Sheet Sample

DAMA Database Setup								
Mode	**Parameter**							
	Backlight Timer	2–60 secs						
DAMA Database	Guard List		1	2	3	4	5	6
			7	8	9	10	11	12
			13	14	15			
	Terminal Data		LAT	LONG	Zulu	Address	Platform	Msg Rel
							Stationary	Manual
	5 KHz I/O Data Rate		2400					
	Satellite Ephemeris		ID Number	LONG	Ascend	Inc		
	Information Codes (25 KHz only)		AC/DC	Request	Meaning			Response
			AC	70	Network address not in guard list.			N/A
			AC	71	Violated maximum precedence.			N/A
			AC	72	Already have a pending service.			N/A
			AC	75	Requester sent teardown message.			N/A
			AC	77	Terminal address not in database.			N/A
			AC	81	Data rate incorrect, check configuration code.			N/A
			AC	82	The called address is incorrect.			N/A
			AC	88	The configuration code is incorrect for the network.			N/A
			AC	89	The configuration code does not match the distant end.			N/A
			AC	90	All called addresses are not available.			N/A
			AC	92	Some called addresses are not available.			N/A
			AC	93	Someone else is running the link test.			N/A
			AC	98	Two or more addresses are network addresses.			N/A

Table 36. A DAMA SATCOM Cut Sheet Sample (Cont'd)

DAMA Cut Sheet			Presets					
Mode	**Parameter**	**Value**	**1**	**2**	**3**	**4**	**5**	**6**
DAMA	Encryption	ANDVT						
		VINSON						
		KG-84						
	Communications	Voice						
		Data						
	Data Rate	75						
		300						
		600						
		1,200						
		2,400						
		4,800						
		9,600						
		16K						
	Channel Variant	5 KHz						
		25 KHz						
	TX Power (decibel-milli-watt)	23–43						
	Channel Number	9–239						
	Receive (RX) Frequency	For reference only						
	TX Frequency	For reference only						
	Configuration Code	5 KHz						
		25 KHz						
	OW Encryption	PT or CT						
	Mode of Operation	Normal						
		EMCON						
		Silent						
	Ranging	Active						
		Passive						
	Satellite ID Number	Passive Ranging only 1–8						

Legend:
AC—
ANDVT—Advanced Narrowband Digital Voice Terminal
CT—cipher text
DAMA—demand assigned multiple access
EMCON—emissions control
ID—identify
I/O—input/output
inc—inclination
KHz—kilohertz
LAT—latitude
LONG—longitude
milli—factor of one thousandth
msg—message
N/A—not applicable
OW—orderwire
PT—plain text
RX—receive
TX—transmit

Table 37. Sample Integrated Waveform (IW) Cut Sheet

IW Cut Sheet			Presets					
Mode	**Parameter**	**Value**	**1**	**2**	**3**	**4**	**5**	**6**
	Satellite ID Number							
	Service Number							
	Note: The options below are for reference only since IW will automatically connect at the correct network parameters for the service number entered.							
IW	Encryption	ANDVT						
		VINSON						
		KG–84						
	Communications	Voice						
		Data						
	Data Rate	75						
		300						
		600						
		1,200						
		2,400						
		4,800						
		6,000						
		7,200						
		8,000						
		9,600						
		16K						
		19.2K						
		28.8K						
		32K						
		38.4K						
		48K						
		56K						
	Voice Mode	LPC–10						
		MELP						
		CVSD						
	Channel Variant	5 KHz						
		25 KHz						
	TX Power (dbm)							
	RX Frequency							
	TX Frequency							
	OW Encryption	PT or CT						
	Mode of Operation	Normal						
		EMCON						
		Silent						
	Ranging	Active						
		Passive						

Legend:
ANDVT—Advanced Narrowband Digital Voice Terminal
CT—cypher text
CVSD—continuously variable slope delta
dbm—decibel (reference in milliwatts)
EMCON—emissions control
ID—identification
I/O—input/output
IW—integrated waveform
K—thousand
KHz—kiloherts
MELP–mixed-excitation linear predictive
OW—orderwire
PT—plain text
RX—receive
TX—transmit

Table 38. A Dedicated Cut Sheet Sample

SATCOM Cut Sheet			Presets					
Mode	**Parameter**	**Value**	**1**	**2**	**3**	**4**	**5**	**6**
SATCOM	Encryption	ANDVT/MELP						
		VINSON						
		4-KG84						
		3-KG84						
	Communications	Voice						
		Data						
	Data Rate	1,200						
		2,400						
		9,600						
		16K						
		19.2K						
		28.8K						
		32K						
		38.4K						
		48K						
		56K						
	TX Power (dbm)							
	Home Channel # (no SATCOM loopback if 999)	9–239 or 999						
	RX Frequency	Required if 999						
	TX Frequency	Required if 999						
	Encoding	Diff						
		Non-Diff						
	Mode Switch	PT or CT						

Legend:
ANDVT—Advanced Narrowband Digital Voice Terminal
CT—cypher text
dbm—decibel (reference in milliwatts)
K—killo (thousands)
MELP—mixed-excitation linear predictive
OW—orderwire
PT—plain text
RX—receive
SATCOM—satellite communications
TX—transmit

Appendix O
DEMAND ASSIGNED MULTIPLE ACCESS INFORMATION REQUEST CODES

Use table 39 to interpret information request codes received by your radio orderwire.

Table 39. Information Request Codes

Note: Wherever it is stated contact the NCTAMS, the regional satellite communications support center may be contacted to provide assistance.

Code	Condition	Action
1-3	Unused	None
4	Disconnect the constant key offender. The controller has determined a constant key offender should be disconnected.	The terminal has been transmitting for 17 minutes—waveform does not allow constant transmission. The AN/PSC–5 terminal does not provide a means to bypass this so all transmissions must be less than 17 consecutive minutes.
5-65	Unused	None
66	The terminal type cannot be connected to the requested guard number. The requested guard number is associated with terminals built to a different version of the MIL-STD. Check the guard number and try again. The FSCS or 183A terminal is requested to connect to a guard number associated with 183 (baseline) terminals. The 183 (baseline) terminal is yah requested to connect to a guard number associated with FSCS and 183A terminals.	Information Request Code 66 is sent when a user requests to join/start a network service using the wrong network address. MIL-STD-188–183, Interoperability Standard For Multiple-Access 5-Khz And 25-Khz Uhf Satellite Communications Channels, uses the odd-numbered (primary) address; this is the AN/PCS–5, AN/PRC–117F, etc. FSCS and MIL-STD-188–183(A) use the even-numbered (alternate = primary + 1), this is the TD–1271 only for now as there are not any 188–183(A) terminals yet certified. The new DAMA SAC channel controller software links this even/odd network address pair to maintain interoperability between all the terminal types. For example VOICE CMD network: Primary network address: 56001 for MIL-STD-188–183; alternate network address: 56002 for TD–1271. The DAMA SAC links 56001 and 56002 in its software to the same data slot. Use of 56001 is required in the AN/PSC–5. Any TD–1271 users would use 56002.
67	The terminal cannot communicate on the assigned channel. The requested service is assigned on a channel to which a MIL-STD-188–183 (baseline) terminal cannot be connected. The channel is identified by an 8-bit channel code and this terminal can only use channels identified by a 6-bit channel code. The channel is a 5 KHz slave channel	AN/PSC–5 terminals would receive this code if mistakenly assigned a 5 KHz slave channel. AN/PSC–5 terminals cannot use these channels. Contact NCTAMS.
68	The logout report has been ignored. Terminal log out can only be performed from Port 1. The logout information report was sent from a port other than Port 1. Change to Port 1 and retry.	Should not receive this code—contact NCTAMS. The AN/PSC–5 is a single-port terminal and, therefore, only uses Port 1. Also, start using code 99 when sending the out-of-service message. This will perform logout on the DAMA SAC.
69	Terminal ID duplicates an existing operational address. The requesting terminal's ID duplicates the address of an operational controller.	A terminal address is the same as a PCC. Check the terminal address.

Table 39. Information Request Codes (Cont'd)		
Code	**Condition**	**Action**
70	The requesting party's guard list does not contain a guard address. The requesting user's port guard list does not contain the guard address of the guard it is trying to activate with the current request.	Put the correct network guard address in the guard list.
71	There is a service request access restriction violation. The service request either has a higher precedence than is allowed by the source's terminal access restriction level or it has a lower precedence than the channel access restriction level.	Send a Status B message. Lower the precedence and reset the service.
72	The requesting party already has an outstanding queued request. Only one request at a time may be queued from a user. This user already has a request queued, therefore, the current request is being canceled.	The following three things may have occurred. (1) A queued service setup was already sent. Only one service of any kind on 25 KHz DAMA is allowed. The operator needs to tear down and set up the new service. (2) The control station believes a service is pending for the terminal. Tear it down and try again. If this does not work, tear it down, place it out-of-service, send a Status B, then set up the service again. (3) Received a busy signal from the distant end. Try again later or page the terminal.
73	The requesting party is not authorized to activate an ALL-CALL. The current request is being canceled because only the controller operator may activate a service to the ALL-CALL address.	This code only applies if the service is to addresses 16383 or 65535. Check the service setup and ensure the correct address is entered. Send the request again with the correct address. If it is still receiving 73, JMINI has incorrectly identified the address contact NCTAMS.
74	The requested terminal is already connected to a DASA service. The requested user is on a terminal that is already connected to a DASA service and, therefore, is unavailable.	The terminal called is unavailable. Tear it down (if required) and try again later.
75	The request is canceled by user. The source of the service request has now canceled the request while it was queued and waiting for a resource.	This is received when teardown of the service is sent before the service is provided (it is usually queued after sending a service setup). No action is required.
76	Queued call is canceled; service queue time-out timer expired. The previously queued request from the requesting user has been canceled due to the controller-imposed time-out limit on queued service requests.	JMINI canceled the service; set up the service again.
77	The terminal does not exist in the controller database. The controller has no record of the requesting terminal's address.	The terminal address is missing from the database. Check the terminal base address to ensure it is correct. If correct, contact the NCTAMS.
78	Request queue is currently full. The controller has too many requests in the queue and cannot accept any more at this time.	Normally, one should not see this; however, a a busy signal is received again. Try again later.
79	Queued call canceled; connection is no longer possible. The controller has deleted a request from queue either at the request of the controller operator or because it is no longer a valid request.	Attempt the service setup again. If the terminal(s) called sent an out of service message, or the radio is the only one up on the network, a different code may be received providing updated information.

