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FIELD MANUAL
No. 11-25

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *15 October 1985*

Signal

Signal Troposcatter Company (Light and Heavy)

PREFACE

This manual describes the Signal Troposcatter Company (Light) and the Signal Troposcatter Company (Heavy). It provides U.S. Army doctrine for the employment and operations of both Signal Troposcatter Companies in a theater of operations and supports AirLand Battle doctrine.

Users of this manual are encouraged to submit recommended changes and comments to improve its clarity or accuracy. Relate comments to the specific page, paragraph, and line of text in which the change is recommended. Provide reasons for each comment to ensure understanding and complete evaluation. Prepare comments on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward directly to the Commander, U.S. Army Signal Center and Fort Gordon, ATTN: ATZH-DTL, Fort Gordon, GA 30905-5070, with an information copy to the Commander, U.S. Army Information Systems Command (USAISC), ATTN: AS-PLN-RM, Fort Huachuca, AZ 85613-5000.

This manual is oriented toward its primary target audience which includes the commander and personnel assigned to both Signal Troposcatter Companies, commanders and staffs of Theater Signal Brigades, and the commander and staff of a Theater Communications Command (Army). It is also of interest to a secondary audience that includes major Army commands and Army service schools.

Communications equipment quantities and types specified in this manual may not coincide with some actual authorizations. Changing communications support requirements should be reflected in authorization documents which can be specifically tailored and are adaptable to new and changing concepts.

This manual does not affect or implement the New Manning System.

This manual contains technical or operational information that is for official Government use only. Distribution is limited to U.S. Government agencies. Requests from outside the U.S. Government for release of this manual under the Freedom of Information Act or the Foreign Military Sales Program must be made to Commander, U.S. Army Signal Center and Fort Gordon, ATTN: ATZH-DTL, Fort Gordon, GA 30905-5070.

Interim changes to this manual are not official unless they are authenticated by The Adjutant General. Users will destroy interim changes on their expiration dates unless sooner superseded or rescinded.

*This manual supersedes FM 11-25, 6 November 1972.

CHAPTER 1

INTRODUCTION

1-1. Purpose

This manual provides doctrinal guidance for the employment and operations of the Signal Troposcatter (Tropo) Companies (Light and Heavy) at echelons above corps (EAC) in a theater of operations. The manual is oriented toward communications support operations behind the corps rear boundary in a large theater of operations. However, it is not limited in scope to any particular theater of operations.

1-2. References

Required and related publications are listed in the appendix.

1-3. Related manuals

This field manual is one of seven manuals prepared by the U.S. Army Information Systems Command (USAISC) for communications doctrine at EAC. The seven manuals provide a comprehensive understanding of theater-level communications.

a. FM 11-23 is the keystone manual, which contains an overview of EAC communications. It provides a structure for a type Theater Communications Command (ARMY) (TCC(A)) and introduces the "building block" units which may be assigned to a TCC(A). The TCC(A) installs, operates, and maintains the Army's Theater Communications System.

b. FMs 11-24 through 11-29 provide specific doctrinal guidance for the employment and operations of individual building block units (battalion and company size).

1-4. Explanation of abbreviations and terms

Abbreviations and special terms used in this manual are explained in the glossary.

1-5. The AirLand Battle

a. The U.S. Army must be prepared to meet a variety of challenges on battlefields worldwide. It must be prepared to fight both highly mechanized forces and light, well-equipped forces. In the areas of greatest strategic concern, the Army must expect battles of greater scope and intensity than ever fought before. It must anticipate battles that include the use of nuclear, biological, and chemical (NBC) warfare and electronic warfare (EW). To win, all available military forces must be coordinated in pursuit of common objectives. AirLand Battle doctrine provides the Army's basic operational concepts to meet these challenges. FM 100-5 describes the AirLand Battle doctrine.

b. AirLand Battle doctrine fuses the separate geographical areas of combat into one battle. It extends from our own rear areas, across the forward line of own troops (FLOT), deep into the enemy's second echelons and rear areas. The theater commander plans and directs the major campaigns, emphasizing maneuver as opposed to close combat. Four basic characteristics express the essence of the AirLand Battle: initiative, depth, agility, and synchronization. They apply to all levels of command and are summarized below.

(1) Initiative is the ability to set the terms of battle by action. Commanders must seize and preserve the initiative. This generates an offensive spirit in the conduct of all operations.

(2) Depth refers to time, space, and resources. Commanders need to use the entire depth of the battlefield to strike the enemy. Depth of resources provides the commander great flexibility over large areas. These resources include the integration of ground and air operations.

(3) Agility means acting faster than the enemy. Commanders must learn of critical events as they occur and act swiftly to avoid enemy strength and exploit enemy weaknesses. This must be done repeatedly.

(4) Synchronization of combat power assists in achieving maximum results. Commanders must waste no effort, initially or as an operation develops. Operations must be synchronized with other services and allies.

c. Communicators must be aware that decisionmaking by battle commanders is extremely time critical. Our decision cycle must be less than that of any enemy. The range, scope, and support of operations is thus highly dependent on command and control. The AirLand Battle requires immediately responsive and highly reliable communications involving signal commanders and officers at all levels.

1-6. Theater Army communications

a. Theater Communications System (Army).

(1) When the Army must operate on a large land mass, the scope of combat forces, support services, and duration of involvement is increased significantly. Extended operations also introduce requirements for Navy and Air Force support, as well as an expanded administrative and logistical base. Each service usually provides its own support services and command structure to ensure the best possible support of

its tactical commanders. The Army headquarters which provides this support is the Theater Army (TA). The TA Headquarters and its support units generally operate in the area to the rear of the corps boundary called the communications zone (COMMZ). (One exception to this doctrine is that a troposcatter terminal (light or heavy) may be used to provide connection into the corps tactical system.) The COMMZ can extend to the water's edge in a large land mass, across a major water body to another land mass, or even to the Continental United States. FM 100-16 provides a detailed discussion of support operations in EAC. It is the source of concepts and doctrine for EAC communications-electronics (C-E) TA operations. It relates the C-E role to the command and control requirements of the theater.

(2) FM 11-23 describes the Army's overall telecommunications system for command and control. The system is called the Army Automation Communications Network (AUTOCOMM). The AUTOCOMM provides tactical, strategic, general support, and theather subnets. The theater subnet is called the Theater Communications System (Army) (TCS(A)). The Signal Tropo Companies (Light and Heavy) are employed in the TCS(A). As indicated above, they may also be employed in the communications system of the tactical subnet.

(3) For many years, the concepts and doctrine for a theater have been focused on Europe with its combined and joint command structures. This has led to heavy reliance on C-E support from the commercial services and facilities which exist in industrially developed central Europe. In this case, communications plans and forces have become very dependent on such host nation support (HNS).

(4) Vietnam and other recent experiences have demonstrated the tremendous resources required to support ground combat in undeveloped regions. Multichannel radio played a major role in providing communications to dispersed units. Troposcatter and satellite radio also proved themselves important to theater command and control.

(5) The new tactical troposcatter radio systems greatly enhance the flexibility and capacity of the Theater Communications System. They can be moved and put in operation more rapidly than their predecessors. Their area of coverage is excellent when compared to other mulitchannel radio systems. A signal path may be as much as 150 miles (241 kilometers) long for the heavy troposcatter system. A troposcatter system creates a common volume in the troposphere which refracts and scatters the signal, causing it to return to earth and complete the link. Figure 1-1 depicts this effect.

b. Army Command and Area Communications System.

(1) The TCS(A) provides both command and area communications. It consists primarily of command and area links in a nodal configuration called the Army Command and Area Communications System (ACACS).

(2) The ACACS provides service to the TA in the COMMZ on a common-user, geographical basis. TA Headquarters is supported by the Signal Command Operations Battalion (Theater) and accesses the ACACS through at least two area signal nodes. Major functional headquarters are interconnected with TA Headquarters through the ACACS. This is accomplished through an extension node provided from the supporting major area node. The major area nodes and extension nodes are provided by the Signal Telecommunications Battalion (Area). The area nodal portion of the ACACs also provides C-E services to other units assigned to or transiting through the COMMZ.

(3) Figure 1-2 shows a representative ACACS found in the TCS(A). The ACACS can provide the high-volume telephone, radio, and record copy services required by larger headquarters. Troposcatter and tactical satellite radio may be employed in either the command or the area portion of the system. They can connect the TCS(A) to the strategic or tactical subnets of the AUTOCOMM network. The ACACS is required to interface with the Defense Communications System (DCS) in at least two locations. The corps area signal system will also interface with the ACACS. See FM 11-23 for a more complete description of the services provided by the TCS(A).

c. Theater Communications Command (Army)

(1) The TCC(A) is under the operational control of the TA commander. It provides communications for U. S. Army units throughout the COMMZ. It may be directed to provide C-E support to other U.S. and non-U.S. units and to provide some or all of the strategic subnets in the theater. It also is responsible for supply and maintenance support for TCC(A) unique C-E, air traffic control (ATC), and navigational aids (NAVAIDS) equipment. The TCC(A) is designed on a building block principle.

(2) Figure 1-3 shows a typical TCC(A). The types and number of units assigned can be changed to meet C-E requirements. If a major conflict should occur, available resources will be severely taxed by current force restrictions. Very important, also, is the fact that our major opponent has made known its intention of disrupting the Army's support areas. C-E units will be primary targets of this threat and must be prepared to combat it effectively. A future war will not be fought only at the front. It will cover the breadth and depth of the entire theater in a simultaneous or nearly simultaneous series of actions.

(3) All these factors emphasize the need for detailed planning at every level within the TCC(A). Thorough planning and frequent practice is the only way to prepare for the surprises which occur in wartime. FM 11-23 provides detailed doctrine for the

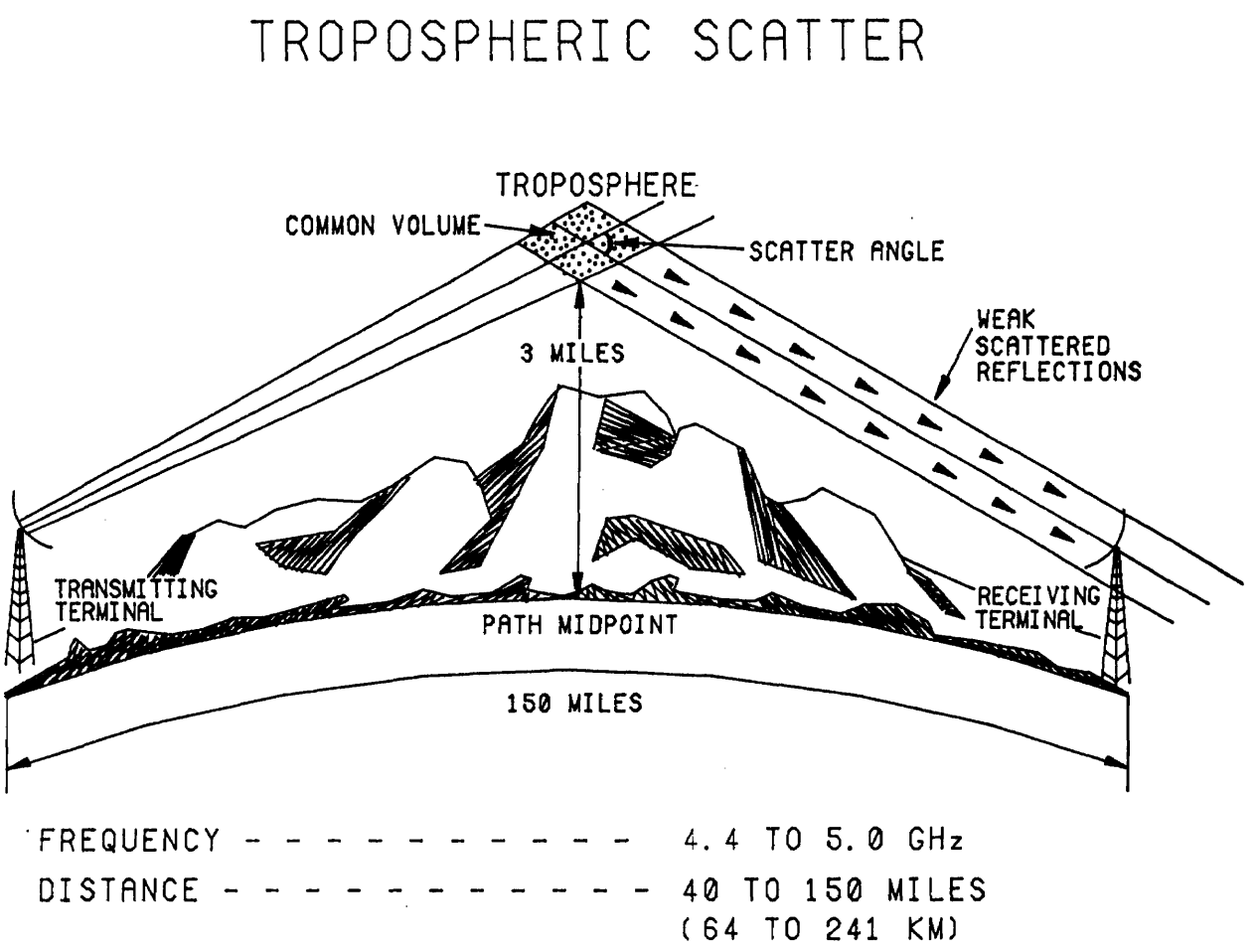

Figure 1–1 Tropospheric scatter radio system.

TCC(A). Generally, one Tropo Company (Heavy), up to 144-channel capability at a planning range of 150 miles (241 kilometers), is assigned to a TCC(A). Also, one Tropo Company (Light), up to 144-channel capability at a planning range of 100 miles (160 kilometers), is usually assigned to each TCC(A) Theater Signal Brigade. Each Company is an essential element in the TCS(A).

