ARMY, MARINE CORPS, NAVY, AIR FORCE

HF-ALE

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR THE HIGH FREQUENCY— AUTOMATIC LINK ESTABLISHMENT (HF-ALE) RADIOS

AIR LAND SEA APPLICATION CENTER

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MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES

Preface

1. Purpose

This consolidated reference will assist joint forces in utilizing high frequency radios as a supplement/alternative to overburdened satellite communications systems for over-the-horizon communications.

2. Scope

This publication describes multi-Service tactics, techniques, and procedures for basic high frequency-automatic link establishment (HF-ALE) radio operations. The contents of this publication are directed at the operator level. It does not delve into technical aspects of HF-ALE operations beyond that necessary for effective tactical use of the equipment.

3. Application

a. This publication provides commanders and their staffs unclassified guidance to simplify planning of HF-ALE radio procedures. It provides access to information on multi-Service communication systems to commanders and staffs conducting home station training or preparing for interoperability training.

b. The United States (US) Army, Marine Corps, Navy, Air Force, and Coast Guard approved this multi-Service publication for use.

4. Implementation Plan

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

Army. Upon approval and authentication, this publication incorporates the 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 (IAW) applicable directives and the Initial Distribution Number listed on the authentication page.

Marine Corps. The Marine Corps will incorporate the procedures in this publication in US Marine Corps training and doctrinal publications as directed by the Commanding General, US Marine Corps Combat Development Command. Distribution of this publication is IAW Marine Corps Doctrinal Publications System.

Navy. The Navy will incorporate these procedures in US Navy training and doctrinal publications as directed by the Commander, Navy Warfare Development Command. Distribution of this publication is IAW Military Standard Requisitioning and Issue Procedures Desk Guide and Navy Standing Operating Procedures Publication 409.

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Air Force. The Air Force will incorporate the procedures in this publication IAW applicable governing directives. Distribution is IAW Air Force Instruction 33-360.

Coast Guard. The Coast Guard will incorporate the procedures in this publication in US Coast Guard (USCG) doctrinal and training publications as directed by the Assistant Commandant for Operations, Director of Operations Policy, USCG. Distribution of this publication is IAW USCG standing operating procedures.

5. User Information

a. US Army Training and Doctrine Command, Marine Corps Combat Development Command, Navy Warfare Development Command, Air Force Doctrine Center, USCG, and the 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 likewise be incorporated in revisions to this document.

c. ALSA encourages recommended changes for improving this publication. Key any comments to the specific page and paragraph and provide a rationale for each recommendation. Send comments and recommendation directly to—

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Multi-Service Procedures for High Frequency—Automatic Link Establishment (HF-ALE) Radios

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EXECUTIVE SUMMARY

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Multi-Service Tactics, Techniques, and Procedures for the High Frequency—Automatic Link Establishment Radios

The military standard HF-ALE radio is widely deployed throughout the US military and provides a viable alternative to overburdened satellite communication systems. Automatic link establishment (ALE) is an improvement to high frequency (HF) radio that allows establishment of considerably clearer over-the-horizon voice communications and robust data transmissions. This publication establishes common tactics, techniques, and procedures to allow HF-ALE users to maximize use of HF-ALE radios in the inventory, as well as new HF-ALE radios currently being acquired.

Chapter I provides an overview of HF radio operations, discussing propagation of radio waves in the atmosphere to include factors affecting atmospheric ionization, frequency and path optimization, and propagation prediction techniques.

Chapter II provides an overview of ALE, a communication system that permits HF radio stations to call and link on the best HF channel automatically without operator assistance. This chapter describes how ALE systems select the best frequency by making use of recently measured radio channel characteristics stored in a memory matrix and by constantly scanning through assigned frequencies to listen for calls. System limitations are also discussed.

Chapter III discusses common parameters required for all radios in the network, the contrast between settings required for different vendor equipment, and factors such as type and number of radios in the network. Communications security, electronic counter-counter measures, and linking protection are also covered.

Chapter IV considers multi-Service ALE network operations. This chapter highlights the detailed planning and coordination required at multiple echelons within a joint force to achieve effective communications among joint users of HF-ALE compatible radios. The functions and responsibilities of joint forces, Services, and key personnel, with respect to HF-ALE operations are described, to include HF-ALE addressing and data distribution.

Chapter V provides guidance to each Service's radio operators and HF radio network coordinator on how to create and operate in a joint HF-ALE voice network. This chapter describes the network details provided by the joint task force J6, what should be done with this information, and key points to consider when implementing the network into a previously established HF communications architecture. These guidelines are also applicable to operating in civil nets.

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Chapter I
High Frequency Overview

High frequency (HF) is a term used to describe the 1.6 to 30 megahertz (MHz) portion of the radio spectrum. This frequency range can provide both short-range and long-haul communications. However, it is also greatly influenced by the earth's atmosphere. To communicate effectively in the HF spectrum, it is necessary to understand radio propagation and how the earth's atmosphere affects this frequency range.

1. Propagation

Propagation describes how radio signals radiate outward from a transmitting source. A radio transmitter's antenna emits radio waves much like the wave motion formed by dropping a stone in a pool of water. This action is simple to imagine for radio waves that travel in a straight line in free space. The true path radio waves take, and how the earth's atmosphere affects these waves, is more complex.

2. Earth's Atmosphere

The earth's atmosphere is divided into three separate regions. The layers are the troposphere, the stratosphere, and the ionosphere. Most of the earth's weather takes place in the troposphere, which extends from the earth's surface to about 10 miles up. The weather variations in temperature, density, and pressure have a great effect on the propagation of radio waves. The stratosphere, which extends from roughly 10 to 30 miles up, has little effect on radio wave propagation. The ionosphere, which extends from 30 to approximately 375 miles up, contains up to four cloud-like layers of electrically charged ions. It is this region and its ionized layers that enable radio waves to be propagated great distances. The ionosphere, and how it effects radio wave propagation, is discussed on page I-2.

3. Types of Propagation

There are two basic modes of propagation: ground waves and sky waves. Ground waves travel along the surface of the earth and are used primarily for short-range communications. Sky waves, reflected by the ionosphere, are "bounced" or reflected back to earth and provide a long-haul communications path, as well as short-range (0 to 180 miles or 300 kilometers [km]) communication in mountainous terrain.

a. Ground Waves. Ground waves consist of three components: surface waves, direct waves, and ground-reflected waves.

(1) Surface Waves. Surface waves travel along the surface of the earth, reaching beyond the horizon. Eventually, surface wave energy is absorbed by the earth. The effective range of surface waves is largely determined by the frequency and conductivity of the surface over which the waves travel. Bodies of water and flat land have the least amount of absorption, while desert and jungle areas have the greatest. For a given complement of equipment, the range may extend from 200 to 250 miles over a conductive, all-sea-water path. Over arid, rocky, nonconductive terrain, however, the