Table 39. Information Request Codes (Cont'd)		
Code	**Condition**	**Action**
80	Enter a configuration code and try again. The terminal operator has not entered a configuration code into the port originating the request since the terminal was powered up or since an RCCOW: Out-of-service message was sent from this port.	Check the configuration code, to ensure there is one and it is correct in the current menu; then, set up the service again.
81	The required data rate cannot be supported. The data rate required for this connection is not supported by any of the channels operating on this satellite.	Requested a different data rate than the original one submitted in the SAR. The channel cannot support changing it to allow use of a different data rate. Set up the service at the original data rate and configuration code (via current mode screen).
82	The requested party is unknown. Check the call directory and try again. The requested user or guard does not exist in the controller database.	Check the terminal or network address in the service set up; then, try again. If the network address is correct and terminals are up in the network, the controller may not have activated the network address. Contact the NCTAMS. (If unable to contact NCTAMS, try making a conference call.)
83	Cannot add users to this guard. The requesting party is already connected to a guard and has attempted to add user port(s) to the guard connection.	The terminal is not at SVC idle. Tear it down; then, retry the call. (Even if it says SVC idle, do this first.)
84	Cannot add a guard to an existing call. The requesting user is already participating in a call and has attempted to add a guard to this preexisting connection.	The terminal is not at SVC idle. Tear it down; then, retry the call. (Even if it says SVC idle, do this first.)
85	The requesting party is not authorized to activate this guard. The requesting user has attempted to activate a guard, but this user is not authorized to activate the guard because the requesting party has attempted to activate a private guard, but is not a network controller for this guard.	The JMINI database has the network guard address marked incorrectly. Contact the NCTAMS to correct this. Or, The unit requested a private guard and the network control station has not, or is not, setting up the service to the network first.
86	The requesting party is not a member of this private guard. The requesting user has attempted to join a private guard, but this user is not an authorized member of this private guard.	The terminal is not listed as part of the private network or is calling the wrong network guard address (check the service setup). Contact the NCTAMS.
87	The requested party's terminal is unauthorized or zeroized. The requested user is on a terminal that is marked in the controller database as in an unauthorized or zeroized state.	Check to ensure the terminal called the correct address. If yes, contact the NCTAMS about the address to find out why it is marked this way. JMINI controller sends.
87	The 5/25 KHz slave channel is not available from the requestor's home channel Requested service requires a 5 KHz or 25 KHz slave channel, but the required slave channel is not accessible from the requestor's home channel.	A service is requested with a terminal and network address assigned to a different home channel. Currently, there is no capability to assign a terminal to either a different home channel or a slave channel associated with a different home channel. If authorized to talk within this network, check the current mode screen to ensure it is set up for the correct home channel. If not, send an out-of-service message, make changes, or select the correct preset. Reenter the DAMA mode on the correct channel and set up service again. DAMA SAC sends.

Table 39. Information Request Codes (Cont'd)		
Code	**Condition**	**Action**
88	The requesting party's device is not compatible with this guard. The requesting port's baseband device is not compatible with the baseband device specified for this guard.	The configuration code does not match what is in the JMINI database for the network guard address. Check the code; if correct per the SAA, try again. If an information code continues to be received, contact the NCTAMS.
89	The requested party has no compatible baseband device. No port on the requested terminal is configured for a baseband device compatible with the baseband port originating the request.	The configuration code does not match what is in the JMINI database for the terminal being called. Check the code; if it is correct, the distant end may have entered the wrong code. Try again, then work with the distant end.
90	None of the requested users is available. Not enough requested users are capable and available to activate the service request.	Try to set up the service later. If making a conference call, page the other terminals. If a network call, there may be no other active users on the network.
91	The connection would cause contention. The requested connection would cause contention with an ongoing communication.	Do a tear down and out-of-service then send Status B and attempt to set up the service again. If this does not work, contact the NCTAMS. The JMINI, mistakenly, has a terminal already in a service.
92	Not all requested parties could be connected. At least one, but not all, of the requested parties could be connected. (This request is honored, connecting all available parties.)	If one set up a conference call and not everyone received the service assigned message, call all the stations and find out who is not there. Prior to making a conference call, it is recommended all users be paged to ensure they are up. This will ensure the terminal does not receive this message. However, if a message is received, send a Status B message. The only way to get any missed terminals into the service is for all to tear down, then have one terminal set up the service again.
93	Other link test in progress. Only one link test can be conducted at a time on a channel when another user terminal is conducting one.	Wait 2–5 minutes, then rerun the link test. Be sure to run it at 32 kilobits per second first.
94	Unable to connect parties from different channels (JMINI sends) or unable to perform frequency switching required for this connection (DAMA SAC sends). Frequency switching is required to connect the requested service, but frequency switching cannot be accomplished for any of the following reasons: terminal or terminals that must switch are not capable of doing so; communications and orderwire channels are not on the same satellite; communications and orderwire channels are not controlled by the same controller; required frame segment on the communications and orderwire channels do not match; or frame timing for the channels may not be aligned.	Request a service with a terminal and network address assigned to a different home channel. Currently, there is no capability to assign the terminal a different home channel. If authorized to talk within this network, check the current mode screen to ensure it is set up for the correct home channel. If not, send an out-of-service message, make changes or select the correct preset, reenter the DAMA mode on the correct channel, and set up service again.

Table 39. Information Request Codes (Cont'd)

Code	Condition	Action
95	Demand assigned activation disabled for this guard. This network can only be activated on a pre-assigned basis. For a user to be able to activate this network, the network management system operator shall check the Allow User to Activate box in the network definition.	The JMINI database has the network guard address marked wrong. Contact the NCTAMS to correct this.
95	DASA requests are reserved for guards only. The requesting user's configuration code indicates a DASA service and the user have requested connection to another user(s). Configuration codes 98 and 99 are reserved for DASA services and only private guards can be assigned to DASA channels.	This code should not be received; contact NCTAMS.
96	No DASA channel available.	This code should not be received; contact NCTAMS.
97	The party is already connected to a DAMA timeslot. Cannot assign a DASA connection if another user port on the requested/requesting user's terminal is participating in a DAMA service of equal or higher precedence. If it were of lower precedence, that user could have been preempted out of the DAMA service.	This code should not be received; contact NCTAMS.
98	Too many guards specified in this request. More than one guard was specified in conference request.	The request can state only one network address. Use the terminal addresses for the other four addresses.
99	Reserved for TD-1271 home channel change notification.	This code should not be received; contact NCTAMS.

Legend:
CMD—command
DAMA—demand assigned multiple access
DASA—demand assigned single access
FSCS—fleet satellite communications system
ID—identification
JMINI—joint ultrahigh frequency military satellite communications network integrated
KHz—kilohertz
MIL-STD—military standard
NCTAMS—Naval Computer & Telecommunications Area Master Station
PCC—primary control center
RCCOW—Reverse Channel Control Order Wire
SAA—satellite access authorization
SAC—satellite access control
SAR—satellite access request
SVC—secure voice communications

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Appendix P
JOINT TACTICAL RADIO SYSTEM (JTRS) ENHANCED MULTI-BAND INTEGRATED WAVEFORM (IW) SET UP

Tables 40, 41, and 42 outline IW set up instructions for commonly deployed radio sets.

Table 40. JTRS Enhanced Multiband Interteam Radio IW Set up

Load Keys	Program and Use IW
PWR on	ALT Mode.
ALT Mode	Press ENT on Program.
Arrow up to KEYFIL ENT	Arrow down to IW ENT.
ENT on DS102	Press Enter on Guard List.
Press ENT again to start	Service 01 – enter to change Press Enter on name, if a name is desired. Arrow down to SVC and enter the Input service number. Key only changes if you loaded it in a different position.
TEK – Sealed TEK01 (default)	Press ESC, then arrow to service 02. This is the same procedure for entering as service 01.
Attach the fill device and prepare to send.	Add more as necessary. Use arrow UP (not DOWN as it will go to the end of the list).
Press PTT to load.	ESC
Orderwire Key	Arrow down to settings and enter SATIS; select the appropriate one for the satellite you are using and enter.
ENT on TEK01 (or whichever number is there)	Press ENT on a downlink.
Up arrow to TSK00 ENT	Press ENT to make a change.
Load Orderwire key twice 00 and 01 are for CONUS and Indian Ocean footprints 02 and 03 are for LANT and PAC footprints	Go to DL Freqs and press Enter.
	Press ENT to change.
	Input a channel number from the SOI.
	Press ESC four times.
	Arrow down twice to EXT HPA (next screen).
	Change to NO.
	Press ESC twice.
	Arrow up to Channel and Press ENT.
	Arrow down to Basic and Press ENT.
	Change to IW and Press ENT.
	Press ENT to select the service to automaticaly connect, then press Exit.
	Press ESC five times to get to the operating screen.
	The radio starts acquiring the satellite and services.
	Press ENT to change the service number.
	Select ALT Mode and scroll to status.
	Press ENT on IW.

Table 40. JTRS Enhanced Multiband Interteam Radio IW Set up (Cont'd)	
	Press ENT on the OW Signal to see how good the signal is. It needs to be above 540 to communicate.
	Press ENT on service to see information on the service.
Legend: ALT—alternate CONUS—continental United States DL—download ENT—enter button ESC—escape button EXT—exit button FREQ—frequency HPA—high power amplifier IW—integrated waveform LANT—Atlantic OW—order wire PAC—Pacific PTT—push-to-talk SVC—service	

Table 41. AN/PSC-5 C/D IW Set up		
Preparation	**IW Preset**	**Operating IW Mode**
Load COMSEC.	ESC to Main menu	ESC to Main menu
PWR on the radio to PT.	3 (Set presets)	1 – Current Mode; Change it to IW.
Rotate the knob to CT when the bit completes.	9 – IW presets	Select a satellite.
The pop-up message will state “go to F1 and press ENT twice”.	1 – Own address – enter the TBA with two zeroes in front.	Watch for “Waiting for Service Announcements”. This indicates you are decrypting orderwire and access should be received in seconds.
Rotate the knob to F1 and press ENT twice.	ESC	“Ranging” then “IW Connected” appear. Service announcements are displayed to show they are available.
F1 equals TEK and KEK. Select AUTO 102 for single key fill.	2 – SATID (only if a downlink needs to be entered).	To change service, place the cursor next to SERV, then use the arrow key to scroll to the desired service. Press enter.
Connect the Fill device.	Select a satellite using arrow keys and ENT.	Alternate – go to MENU and select 1. Network services (2 – is ad hoc).
Prepare to send to Radio.	Next to “Change Downlinks”, arrow to Yes, press ENT.	Display the services available and their configurations.
Radio will change to Key Location. Use 01, press ENT.	Put downlink in position 1.	MENU allows changes to the configuration, i.e., changing power levels (2 – Radio information) or adding services (1 – Network List).
Key type does not matter. Press ENT.	ESC	Option available to send OTAR/OTAT.
Perform in the same functions in the same order for additional keys.	3 – Radio Info (defaults to all correct items)	4 – Messages – used to review orderwire messages
Rotate knob to F2 to load Orderwire keys	Tpwr 42 dbm or 20 watts; change these if desired.	5 – Asynchronous data transfer burst option (not normally used).
Select DS-102, press ENT	CCode – Phase II	END – Ad hoc ends service when completed with communications.
Press 1 for Fill Orderwire	OW CT	
Connect the fill device and prepare to send the key to the radio.	TXOPT – Normal (Silent is receive only).	
NEVER use key locations 1-8 and 5-8.	Own address – if it is not programmed in “Your Address”, program it here.	
1 and 2 are for CONUS and Indian Ocean footprints. 3 and 4 are LANT and PAC footprints.	TERM ID is based on serial numbers and are display only.	

Table 41. AN/PSC-5 C/D IW Set up (Cont'd)		
Load the same key twice.	**OW Key location is display only and will change to the location being used when IW is accessed.**	
Rotate the knob back to CT.	**ADV Data MD. Off for PDA-184, ON for embedded VIASAT**	
	Range Active	
	Plat: Ground/Maritime (Air Rotary/Air Fixed if on aircraft).	
	4 – Network List	
	Net 1 – 15: Enter service numbers. Asterisks will indicate the automatic connection service. To change it, scroll to the service number and press ENT again.	
	5 – Preassigned Service Presets – these are only used if information sent from the controller will not be used.	
	6 – Audio Alert Tones – may be applied as desired.	