1-7. Echelons above corps support

EAC commanders must be prepared to operate in both joint and combined operations on the AirLand Battlefield. FM 100-16 includes broad doctrine concerning EAC support in both type operations and contingency deployment. Particularly in combined operations, command and control, as well as intelligence collection and dissemination, present unique problems. Nations are reluctant to relinquish sovereign rights in these areas. In all cases, C-E support must be specifically tailored to meet the support and operational requirements of the type theater of operations. Signal commanders and planners must be aware of this. These requirements are best understood in terms of the two typical EAC situations explained in FM 100-16. The two major scenarios in which the TCC(A) will be called upon to provide EAC support are support to forward-deployed forces and support to nonforward-deployed forces. The two scenarios are briefly described below/ FM 100-16 can be consulted for a more detailed discussion of each.

a. Support to forward-deployed forces. Support to forward-deployed forces normally involves combined operations. U.S. forces are predeployed in a foreign country and operate with allied nations in an established theater. The European North Atlantic Treaty Organization (NATO) and Korean Combined Forces Command (CFC) are examples where U.S. forces are forward-deployed in foreign countries. In both cases, an established formal allied command structure exists, HNS agreements exist, and a TCS(A) is in place. A forward-deployed situation provides the benefits of time, planning, and experience in a specific theater of operations prior to an outbreak of hostilities.

b. Support to nonforward-deployed forces. Support to nonforward-deployed forces involves a contingency situation. A joint U.S. contingency force, with or without allied assistance, deploys to an area without a significant preestablished U.S. support base. It is anticipated that prepositioned war material stocks and

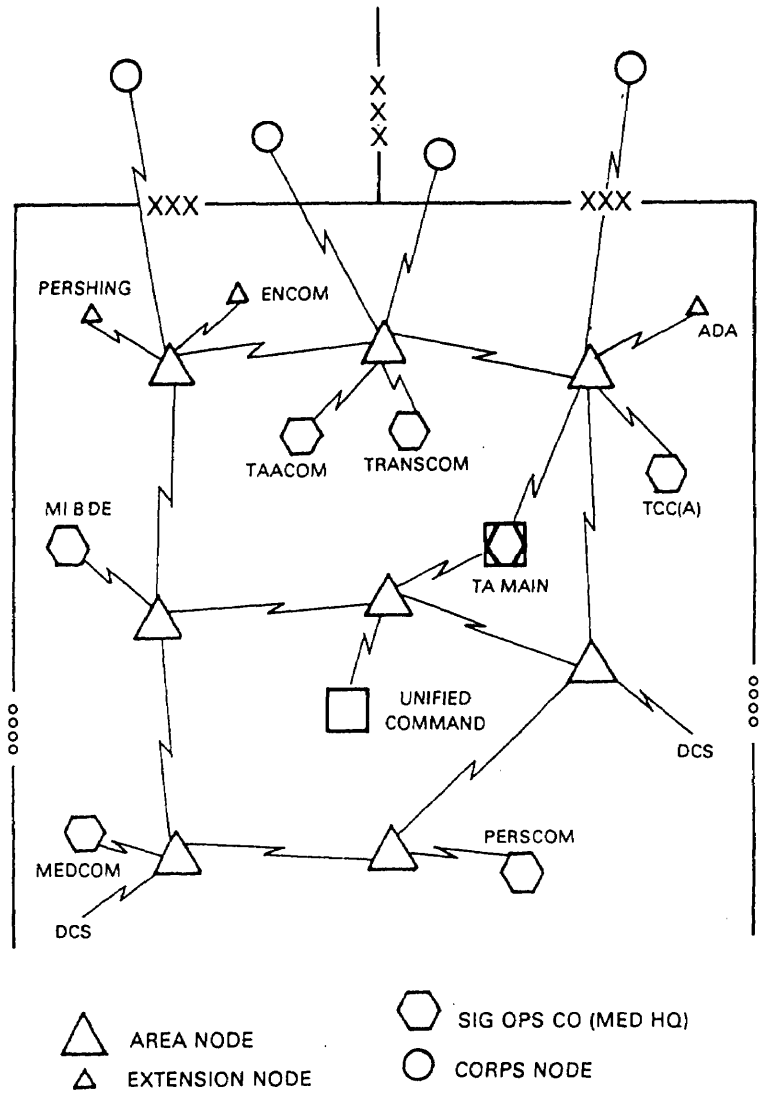

Figure 1-2 Army Command and Area Communications System.

HNS agreements will be minimal or nonexistent. Initial objectives will be limited. Planning must include a follow-on buildup and sustainment capability. The TCC(A) building block concept permits situation-dependent growth and maturity of the TCS(A).

1-8. Role of the Signal Troposcatter Companies (Light and Heavy)

The Signal Tropo Companies (Light and Heavy) provide the theater commander with flexible, reliable, and secure communications. Their troposcatter radio systems consist of equipment that can span great distances for command and control of theater forces. Each member of a Tropo Company plays a significant role in the unit's important mission. The focus of this manual is on the employment and operations of the Tropo Companies. Associated subjects essential to successful accomplishment of the Tropo Companies' mission also are discussed. Chapters 10 through 13 provide a ready reference in communications planning, NBC and electronic warfare, rear battle operations, and training. This manual does not tell all one needs to know in these areas. It does serve as a point of departure and leads to an array of documents which provide the detail required. FM 100-16 and FM 11-23 provide information on the functional and organizational environment in which the Tropo Companies operate.

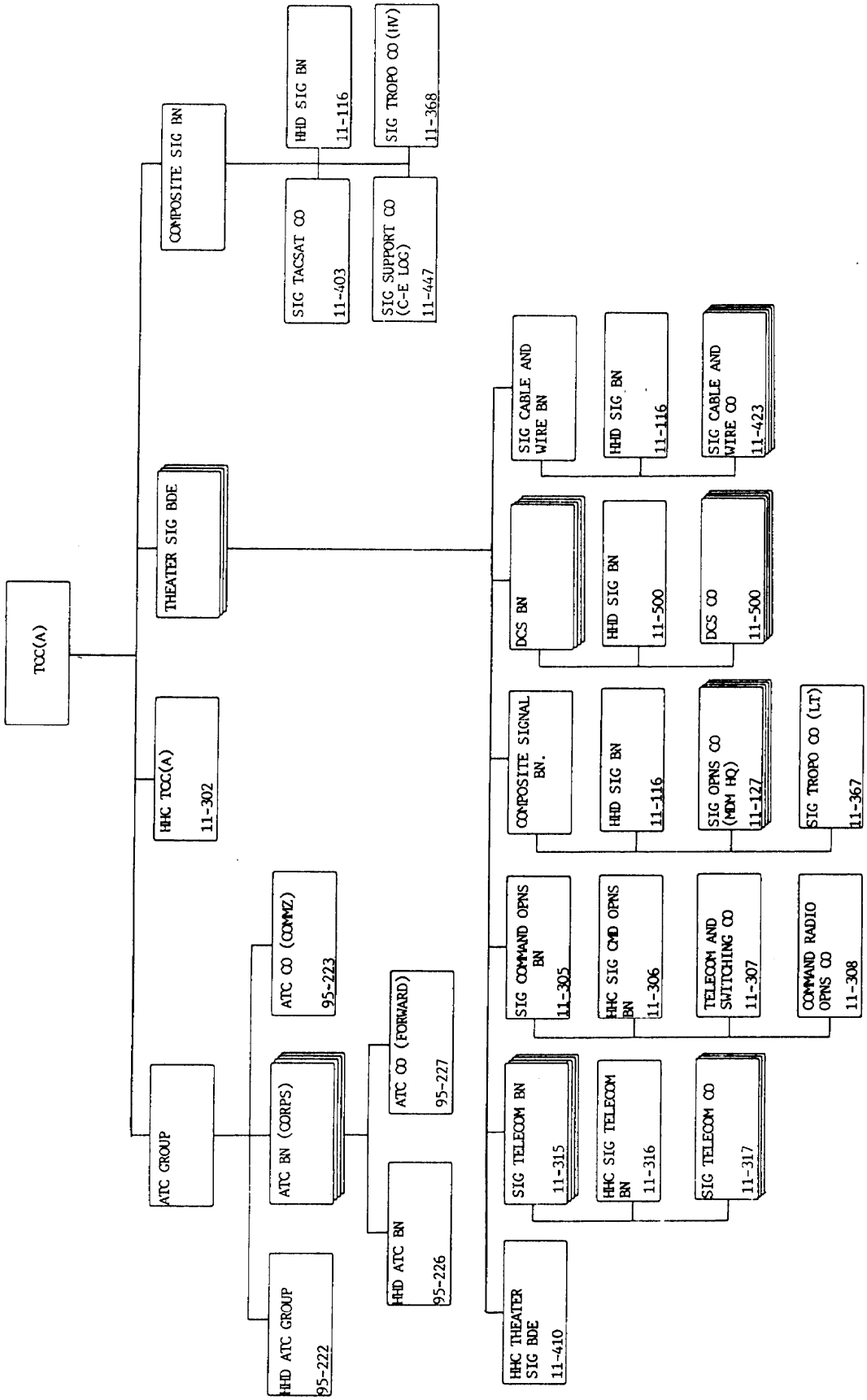

Figure 1-3. Type Theater Communications Command (Army).

CHAPTER 2

SIGNAL TROPOSCATTER COMPANY (Light)

2-1. Introduction

a. The Signal Troposcatter Company (Light) is organized and equipped to support a wartime TA. It operates in the COMMZ of a theater.

b. The Tropo Company is essential to responsive communications support in t he TCS(A). Planning must keep pace with changing requirements. Requirements may dictate augmentation. Discussions will be limited to the Company's organic assets.

c. Company support requirements will depend on–

(1) Mission of supported headquarters.

(2) Force size.

(3) Geographical area.

2-2. Structure

The Tropo Company (Light), table of organization and equipment (TOE) 11-367, is a building block unit designed to provide high-quality, multichannel troposcatter radio communications links for long-distance communications. The Company can command and control additional troposcatter radio teams without headquarters augmentation.

a. Mission. The Tropo Company provides multichannel troposcatter radio links. These links may be used to connect major headquarters or area signal nodes in a TCS(A).

b. Assignment.

(1) The Tropo Company (Light) may be assigned to the TCC(A) or a subordinate Theater Signal Brigade.

(2) Platoons or sections may be attached to other signal units. If so, technical control usually passes to that signal unit. Overall system technical operations often are directed and engineered at theater level.

(3) The Company is a category III unit. There is normally one Tropo Company (Light) in a Theater Signal Brigade.

c. Type organization. The Tropo Company (Light) is not adaptable to a type B organization employing indigenous personnel (AR 310-31).

d. Organization. The Signal Tropo Company (Light) consists of the following:

(1) A Company Headquarters.

(2) A Technical Control Section.

(3) Four Troposcatter Platoons.

(4) A C-E Maintenance Section.

2-3. Command and control

The Tropo Company (Light) is under the command and control of the TCC(A) or the TCC(A) Theater Signal Brigade of attachment. Terminals will be widely dispersed. Technical direction is received by terminal sections from system controllers. The Company commander's means for exercising internal command and control are discussed under resources in this chapter. General and special operating instructions contained in the communications-electronics operating instructions (CEOI) and standing operating procedures (SOPs) should be used to cover normal situations.

a. Company Headquarters. The Company Headquarters provides the Company commander with the means to direct and coordinate operations and training. The staff plans for and coordinates administrative and logistical support to the other elements of the Company. Execution of plans and orders depends on higher headquarters logistical support, especially transport priorities.

(1) *The Company Command Element.* The Tropo Company presents a unique command challenge. The wide dispersion of its terminal sections complicates normal administrative and logistics support, thus making it difficult to exercise command and provide leadership. The Company platoon officers and noncommissioned officers (NCOs), in effect, must function as staff and line leaders.

(a) The Company commander is responsible for successfully accomplishing assigned missions and functions. The commander exercises command and control by issuing orders and directives to the operating elements.

(b) The first sergeant is the senior NCO in the Company. He or she acts in the name of the Company commander when dealing with other NCOs, and is the commander's principal enlisted adviser. The first sergeant supervises the functions of the enlisted personnel in the Company. The fact that Company personnel operate at a distance from Company Headquarters makes this task difficult. All Company NCOs find themselves performing many tasks which would ordinarily be done for them in other type units. The first sergeant maintains close contact with the sergeant major/command sergeant major of higher headquarters. He or she assists the commander by ensuring day-to-day tasks are performed, to include administration, training, scheduling, internal operations, and counseling (enlisted personnel).

(c) The unit clerk assists the first sergeant by providing routine administrative support for day-to-day requirements. The unit clerk also assists in the operation of the switchboard ((d) below).

(d) A switchboard operator operates the manual telephone switchboard and the high frequency (HF)/

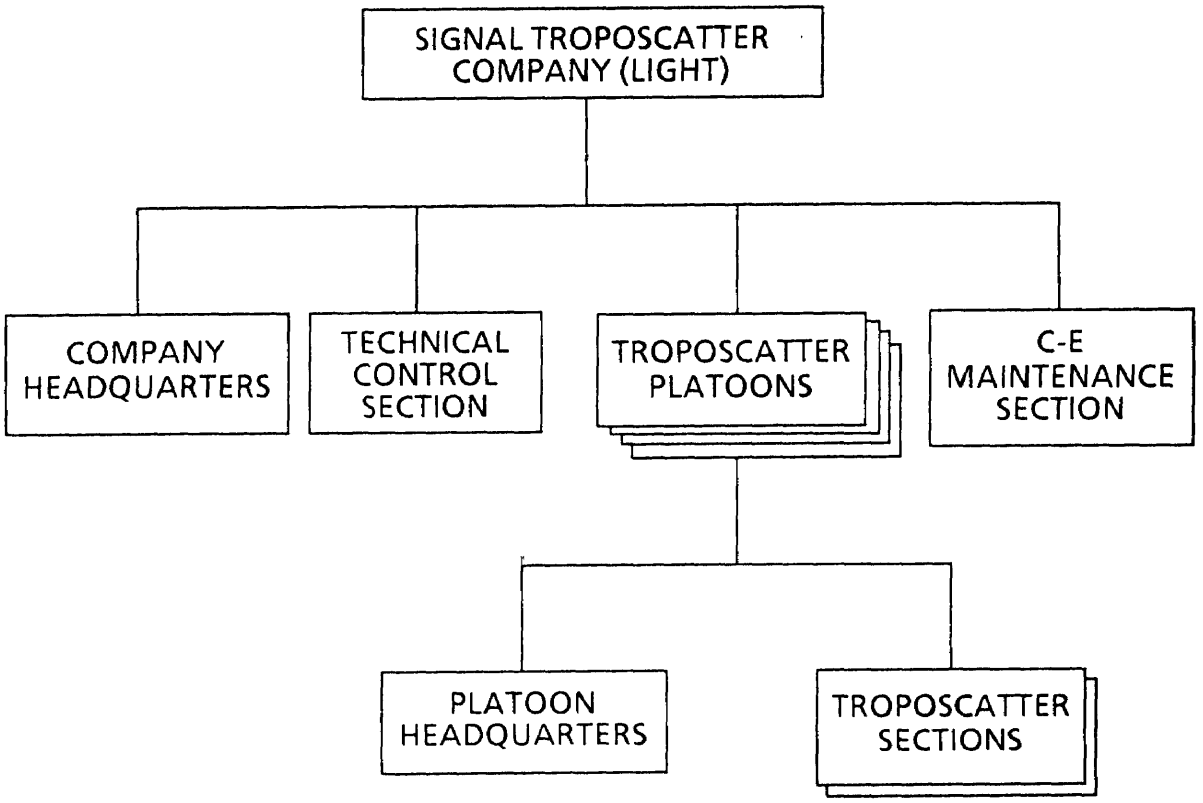

Figure 2–1 Organization of the Signal Troposcatter Company (Light).

single sideband (SSB) radio.

(2) *Food Service Element.* The food service sergeant, first cook, and four food service specialists provide a 24-hour dining facility. See FM 10-23 for details of unit feeding. Isolated sections require food service support from other units.

(3) *Supply Element.* The supply sergeant is assisted by an equipment records and parts specialist and an armorer. Supply operations provide the repair parts for operation of Company C-E equipment and vehicles. See DA Pamphlet 710-2-1 and FM 10-14 for details of unit supply.

(a) The supply sergeant acquires and distributes supplies, ensures that supply records are maintained, and supervises the armorer and the equipment records and parts specialist.

(b) The armorer is responsible for unit level maintenance of organic weapons. He or she maintains a prescribed load list (PLL) of organizational repair parts for weapons organic to the Company.

(c) The equipment records and parts specialists maintains the PLL for organizational demand-supported signal repair parts.

(4) *NBC Element.* The chemical NCO is responsible for the accomplishment of the Company commander's NBC program. As a minimum, the chemical NCO–

(a) Is the principal NBC adviser to the commander.

(b) Ensures authorized NBC equipment is on hand and maintained.

(c) Develops individual and collective NBC training.

(d) Determines unit NBC team requirements.

(e) Ensures team members are appointed on unit orders, equipped, and trained.

(f) Ensures NBC training is conducted during physical training and during daily routines.

(5) *Motor Maintenance Element.* The maintenance supervisor is assisted by five light wheel vehicle mechanics, a PLL clerk, three power generator equipment repairers, a recovery vehicle operator, a utilities equipment repairer, and four petroleum large vehicle operators.

(a) The maintenance supervisor is the principal maintenance adviser to the commander. He or she plans for and supervises unit-level maintenance of vehicles and power generators organic to the Company, supervises maintenance personnel, and provides supervised on-the-job-training.

(b) The light wheel vehicle mechanics provide unit-level maintenance on organic vehicles.

(c) The PLL clerk is responsible for the maintenance of motor repair parts records and stockage of organizational demand-supported items.

(d) The power generator equipment repairers are responsible for unit-level maintenance of equipment organic to the Company.

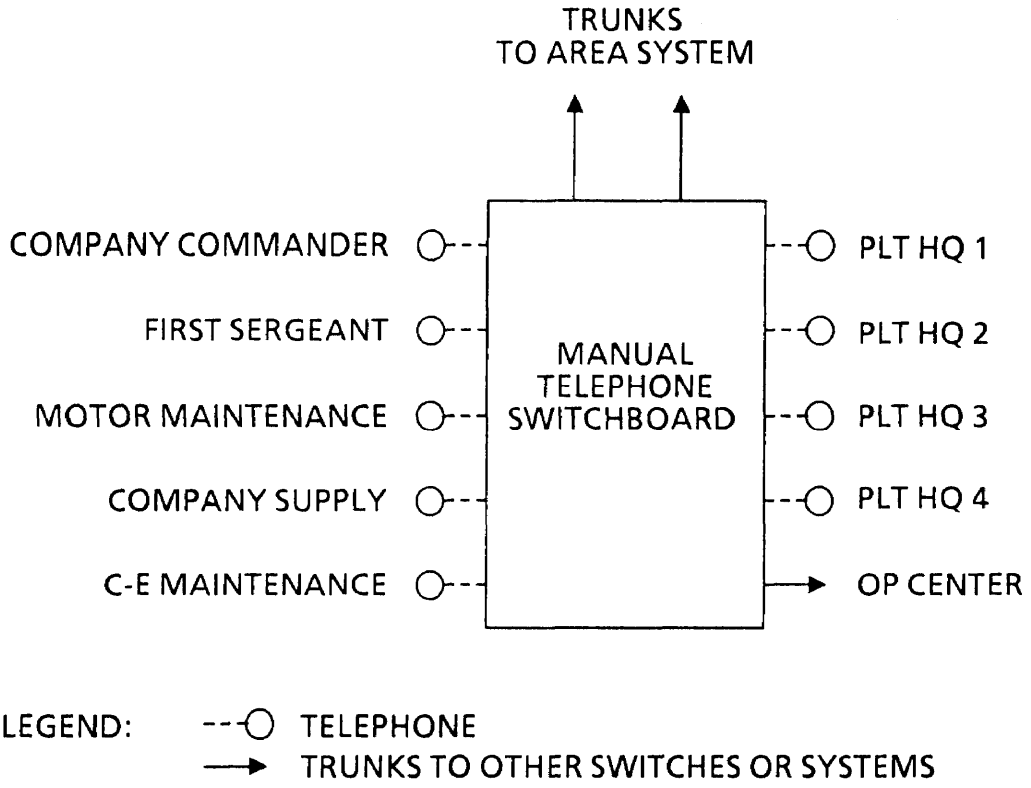

Figure 2–2. Signal Troposcatter Company (Light) Type Telephone Net.

(e) The recovery vehicle operator is responsible for retrieving disabled vehicles.

(f) The utilities equipment repairer is responsible for the light set organic to the Company.

(g) The petroleum large vehicle operators are responsible for petroleum, oils, and lubricants (POL) resupply to widely dispersed tropo sites.

b. Resources available. The Company commander has the following resources for command and control:

(1) Existing common-user telephone network.

(2) Local message centers.

(3) Internal telephone network (switchboard and telephones).

(4) HF/SSB radio.

(5) Troposcatter voice orderwire.

(6) Messenger service.

c. Internal communications. Communications among the Company commander, the Technical Control Section, and the displaced radio terminals is essential. The type communications required depends on the type message or report. The following means of communications will normally be available:

(1) Access to the common-user network.

(2) Manual telephone systems. See figure 2-2.

(3) An HF/SSB radio Company Command and Technical Control Net.

Company Technical Control uses the net to supervise system installation, system quality, circuit rerouting, and displacement. The Platoon Command and Technical Control Nets are netted together for this function. Figure 2-3 shows the Company Command and Control Net.

(4) Troposcatter orderwire channel for terminal-to-terminal technical control.

2-4. Employment

The Company will normally be employed at EAC in the COMMZ. It provides a multichannel communications system or links in a system when it is more practical to use tropospheric radio because of terrain, distance, or the tactical situation. The Tropo Company (Light) provides an extended range over multichannel line of sight (LOS) systems of the TCS(A) between area signal nodes and major headquarters.

a. Functions.

(1) At full strength, the Signal Tropo Company (Light) can install, operate, and maintain 16 terminals, or up to 8 multichannel systems. These terminals are mobile and can be installed and disassembled by three persons in 1 hour with the quick-reaction antenna (QRA). They are air transportable. Although mobile, they cannot operate in transit.

(2) Troposcatter radio provides reliable high-quality voice, teletypewriter, and data circuits over extended distances. Because of its method of radio wave propagation, troposcatter radio is not limited to LOS transmissions.

b. Employment in the Theater Communications Command (Army). One Signal Tropo Company (Light)

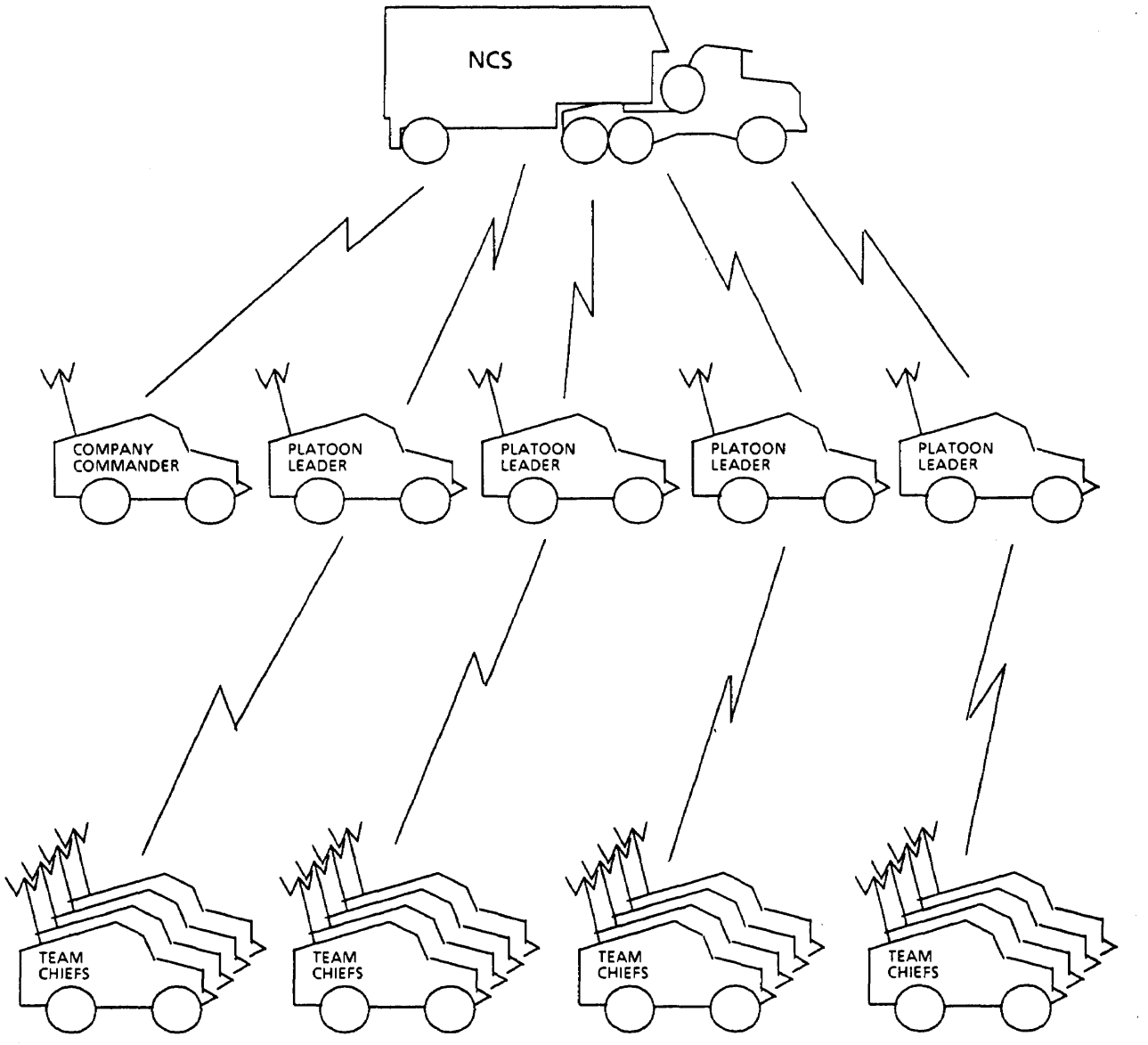

Figure 2–3. Signal Troposcatter Company (Light) Type HF/SSB Radio Command and Technical Control Net.

is normally assigned to a Theater Signal Brigade. It is employed to provide–

(1) Complete direct point-to-point command links between major command and functional headquarters in the COMMZ.

(2) Communications links between area signal nodes in the TCS(A). These links extend over inaccessible areas. Circuits are either terminated at a node or redirected to other links.

(3) Skip node capability to bypass nodes.

2-5. Operations

The Signal Tropo Company (Light) provides communications links over extended distances between COMMZ headquarters and between area signal nodes. Operations require detailed link engineering, site planning, and preparation.

a. Capabilities. The Signal Tropo Company (Light) can provide the following:

(1) Installation, operation, and maintenance of eight troposcatter radio communications links (two terminals per link). These links are capable of spanning a nominal distance of up to 100 miles (160 kilometers) with maximum traffic channels.

(2) Circuit patching and limited test facilities to provide a technical control capability.

b. Limitations.

(1) The Signal Tropo Company (Light) requires the following support:

(a) Health, religious, financial, and legal services.

(b) Personnel and administrative services.

(c) Bulk POL resupply.

(d) Supplemental transportation.

(e) Refrigeration repair.

(2) Troposcatter installation may require a site survey for topography, siting, soil condition, terrain, bearings, horizon angles, and distances between terminals. Engineer support often is required for access to and development of remote sites. Because troposcatter sites are high priority targets, a high degree of physical security is required. Security forces from combat arms or indigenous troops may be required.

(3) Cable and radio teams will be required to extend circuits to outlying units. The Theater Army Area Command (TAACOM) support element is required for intermediate (general support (GS)) maintenance and logistical support of organic C-E equipment. Intermediate (GS) maintenance for communications security (COMSEC) equipment is provided by the GS unit of the TCC(A). Army aviation support may be required to supply and maintain troposcatter terminals in isolated areas.

(4) Frequencies must be engineered and assigned by the TCC(A).

c. Defense. Personnel of the Signal Tropo Company (Light) may be used to conduct a coordinated defense of their area or a limited defense of an installation. Remote installations may require security forces. Use of Company personnel in defense may result in reduced communications support. Chapter 12 has more information on rear battle operations defense and operations in an NBC environment.

d. Mobility.

(1) The Company headquarters has the following organic vehicles for transport of personnel and equipment:

(a) Truck utility: tactical ¾-ton with equipment (W/E) M1OO9.

(b) Truck cargo: tactical 5/4-ton 4x4 W/E M1008.

(c) Truck cargo: 2½-ton 6x6 W/E.

(d) Truck cargo: 5-ton 6x6 LWB W/E.

(e) Truck wrecker: 5-ton 6x6 with winch W/E.

(2) The Company is air transportable. TA aviation assets may be required for emergency transport of support personnel and repair parts.

2-6. Deployment

a. The Signal Tropo Company (Light) may be deployed in a theater or to support contingency operations. Simultaneous displacement of all Company elements is not likely after initial deployment. Company elements may be deployed to establish links between a COMMZ headquarters and forward command posts separated by an impassable land or water barrier.

b. Normally, the Company Headquarters will be collocated with one of the deployed operating elements. However, maintenance, supply, and personnel support of dispersed terminals may be primary considerations that determine the headquarters location.

CHAPTER 3

TECHNICAL CONTROL SECTION

3-1. Introduction

a. The Technical Control Section provides limited technical control, circuit patching, and test facility capability. It supervises the Signal Tropo Company (Light) technical operations and may also be used to complement the technical control facilities of other supported signal units.

b. The Section has a Communications Technical Control Center (AN/TSQ-84), an Operations Center (AN/MSC-31), air conditioning, power generators, and support equipment.

3-2. Structure

The Technical Control Section provides personnel and equipment for diagnostic and engineering services of troposcatter signals and channels.

a. Mission. The Technical Control Section provides technical control, circuit patching, and limited quality-assurance test facilities. It supervises quality of the circuits and systems of the Company and those operated by signal units that interface with the Company.

b. Assignment. The Technical Control Section is organic to the Signal Tropo Company (Light), TOE 11-367.

c. Organization. The Technical Control Section provides continuous operations in support of the Company or an area of assignment. Operations are normally in two 12-hour shifts.