Legend:
ADV—advanced
AUTO—automatic
COMSEC—communications security
CONUS—continental United States
CT—cypher text
dbm—decibel (reference in milliwatts)
ID—identification
IW—integrated waveform
KEK—key encryption key
LANT—Atlantic
OTAR—over the air rekey
OTAT—over the air transfer
OW—orderwire
PAC—Pacific
PT—plain text
PWR—power
SATID—satellite identification
SERV—service
TBA—terminal base address
TEK—transmission encryption key
Tpwr—transmit power
TXOPT—transmit option

Table 42. PRC-117F IW Set up	
Load/Program the PRC-117F	**Using IW**
Power ON to PT.	Press CLR back to Operating Screen. Change Mode (3) to IW
Change it to LD.	Radio will go through Acquiring, Range, and Idle. The bar on the right is own signal strength. The timer is for each of the downlinks.
Select Fill Device: KYK-13.	
Select Crypto type: ANDVT, KG84, and Satellite need to be loaded.	If it stays in Acquiring: Put the downlink into the list under SATIDTABLE. Check the correct Orderwire key and assignment in the correct TSEC locations. Check the antenna and cable, ensure there are 50 feet between radios. Call the RSSC if all of these are good.
Select Key type: TEK (ANDVT/KG84) or TSK (Satellite)	
Key Number:)1 and Enter	If it stays in Range: Ensure services is not set up to automatically connect. Check the antenna, cable, and power. Toggle IW via mode (3) off and on.
Prepare crypto device to send the DS-102 key.	
Press Enter again on the radio when indicated on the fill device.	From Idle: Press the call button (1) to connect to a service or change to a different service. Select from the list of available services.
Fill on each (at a minimum, KG-84, ANDVT, and Orderwire (Satellite) TSK).	No disconnect is required.
Switch back to CT.	
Press 8 – PGM.	
Press ENT on the screen that states you will lose the network.	
Press the right or left arrow to get to IW, then press ENT.	
Press ENT on NETS.	
Select NET to Modify (0-9) – start with 0. Only one network is required per satellite. All services can be assigned to that network.	
Activate in list – Yes and press ENT.	
Satellite ID – select a satellite using up and down arrows (i.e., UFO, FLTSAT, or MUOS). Press ENT to select one.	
Services: Enter all service numbers provided 01801–6552=35. They are the only options. Auto connect – ALWAYS set it to N. It defaults to Y, so change it.	
To enter service numbers, press the right arrow to highlight 00000 then enter a number. Press the left arrow to change Y to N. Use the up arrow (9) to enter each additional number. Press ENT to save all numbers. (The message should be: Service Update Successful.)	
Transmit Capability – Full, press ENT	
Ranging Method – Active, press ENT	
Ranging Method – select the appropriate item and press ENT	
This brings up the menu – press ENT on TSEC.	
Encrypted Key Location as follows: AKAD C 5592: CONUS – position 0,1 AKAD C 5594: LANT – position 2,3 AKAD c5596: Indian Ocean - position 0.1 AKAD C 5598: PAC: position 2,3 4–7 are NEVER used (until further notice)	

Table 42. PRC-117F IW Set up (Cont'd)	
Load/Program the PRC-117F	**Using IW**
Power – as desired (Ignore VAU if not using one).	
Name – if desired.	
PCFG – not required. CLR to NETS SATIDTABLE.	
PORTCONFIG menu and select SATIDTABLE.	
Enter on EDIT: Select same satellite as before.	
IGNORE: SATNAME and SATID. Scroll to Downlink and ENT.	
Check for the provided downlink. If it is not in list, enter it into Downlink 1.	
Programming Complete	

Legend:

ANDVT—advanced narrowband digital voice terminal
CLR—clear
CT—cypher text
CONUS—continental United States
ENT—enter
FLTSAT—
IW—integrated waveform
LANT—Atlantic
MUOS—mobile user objective system
NETS—networks
PAC—Pacific
PGM—program
PT—plain text
RSSC—regional satellite communications support center
TEK—transmission encryption key
TSEC—telecommunications security
TSK—transmission security key
UFO— ultrahigh frequency follow-on

Appendix Q
JOINT SPECTRUM INTERFERENCE REPORT PROGRAM

1. General

a. Victims of interference report electromagnetic interference (EMI) using the joint spectrum interference report online (JSIRO). JSIRO is a web-based, centralized application containing data and correspondence for reported EMI, intrusion, and jamming incidents. It is the repository for the results of analyses, collected data, and supporting documentation for EMI resolution to support trend and future interference resolution analysis. EMI is any electromagnetic disturbance that interrupts, obstructs, degrades, or limits the effective performance of electronics and electrical equipment. EMI can be intentionally induced, as in some forms of electronic warfare; or unintentionally, as a result of spurious emissions, responses or intermodulation products.

2. Joint Spectrum Interference Isolation and Data Collection

a. EMI mitigation begins with operator-level troubleshooting and reporting. It is imperative that affected users attempt to resolve EMI incidents at the lowest possible level. Troubleshooting may identify the source of the interference as truly EMI or, as in most cases, an equipment or operator failure. Reporting facilitates situational understanding and supports solution development. Report and investigate all prohibitive EMI through the JSIR program. Not all EMI incidents are prohibitive, however; prohibitive EMI has an operational impact. Trained equipment operators should identify the difference between prohibitive EMI, equipment failure, and purposeful interference by the enemy. The JSIRO report is submitted through intelligence channels by the appropriate authority if the interfering signal is determined to be from a hostile source.

b. The spectrum manager or the victim of interference is responsible for reporting the type of interference, the actions used to overcome it, the suspected cause of the interference, and any comments related to the signal using the joint spectrum interference report format described in table 43.

Table 43. JSIRO	
Item Number	**Data Input**
1	Frequencies affected by the interference.
2	Locations of systems experiencing the interference.
3	The affected system name, nomenclature, manufacturer (with model number), or other system description. If available, include the equipment characteristics of the victim receiver, such as bandwidth, antenna type, and antenna size.
4	The operating mode of the affected system. If applicable, include the following: frequency agile, pulse Doppler, search, and upper and lower sidebands.
5	The characteristics of the interference (e.g., noise, pulsed, continuous, intermittent, frequency, or bandwidth).
6	The description of the interference effects on victim performance (e.g., reduced range, false targets, reduced intelligibility, or data errors).
7	Enter the dates and times the interference occurred. Indicate whether the duration of the interference is continuous of intermittent, the approximate repetition rate of the interference, and whether the amplitude of the interference is varying or constant. Indicate if the interference is occurring at a regular or irregular time of day, and if the occurrence of the interference coincides with any ongoing local activity.
8	The location of possible interference sources (coordinates or line of bearing, if known; otherwise, state as unknown).
9	A listing of other units affected by the interference (if known) and their location or distance, and bearing from the reporting site.
10	Clear and concise narrative summary information about the interference, and any local actions taken to resolve the problem. The operator is encouraged to provide any other information, based on observation or estimation, that is pertinent in the technical or operational analysis of the incident. Identify whether the information furnished is an actual observation, measurement or estimate. Avoid the use of United States Army or program jargon and acronyms.
11	Refer to message traffic related to the reported interference problem. Include the message date-time group, originator, action addressees, and subject line.
12	Indicate whether the problem is identified or resolved.
13	Indicate if joint spectrum interference resolution technical assistance is desired or anticipated.
14	Provide point of contact information, including name, unit, and contact phone numbers.

Appendix R
General Chairman Joint Chiefs of Staff Accepted Doctrinal Nets Relevant to Tactical Radio Operations

The following command and control (C2) network descriptions explain the majority of the single channel C2 networks required to support deployed joint tactical radio operations. Additional network information frequencies, channels, communications security, members, etc., are routinely published in Service-specific planning documents described in chapter 1. Tables 44, 45, and 46, gives common joint tactical radio network descriptions for the combatant command, joint task force, and joint force air component commander networks respectively, that operators can use to determine network use when reviewing joint planning documents.

Table 44. Combatant Command Network Descriptions for Operators
a. CCDR Command Network (CCDR 1). A secure UHF TACSAT voice network connecting supported CCDR, CJTF, designated subordinates (including the on-site commander). Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
b. CCDR Command Network (1A). A secure HF-SSB voice network connecting the CCDR and CJTF designated subordinates (including the on-site commander). Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
c. Command Data Network (3). A secure HF-SSB data network between supported CCDR and CJTF. (Note: It may also be routed over available DCS-Tactical paths.) Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
d. Command Data Network (3A). A secure HF-SSB data network between the supported CCDR and CJTF. (Note: It may also be routed over available DCS-Tactical paths.) Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
e. Command Data Network (3B). A secure HF-SSB data network between supported v and COMDEFCOM. (Note: It may also be routed over available DCS-Tactical paths.) Network Members: Published in Annex K (JOPES or APEX formatted document) NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
f. CCDR Special Intelligence Network (4). A secure UHF TACSAT data network linking supported CJTF, and selected special intelligence elements. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.

Table 44. Commander in Chief Network Descriptions for Operators (Cont'd)
h. Special Intelligence Teletype Circuit (5A). A secure duplex 100 WPM data circuit with CJTF 140 when forward deployed. Circuit is to become operational upon activation of CJTF 140. NCS: CCDR. Operating Parameters: Routed over US Navy tactical paths if CJTF 140 is embarked on a US Navy ship (JTF-8A) or via DISA DSCS or other DCS paths if CJTF 140 is forward deployed ashore (JTF-9A).
i. Missile Defense Warning (6). A secure UHF TACSAT voice network connecting supported CCDR and CJTF designated subordinates (including the on-site commander). Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CCDR. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
Legend: APEX—Adaptive Planning and Execution system CCDR—combatant commander CJTF—commander joint task force DCS—defense communications system DISA—Defense Information Systems Agency DSCS—Defense Satellite Communications System HF—high frequency JOPES—Joint Operation Planning and Execution System NCS—network control station SPINS—special instructions SSB—single sideband TACSAT—tactical satellite communications UHF—ultrahigh frequency US—United States WPM—words per minute

Table 45. Joint Task Force Network Descriptions for Operators
a. Embassy Emergency-Voice Command Network (JTF-3). Secure and nonsecure HF-SSB voice network between military commanders and an embassy in the area of a crisis. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
b. Embassy Emergency-Voice Command Network (JTF-3A). A secure VHF-FM voice network between military commanders and Embassy in the area of a crisis. Network Members: Published in Annex K (JOPES or APEX formatted document) NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
c. Embassy Emergency-Data Command Network (JTF-3B). A secure HF-SSB data network between military commanders and Embassy in the area of a crisis. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.

Table 45. Joint Task Force Network Descriptions for Operators (Cont'd)
d. Noncombatant Evacuation Network (JTF-6). A secure UHF TACSAT voice network activated by CJTF or senior objective area commander to link selected evacuation points and elements being evacuated. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
e. Non-Combatant Evacuation Network (JTF-6A). A nonsecure HF-SSB voice network activated by CJTF or senior objective area commander to link selected evacuation points and elements being evacuated. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
f. Joint Medical Regulation Network (JTF-7). A nonsecure HF-SSB voice network linking CJTF-designated medical authorities. Network Members: Determined by CJTF-CJTF. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
g. Joint Medical Regulation Network (JTF-7A). A nonsecure VHF-FM voice network linking CJTF-designated medical authorities. Network Members: Determined by CJTF. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
h. JTF Objective Area Intelligence Network (JTF-10A). A secure UHF TACSAT network linking supported, CCMD CJTF, and selected intelligence elements. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
i. JTF Objective Area Special Intelligence Network (JTF-10C). A secure UHF TACSAT between CCDR, CJTF and subordinate and supporting commanders. Network Members: Published in Annex K (JOPES or APEX formatted document) NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
j. Joint Command Network (JTF-11). A secure UHF TACSAT voice between CJTF and components. Network Members: CJTF, AFFOR, ARFOR, MARFOR, NAVFOR, SOCFOR, and other component elements. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
k. Joint Command Network (JTF-11A). A secure HF-SSB voice (backup to JTF 11) between CJTF and components. Network Members: CJTF, AFFOR, ARFOR, MARFOR, NAVFOR, SOCFOR, and other component elements. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
l. Joint Administrative-Logistics Network (JTF-12). A secure UHF TACSAT voice and facsimile network connecting CJTF and subordinate forces to coordinate routine administrative and logistical requirements. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
m. Joint Administrative-Logistics Network (JTF-12A). A secure HF-SSB voice (backup to JTF 12). Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.