3-3. Command and Control

The Technical Control Section provides the means for the Company commander to control the Signal Tropo Company (Light). The area communications chief supervises section personnel.

a. Technical Control Section Personnel. The technical control officer represents the commander and provides direct supervision to the personnel assigned to the Section. Personnel assigned to the Section perform two separate, but related, functions: facilities control and circuit control.

(1) The area communications chief, an illustrator, single-channel radio operators, and telecommunications center operators operate the Communications Operations Center (AN/MSC-31). The Operations Center provides the facilities control.

(a) The area communications chief supervises section personnel; prepares system plans, diagrams, and circuit orders; coordinates troposcatter system installation, operation, and maintenance; reroutes circuits as required or as directed by the higher echelon systems control element; coordinates locations, services, and displacements with supported units; coordinates redeployment of terminals; and maintains current systems and equipment status, unit readiness, map profiles, site plans, and other operations information.

(b) The illustrator prepares systems and circuit diagrams, status displays, and map profiles.

(c) The radio operators operate the HF/SSB radio in the Company Command and Technical Control Net and are responsible for operation of the SB-22/PT switchboard in the AN/MSC-31.

(d) The combat telecommunications center operators are responsible for the operation of the teletypewriters in the Operations Center.

(2) The circuit control sergeant and three tactical circuit controllers operate the Communications Technical Control Center (AN/TSQ-84). The Technical Control Center provides circuit control.

(a) The circuit control sergeant supervises personnel in the Technical Control Facility that provides interface, interconnect, and test facility for communications systems and circuits that enter or exit the site.

(b) The tactical circuit controllers reduce circuit outage time by rerouting circuits or channels; establish emergency interconnections between troposcatter terminals and between terminals and communications units; correct difficulties between local and distant facilities by directing equipment checks; conduct tests to isolate, diagnose, and correct faults; place circuits into service as traffic load increases; maintain circuit outage records; and ensure continuity and responsiveness of communications.

b. Resources Available. The technical control officer, the area communications chief, and the circuit control sergeant have the following resources to establish and/or maintain operational and technical control of the Company systems:

(1) Existing common-user telephone network.

(2) Local message centers.

(3) Internal telephone network (switchboard and telephones).

(4) HF/SSB radio.

(5) Troposcatter voice orderwire.

(6) Teletypewriter.

(7) Messenger service.

c. Internal Communications. The following means of communications will normally be available:

(1) Access to the common-user telephone network.

(2) Organic equipment that provides a manual telephone system. A manual switchboard is located in the AN/MSC-31. See figure 2-2.

(3) HF/SSB radio Company Command and Technical Control Net located in the Operations Center (AN/MSC-3l) used to communicate with distant troposcatter sites. See figure 2-3.

(4) Troposcatter orderwire to pass instructions and information.

(5) Teletypewriter circuits to pass coordination instructions.

3-4. Employment

a. The Technical Control Section is employed as a single unit. It provides technical expertise to ensure quality communications on systems and channels which pass through its area.

b. At full strength, the Technical Control Section is capable of providing continuous facility and circuit control services. These include, but are not limited to–

(1) Systems planning and interfaces.

(2) Circuit activation, routing, rerouting, and restoral.

(3) Circuit testing, fault isolation, and quality assurance.

(4) Status reporting and recordkeeping.

(5) Internal and external coordination.

3-5. Operations

The Technical Control Section is responsible for controlling all C-E operations directed by the Company. It coordinates action directed by higher engineering and technical control elements. Its functions are complicated because directions can come from several sources and interfaces to other links not under its control. It is responsible for quality of Company-operated systems and circuits.

a. Capabilities. The Technical Control Section provides–

(1) Facility control.

(2) Circuit control.

(3) Continuous operations.

(4) Net control for HF/SSB Company Command and Technical Control Net(s).

b. Limitations.

(1) The Technical Control Section depends on Company Headquarters for administrative, logistical, food service, billeting, and personal service.

(2) Company Headquarters provides organizational maintenance on vehicles, environmental control equipment, and power generators.

(3) The Company C-E Maintenance Section provides intermediate (direct support (DS)) maintenance on organic C-E equipment.

(4) Intermediate (GS) maintenance for COMSEC equipment is provides by the GS unit of the TCC(A).

c. Defense.

(1) Technical Control Section personnel may be used to assist in a limited coordinated defense of an installation or an area of assignment. This may include rear battle operations, operations in an internal defense, or operations under NBC conditions.

(2) Due to the critical nature of the Section's mission and the limited number of assignment personnel, personnel should be used only during extreme emergencies. Technical control will deteriorate rapidly if personnel are used for any purpose other than assigned duties.

d. Mobility. The Technical Control Section has one 5/4-ton 4 x 4 cargo truck, with a communications kit and two 2½-ton 6 x 6 cargo trucks. The 2½-ton trucks are used to transport the AN/TSQ-84 and the AN/MSC-31. Additional transport for personnel and supplies must be provided by the Company.

3-6. Deployment

The Technical Control Section will normally be collocated with the largest concentration of troposcatter elements of the Signal Tropo Company (Light).

CHAPTER 4

TROPOSCATTER PLATOONS (Light)

4-1. Introduction.

a. The Signal Tropo Platoons (Light) are organized and equipped to support a wartime TA by providing communications links up to 100 miles (160 kilometers) between major commands and major functional headquarters, and area signal nodes in the TCS(A) inaccessible due to distance, vulnerability, and reliability.

b. It is essential that the Signal Tropo Platoons (Light) provide responsive communications support in the TCS(A). Planning must keep pace with changing requirements.

4-2. Structure

The Signal Tropo Company (Light) has four identical Tropo Platoons. Each Tropo Platoon has two Tropo Sections, which consist of two terminal teams each. Each has personnel and equipment required to transport, install, operate, and maintain the troposcatter terminals.

a. Mission. The Tropo Platoon is responsible for installation, operation, and maintenance of multichannel troposcatter terminals and associated patching facilities as directed.

b. Assignment. The Tropo Platoon is organic to the Signal Tropo Company (Light). Each Platoon remains under the command and control of the Company commander. When dispersed, elements of the Platoons may be attached to another headquarters for rations and quarters.

c. Organization. The Tropo Platoon provides continuous operations in the TCS(A). The four Platoons provide a total of 16 Terminal Teams. Operations normally are in two 12-hour shifts. Each Platoon is organized with two Tropo Sections containing two Terminal Teams each. See figure 4-1.

4-3. Command and Control

The Tropo Platoons are under the command and control of the Signal Tropo Company (Light) Company commander. The Platoon leader and tactical satellite/microwave system supervisor of each Platoon supervise assigned personnel.

a. Troposcatter Platoon Personnel.

(1) Each Platoon Headquarters consists of a Platoon leader and tactical satellite/microwave system supervisor and a power generator equipment repairer. The Platoon leader and Platoon sergeant supervise the installation and operation of the Tropo Sections and Terminal Teams assigned to the Platoon.

(2) Each Tropo Section consists of a tactical satellite/microwave system supervisor and six tactical satellite/microwave system operators.

(3) Each Tropo Section consists of two Terminal Teams. Each Team consists of three tactical satellite/microwave system operators. The Team chief is the senior enlisted member.

b. Resources Available. The Company commander, Platoon leaders, and tactical satellite/microwave system supervisors have the following resources to establish and/or maintain operational and technical control of Platoon systems:

(1) Existing common-user telephone system, if available.

(2) Local message centers.

(3) Internal Telephone network.

(4) HF/SSB radio.

(5) Troposcatter orderwire.

4-4.Employment

a. The assets of the Tropo Platoons will be required to meet the various needs of the TCC(A). Although multihop (back-to-back repeater) operation is possible, this method of employment is not considered efficient. Distances exceeding a 100-mile (160-kilometer) planning range should be covered via multichannel tactical satellite communications (TACSATCOM) assets or heavy tropo. All of the system planning factors should be taken into account in determining if a given tropo system should be employed in the tropo mode or the LOS mode. Information Sheet 1102, Microwave and Troposcatter Radio Systems Engineering, prepared by the Signal School at Fort Gordon, GA, provides formulas, checklists, tables, and graphs for determining link parameters or feasibility. These factors include, but are not limited to, radio link distance, acceptable bit error rates (BER), number of circuits required, terrain to be traversed, and the proximity of enemy means of intercept or jamming.

b. The tropo systems may be used in any of the following ways:

(1) Line of communications (LOC) interconnect mode.

(2) Extension of existing defense communications systems.

(3) Skip-node operation.

(4) Contingency extension or restoral of U.S./allied communications systems.

(5) Major headquarters connectivity to include allied or host nation.

c. Two Terminal Teams work together to operate a multichannel link. The terminals may be separated by as much as 100 miles (160 kilometers).

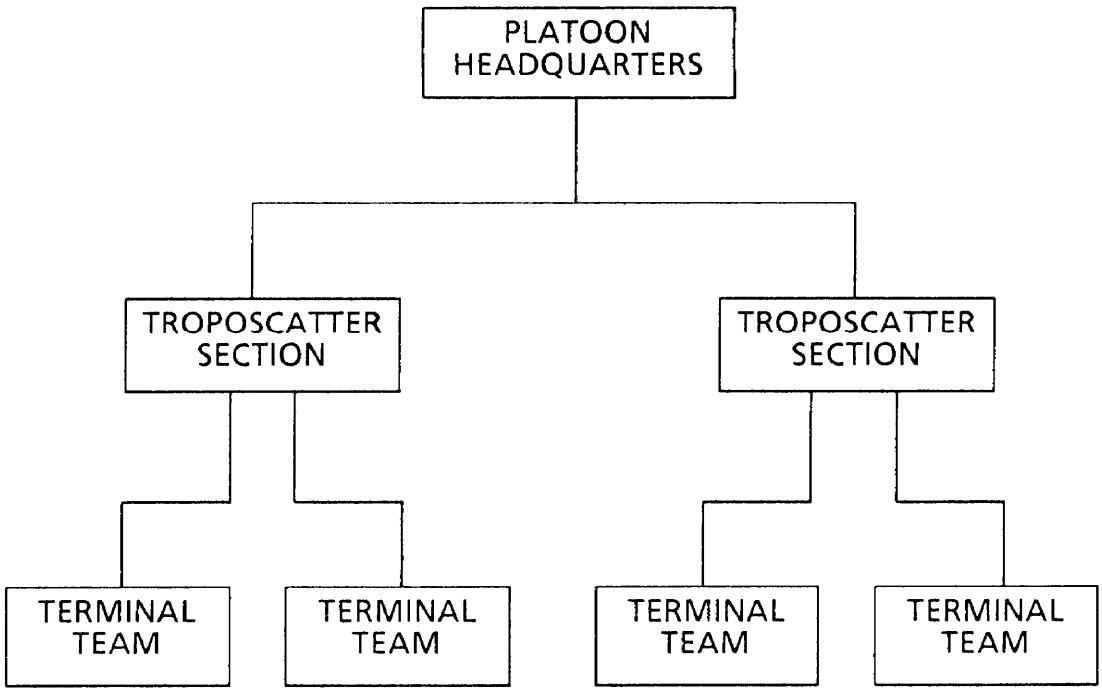

Figure 4–1. Organization of a Light Troposcatter Platoon.

4-5. Operations

The Light Tropo Platoon installs, operates, and maintains troposcatter radio communications links between widely separated headquarters. Light troposcatter terminals should be sited on high ground. Site elevation is important, although not as critical as it is for very high frequency (VHF) systems. Loss is dependent on the antenna takeoff angle at each end of the path plus distance and data rate. Antenna beam clearance of nearby obstructions is important. HF/SSB is initially used to provide communications for terminal lineup.

a. Capabilities.

(1) The Tropo Platoons can–

(a) Install, operate, and maintain eight troposcatter links (two terminals per link).

(b) Provide links of up to 100 miles (160 kilometers). Each link can provide up to four digital groups.

(c) Support analog subscriber channels in lieu of digital subscriber loops. This is accomplished by replacing a digital loop card with an analog applique card. Each card supports two traffic channels.

(d) Operate 24 hours a day.

(e) Provide dual diversity capability.

(f) Provide bulk encrypted transmission.

(g) Provide voice orderwire circuits for coordination between terminals.

(2) The C-E Maintenance Section provides intermediate (DS) maintenance on organic equipment.

b. Limitation. The Tropo Platoons are dependent on Company Headquarters for administrative, logistical, food service, billeting, and other personal services. Tropo Platoons located away from the Company require these services from the supported headquarters.

c. *Defense.*

(1) Tropo Platoon personnel may be used to assist in a limited coordinated defense of the installation or area of assignment. This may include rear battle operations, operations in an internal defense, or operations in an NBC environment.

(2) Due to the minimum level of staffing in the Tropo Platoon and the critical nature of its mission, use of these personnel as a defensive force should be limited to extreme emergencies.

(3) When personnel must assist in defense, communications services will be degraded.

d. Mobility. Each Tropo Platoon Headquarters has a 5/4-ton 4x4 cargo truck with a communications kit. Each Tropo Section has a 4x4 commercial utility cargo vehicle (CUCV). Additional transportation for personnel and supplies must be provided by the Company.

4-6. Deployment

Tropo Platoons may be deployed throughout the EAC. Proper planning for, and utilization of, tropo equipment will enhance or extend existing communications systems, replace existing systems, or restore degraded or destroyed systems. Such planning requires properly engineered parameters and consideration of troposcatter radio limitations.

CHAPTER 5

COMMUNICATIONS-ELECTRONICS MAINTENANCE SECTION (LIGHT)

5-1. Introduction

The C-E Maintenance Section provides intermediate (DS) maintenance on organic C-E equipment and COMSEC equipment.

5-2. Structure

The C-E Maintenance Section is staffed with a C-E technician (warrant officer), a C-E maintenance chief, tactical microwave system repairers, a crypto systems repairer, and a C-E material control and accounting specialist.

a. Mission. The C-E Maintenance Section provides intermediate (DS) maintenance on organic C-E and COMSEC equipment for the Company.

b. Assignment. The C-E Maintenance Section is organic to the Signal Tropo Company (Light), TOE 11-367.

c. Organization. The Section is staffed to provide continuous maintenance support on unit troposcatter radio equipment and COMSEC equipment. Maintenance support teams provide maintenance support to dispersed sections of the Tropo Platoons.

5-3. Command and control

The C-E Maintenance Section is under the direct command and control of the Signal Tropo Company (Light) Company commander. The C-E technician supervises Section personnel.

a. C-E Maintenance Section personnel.

(1) The C-E technician ensures intermediate (DS) maintenance is performed on unit equipment.

(2) The C-E maintenance chief–

(a) Supervises enlisted personnel.

(b) Schedules maintenance.