Table 45. Joint Task Force Network Descriptions for Operators (Cont'd)
n. Joint-Combined Search and Rescue Network (JTF-17). A nonsecure HF-SSB voice network. Links search and rescue elements. Network Members: On-scene surface and airborne, search and tactical air control elements. NCS: JSRC. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
o. Joint-Combined Search and Rescue Network (JTF-17A). A nonsecure UHF voice network. Links search and rescue elements. Network Members: On-scene surface and airborne search and tactical air control elements. NCS: JSRC. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
p. Joint-Combined Search and Rescue Network (JTF-17B). A nonsecure VHF-FM voice network linking search and rescue elements. Network Members: On-scene surface and airborne search and tactical air control elements. NCS: JSRC Operating Parameters: Published in Annex K or SPINS based on the lead agency.
q. JTF Communications Engineering Network (JTF-18). A secure HF-SSB voice network for coordination relating to communications systems operation. Network Members: CJTF, AFFOR, ARFOR, MARFOR, NAVFOR, SOCFOR, and other component elements. NCS: JCCC. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
r. Joint Information Bureau Network (JTF-19). A nonsecure HF-SSB operated in accordance with SPINS promulgated by the supported JIB. Network Members: TBP. NCS: JIB. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
s. Joint Information Bureau Network (JTF-19A). A nonsecure VHF-FM operated in accordance with SPINS promulgated by the supported Joint Information Bureau. Network Members: Published in Annex K (JOPES or APEX formatted document). NCS: JIB. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
t. JTF Objective Area Voice Command Network (JTF-23). A secure VHF-FM voice command network linking the JTF forward-deployed element in the objective area with designated subordinates. Network Members: CJTF and designated subordinates. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
u. Medical Evacuation Network (JTF-24). A nonsecure VHF-FM voice network. Links JTF units for medical evacuation. Network Members: Determined by CJTF. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
v. Commander Joint PSYOPNET (JTF-70). Configuration to be promulgated when activation is required. Network Members: CJTF and designated subordinates. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
w. Joint Counter Intelligence Coordination Network (JTF-75). Configuration to be promulgated when activation is required. Network Members: CJTF and designated subordinates. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.

Table 45. Joint Task Force Network Descriptions for Operators (Cont'd)
x. Joint Supporting Arms Coordination Network (JTF-81). A secure HF-SSB voice network but, conventionally, it is a secure UHF TACSAT enabled voice network for component forces to coordinate with CJTF concerning supporting arms for fire which impacts outside the task force AOR. Network Members: CJTF, NAVFOR, SACC, ARFOR TOC, MARFOR, FSIC-FSCC and NGF support group commander. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
y. Joint Supporting Arms Coordination Network (JTF-81A). A secure VHF-FM voice networks but, conventionally, a secure UHF TACSAT enabled voice network for component forces to coordinate with CJTF concerning supporting arms for fire which impacts outside the task force AOR. Network Members: CJTF, NAVFOR, SACC, ARFOR TOC, MARFOR, FSIC-FSCC and NGF support group commander. NCS: CJTF. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
z. Naval Fire Control (JTF-82). A secure or nonsecure HF-SSB voice network but conventionally a secure UHF TACSAT enabled voice network used to pass mission status and relief reports from the firing ships to CTF SACC. Network Members: CTF SACC, all NF ships, Commander, Naval Gunfire Support Group, FSCC and TOC. NCS: CTF SACC Operating Parameters: Published in Annex K or SPINS based on the lead agency.
aa. Naval Fire Support Network (JTF-83).A secure HF-SSB voice neworkt but conventionally a secure UHF TACSAT enabled voice network supporting requests for fire, ship assignments, and orders pertinent to execution of fires. Network Members: All Naval forces support ships, Commander, Naval Fire Support Group, SACC, FSCC, TOC, ABCCC, and Sensor Application Team. NCS: NGFS Operating Parameters: Published in Annex K or SPINS based on the lead agency.
bb. Naval Fire Ground Spot Network (JTF-84).A secure HF-SSB voice network but conventionally a secure UHF TACSAT enabled voice network between SFCP and assigned direct support gunfire ship. Network Members: Published in the Tab G to the Appendix 19 (Fires), to Annex C Operations and the Annex K Guard Chart NCS: SFCP. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
cc. Naval Fire Ground Spot Network (JTF-84A). A secure VHF-FM voice network but conventionally a secure UHF TACSAT enabled voice network between SFCP and assigned direct support gunfire ship. Network Members: Published in the Tab G to the Appendix 19 (Fires), to Annex C Operations and the Annex K Guard Chart NCS: SFCP. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
dd. Joint Link-up Network (JTF-85). A secure VHF-FM voice network but conventionally a secure UHF TACSAT enabled voice network to coordinate rendezvous of separate elements or detached elements rejoining parent organizations (multiple discrete frequencies). Network Members: Published in Annex K (JOPES or APEX formatted document). Network Members: TBP (mission specific). Operating Parameters: Published in Annex K or SPINS based on the lead agency.

Table 45. Joint Task Force Network Descriptions for Operators (Cont'd)
ee. Naval Fire Ground Spot (expansion network) (JTF-86). A secure or nonsecure HF SSB network but conventionally a secure UHF TACSAT enabled voice network used to call for and adjust fire for units of TF. Assignment of SFC SPOT network to firing ship and SFC SPOT team will be made by CTF SACC. NCS: TBP Network Members: ANGLICO, SFC SPOT Teams, general and direct support ships assigned, Naval Fire liaison officer at BN, and CTF TOC. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
ff. Combined Forces Link-up Network (JTF-91). A nonsecure VHF-FM voice network to coordinate rendezvous of separate elements or detached elements rejoining parent organizations (multiple discrete frequencies). Network Members: TBP (mission specific). NCS: TBP. Operating Parameters: Published in Annex K or SPINS based on the lead agency.
gg. NF Airspot Control (JTF-93). A secure or nonsecure UHF voice network. Used by an airborne spotter to call and adjust fire. Assignment of this network to an air spotter will be made over the tactical air observation network, and to the firing ships on JTF 83, naval fire support. Only one fire mission at a time, per network will be conducted. Network Members: Air Spotter, Direct and general support ships assigned, naval fire liaison officer of the supported unit Network Members: TBP (mission specific). NCS: TBP. Operating Parameters: Published in the SPINS based on the lead agency.
Legend: AFFOR—Air Force Forces ANGLICO—Air Naval Gunfire Liaison Company AOR—Area of Responsibility APEX—Adaptive Planning and Execution system ARFOR—Army Forces ABCCC—Airborne Command and Control Center BN—battalion CJTF—commander, joint task force CTF—coalition task force DCS—defense communications system FM—frequency modulation FSCC—fire support coordination center FSIC—forward sensor interface control HF—high frequency JCCC—joint command and control center JIB—joint integration board JOPES—Joint Operation Planning and Execution System JSRC—Joint Search and Rescue Center JTF—joint task force MARFOR—Marine Corps forces NAVFOR—Navy forces NCS—network control station NF—naval Fire NGF—National Guard Forces NGFS—Naval Gunfire Support SACC—supporting arms coordination center SFCP—Shore Fire Control Party SFC—surface SOCFOR—Special Operations Command Forces SPINS—special instructions SPOT—sensor placement optimization tool SSB— single sideband TACSAT—tactical satellite communications TBP— to be provided TF—task force TOC—Tactical Operations Center UHF—ultrahigh frequency VHF-FM—very high frequency

Table 46. Joint Force Air Component Commander Network Descriptions for the Operator's Table
a. Joint Air Coordination Network (AC-1). A secure UHF TACSAT voice network. Links military air control agencies for coordination of air operations within and adjacent to the objective area. Network Members: CJTF, JFACC, AFFOR, ARFOR, MARFOR, NAVFOR, SOCFOR, AWACS, ABCCC, others as required and directed by CJTF. NCS: JFACC. Operating Parameters: Published in SPINS.
b. Joint Air Coordination Network (AC-1A). A secure HF-SSB voice network backup to a UHF satellite network. It links military air control agencies for coordination of air operations within and adjacent to the objective area. Network Members: CJTF, JFACC, AFFOR, ARFOR, MARFOR, NAVFOR, SOCFOR, AWACS, ABCCC, others as required and directed by CJTF. NCS: JFACC. Operating Parameters: Published in SPINS.
c. Civil Air Control Common (AC-2). A nonsecure VHF voice network designated by the FAA or Civil Air Route Traffic Control Center, to be used by US Air Force air traffic control functions at CTF CRCs for control of civil aircraft movement in or through tactical airspace. Network Members: Air control agencies, transient aircraft, AWACS and ABCCC (if applicable). Network Control: JFACC. Operating Parameters: Published in SPINS.
d. Tactical Air Traffic Control Network (AC-3). A nonsecure UHF voice network guarded by air control agencies of US Navy and USMC TACSs for initial report by tactical aircraft in support of CTF units. Also, it is used by administrative and transient aircraft to establish contact with the appropriate control agency. The circuit also may be used by US AFFOR elements for TACS and common initial reporting networks. Network Members: Air control agencies, administrative and transient aircraft operating parameters, TBP. Network Control: As directed inside SPINS. Operating Parameters: Published in SPINS.
e. Tactical Air Traffic Control Common (AC-3A) (Network Name is TATC CMN). Nonsecure VHF and UHF voice networks (COMMONS) guarded by all US Air Force radar facilities for initial report by tactical aircraft in support of US AFFOR CRCs and CREs for control of civil and military aircraft movement in or through tactical airspace. Normally, VHF is used for civil aircraft and UHF for military aircraft. These frequencies also may be used for handoff to appropriate agencies (which provide guidance for air refueling activities (TACANs and associated voice comms)). Network Members: Air control agencies (e.g., CRC, FACP). Airborne control elements (AWACS, and ABCCC (if applicable)) Network Control: ATC or combat communications as directed in SPINS. Operating Parameters: Published in SPINS.
f. Tactical Air Direction Network (AC-4). Secure UHF voice networks provide direction of aircraft conducting a CAS mission (multiple discrete frequencies). Network Members: NAVFOR, TACC, DASC, ASOC, ABCCC, FACs, TACPs, CREs, AC-130s (as required), ANGLICO. Network Control: Directed in SPINS. Operating Parameters: Published in SPINS.