(c) Coordinates onsite maintenance.

(d) Dispatches maintenance support teams.

(3) The tactical microwave systems repairers perform intermediate (DS) maintenance on organic C-E equipment.

(4) The crypto systems repairer performs intermediate (DS) maintenance on organic COMSEC equipment.

(5) The C-E material control and accounting specialist maintains maintenance schedules, requisition status reports, PLL, and accountability records.

b. Resources available. The C-E Maintenance Section has the following resources to control and coordinate its activities:

(1) Common-user telephone network.

(2) Local message centers.

(3) Internal telephone network.

(4) Troposcatter orderwire through a local Terminal Team.

(5) HF/SSB radio net.

5-4. Employment

The Section will normally be employed as a single unit. Maintenance support teams may be organized to provide assistance for the dispersed elements.

a. Capabilities. The C-E Maintenance Section provides–

(1) Intermediate (DS) maintenance on organic C-E and COMSEC equipment.

(2) Onsite maintenance to dispersed terminal locations.

b. Limitations. The Section depends on the Company Headquarters for administrative, logistical, food service, billeting, and other personal services support.

(1) Personnel assigned to the Company Headquarters provide unit maintenance on organic vehicles.

(2) Intermediate (GS) maintenance for C-E equipment is provided by GS units of the TAACOM.

(3) Intermediate (GS) maintenance for COMSEC equipment is provided by GS units of the TCC(A).

c. Defense.

(1) The defensive capabilities of the Section are limited. Personnel may be used to assist in a limited coordinated defense of the installation or unit area of assignment. This may include rear battle operations, operations in an internal defense, or operations under NBC conditions.

(2) If personnel are used to augment defensive forces, their maintenance capabilities will be degraded.

d. Mobility.

(1) The C-E Maintenance Section has the following vehicles:

(a) Truck cargo: tactical 5/4-ton 4x4 W/E M1008.

(b) Truck cargo: 2½-ton 6x6 W/E.

(c) Electronic shop shelter mounted.

(2) Additional transport of personnel and supplies must be provided by the Company.

5-5. Deployment

a. The C-E Maintenance Section will normally be deployed with the Company Headquarters.

b. The Section may be collocated with a Tropo Platoon if the major concentration of terminals is in one general area.

CHAPTER 6

SIGNAL TROPOSCATTER COMPANY (HEAVY)

6-1. Introduction

a. The Signal Tropo Company (Heavy) is organized and equipped to support a wartime TA. It operates in the COMMZ of a theater.

b. Like the Signal Tropo Company (Light), the Signal Tropo Company (Heavy) is essential to responsive communications support in the TCS(A). Planning must keep pace with changing requirements. Requirements may dictate augmentation. Discussions will be limited to the Company's organic assets.

c. Company support requirements will depend on–

(1) Mission of supported headquarters.
(2) Force size.
(3) Geographical area.

6-2. Structure

The Tropo Company (Heavy), TOE 11-368, is a building block unit. It is designed to provide high-quality, high-capacity multichannel troposcatter radio communications links for long-distance communications.

a. Mission. The Signal Tropo Company (Heavy) provides multichannel troposcatter radio links. These links connect major headquarters or area signal nodes in a TCS(A).

b. Assignment.

(1) The Tropo Company (Heavy) is usually assigned to the TCC(A). It may be assigned to a subordinate Theater Signal Brigade.

(2) Platoons or sections may be attached to other signal units. Technical control usually passes to the signal unit of attachment. Overall system technical operations often are directed and engineered at theater level.

(3) The Company is a category III unit. Normally, only one Signal Tropo Company (Heavy) is assigned to a TCC(A).

c. Type organization. The Signal Tropo Company (Heavy) is not adaptable to a type B organization employing indigenous personnel (AR 310-31).

d. Organization. The Signal Tropo Company (Heavy) consists of the following:

(1) A Company Headquarters.
(2) An Operations Section.
(3) Two Troposcatter Platoons.
(4) A C-E Maintenance Section.

6-3. Command and control

The Signal Tropo Company (Heavy) is under the command and control of the TCC(A) or the TCC(A) Theater Signal Brigade of attachment. Terminals will be separated widely. The Company commander's means for exercising internal command and control are discussed in b below. Technical direction is received by terminal sections from systems controllers. General and special operating instructions contained in the CEOI and SOPs should be used to cover normal situations.

a. Company Headquarters. The Company Headquarters provides the Company commander with the means to direct and coordinate operations and training. The staff plans for and coordinates administrative and logistical support to Company elements. Execution of plans and orders depends on higher headquarters logistical support, especially transport priorities.

(1) *The Company Command Element.* The Signal Tropo Company (Heavy) presents a unique command challenge. Terminal sections will be dispersed throughout the area of assignment. They can be separated by as much as 150 miles (241 kilometers). This complicates normal administrative and logistics support. It is difficult to exercise command and provide leadership. Company platoon officers and NCOs, in effect, must function as staff and line leaders.

(a) The Company commander is responsible for the successful accomplishment of assigned missions and functions. The commander exercises command and control by issuing orders and directives to the operating elements.

(b) The first sergeant is the senior NCO in the Company. He or she acts in the name of the Company commander when dealing with other NCOs, and is the commander's principal enlisted adviser. The first sergeant supervises the functions of the enlisted personnel in the Company. The fact that Company personnel operate at great distances from Company Headquarters makes this task difficult. All Company NCOs must assume many tasks which ordinarily would be done for them in other type units. The first sergeant maintains close contact with the sergeant major/command sergeant major of higher headquarters. He or she assists the commander by ensuring day-to-day tasks are performed, to include administration, training, scheduling, internal operations, and counseling (enlisted personnel).

(c) The unit clerk assists the first sergeant by providing routine administrative support for day-to-day requirements.

(d) The single channel radio operator operates the manual telephone switchboard and the HF/SSB radio.

(2) *Food Service Element.* The food service ser-

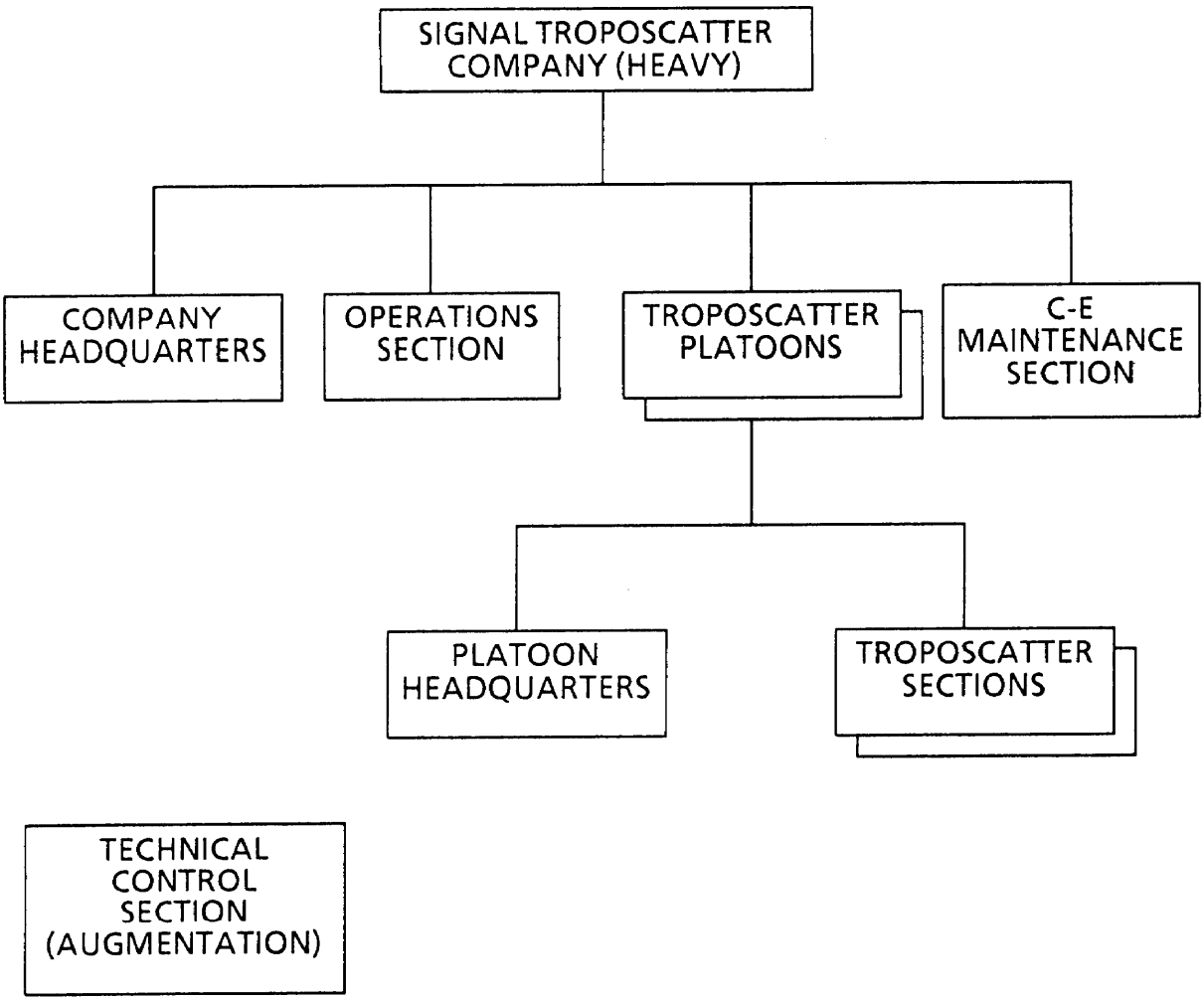

Figure 6–1. Organization of the Signal Troposcatter Company (Heavy).

geant, first cook, and food service specialists provide a 24-hour dining facility. Isolated sections require food service support from other units. See FM 10-23 for details on unit feeding.

(3) *Supply Element.* The supply sergeant is assisted by the equipment records and parts specialist and the armorer. Supply operations must provide the repair parts for operation of Company C-E equipment and vehicles. See DA Pamphlet 710-2-1 and FM 10-14 for details of unit supply.

(a) The supply sergeant acquires and distributes supplies, maintains supply records, and supervises the armorer and the equipment records and parts specialist.

(b) The armorer is responsible for unit-level maintenance of weapons organic to the Company. He or she maintains a PLL of organizational repair parts.

(c) The equipment records and parts specialist maintains the PLL for organizational demand-supported signal repair parts.

(4) *NBC Element.* The chemical NCO is responsible for the accomplishment of the Company commander's NBC program. As a minimum, the chemical NCO–

(a) Is the principal NBC adviser to the commander.

(b) Ensures authorized NBC equipment is on hand and maintained.

(c) Develops individual and collective NBC training.

(d) Determines unit NBC team requirements.

(e) Ensures team members are appointed on unit orders, equipped, and trained.

(f) Ensures NBC training is conducted during physical training and during daily routines.

(5) *Motor Maintenance Element.* The maintenance supervisor is assisted by a PLL clerk, light wheel vehicle mechanics, power generator equipment repairers, and a petroleum large vehicle operator.

(a) The maintenance supervisor is the principal maintenance adviser to the commander, plans for and supervises maintenance of unit vehicles and power generators, and supervises maintenance personnel.

(b) The PLL clerk is responsible for the main-

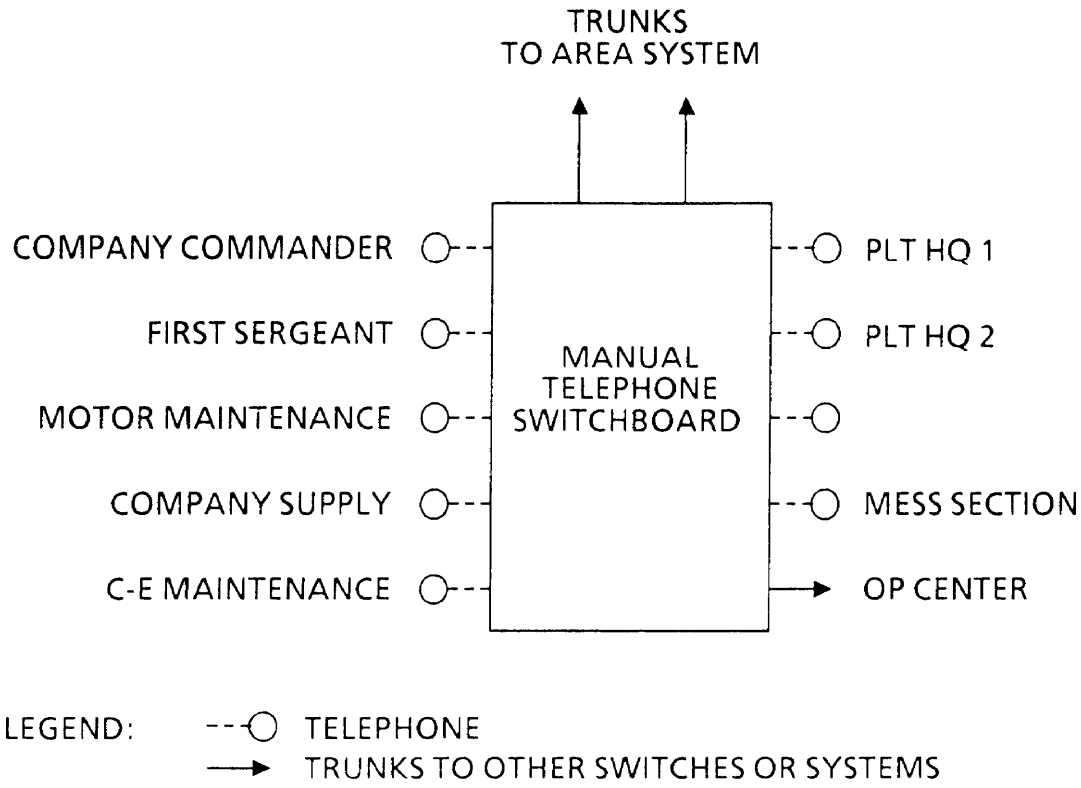

Figure 6–2. Signal Troposcatter Company (Heavy) Type Telephone Net.

tenance of repair parts records and stockage of organizational demand-supported repair parts.

(c) The light wheel vehicle mechanics perform unit-level maintenance on organic vehicles.

(d) The power generator equipment repairers are responsible for the intermediate (DS) maintenance on power generating equipment.

(e) The recovery vehicle operator retrieves disabled vehicles.

(f) The utilities equipment repairer is responsible for the light set organic to the Company.

(g) The petroleum large vehicle operator is responsible for POL resupply to the widely dispersed tropo sites.

b. Resources available. The Company commander has the following resources for command and control:

(1) Existing common-user telephone network.

(2) Local message centers.

(3) Internal telephone network (switchboard and telephones).

(4) HF/SSB radio.