Table 46. Joint Force Air Component Commander Network Descriptions for the Operator's Table (Cont'd)
g. Fighter Air Direction-Combat Air Patrol-Air Defense Network (AC-5). A nonsecure UHF voice network supporting aircraft mission briefs and control of combat air patrol aircraft performing air defense alert, fighter escort, and threat intercept missions. Network Members: US Navy, USMC, US Air Force TACS facilities. Operating Parameters: TBP.
h. In-flight Report (AC-8). A nonsecure UHF voice. Links TACSs and aircraft. Network Members: US Air Force TACS facilities, tactical aircraft. NCS: TACS facility. Operating Parameters: Published in SPINS.
i. UHF Airborne Relay (AC-9). A secure or nonsecure UHF used to provide and extend PTP UHF voice communications between ground and surface elements. Network Members: Ground elements, airborne relay, surface element. NDS: Published/directed inside SPINS. Operating Parameters: Published in SPINS.
j. UHF Airborne Relay (AC-9A). A secure or nonsecure UHF used to provide and extend PTP UHF data (Link) communications between ground and surface elements. Network Members: Ground elements, airborne relay, surface element. NCS: Published/directed in SPINS. Operating Parameters: Published in SPINS.
k. Joint Air Support Coordination Network (AC-10). A secure HF-SSB voice network but conventionally a UHF TACSAT enabled voice network used to coordinate immediate air support. Network Members: CJTF, JFACC, ARFOR, MARFOR, AFFOR, NAVFOR, and SOCFOR. NCS: JFACC or directed in SPINS. Operating Parameters: Published in SPINS.
l. Joint Air Support Coordination Network (AC-10A). A secure VHF-FM voice network to coordinate immediate air support. Network Members: CJTF, JFACC, ARFOR, MARFOR, AFFOR, NAVFOR, SOCFOR NCS: JFACC or directed in SPINS. Operating Parameters: Published in SPINS.
m. TADIL A/Link 11 (AC-11). A secure HF-SSB but conventionally a UHF TACSAT netted TADIL data link. Network Members: AOC, air control agencies, and units who are TADIL A capable. NCS: TBP. Operating Parameters: Published in SPINS.
n. TADIL A/Link 11 (AC-11A). A secure UHF netted TADIL data link. Network Members: AOC, air control agencies, and units that are TADIL A capable. NCS: TBP. Operating Parameters: Published in SPINS.
o. TADIL J/Link 16 (AC-11B). A secure, jam resistant, nodeless data link that uses the JTIDS and protocols, conventions, and fixed-word message formats defined by the JTIDS Technical Interface Design Plan. Network Members: AOC, TAOC, TACC, AFLOAT, ATDS, MPC, and others as applicable. NCS: TBP. Operating Parameters: Published in SPINS.
p. TADIL B/Link 11B (AC-13). A secure or nonsecure, full-duplex, HF, PTP link but conventionally a UHS TACSAT enabled link. Network Members: AOC, TAOC, TACC AFLOAT, ATDS, MPC, and others as applicable. NCS: TBP. Operating Parameters: Published in SPINS.
q. Interface Coordination Network (AC-14). A secure HF-SSB voice but conventionally a UHF TACSAT enabled, dual-function network (tactical weapon employment coordination, digital message and interface control).

Table 46. Joint Force Air Component Commander Network Descriptions for the Operator's Table (Cont'd)
Network Members: AOC, TAOC, AADCP, ATDS, MPC, others as applicable. NCS: TBP. Operating Parameters: Published in SPINS.
r. Track Supervision Network (AC-15). A secure or nonsecure HF-SSB voice network but conventionally a UHF TACSAT voice network used to assist units entering or exiting the interface. Network Members: AOC, TAOC, AADCP, ATDS, MPC, others as applicable. NCS: TBP. Operating Parameters: Published in SPINS. Appendix C
t. Datalink Coordination Network (DCN) (AC-16). A secure or nonsecure HF-SSB voice primary to coordinate equipment supporting TADIL operations. Network Members: AOC, TAOC, AADCP, MPC, others as applicable. NCS: TBP. Operating Parameters: Published in SPINS. Appendix C
v. Virtual Private Network (AC-17). A secure UHF voice network but conventionally a UHF TACSAT enabled network used to forward nondigital, SIGINT information to other interface subscribers. Network Members: AOC, airborne C2 aircraft, SIGINT aircraft, others as applicable. NCS: SIGINT. Operating Parameters: Published in SPINS Appendix C.
x. Tactical Air Request Network (AC-18). A secure HF-SSB voice network to request immediate air support from air control agencies. Network Members: AOC, NAVFOR TACC, DASC, ASOC, ABCCC, CREs, and TACPs. NCS: TBP. Operating Parameters: Published in SPINS Appendix C.
y. Fighter Check-In Network (AC-19). A secure or nonsecure UHF voice network to direct joint fighter type aircraft missions. Network Members: AWACS, other control aircraft and participating fighter aircraft. NCS: TBP. Operating Parameters: Published in SPINS Appendix C.
z. Fighter Air Direction Network (AC-19A). A nonsecure UHF voice network to direct joint fighter type aircraft missions. Network Members: AWACS, other control aircraft and participating fighter aircraft. NCS: TBP. Operating Parameters: Published in SPINS Appendix C.
aa. Air Traffic Control (AC-20). A nonsecure UHF voice for air traffic control services. Network Members: CRC, TACC or DASC Ashore, others as applicable NCS: ATC. Operating Parameters: Published in SPINS.
bb. Air Traffic Control (AC-20A). A nonsecure VHF voice for air traffic control services. Network Members: CRC, TACC-DASC ASHORE, others as applicable NCS: DASC. Operating Parameters: Published in SPINS.

Table 46. Joint Force Air Component Commander Network Descriptions for Operators Table (Cont'd)
cc. Air Refueling (AC-23). Discrete A-A UHF voice frequencies (primary and secondary), paired with a specific air refueling TACAN, to be used for control of the air refueling operations. They will be used by TACS elements and tactical fighter aircraft engaged in air refueling to complete tanker rendezvous with the corresponding air-air TACAN frequencies- identifiers. Air Refueling frequencies and associated A-A TACANs will be assigned and published in the applicable air tasking order. Network Members: Specific tanker and tactical aircraft. NCS: TBP. Operating Parameters: TBP
dd. Helicopter Direction Network (AC-24). A nonsecure UHF voice network used to control helicopter assets in the JTF operating area. Network Members: Helicopter control authorities. NCS: DASC. Operating Parameters: Published in SPINS Appendix C.
ee. Helicopter Command Network (AC-25). A secure UHF voice net. Links USMC TACC and naval helicopter support units. Network Members: USMC TACC, naval helicopter support units, others as applicable. NCS: USMC TACC. Operating Parameters: Published in SPINS Appendix C.
Legend: ABCCC—Airborne Command and Control Center AFFOR—Air Force forces ANGLICO—Air Naval Gunfire Liaison Company AOC—air operations center ARFOR—Army forces ASOC—air support operations center ATC—Air Traffic Control ATDS—air tactical data system AWACS—Airborne Warning and Control System C2—command and control CAS—close air support CJTF—Commander, Joint Task Force CMN—coalition military network comms—communications CRC—control and reporting center CRE—contingency response element CTF—coalition task force DASC—Department of the Army Systems DCS—defense communications system FAA—Federal Aviation Administration FAC—forward air control FACP—forward air control post FM—frequency modulation FSCC—fire support coordination center HF—high frequency JFACC—Joint Forces Air Component Commander JTF—joint task force JTIDS—joint tactical information distribution system MARFOR—Marine Corps forces MPC—mission planning center NAVFOR—Naval forces NCS—network control station NF—naval fire NGF—National Guard forces PTP—point-to-point SIGINT—signals intelligence SOCFOR—Special Operations Command forces SPINS—Special Instructions SPOT—sensor placement optimization tool SSB—single sideband TACAN—tactical air navigation system TACC—tactical air coordination center TACP—tactical air control party TACSAT—tactical satellite communications TACS—tactical air control systems coordinator TADIL—tactical digital information link TAOC—tactical air operations center TATC—tactical air traffic control TBP—to be provided TOC—tactical operations center UHF—ultrahigh frequency US—United States USMC—United States Marine Corps VHF—very high frequency

Appendix S
EQUIPMENT NOMENCLATURE MATRIX

Table 47 is a quick-reference chart detailing capabilities and interoperability modes for common military radios used throughout the joint Service environment. This is not an all-inclusive list. Joint Interoperability Test Command maintains a list of all approved radios and their operating modes for the Department of Defense on their website, http://jitc.fhu.disa.mil/reg/.

Table 47. Tactical Radio Equipment Nomenclature

System Nomenclature	Frequency Band						Multi-band Radio	Frequency Range	Select features, waveforms and modes of operation
	HF 2-30 MHz	VHF 30-300 MHz		UHF 300-3000 MHz					
	LOS/ BLOS	LOS		LOS		BLOS			
		AM	FM	AM	FM	SATCOM			
AN/ARC-164			X	X	X		Yes	30.000-399.975 MHz	Voice radio capable of operating UHF LOS HQ II ECCM in AM and FM mode (FM available for VHF/UHF with MXF-243 control) features MIL- STD-1553B interfaces.
AN/ARC-171				X	x		No	225.000-399.975 MHz	Transmits and receives time-of-day signal for HQ I/II AWACS system
AN/ARC-174	X						No	2.00-29.99 MHz	Voice radio capable of operating HF.
AN/ARC-182			X	X	X		Yes	30.000-399.975 MHz	Voice radio capable of operating UHF LOS HQ II ECCM in AM and FM mode features MIL-STD-1553B interfaces, standard avionics radio for the US Air Force and US Army.
AN/ARC-186		X	X				No	30.000-151.975 MHz	Voice radio capable of operating VHF LOS in AM or FM mode.
AN/ARC-187				X	X	X	No	225.000-399.975 MHz	Voice radio capable of operating HQ UHF in AM or FM modes for LOS and SATCOM DAMA MIL-STD-188-181/182 and 183.
AN/ARC-190	X						No	2.000-29.999 MHz	Voice and data radio capable of operating HF USB/LSB, ISB, or AM provides LOS and BLOS communications and is the mainstay of HF communications in the US Air Force having been installed in a large variety of fixed and rotary wing aircraft.
AN/ARC-201D			X				No	30.000-87.975 MHz	Voice radio capable of operating VHF LOS in FM mode can operate SINCGARS in the SC or FH
AN/ARC-204A				X	X		No	225.000-399.975 MHz	Voice radio capable of operating in clear secure HQ UHF AM or FM modes in LOS.

Table 47. Tactical Radio Equipment Nomenclature (Cont'd)

System Nomenclature	Frequency Band						Multi-band Radio	Frequency Range	Select features, waveforms and modes of operation
	HF 2-30 MHz	VHF 30-300 MHz		UHF 300-3000 MHz					
	LOS/ BLOS	LOS		LOS		BLOS			
		AM	FM	AM	FM	SATCOM			
AN/ARC-210 (RT-1851A(C), RT-1939(C))		X	X	X	X	X	Yes	30.000-399.975 MHz	Voice and data four-channel radio capable of operating UHF/VHF, SINCGARS, HQ I and II in AM or FM modes and SATCOM DAMA MIL-STD-188-181/-182/-183 for BLOS.
AN/ARC-220	X						No	2.000-29.999 MHz	Voice and data radio capable of operating HF has HF ALE capability.
AN/ARC-222		X	X				No	30.000-115.975 MHz	Voice and data radio capable of operating VHF LOS in AM or FM mode. SINCGARS SC mode.
AN/ARC-231		X	X	X	X	X	Yes	30.000-512 MHz	Voice and data radio capable of operating VHF/UHF LOS in AM or FM Mode, ATC, maritime, HQ I and II and SATCOM DAMA; MUOS to be added.
AN/ARC-232		X	X	X	X		Yes	30.000-399.975 MHz	Voice and data radio capable of operating VHF/UHF LOS radio in AM and FM modes, VHF maritime, Saturn; HQ I/II ECCM; MIL-STD-1533 compatibility; and a panel or remote mount configuration. Options include SINCGARS, 8.33 KHz channel spacing.
AN/GRC-171D				X			No	225.000-399.975 MHz	Voice radio capable of operating UHF AM/FM LOS air traffic communications in AM or HQ modes.
AN/GRC-193	X						No	2.000-29.999 MHz	Voice and limited data radio capable of operating HF in USB, LSB voice, data, CW, and TTY modes.
AN/GRC-211		X					No	116-151.975 MHz	Voice radio capable of operating UHF in AM Mode, used for ATC of aircraft.
AN/GRC-213	X						No	2.000-29.999 MHz	Voice and limited data radio capable of operating HF in single sideband, voice/CW, and data modes.
AN/GRC-240		X		X			Yes	116.000-399.975 MHz	Voice radio capable of operating VHF/UHF-AM communications HQ I and II sideband, voice/CW, and data modes.
AN/PRC-104	X						No	2.000-29.999 MHz	Voice radio capable of operating HF.
AN/PRC-113		X		X			Yes	116.000-399.975 MHz	Voice radio operating in the VHF and UHF AM mode used by forward air controllers for LOS air to ground communications.

Table 47. Tactical Radio Equipment Nomenclature (Cont'd)

System Nomenclature	Frequency Band						Multi-band Radio	Frequency Range	Select features, waveforms and modes of operation
	HF 2-30 MHz	VHF 30-300 MHz		UHF 300-3000 MHz					
	LOS/ BLOS	LOS		LOS		BLOS			
		AM	FM	AM	FM	SATCOM			
AN/PRC-117F		X	X	X	X	X	Yes	30.000-512.000 MHz	Voice and data radio capable of operating SINCGARS ECCM, VHF/UHF LOS in AM and FM, HQ II ECCM, SATCOM MIL-STD-188-181B, MIL-STD-188-182A, MIL-STD-188-183A.
AN/PRC-117G (RT-1949)		X	X	X	X	X	Yes	30.000 MHz-2.000 GHz	Voice and data radio capable of operating SINCGARS, HQ II, VHF/UHF AM and FM, ANW2, MIL-STD-188-181B SATCOM, high-performance waveform SATCOM.
AN/PRC-119			X				No	30.000-87.975 Hz	Voice and data radio capable of operating SINCGARS VHF FM LOS in single channel and FH modes. This is the primary voice communications system for US Army and Marine Corps forces.
AN/PRC-127			X				No	136.00-160.00 MHz	Voice radio capable of operating VHF FM
AN/PRC-128			X				No	30.000-87.975 MHz	Voice radio capable of operating VHF FM interoperable with SINCGARS in SC mode.
AN/PRC-148		X	X	X	X		Yes	30.000-512.00 MHz	Voice and data radio capable of operating HQ I/II, SINCGARS ESIP in single channel or FH mode; and analog narrowband capable.
AN/PRC-150	X						No	1.600-60.000 MHz	Voice and data radio capable of operating HF ALE.
AN/PRC-152		X	X	X	X	X	Yes	30.000-512.00 MHz and 762-870 MHz	Voice and data radio capable of operating SINCGARS, VHF/UHF LOS in AM and FM, HQ II, SATCOM MIL-STD-188-181B.
AN/PRC-153				X	X		No	380.000-470.00 MHz	Voice radio capable of operating short distances within a small unit/team; primarily used by Marines.
AN/PRC-154					X		No	300.000 MHz-2.000 GHz	Voice and networking data radio capable of operating SRW in the UHF and L-band (commercial).
AN/PRC-155	X		X		X	X	Yes	2.000 MHz-2.500 GHz	Voice and networking data, 2-channel radio capable of operating SINCGARS, SRW, SATCOM integrated waveform, and MUOS.
AN/PRC-343				X	X		No	2.400-2.483 GHz	Voice and data capable radio utilizing upper UHF frequencies to communicate short distances within a small unit (squad/team).

Table 47. Tactical Radio Equipment Nomenclature (Cont'd)

System Nomenclature	Frequency Band						Multi-band Radio	Frequency Range	Select features, waveforms and modes of operation
	HF 2-30 MHz	VHF 30-300 MHz		UHF 300-3000 MHz					
	LOS/ BLOS	LOS		LOS		BLOS			
		AM	FM	AM	FM	SATCOM			
AN/PSC-5C		X	X	X	X	X	Yes	30.000-420.000 MHz	Voice and data radio capable of operating VHF and UHF LOS in AM and FM modes, SATCOM, DAMA, IW, ATC, and maritime.
AN/PSC-5D		X	X	X	X	X	Yes	30.000-512.000 MHz	Voice and data radio capable of operating VHF and UHF LOS in AM and FM modes, SINCGARS, HQ I and II, SATCOM, DAMA, IW, and maritime.
AN/PSC-14					X		No	1525.000 to 1660.500 MHz	Voice and data radio capable of operating in the SATCOM UHF spectrum uses QPSK and QAM for modulation and communicates over a commercial satellite-provided system.
AN/PSQ-6D					X		No	420.000-450.000 MHz	Networking data radio capable of operating EPLRS waveform and SADL in FH mode.
AN/PRQ-7					X	X	No	225.000-299.975 MHz	Voice and limited text radio capable of UHF LOS and SATCOM BLOS Army and US Air Force primary search and rescue radio.
AN/URC-107					X		No	969.000Hz-1.215 GHz	Voice/data radio capable of operating Link 16/TADIL-J used on a variety of airborne and ship platforms.
AN/URC-109	X						No	10.000K Hz-29.999 MHz	Voice and data radio capable of operating VLF, LF, MF, and HF.
AN/URC-131	X						No	2.000-29.999 MHz	Voice and data radio capable of operating HF.
AN/URC-138					X		No	969.000 MHz-1.215 GHz	Voice and data radio capable of operating Link 16/TADIL-J used on a variety of airborne, ship, and ground platforms.
AN/URC-141					X		No	969.000 MHz-1.215 GHz	Voice and data radio capable of operating MIDS, JTIDS Link 16 used on a variety of airborne, ship, and ground platforms. (Commonly referred to as MIDS JTRS)
AN/URC-146	X						No	2.000-29.999 MHz	Voice and data radio capable of operating HF and has ALE.
AN/USC-61C	X	X	X	X	X	X	Yes	2.000 MHz-2.000 GHz	Voice and data multichannel radio capable of operating HF, VHF, UHF, and SATCOM channels, will include MUOS in the future.

Table 47. Tactical Radio Equipment Nomenclature (Cont'd)

System Nomenclature	Frequency Band						Multi-band Radio	Frequency Range	Select features, waveforms and modes of operation
	HF 2-30 MHz	VHF 30-300 MHz		UHF 300-3000 MHz					
	LOS/ BLOS	LOS		LOS		BLOS			
		AM	FM	AM	FM	SATCOM			
AN/USQ-140 (V)1, 2, 3, 4, 6, and 7					X		No	969.000 MHz-1.215 GHz	Voice and data radio capable of operating Link 16/TADIL-J used on a variety of airborne, ship, and ground platforms. (Commonly referred to as MIDS LVT.)
AN/WSC-3				X	X	X	No	225.000-399.975 MHz	Voice and data radio capable of operating UHF in AM and FM Link 11 modes and SATCOM.
CG/URC-1(V) (RT-9000)	X						No	1.6-29.999 MHz	Voice and data radio capable of operating HF and HF ALE.
MICOM 3T	X						No	1.6-29.999 MHz	Voice and data radio capable of operating HF and HF ALE USB, LSB, AME, CW, ARQ, FEC.
RT-2400A	X						No	2.0-29.999 MHz	Voice and data radio capable of operating HF and HF ALE USB, LSB, AME, CW, ARQ, and FEC.
TMR-90	X						No	1.5 MHz-29.999 MHz	Voice radio capable of operating HF and HF ALE USB, LSB, ISB, AM, and AME.
URG-III (RT-2200)	X						No	1.5-29.999 MHz	Voice and data radio capable of operating HF and HF ALE USB, LSB, ISB, AM, AME, CW, and NBFM. Note: With the correct modem, the URG-III (RT-2200) is capable of supporting Link 11 and Link 22.

Legend:
ALE—automatic link establishment
AM—amplitude modulation
AME—amplitude modulation equivalent
ANW2—Adaptive Networking Wideband
ARQ—Automatic Repeat Query system
ATC—air traffic control
AWACS—
BLOS—beyond line of sight
CW—continuous waveform
DAMA—demand assigned multiple access
ECCM—electronic counter-countermeasures
EPLRS—enhanced position location reporting
ESIP—enhanced single-channel ground and airborne radio system improvement
FEC—forward error correction
FH—frequency hopping
FM—frequency modulation
GHz—gigahertz
HF—high frequency
HQ—HAVE QUICK
ISB—independent sideband
IW—integrated waveform
JTIDS—Joint Tactical Information Distribution
JTRS—joint tactical radio system
KHz—kilohertz
LF—low frequency
LOS—line of sight
LSB—lower sideband
LVT—low volume terminal
MF—medium frequency MHz—megahertz
MIDS—multifunctional information distribution
MIL-STD—military standard
MUOS—mobile user objective system
MXF—multi-function
NBFM—narrowband frequency modulation
QAM—quadrature amplitude modulation
QPSK—quadrature phase shift keyed system
SADL—situation awareness data link
SATCOM—satellite communications Program
SATURN—Second generation Anti-jam Tactical
SC—single-channel
SHF—super-high frequency
SINCGARS—single-channel ground and airborne radio system
SRW—Soldier radio waveform
TADIL-J—tactical digital information link-Joint
TTY—teletype
UHF Radio for NATO
UHF—ultrahigh frequency
US—United States
USB—upper sideband
VHF—very high frequency
VLF—very low frequency

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GLOSSARY

PART I – ABBREVIATIONS AND ACRONYMS

3G	third generation
4G	fourth generation
	A
A5JG	United States Air Force Directorate of Plans, Programs and Requirements, Fielded Gateways Branch
AADS	Amphibious Assault Direction System
ABCCC	Airborne Command and Control Center
ACC	Air Combat Command
ACE	aviation combat element (USMC)
ACEOI	automated communications-electronics operating instructions
ADDSI	Army data distribution system interface
AEP	airborne executive processor
AFB	Air Force Base
AFFOR	Air Force forces
AFP	AN/ARC-210 fill program
AFTTP	Air Force tactics, techniques, and procedures
AGC	automatic gain control
ALE	automatic link establishment
ALSA	Air Land Sea Application (Center)
AM	amplitude modulation
AMD	automatic message display
ANCD	automated network control device
ANDVT	advanced narrowband digital voice terminal
ANGELICO	Air Naval Gunfire Liaison Company
ANW2	Adaptive Networking Wideband Waveform
AO	action officer
AOC	air operations center
AOR	area of responsibility
APEX	Adaptive Planning and Execution system
APO	Army post office
ARFOR	Army Forces
ARG	amphibious ready group
ARSTRAT	Army Strategic Command
ASOC	air support operations center
ATC	air traffic control
ATDS	air tactical data system
ATF	amphibious task force
ATO	air tasking order
ATP	Army techniques publication
AWACS	Airborne Warning and Control System
	B

BACN	Battlefield Airborne Communications Node
BDE	brigade
BER	bit error rate
BLOS	beyond line-of-sight
BN	battalion
bps	bits per second

C

CD&I	Combat Development and Integration
C2	command and control
CAOC	combined air operations center
CAS	close air support
CAT	computed axial tomography
CATF	commander, amphibious task force
CCDR	combatant commander
CCIR	commander's critical information requirement
CCMD	combatant command
CD	compact disc
CDL	common data link
CE	command element (MAGTF)
CEOI	communications-electronics operating instructions
CFACC	combined force air component commander
CG	commanding general
CIB	Common Interactive Broadcast
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
CJTF	commander, joint task force
CLR	combat logistics regiment
CMD	command
CMN	coalition military network
CO	company
COMM	commercial
comms	communications
COMSEC	communications security
CONAUTH	controlling authority
CONEX	contingency and exercise
CONUS	continental United States
COP	common operating picture
COTM	communications-on-the-move
COTS	commercial off-the-shelf
CPD	combat plans division
CPM	continuous phase modulation
CRC	control and reporting center
CRE	contingency response element
cryptonet	cryptographic network
cryto	cryptographic
CSAR	Combat Search and Rescue

CSEP	single-channel radio electronic countermeasure
CSG	carrier strike group
CSS	combat service support
C-SSE	consolidated satellite communications system expert
CT	cipher text
CTF	coalition task force
CVSD	continuously variable slope delta
CWC	composite warfare commander and contingency and exercise working group