(5) Troposcatter voice orderwire.

(6) Messenger service.

c. Internal communications. Communications among the Company commander, the Operations Section, and the displaced radio terminals is essential. The type communications required depends on the type message or report. The following means of communications will normally be available:

(1) Access to the common-user network.

(2) A manual telephone system. See figure 6-2.

(3) An HF/SSB radio Company Command and Technical Control Net. The Company Operations Section uses the net to supervise system installation, system quality, circuit rerouting, and displacement. The Platoon Command and Technical Control Nets are netted together for this function. Figure 6-3 shows the Company Command and Technical Control Net.

(4) Troposcatter orderwire channel for terminal-to-terminal technical control.

(5) Motor messenger service provided by organic personnel and equipment.

6-4. Employment

The modern battlefield demands extensive command and control communications. The Signal Tropo Company (Heavy) will be employed at EAC in the COMMZ to provide multichannel communications systems or links in a system when such use is more practical due to terrain, distance, or the tactical situation.

a. Functions.

(1) At full strength, the Signal Tropo Company (Heavy) can install, operate, and maintain eight terminals, or four multichannel systems. Terminals are mobile and air transportable. They can be installed or disassembled by four persons in 5 hours. They cannot

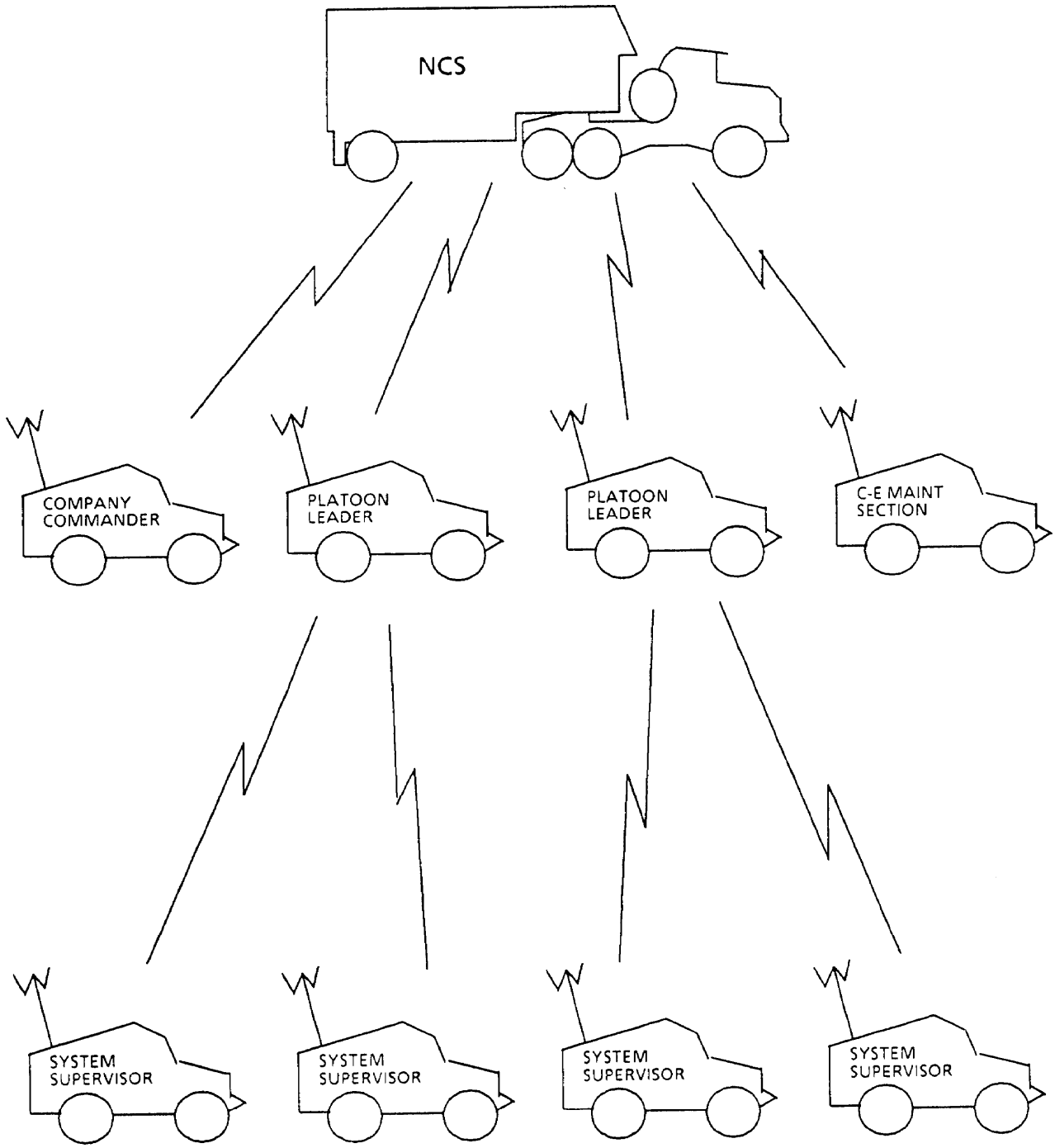

Figure 6–3. Signal Troposcatter Company (Heavy) Type HF/SSB Company Command and Technical Control Net.

operate in transit.

(2) Troposcatter radio provides reliable high-quality voice, teletypewriter, and data circuits over extended distances. Because of its method of radio wave propagation, troposcatter radio is not limited to LOS transmissions.

b. Employmmt in the Theater Communications Command (Army). One Signal Tropo compay (Heavy) is assigned to a TCC(A). It is employed to provide–

(1) Long-range, single-hop links between major COMMZ headquarters.

(2) Communications links between nodes over inaccessible areas or areas not under friendly control.

(3) Skip-node links to bypass nodes.

6-5. Operations

The Signal Tropo Company (Heavy) provides communications links over extended distances between COMMZ headquarters and between area signal nodes. Operations require detailed link engineering and site planning and preparation.

a. Capababilities. The Signal Tropo Company (Heavy) can provide the following:

(1) Installation, operation, and maintenance of four troposcatter radio communications links (two terminals per link). These links are capable of spanning distances of up to 150 miles (241 kilometers).

(2) Operation in the quad (space and frequency) diversity mode.

(3) Circuit patching and test facilities to provide a limited technical control capability when augmented.

b. Limitations.

(1) The Signal Tropo Company (Heavy) requires the following support:

(a) Health, religious, financial, and legal services.

(b) Personnel and administrative services.

(c) Bulk POL resupply.

(d) Supplemental transportation.

(e) Refrigeration repair.

(2) Troposcatter installation may require a site survey for topography, siting, soil condition, terrain, bearings, horizon angles, and distances between terminals. Engineer support often is required for access to and development of remote sites. Antenna rigging and equipment placement may also require heavy lift equipment. Because troposcatter sites will be high priority targets, a high degree of physical security is required. Security forces from combat arms or indigenous troops may be required.

(3) Cable and radio teams will be required to extend circuits to outlying units. The TAACOM support element is required for intermediate (GS) maintenance and logistical support or organic C-E and COMSEC equipment. TA aviation assets may be required to supply and maintain troposcatter terminals in isolated areas.

(4) Frequencies must be engineered and assigned by the TCC(A). Communications engineering, to include path analysis, antenna orientation, and equipment layout, is required.

c. Defense. Personnel of the Signal Tropo Company (Heavy) may be used to conduct a coordinated defense of their area or a limited defense of an installation. Remote installations may require security forces. Use of Company personnel in defense may result in reduced communications support. Chapter 12 has more information on rear battle operations and operations in an NBC environment.

d. Mobility

(1) The Company Headquarters has the following organic vehicles for transport of personnel and equipment:

(a) Truck utility: tactical ¾-ton W/E M1OO9.

(b) Truck cargo: tactical 5/4-ton 4x4 W/E M1OO8.

(c) Truck cargo: 2½-ton 6x6 W/E.

(d) Truck cargo: 5-ton 6x6 LWB W/E.

(e) Truck wrecker: 5-ton 6x6 w/winch W/E.

(2) The Company is air transportable. TA aviation assets may be required for emergency transport of support personnel and repair parts.

6-6. Deployment

a. The Signal Tropo Company (Heavy) may be deployed in a theater or to support contingency operations. Simultaneous displacement of all Company elements is not likely after initial deployment. Company elements may be deployed to establish links between a COMMZ headquarters and forward command posts separated by an impassable land or water barrier.

b. Normally, the Company Headquarters will be located near a cluster of its operating elements. However, maintenance, supply, and personnel support of dispersed terminals may be primary considerations that ultimately determine its location.

CHAPTER 7

OPERATIONS SECTION

7-1. Introduction

The Operations Section provides the personnel and equipment required to assist the Company commander in coordinating the employment, management, and operational and technical control of communications equipment installed and operated by the Company.

7-2. Structure

The Section is staffed and equipped to provide 24-hour operations. Operations are conducted in two 12-hour shifts.

a. Mission. The Operations Section provides command and control coordination between the dispersed troposcatter radio terminals and other elements of the TCS(A).

b. Assignment. The Operations Section is organic to the Signal Tropo Company (Heavy), TOE 11-368.

7-3. Command and control

The Operations Section provides the Company commander with control of the Signal Tropo Company (Heavy). The operations officer assists the commander by providing direct supervision over the Operations Section.

a. Operations Section personnel.

(1) The operations officer assists the Company commander in supervisory implementation of communications system control element (CSCE) directives, coordinates the employment of Company elements, and oversees the routine matters related to Company operations.

(2) The C-E operations chief is the senior NCO and accomplishes the following:

(a) Assists the operations officer in Section operations.

(b) Supervises the duty performance of the enlisted members of the Section.

(3) The illustrator prepares system diagrams and graphic circuit traffic diagrams for systems engineering.

(4) A tactical microwave system supervisor, a tactical circuit controller, and a combat telecommunications center operator constitute an operational shift. Two shifts are required for 24-hour operation. Each shift is responsible for routine functions of the Operations Central, technical assistance to resolve systems problems, and informing the officer in charge (OIC) and noncommissioned officer in charge (NCOIC) on status.

(5) The single channel radio operator operates the vehicular-mounted HF/SSB radio in the Company Command and Technical Control Net.

b. Resources available. The operations officer has the following resources to establish and/or maintain operational control of the Company systems:

(1) Existing common-user telephone network.

(2) Local message centers.

(3) Internal telephone network (switchboard and telephones).

(4) HF/SSB radio.

(5) Troposcatter voice orderwire.

(6) Messenger service.

c. Internal communications. The following means of communications will normally be available:

(1) Access to the common-user telephone network.

(2) Internal manual telephone system. Refer to Figure 6-2.

(3) HF/SSB radio Company Command and Control Net. Refer to Figure 6-3.

(4) Troposcatter orderwire.

7-4. Employment

a. The Operations Section provides technical expertise to ensure quality communications on systems and channels which pass through its area. The Section is employed as a single unit.

b. At full strength, the Operations Section is capable of providing–

(1) Technical assistance and control communications.

(2) Circuit and systems information and records.

(3) Display boards and overlay screens.

(4) Internal/external coordination.

(5) Movement coordination.

7-5. Operations

The Operations Section prepares and maintains plans and SOPs affecting Company operations, equipment status information, and status of systems and circuits within the Company's area of responsibility. The Operations Section also implements directives and technical instructions received from the CSCE.

a. Capabilities. The Operations Section provides–

(1) Command and control.

(2) Circuit and systems control.

(3) Equipment status information.

(4) Planning and SOP guidelines.

(5) Technical assistance.

(6) Net control for HF/SSB Command and Technical Control Net(s).

b. Limitations.

(1) The Section depends on Company Headquarters for administrative, logistical, food service, billeting, and personal service.

(2) Company Headquarters provides unit level maintenance on vehicles, environmental control equipment, and power generators. The Company C-E Maintenance Section provides intermediate (DS) maintenance on organic C-E and COMSEC equipment.

c. Defense.

(1) Operations Section personnel may be used to assist in a limited, coordinated defense of the installation or area of assignment. This may include rear battle operations, operations in an internal defense, or operations under NBC conditions.

(2) Due to the critical nature of the Section's mission and the limited number of assigned personnel, personnel should be used only during extreme emergencies.

d. Mobility.

(1) The Operations Section has the following vehicles:

(a) Truck utility: ¾-ton W/E M1OO9.

(b) Truck cargo: 2½-ton 6x6.

(2) Additional transportion for personnel, equipment, or supplies must be provided.

7-6. Deployment

The Operations Section will normally be collocated with the largest concentration of troposcatter elements of the Signal Tropo Company (Heavy), and in the general vicinity of the Company Headquarters element.

CHAPTER 8

TROPOSCATTER PLATOONS (HEAVY)

8-1. Introduction

a. The Signal Tropo Platoons (Heavy) are organized and equipped to support a wartime TA by providing communications links up to 150 miles (241 kilometers) between major commands and major functional headquarters, and area signal nodes in the TCS(A) inaccessible due to distance, vulnerability, and reliability.

b. It is essential that the Signal Tropo Platoons (Heavy) provide responsive communications support in the TCS(A). Planning must keep pace with changing requirements.

8-2. Structure

The Signal Tropo Company (Heavy) has two identical Tropo Platoons. Each Tropo Platoon has two Tropo Sections which consist of two Terminal Teams each. Each has personnel and equipment required to transport, install, operate, and maintain the troposcatter terminals.

a. Mission. The Heavy Tropo Platoon is responsible for installation, operation, and maintenance of multichannel heavy troposcatter terminals.

b. Assignment.

(1) The Tropo Platoon is organic to the Signal Tropo Company (Heavy). Each Platoon remains under the command and control of the Company commander.

(2) Elements of the Platoons will be attached to another headquarters for rations and quarters when dispersed.

c. Organization.

(1) The Tropo Platoon provides continuous operations. Two Platoons provide a total of eight Terminal Teams. Operations normally are in two 12-hour shifts.

(2) Each Platoon is organized into two Tropo Sections with two Terminal Teams each. See Figure 8-1.

8-3. Command and control

The Tropo Platoons are under the command and control of the Signal Tropo Company (Heavy) Company commander. The Platoon leader, Platoon sergeant, and tactical microwave system supervisors in each Section supervise assigned personnel.

a. Troposcatter Platoon personnel.

(1) Each Platoon Headquarters consists of a Platoon leader, a Platoon sergeant, and a vehicle driver. The Platoon leader and the Platoon sergeant supervise the installation of equipment and operational functions of the Tropo Sections and Terminal Teams.

(2) The Tropo Sections are supervised by tactical microwave system supervisors. Each Section supervisor has the responsibility for two troposcatter Terminal Teams.

(3) Each Terminal Team consists of a tactical microwave team chief and tactical microwave system operators. The team chief is responsible for the installation and operation of the assigned terminal equipment.

b. Resources available. Platoon leaders, Platoon sergeants, tactical microwave system supervisors, and tactical microwave team chiefs have the following resources to establish and/or maintain operational and technical control of Platoon systems:

(1) Existing common-user telephone system.
(2) Local message centers.
(3) Internal telephone network.
(4) HF/SSB radio.
(5) Troposcatter orderwire.

8-4. Employment

a. Assets of the Tropo Platoons will be required to meet the various requirements of the TCC(A). Distances exceeding a 150-mile (241-kilometer) planning range should be covered via multichannel TACSATCOM assets.

b. System planning factors must be considered to determine if a tropo system should be employed in the tropo or LOS mode. Information Sheet 1102, Microwave and Tropospheric Radio Systems Engineering, prepared by the Signal School at Fort Gordon, GA, provides formulas, checklists, tables, and graphs for determining link parameters or feasibility. These factors include, but are not limited to, radio link distance, acceptable BER, number of circuits required, terrain to be traversed, and proximity of enemy means of intercept or jamming. The tropo systems may be used in any of the following ways:

(1) LOC interconnect mode.
(2) Extension of the DCS.
(3) Skip-node operation.
(4) Contingency extension or restoral of U.S./allied communications systems.
(5) Connection between combined allied or host nation major headquarters.

c. Two Terminal Teams must work together to operate a multichannel link. The terminals may be separated by as much as 150 miles (241 kilometers).

8-5. Operations

The Heavy Tropo Platoons install, operate, and maintain troposcatter radio communications links between widely separated headquarters. Heavy troposcatter

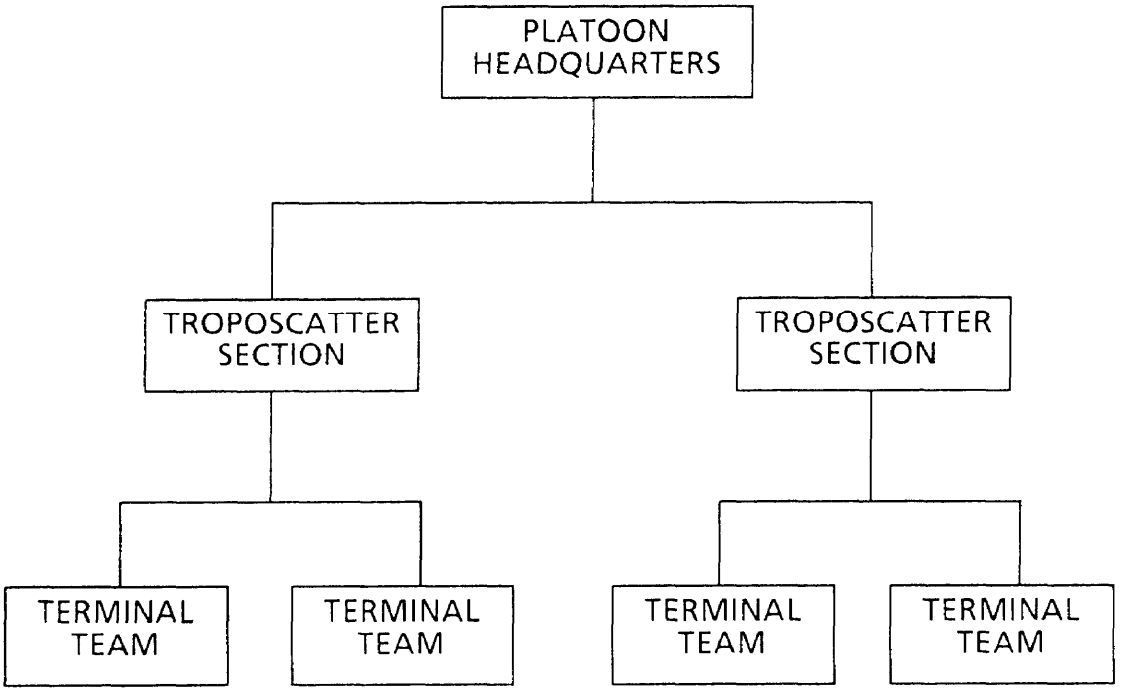

Figure 8–1. Organization of a Heavy Troposcatter Platoon.

terminals should be sited on high ground. Site elevation is important, although not as critical as it is for VHF' systems. Loss is dependent on the antenna take-off angle at each end of the path plus distance and data rate. Antenna beam clearance of nearby obstructions is also important. HF/SSB is initially used to provide communications for terminal lineup.

a. Capabilities. The Heavy Tropo Platoons can–

(1) Install, operate, and maintain four troposcatter radio links (two terminals per link).

(2) Provide links of up to 150 miles (241 kilometers). Each link can provide up to four digital groups.

(3) Support analog subscriber channels in lieu of digital subscriber loops by replacing a digital loop card with an analog applique card. Each card supports two traffic channels.

(4) Operate continuously.

(5) Provide orderwire circuits for coordination between terminals.

(6) Provide quad diversity capability (2x2 kilowatt (kW) output).

b. Limitations.

(1) The Tropo Platoons are dependent on Company Headquarters for administrative, logistical, food service, billeting, and other personal services support. The Tropo Platoons located away from the Company require these services from the supported headquarters.

(2) The C-E Maintenance Section of the Company provides intermediate (DS) maintenance on organic C-E and COMSEC equipment.

c. Defense.

(1) Tropo Platoon personnel may be used to assist in a limited, coordinated defense of the installation or area of assignment. This may include rear battle operations, operations in an internal defense, or operations in an NBC environment.

(2) Due to the minimum level of manning in the Tropo Platoons and the critical nature of their mission, use of these personnel as a defensive force should be limited to extreme emergencies.

(3) When personnel assist in a defensive role, communications support services will be degraded.

d. Mobility.

(1) Each Tropo Platoon Headquarters has one truck utility: tactical ¾-ton W/E M1009.

(2) Each Tropo Section has one truck utility: tactical ¾-ton W/E M1009.

(3) Each of the eight Terminal Teams has the following organic vehicles:

(a) Truck cargo: 2½-ton 6x6 W/E.

(b) Truck cargo: drop-side 5-ton 6x6 W/E.

(4) Additional transport of personnel and evacuation of equipment will require support from the local transportation or aviation unit.

8-6. Deployment

The Tropo Platoons may be deployed throughout the EAC. Proper planning for and utilization of tropo equipment will enhance, extend, or replace existing systems, or restore degraded or destroyed systems. Such planning requires properly engineered parameters and consideration of troposcatter radio limitations.

CHAPTER 9

COMMUNICATIONS-ELECTRONICS MAINTENANCE SECTION (HEAVY)

9-1. Introduction

The C-E Maintenance Section provides intermediate (DS) maintenance on C-E and COMSEC equipment organic to the Signal Tropo Company (Heavy) and its operational elements.

9-2. Structure

The C-E Maintenance Section is staffed with a C-E technician (warrant officer), a C-E maintenance chief, a tactical microwave system repairer, a tactical communications system operator/mechanic, a crypto systems repairer, and a material control and accounting specialist.

a. Mission. The C-E Maintenance Section provides responsive intermediate (DS) maintenance on organic C-E and COMSEC equipment for the Company.

b. Assignment. The C-E Maintenance Section is organic to the Signal Tropo Company (Heavy), TOE 11-368.

c. Organization. The Section is staffed to provide continuous maintenance support on unit troposcatter radio and COMSEC equipment. Maintenance support teams provide maintenance support to dispersed sections of the Tropo Platoons.

9-3. Command and control

The C-E Maintenance Section is under the direct command and control of the Signal Tropo Company (Heavy) Company commander. The C-E technician supervises Section personnel.

a. C-E Maintenance Section personnel.

(1) The C-E technician ensures intermediate (DS) maintenance is performed on unit equipment.

(2) The C-E maintenance chief–

(a) Supervises enlisted personnel.

(b) Schedules maintenance.

(c) Coordinates onsite maintenance.

(d) Dispatches maintenance support teams.

(3) The tactical microwave system repairer and the tactical communications system operator/mechanic perform intermediate (DS) maintenance on organic C-E equipment. The operator/mechanic also operates the HF/SSB radio in the Company Command and Control Net.

(4) The crypto systems repairer performs intermediate (DS) maintenance on organic COMSEC equipment.

(5) The C-E material control and accounting specialist maintains maintenance schedules, requisition status reports, PLL, and accountability records.

b. Resources available. The C-E Maintenance Section has the following resources available for controlling and coordinating activities:

(1) Common-user telephone network.

(2) Local message centers.

(3) Internal telephone network.

(4) Troposcatter orderwire.

(5) Engineering orderwire (HF/SSB radio).

9-4. Employment

The Section will normally be employed as a single unit with the Company Headquarters. Maintenance support teams may be organized to provide assistance for the dispersed elements.

a. Capabilities. The C-E Maintenance Section provides–

(1) Intermediate (DS) maintenance on organic C-E and COMSEC equipment.

(2) Onsite maintenance to dispersed terminal locations.

b. Limitations.

(1) The Section depends on the Company Headquarters for administrative, logistical, food service, billeting, and other personal services support.

(2) Personnel assigned to the company Headquarters provide unit-level maintenance on organic vehicles.

(3) Intermediate (GS) level C-E maintenance will be provided by the GS units of the TAACOM.

(4) Intermediate (GS) level COMSEC maintenance will be provided by the GS units of the TCC(A).

c. Defense.

(1) The defensive capabilities of the Section are limited. Personnel may be used to assist in a limited, coordinated defense of the installation or unit area of assignment. This may include rear battle operations, operations in an internal defense, or operations under NBC conditions.

(2) If personnel are used to augment defensive forces, the maintenance capabilities will be degraded.

d. Mobility.

(1) The C-E Maintenance Section has the following vehicles:

(a) Truck cargo: tactical 5/4-ton 4x4 w/communications kit.

(b) Truck cargo: tactical 5/4-ton 4x4 W/E M1008.

(c) Truck cargo: 2½-ton 6x6 W/E.

(d) Electronic shop shelter mounted.

(2) Additional transport for personnel and supplies must be provided by other elements of the Company.

9-5. Deployment

a. The C-E Maintenance Section will normally be deployed with the Company Headquarters.

b. The Section may be collocated with a Tropo Platoon if the major concentration of terminals is in one general area.

CHAPTER 10

PLANNING

10-1. Introduction

a. C-E planning is a continuous process. It involves analyzing, allocating, and integrating C-E resources to support requirements. All commanders rely on communications to–

(1) Control elements of their command.
(2) Gather information.
(3) Distribute intelligence.
(4) Coordinate operations.

When you are out of communications, you are out of command!

b. Troposcatter communications planning is guided by the supported commander's priorities. It must be geared to accomplish the mission. The planning demands that all Company planners understand troposcatter radio capabilities and limitations. Further, the Company commanders must see that no details are overlooked.

c. This chapter provides an overview of C-E planning with emphasis on Company planning for troposcatter operations. It briefly discusses the standardized planning procedures and techniques that help to ensure all relevant factors are considered. Reference is made to other publications that provide more detail.

10-2. Troposcatter operations planning

a. Planning for Tropo Company employment is accomplished at TCC(A) and Theater Signal Brigade level. Plans and orders generally will originate at the Signal Brigade's communications system planning element (CSPE). When the Tropo Company is assigned to a composite battalion, the plans will be further developed by the battalion staff. The Tropo Company must advise higher commanders and staff of unit readiness and be involved in higher headquarters planning.

b. Technical operation of the tropo Sections is directed by the organic Technical Control Section (Light) or Operations Section (Heavy). The composite battalion CSCE assists in circuit direction on as near a real-time basis as possible. The CSCE also coordinates with the communications nodal control elements (CNCE) in the area system. FM 24-22 provides a detailed discussion of management and control planning under the C-E Management System (CEMS).

c. There are numerous functions that must be planned within the Tropo Company. Systems plans, diagrams, and circuit orders are prepared in the Company Operation Center primarily by the Company commander and area communications chief or C-E operations chief. Logistics support, unit movements, site preparation and defense, and so forth, are planned by the Company commander and all subordinate leaders. When doing so, they should follow the same sequence of commander and staff planning actions used by higher commanders and their staffs. This sequence, shown in figure 10-1, describes a logical and systematic way to solve problems. The extent to which each step (exclusive of the decision) is performed by the Company commander varies. It can be influenced by the situation and time available. Frequently, many of these steps are carried out concurrently. The initial step involves mission analysis-determining precisely what has to be done before determining how best to accomplish it. This decisionmaking process is described in detail in FM 101-5.

10-3. Plan development and orders

Tropo Company operations require extensive coordination and rapid adjustment to changing situations. Company facilities usually connect with multichannel radio and wire and cable facilities, as well as with each other, light and heavy troposcatter. The use of standardized planning/decisionmaking techniques will provide the detail necessary to achieve these ends. This paragraph provides a brief description of some techniques for Company planners. Reference is made to other publications for details. The best planning results from careful application of common sense to these fundamental planning techniques. C-E planning must be included in Company leader training.

a. Communications-electronics estimate of the situation. C-E planning starts with an estimate of the situation. This is a five-step process. Table 10-1 shows the basic process. At Company level, a mental estimate or informal written estimate is probably enough. The C-E estimate begins when a mission is assigned or deduced. The estimate is continuously updated. FM 24-16 contains a detailed discussion on the preparation of a C-E estimate.

b. Communications-electronics plan.

(1) The C-E plan amplifies the decision in paragraph 5 of the estimate. The C-E planning format is the same format used to develop an operation order (OPORD) and its C-E annex. Refer to table 10-2.

(2) Tropo Company planning involves anticipation of future resource needs. Many resource needs (for example, air transport, bulk fuels, and rations) must be obtained from other units or services. Planning matches what is required with what is available.