D

D2CE	degraded and denied communications environment
DAMA	demand assigned multiple access
DASA	demand assigned single access
DASC	direct air support center
DASC(A)	direct air support center (airborne)
dB	decibel
dbm	decibel (reference in milliwatts)
DC	direct current
DCS	defense communications system
DF	direction finding
DISA	Defense Information Systems Agency
DIV	division
DOD	Department of Defense
DODIN	Department of Defense Information Network
DOM	day of month
DSC	defensive space control
DSCS	Defense Satellite Communications System
DSN	Defense Switched Network

E

Eb/No	energy bit to noise power
EEM	electromagnetic interference event message
E-Lite	enhanced position location reporting system-lite
EMI	electromagnetic interference
EPLRS	enhanced position location reporting system
ESC	escape
ET	electronic telemetry
EUR	Europe
EW	electronic warfare
EXT	exit

F

FAC	Forward Air Controller
FAC(A)	Forward Air Controller (Airbourne)
FACP	forward air control party
FAX	facsimile
FBCB2	force battle command brigade and below
FCC	Federal Communications Commission

FFH	fast frequency hopping
FFT	friendly force tracker
FH	frequency hopping
FH-M	frequency hopping-master
FLTSAT	fleet satellite
FM	frequency modulation
FMA-net	frequency management A-network
FMT-net	frequency management training network
FOB	forward operating base
freqs	frequencies
FSCC	fire support coordination center
FSCS	fleet satellite communications system
FSIC	forward sensor interface control
FSK	frequency-shift keying

G

G-2	United States Army or Marine Corps Component Command, Intelligence
G-6	United States Army or Marine Corps Component Command, Control, Communications, and Computer Systems
G-7	United States Army or Marine Corps Component Command, Training
GAA	gateway access authorization
GAR	gateway access request
GCE	ground combat element (MAGTF)
GIS	ground infrastructure segment
GNWO	Global Narrowband Watch Office
GPS	Global Positioning System

H

HBSS	host base security system
HCLOS	high capacity line of sight
HF	high frequency
HPA	high power amplifier
HQ	HAVE QUICK
HQMC	Headquarters, Marine Corps
HZ	hertz

I

I/ATO	interim approval to operate
I/O	input/output
IAW	in accordance with
IBS	Integrated Broadcast Service
IC	information center
ID	identification
IMSI	international mobile subscriber identity
inc	inclination
INMARSAT	international maritime satellite
IO	information operation

IOPA	input/output port address
IP	internet protocol
IRC	information request codes
ISB	independent sideband
ITNE	integrated tactical network environment
IW	integrated waveform
IWCS	integrated waveform control system

J

J-6	United States Joint Staff Communication Systems Directorate
JACS	joint automated communications and electronics operating instructions system
JCCC	joint command and control center
JCMA	joint communications security monitoring activity
JCMO	joint communications security management office
JCSE	joint communications support element
JFACC	joint force air component commander
JFC	joint force commander
JFCC-SPACE	Joint Functional Component Command for Space
JFLCC	joint force land component commander
JIB	joint integration board
JICO	joint interface control office
JIST	joint integrated satellite communications tool
JITC	Joint Interoperability Test Command
JMINI	joint ultrahigh frequency military satellite communications network integrated
JOPES	Joint Operation Planning and Execution System
JP	joint publication
JREAP	joint range extension application protocol
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JSIRO	joint spectrum interference resolution online
JSMPS	Joint Satellite Communications Management and Planning System
JSPIRO	Joint Spectrum Interference Resolution Online
JSPOC	Joint Space Operations Center
JSTARS	Joint Surveillance Target Attack Radar System
JTAR	joint tactical air strike request
JTF	joint task force
JTIDS	Joint Tactical Information Distribution System
JTRS	joint tactical radio system

K

Kbps	kilobits per second
KEK	key encryption key
KEYMAT	keying material
KHz	kilohertz

km	kilometer
	L
LAAD	low-altitude air defense
LAMPS	Light Airborne Multipurpose System (helicopter)
LANT	Atlantic
LAT	latitude
LCAC	landing craft, air cushion
LCD	liquid crystal display
LCE	logistics combat element (MAGTF)
LeMay Center	Curtis E. Lemay Center for Doctrine Development
LFOC	landing force operations center
LHA	amphibious assault ship
LHD	multipurpose amphibious assault ship
LNO	liaison officer
LONG	longitude
LOS	line of sight
LPC	linear predictive code/coding
LPD	amphibious transport dock
LQA	link quality analysis
LSD	landing ship, dock
LVT	Low volume terminal
	M
MAGTF	Marine air-ground task force
MARFOR	Marine Corps forces
MARLO	Marine liaison officer
MATCS	Marine Air Traffic Control Squadron
MBITR	multiband inter/intra team radio
MCF	mission configuration file
MCT	Mobile User Objective System capable terminal
MDCOA	most dangerous course of action
MELP	mixed-excitation linear predictive
M-HOP	multiple hop
MHz	megahertz
MIDS	multifunctional information distribution system
MILSATCOM	military satellite communications
MIL-STD	military standard
MILSTRAP	military standard transaction reporting and accounting procedure
MLCOA	most likely course of action
MLE	maritime law enforcement
MLG	Marine logistics group
MPC	mission planning center
MRI	magnetic resonance imaging
MSG	message
MTTP	multi-Service tactics, techniques, and procedures
MUOS	Mobile User Objective System

MWOD	multiple words-of-the-day
	N
NATO	North Atlantic Treaty Organization
NAVFOR	Navy forces
NAVTEX	Navigational Telex
NCS	network control station
NCTAMS	Naval Computer and Telecommunications Area Master Station
NCTS	Naval Computer and Telecommunications Station
net	network
NGF	National Guard forces
NGFS	Naval gunfires support
NIPRNET	Nonsecure Internet Protocol Router Network
NLT	no later than
NMRI	nuclear magnetic resonance imaging
NMS	network management station
NORAD	North American Aerospace Defense Command
NOSC	network operations and security center
NOTM	network on the move
NTTP	Navy tactics, techniques, and procedures
NWDC	Navy Warfare Development Command
	O
OPORD	operation order
ops	operations
OPSEC	operations security
OPTASK	operation task
OTA	over the air
OTAR	over the air rekeying
OTAT	over the air transfer
OTC	officer in tactical command
OW	order wire
	P, Q
PAC	Pacific
PCC	primary control center
PCE-L/M	patrol craft escort-land/maritime
PCS	primary control ship
PGM	program
POC	point of contact
PPLI	precise participant location and identification
PPP	primary patch panel
PRC	portable radio communication
PSC	portable satellite communications
PSK	phase-shift keying
PT	plain text
PTN	point to network
PTP	point-to-point

PTS	planning tool satellite access controller component
PTT	push-to-talk

R

R/T	receive/transmit
RAN	radio access node
RCCOW	Reverse Channel Control Over Wire
RECCE	reconnaissance
RETRANS	retransmission
RF	radio frequency
RFI	radio frequency interference
RS	radio set
RSL	receive signal level
RSSC	regional satellite communications support center
RT	receiver transmitter
RX	receive

S

SA	situational awareness
SAA	satellite access authorization
SAC	satellite access control
SACC	supporting arms coordination center
SADL	situation awareness data link
SAR	satellite access request
SATCOM	satellite communications
SATID	satellite identification
SATURN	Second Generation Antijam Tactical Ultrahigh Frequency Radio for NATO
SA-WCDMA	spectral adaptive wideband code division multiple access
SCR	system change request
SCS	secondary control ship
SCS	satellite control system
SERV	service
SFC	surface
SFCP	Shore Fire Control Party
SIGINT	signals intelligence
SINCGARS	single-channel ground and airborne radio system
SIPRNET	SECRET Internet Protocol Router Network
SKL	Simple Key Loader
SOCFOR	Special Operations Command forces
SOF	special operations forces
SOI	signal operating instructions
SOLE	special operations liaison element
SPAWAR	Space and Naval Warfare Systems Command
SPINS	special instructions
SPOT	sensor placement optimization tool
SQN	squadron
SRK	steady receive key

SRW	Soldier radio waveform
SSB	single sideband
SVC	secure voice communications

T

TACAN	tactical air navigation
TACC	tanker airlift control center
TACP	tactical air control party
TACS	tactical air control system
TACSAT	tactical satellite communications
TADIL	tactical digital information link
TAOC	tactical air operations center
TATC	tactical air traffic control
TBA	terminal base address
TBP	to be provided
TDL	tactical data link
TDMA	time division multiple access
TDN	tactical data network
TEK	traffic encryption key
TELECOM	telecommunications
TF	task force
T-Net	training network
TOC	Tactical operations center
TOD	time of day
Tpwr	transmit power
TRANSEC	transmission security
TSEC	telecommunications security
TSK	transmission security key
TTNT	Tactical Targeting Network Technology
TTP	tactics, techniques, and procedures
TX	transmit
TXOPT	transmit option

U

UFO	ultrahigh frequency follow-on
UH-1	helicopter
UHF	ultrahigh frequency
UIC	unit identification code
US	United States
USAF	United States Air Force
USAFCENT	United States Air Force Central Command
USAFRICOM	United States Africa Command
USB	upper side band
USCENTCOM	United States Central Command
USCG	United States Coast Guard
USEUCOM	United States European Command
USMC	United States Marine Corps
USN	United States Navy

USNORTHCOM	United States Northern Command
USPACOM	United States Pacific Command
USSOCOM	United States Special Operations Command
USSOUTHCOM	United States Southern Command
USSTRATCOM	United States Strategic Command
USTRANSCOM	United States Transportation Command
UTC	Coordinated Universal Time

V

VHF	very high frequency
VoIP	voice over internet protocol

W, X, Y, Z

WCDMA	Wideband Code Division Multiple Access
WOC	wing operations center (USAF)
WOD	word of the day
WPM	words per minute

PART II – TERMS AND DEFINITIONS

acquisition—A necessary preliminary condition of a receiver by which frequency and phase ambiguities of an incoming radio frequency carrier are sufficiently resolved to allow information modulated onto the carrier to be properly demodulated. (NTRP 1-02)

active mode—The frequency-hopping mode of operation for HAVE QUICK radios. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

active ranging—The process by which a terminal estimates its range to a satellite by the transmission and subsequent reception of its own burst. (MIL-STD-188-182B)

address—16-bit addresses used for identifying terminals, nodes, and subnets. (MIL-STD-188-185)

ad-hoc—A service that has parameters specified by a terminal user via a request sent through the Demand Assigned Multiple Access control system. An ad hoc service is always a demand-assigned (DA) service. (MIL-STD-188-182B)

allocation—The operational real-time assignment of satellite communications payload resources to an approved user for use in activating a communications link or network. (CJCSI 6250.01A).

asynchronous data transfer—User-to-user communications service that operates on a multiple-access channel in a specified time-slot size. Asynchronous data transfer service provides a communications link that can support variable data rate transfer. The number of data bits that can be communicated in the asynchronous data transfer time slot is an integer number of bytes, and can be calculated from the burst rate, forward error correction code rate, and size of the time slot. Asynchronous data transfer services operate: (1) with a fixed burst rate, defined by the service burst parameters; or (2) with a variable burst rate, which can vary from frame to frame. The variable rate at the transmitter is controlled by an adaptive higher layer protocol and at the receiver is determined from the received preamble. (MIL-STD-188-183B)

bit error rate—The number of erroneous bits divided by the total number of bits transmitted, received, or processed over some stipulated period. Note 1: Examples of bit error ratio are (a) transmission bit error rate, i.e., the number of erroneous bits received divided by the total number of hits transmitted; and (b) information bit error rate, i.e., the number of erroneous decoded (corrected) bits divided by the total number of decoded (corrected) bits. Note 2: The bit error rate is usually expressed as a coefficient and a power of 10, for example, 2.5 erroneous hits out of 100,000 bits transmitted would he 2.5 out of 103 or 2.5 x 10-5. FED-STD-1037C, Telecommunications Glossary Terms.

burst rate—The over-the-air transmission rate (modulation rate) in symbols per second (sps). (MIL-STD-188-183B)

burst—A time-limited transmission composed of a synchronization preamble and a finite-length data stream. (MIL-STD-188-185)

carrier—A multichannel telecommunications system in which a number of individual circuits (data, voice, or combination thereof) are multiplexed for transmission between nodes of a network. (188) Note 1: In carrier systems, many different forms of multiplexing may be used, such as time-division multiplexing and frequency-division multiplexing. Note 2; Multiple layers of multiplexing may ultimately be performed upon a given input signal; i.e., the output resulting from one stage of modulation may in turn be modulated. Note 3: At a given node, specified channels, groups, super groups, etc., may be demultiplexed without demultiplexing the others. (FED-STD-1037C)

channel controller—A control station system that uses orderwires to define system timing and to control access to all defined services. Each channel controller is authorized to provide control over a particular set of ultrahigh frequency channels on one satellite. (MIL-STD-188-182B)

channel resources—The available time, bandwidth, and power available on a channel. (MIL-STD-188-182B)

circuit service—A user-to-user communications service that provides a communication link that accommodates fixed-data-rate transfers with relatively low throughput delays. (MIL-STD-188-182B)

contention—A condition that arises when two or more data stations attempt to transmit at the same time over a shared channel, or when two data stations attempt to (transmit at the same time in two-way alternate communication. Note: A contention can occur in data communications when no station is designated a master station. In contention, each station must monitor the signals and wait for a quiescent condition before initiating a bid for master status. 2. Competition by users of a system for use of the same facility at the same time. (FED-STD-1037c)

continuous phase modulation—A phase-only modulation technique in which the signal phase changes are continuous. Continuous phase modulation is implemented as a constant-envelop waveform, i.e. the transmitted carrier power is constant. continuous phase modulation is attractive because the phase continuity yields high spectral efficiency and the constant-envelop yields excellent power efficiency. The primary drawback is the high implementation complexity. The advanced software of integrated waveform provides the continuous phase modulation coding. (MIL-STD-188-181C,)

control segment—One of the three segments of a satellite communications system. It pertains to the channels control sites where the channel control systems are located providing primary control center and alternate control center services.

control sites—Pertains to the naval computer and telecommunications area master station/naval computer and telecommunications station where the ultrahigh frequency satellite communications channel control systems are located.

control station—The equipment and software required to perform resource management, channel control, and external interface functions (as specified in this MIL-STD) in two adjacent satellite coverage areas. (MIL-STD-188-185)

cosite interference—Cosite interference refers to two or more transmitters located near each other that cause jamming or degraded operations. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

Demand Assigned Multiple Access Forward Orderwire—An orderwire transmitted from a channel controller to provide information for a terminal to access demand-assigned services. (MIL-STD-188-182B)

Demand Assigned Multiple Access Return Orderwire—An orderwire transmitted by a terminal to request channel resources assigned on demand, to respond to channel controller requests and to convey other status and configuration information to a channel controller. (MIL-STD-188-182B)

digital modulation—A technique for transmitting digital information bits (0's or 1's) using an radio frequency signal.

electromagnetic interference—Any electromagnetic disturbance, induced intentionally or unintentionally, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics and electrical equipment. (DOD Dictionary of Military and Associated Terms. Source: JP 3-13.1)

electronic protection—Division of electronic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy use of the electromagnetic spectrum that degrade, neutralize, or destroy friendly combat capability. See also electronic attack; electronic warfare; electronic warfare support. (DOD Dictionary of Military and Associated Terms. Source: JP 3-13.1)

electronic warfare—Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. See also directed energy; electromagnetic spectrum; electronic attack; electronic protection; electronic warfare support. (DOD Dictionary of Military and Associated Terms. Source: JP 3-13.1)

footprint—The area on the surface of the earth within a satellite's transmitter or sensor field of view. (DOD Dictionary of Military and Associated Terms)

forward orderwire—The category of orderwire used to transmit control and status information from a CC to terminals. There are three types of forward orderwire: system forward orderwire, update forward orderwire, and demand assigned multiple access forward orderwire. (MIL-STD-188-182B)

frame format—The frame timeslot configuration defined by the combination of frame sub formats in use for user segments A, B, and C. Also refers to the 3-digit hexadecimal code used to specify this configuration. (MIL-STD-188-185)

frame—A repetitive, equal-length time interval over which communication resources on a channel are allocated into time slots. A frame is 1.38 6 seconds long and consists of 26,624 time chips, which are grouped into waveform overhead and user-to-user control time slots. (MIL-STD-188-182B)

frequency-shift keying—A form of frequency modulation. In frequency-shift keying modulation, the frequency of the carrier is discretely controlled by the transmitted

information bits. In binary frequency-shift keying, the instantaneous frequency of a signal is shifted between two discrete values called the mark and space frequencies. (MIL-STD-188-181A)

guard list—set of service numbers associated with an input/output port. Upon activation of a preplanned service identifying a guarded service number, a terminal connects the input/output port associated with the guarded service number to the designated communications service. (MIL-STD-188-182B)

home channel—A 25 KHz channel on which an station forward orderwire is transmitted. Also known as master channel. (MIL-STD-188-183B).

hop rate—The rate at which HAVE QUICK radios switch from one frequency of the hopset to the next. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

hop sequence—The pattern of frequencies transmitted and received over radios in the network hop. The network ID, mission day and time of day are input to the linear sequence generator. The linear sequence generator output and the transmission security are input to the KGV-10, whose output determines the pattern of hop. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

hopping pattern—The specific order in which HAVE QUICK radios switch from one frequency of the hopset to the next. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

hopset—Frequencies made available for a single-channel ground to airborne radios radio to hop on are called a Hopset. A typical hopset consists of what remains of the total 2320 frequencies after protected frequencies, such as commercial television, are removed. Protected frequencies are frequently referred to as Lockouts. In any case, except for technical purposes, lockouts are treated as an integral part of the hopset. (Source: TM 11-5820-890-10-8)

integrated waveform—The integrated waveform is the improved time division multiple access waveform standard defined in MIL-STD-188–181C, 182B, and -183B. Integrated waveform greatly improves quality of services and access to ultrahigh frequency satellite communications resources over Demand Assigned Multiple Access. (MIL-STD-188-181C, 182B, and 183B)

interoperability—The ability to operate in synergy in the execution of assigned tasks, or 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 degree of interoperability should be defined when referring to specific cases. (DOD Dictionary of Military and Associated Terms: Source JP 3-0 for Definition 1 and JP 6-0 for Definition 2.)

Joint Tactical Information Distribution System—A secure anti-jam point-to-point information distribution system used by all Services to provide the big picture. Joint Tactical Information Distribution System platforms can exchange location

for friendly, hostile, and neutral plat- forms and navigation information. Terminals are flexible and can limit the amount of information relayed or received. (Source: TM 11-7021-223-10)

Master Channel—A 25 KHz channel on which an secondary forward orderwire is transmitted. Also known as home channel. (MIL-STD-188-183B)

mission day—The date of the operation; corresponds to the Julian date. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

mission set—A block of fill data generated from the US Air Force key data management system for loading into a specific radio to perform a specific mission. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

multiple hop—Operations that relay information between two or more satellite channels. (MIL0STD-188-185)

net number—A number that selects the specific group of frequencies over which HAVE QUICK radios will hop. It ensures that users on different networks do not hop onto the same frequency at the same time. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

normal mode—The single-channel ultrahigh frequency mode of operation for HAVE QUICK radios. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

orderwire—The portion of the Demand Assigned Multiple Access (or Time Division Multiple Access) frame used for transmission of management, control, and status information among the channel controllers and terminal users. (MIL-STD-188-182B)

passive ranging—A process by which the terminal determines the signal propagation time to the satellite by means other than transmitting a ranging signal. (MIL-STD-188-185)

primary channel controller—The control station function responsible for providing timing, configuration, and acquisition parameters, and for assigning satellite resources for a single ultrahigh frequency military satellite communications channel. (MIL-STD-188-185)

queued service—A demand-assigned user-to-user communications service waiting to be assigned communications resources that is placed in a queue at the channel controller pending possible future assignment of resources. Queued services are either blocked or pending. (MIL-STD-188-182B)

segment—One or more time slots of a time division multiple access frame with a single function. (MIL-STD-188-185)

slave channel—A 25 KHz channel that does not contain a forward orderwire service or a 5 KHz channel that does not contain a forward orderwire or Demand Assigned Multiple Access Return Orderwire service. (MIL-STD-188-182B)

space weather—The conditions and phenomena in space and specifically in the near-Earth environment that may affect space assets or space operations. Space weather may impact spacecraft and ground-based systems. Space weather is influenced by phenomena such as solar flare activity, ionospheric variability, energetic particle events, and geophysical events. (DOD Dictionary of Military and Associated Terms: Source JP 3-14)

subnet—A group of terminals with a need for common communications that share a single address (subnet address) in addition to the terminal's primary address. (MIL-STD-188-185)

telemetry, tracking, and commanding—Refers to the brain of a satellite and its operating system. Telemetry, tracking, and control is the satellite's method for storing and analyzing the data it collects, and controlling its various systems. It also logs every activity of the satellite, receives information from the ground station, and takes care of any general upkeep or housekeeping, the satellite needs to do. (National Aeronautics and Space Administrations, www.nasa.gov)

terminal base address—A 24 bit number used to uniquely identify each terminal that processes orderwires. A terminal address is assigned to and programmed into each terminal and should not be changeable by the terminal operator. (MIL-STD-188-183B)

time of day—A signal that synchronizes HAVE QUICK radios to a common time base for active mode operation. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

traffic encryption key—A traffic encryption key enables the single-channel ground and airborne radio system to operate in a secure, cipher text mode of communications. The traffic encryption key is loaded into the single-channel ground to airborne radio system receiver transmitter from an automated network control device, or other communication security fill device, if desired. (Source: TM 11-5820-890-10-8)

transmission security key—The pattern in which the radio selects frequencies to hop on is pseudo-random, as determined by the transmission security key. Depending upon the number of frequencies available for hopping and the transmission security key itself, the exact sequence of frequencies used during any one second will not be repeated for long periods of time. (Source: TM 11-5820-890-10-8)

transmission security—Internal to the terminal, transmission security is the component of communications security that results from all measures designed to protect transmissions from interception and exploitation by means other than cryptanalysis. (CJCSI 6251.01D, DOD Dictionary of Military and Associated Terms, and JP 6-0)

Universal Time—A measure of time that conforms, within a close approximation, to the mean diurnal rotation of the Earth and serves as the basis of civil timekeeping. Also called Zulu time. (Formerly called Greenwich Mean Time.) (DOD Dictionary of Military and Associated Terms. Source: JP 5-0)

waveform—The combination of baseband signal structure, radio frequency signal structure, and protocols required to define a signal transmission and reception. In Narrowband satellite communications, the term waveform is most often used to refer to the signal being used (e.g., 5 KHz or 25 KHz Demand Assigned Multiple Access). (CJCSI 6251.01)

wideband—In ultrahigh frequency satellite communications, wideband describes a medium-capacity voice/data communications circuit, path, or channel. This usually implies that the channel is capable of carrying a signal bearing data at a rate greater than 2.4 Kbps and up to 64 Kbps. For single-channel non-Demand Assigned Multiple Access ultrahigh frequency satellite communications, communications up to 9.6 Kbps in 5 KHz channels are called narrowband channels; communications up to 64 Kbps in 25 KHz channels are called wideband channels. (MIL-STD-188-181B)

word-of-day—A transmission security variable that defines the sequence of frequencies, the dwell times, and the hopping rates for HAVE QUICK radios in the active mode. (Source: This term and its definition are applicable only in the context of this publication and cannot be referenced outside this publication)

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By Order of the Secretary of the Army

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