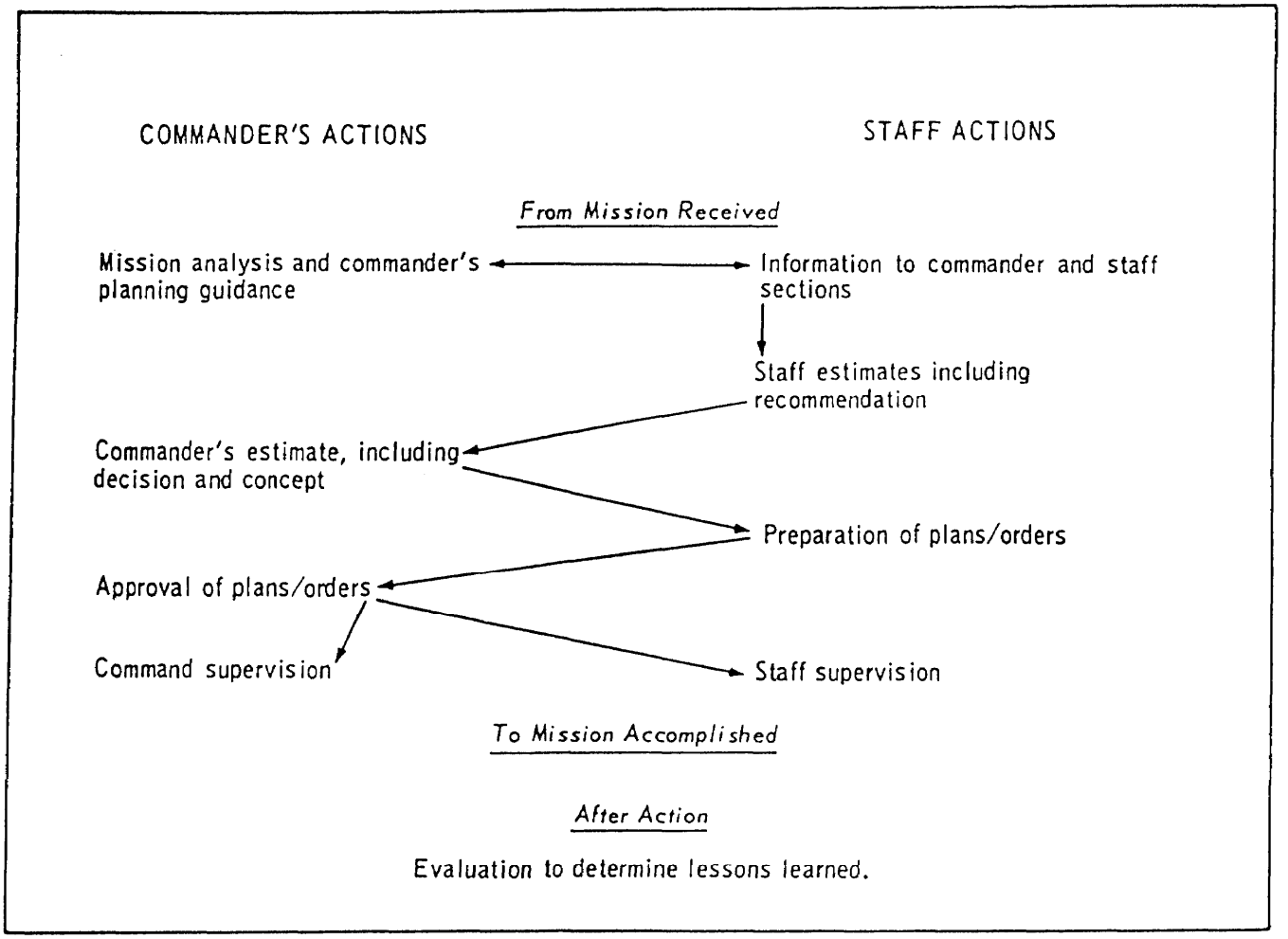

Figure 10-1. Commander and Staff Planning Actions.

If requirements cannot be met, either requirements must be reduced or more resources must reobtained. For detailed discussion on considerations for developing C-E plans, see FM11-23, FM 24-l, and FM 24-16.

(3) Weather, terrain, and the enemy are routine considerations in the estimate process. Unusual terrain and extreme climatic conditions have a significant effect upon troposcatter systems. Detailed information about operations in special climatic environments is found in the FM 90-series and FM 24-21. NBC warfare also presents unique circumstances. The NBC environment is introduced in Chapter 12 and discussed in detail in FM 3-100.

c. Classes of signal unit orders. Orders fall into two general classes: routine and combat.

(1) *Routine orders.* Routine orders cover administrative matters. The distance between elements of the Tropo Company makes control difficult. For this reason, the Company commander must make maximum use of SOPs and instructions. These documents have the authority of combat orders.

(a) Standing operating procedures. SOPs contain instructions which lend themselves to a definite or standardized procedure. In particular, the operation of C-E equipment, facilities, and systems requires SOPs. Other SOPs are prepared as required. Uniform practices established by SOPs promote understanding and teamwork and minimize confusion and error. FM 24-16 suggests subjects for signal unit SOPs.

(b) C-E operating instructions. CEOI provide the guidance communications users need to operate most command and control communications. The primary feature of the CEOI is the capability to change call signs, suffixes, and frequencies at least every 24 hours. The command CEOI is the only authorized document from which to extract call signs and frequencies. FM 24-16 should be consulted for a detailed description of the CEOI and how to use it.

(c) Allied and joint publications. A series of international agreements and procedures govern the operation of C-E systems in support of combined operations. Under certain circumstances, there may be memorandums of agreement or memorandums of understanding with a host nation. Other agreements and procedures are Allied Communications Publications

TABLE 10-1
FORMAT FOR THE ESTIMATE OF THE SITUATION

ESTIMATE OF THE SITUATION (See FM 24-16, app B, for an example of a C-E estimate.)

1. MISSION
   Know the problem.
2. THE SITUATION AND COURSES OF ACTION
   Assemble all the facts that bear on the problem.
   Consider difficulties that could adversely affect mission accomplishment.
   Determine possible solutions.
3. ANALYSIS OF OPPOSING COURSES OF ACTION
   Analyze each possible solution to determine advantages and disadvantages
4. COMPARISON OF OWN COURSES OF ACTION
   Compare possible solutions.
   Select solution that best solves the problem.
5. DECISION (OR RECOMMENDATION)
   Transcribe the selected solution into a decision (if it is the commander's estimate) or recommendation (if it is the staff's estimate).

(ACPs) and International Standardization Agreements (STANAGs). Joint Army, Navy, Air Force Publications (JANAPs) are a series of service agreements governing communications procedures in joint operations. The instructions in JANAPs agree with those in allied publications, and all take precedence over conflicting provisions of Army publications (AR 310-2). Appendix A lists pertinent ACPs, STANAGs, and JANAPs.

(2) *Combat orders.* Combat type orders pertain to operations in the field. They are used to direct, control, and/or govern the use of C-E assets. Detailed discussions of signal unit orders, procedures, and instructions are found in FM 24-16. Combat-type orders express the commander's concept of the operation. They convey instructions to subordinate commanders and must be clear, complete, and concise. Tropo Company officers and NCOs should make a practice of issuing instructions in the appropriate order format. There are three common types of combat orders.

(a) Warning order. A warning order gives advance notice of an operation or an order that is to follow. It contains as much information as is available at the time and is usually issued orally.

(b) Operation order. OPORDs detail coordinated actions necessary to carry out the commander's concept. They follow the standard five-paragraph format shown in Table 10-2. Company OPORDs can usually be issued orally.

(c) Fragmentary order (FRAGO). FRAGOs are essential for contingency and other quick-reaction changes to plans, such as command post (CP) and troposcatter site relocation, enemy jamming, or intrusions. They often can be issued orally and follow the OPORD format.

TABLE 10-2
FORMAT FOR A SIGNAL UNIT OPERATION ORDER

OPERATION ORDER (See FM 24-16, app C, for an example of a signal unit OPORD; also see app D for an example of a C-E annex.)

1. SITUATION
   a. Enemy forces (location, strengths, capabilities, activity).
   b. Friendly forces (task organization, locations, signal support).
   c. Attachments and detachments (units attached or detached and effective time).
2. MISSION (clear, concise statement of battalion or company mission).
3. EXECUTION
   a. Concept of operation (types and phasing of communications support).
   b. Tasks for subordinate units (specific tasks for subordinate signal units).
   c. Coordinating instructions (information common to two or more units concerning signal centers, C-E systems, messenger, wire, radio, and so forth).
4. SERVICE SUPPORT (information pertaining to rations, medical support, transportation, and other combat support matters).
5. COMMAND AND SIGNAL
   a. Command (location of command post).
   b. Signal (CEOI number in effect, reference to applicable C-E annex or SOP).

10-4. Records and reports

Accurate C-E records and reports are a necessity. They provide commander and staff with impartial and factual data about a unit's operations. Troposcatter operations records and reports are established by the Company Operations Center and Battalion CSCE. FM 24-16 discusses records and reports that pertain to signal operations, supply and maintenance, and unit readiness. Examples of many records and reports are also shown in FM 24-16, Appendix G.

10-5. Site planning

a. Troposcatter radio systems design and general location of sites are in the OPORD. The exact location must be selected and the system configured on the ground. Site planning is usually carried out at the platoon level. In many cases, the troposcatter section or team chief must do the site plan. The plan must consider communications requirements, logistics support, protection of resources, and the electronic threat. Light and heavy troposcatter terminals may also be collocated.

b. Planning considerations for troposcatter transmission paths differ from LOS paths due to the mode

of propagation. Troposcatter terminals should be sited on high ground whenever possible. A relatively flat hilltop location with good drainage is usually the most desirable site. Troposcatter site elevation is important because troposcatter path loss is highly dependent on the angle the antennas at each end of the path make with the horizon. Alternative site diagrams should be prepared for various antenna, generator, and shelter configurations. Coordination with engineers may be necessary for site preparation. See FM 24-21 for information on troposcatter siting, system operating techniques, and path engineering. Also see the microwave and troposcatter systems engineering data (information Sheet 1102) prepared by the Signal Center at Fort Gordon, GA.

10-6. Movement planning

Under AirLand Battle doctrine, a signal unit cannot expect to stay in one place very long, even at EAC. Supported units and CPs will be displacing. Troposcatter terminal sections will be constantly planning, installing, and moving facilities. Sometimes this must be done without Company level support. Sections must be able to set up, tear down, and reestablish communications faster than ever before. The Tropo Company commander should be aware of these mobility objectives and emphasize movement training. Constant coordination with supported headquarters planners is required for timely displacement.

a. Road marches.

(1) A primary concern is rapid movement of troposcatter elements in support of tactical operations. Road march planning must often be accomplished hastily. It consists of concurrently determining requirements, analyzing capabilities, and establishing priorities. Success or failure of a major mission may depend on the ability to move rapidly and reestablish necessary communications. The preparation of unit movement SOPs and movement training will help in achieving proficiency in road marching. Proper driver and preventive maintenance training also contributes to the quick and safe movement of the unit.

(2) The following routine items should be included in Company movement SOP:

(a) Loading plans.
(b) Composition of march units.
(c) Control measures.
(d) Rates of march.
(e) Time intervals and distances.
(f) Timing and duration of halts.
(g) Tasks during halts.
(h) Organization of reconnoiter parties.
(i) Security measures.
(j) Reporting instructions.
(k) Location of CP.
(l) Communications.

(3) Training must be conducted to test and check load plans, improve SOPs, and maintain operational efficiency. Integrate occupation of assembly areas and road marches into other types of training whenever possible. See FM 55-30 for details on motor transport operations.

b. Command post displacement. Signal personnel must be particularly proficient during CP displacement. Two methods of displacement are generally used: phased and total. In each case, site planning must be accomplished. FM 24-1 contains information concerning CP displacement during combat.

(1) *Phased Displacement.* In this method, minimum essential communications are installed at the new site. This provides communications for the first CP elements that displace. Continuity of operations is maintained as elements phase out of the old location and build up in the new area.

(2) *Total displacement.* In this method, operations close out at the main CP at a designated time, and all elements move at once. An alternate CP is established for command and control until the main CP has displaced and has sufficient communications.

c. Air, water, and rail movement.

(1) Tropo Company deployment to a theater may involve one or all three of these types of movement. Support of rapid deployment forces will require air movement. Higher headquarters coordinates with appropriate units (Air Force, TAACOM, and so forth) and plans for the specific types of movement. The Company must have basic plans and SOPs for movement by air, sea, or rail. Designated unit personnel should be trained in air-loading procedures. Rail movement is often a Company responsibility. Coordination with movement experts is mandatory. This ensures that all unique aspects of the C-E equipment/unit are addressed.

(2) Specific plans for known operations must be developed in advance. This avoids confusion at the air, sea, or rail embarkation point. Units moving into such ports must be prepared to sustain themselves. Delays can occur and rations and supplies may not be available. Safety, SOPs, and unit training are essential, See AR 55-355, Chapter 214, for additional information on movement planning.

CHAPTER 11

ELECTRONIC WARFARE

11-1. Introduction

a. Communications have always been the heart of command and control. On today's highly sophisticated battlefield, the Army places even greater dependence on communications and other battlefield electronic systems. Our potential enemies (Threat forces) know this. A large part of Threat resources will be dedicated against our command and control systems. EW will be used by both sides to an extent not known in the past. How vulnerable we are to Threat EW depends very much on the communicator.

b. Tropo Company personnel must be trained to recognize the Threat's EW activities and know what to do about them. This chapter introduces EW and highlights actions taken at the C-E operating level to minimize its effect. Specific tactics that will help plan the defensive against EW are found in FM 32-30 and equipment TMs.

11-2. Components of electronic warfare

a. Three components of EW are described in FM 32-30. They include all types of battlefield electronic systems: communications, surveillance, target acquisition, and others. This manual deals with EW only as it involves communications systems that support TA command and control.

b. Table 11-1 summarizes the three components of EW as they pertain to communications devices. The first two EW components, electronic warfare support measures (ESM) and electronic countermeasures (ECM), are technical. We rely on military intelligence (MI) units and U.S. Army Intelligence and Security Command (USAINSCOM) for advice and implementation of ESM and ECM. The Threat force's equivalent of our ESM and ECM is described as radioelectronic combat (REC). To counter Threat use of REC, we rely on communicators to use electronic counter-countermeasures (ECCM).

11-3. Electronic threat

The Threat forces use REC measures to collect intelligence data against our C-E systems. This is what intercept provides. The Threat then decides what REC would be appropriate from the data gained through intercept. High on the Threat REC target list will be theater level troposcatter communications. The Threat will use selected reconnaissance and REC assets to detect and locate terminals, links, and relays. The Threat will attempt to disrupt those communications which are considered priority targets. Figure 11-1 depicts the Threat's REC cycle. The goal of REC is to disrupt friendly use of the electromagnetic spectrum through destruction, deception, or jamming. The Threat will coordinate all three in an attempt to deprive us of command and control. All Tropo Company personnel must understand the severity of this electronic threat. More specific information on Threat force's electronic intercept and direction-finding capabilities can be found in FM 100-2-1. About 25 seconds after friendly communications begin, the Threat targeting sequence can continue even if friendly communications cease. Accordingly, the danger point is when radio transmissions exceed 20-25 seconds.

a. Interception of signa1s intelligence. It is difficult for Threat forces to fix on a troposcatter terminal. However, the radios used for Tropo Company command and control are highly vulnerable to REC. Through an alert Threat signals intelligence effort, we

TABLE 11-1
COMPONENTS OF ELECTRONIC WARFARE

Component	Objective	Actions
Electronic warfare support measures	Disclose information about enemy communications	Search, intercept, identify, locate
Electronic countermeasures	Deny or reduce use of enemy communications	Jam, deceive
Electronic counter-countermeasures	Ensure continued effective use of friendly communications (protect against enemy detection, location, and identification)	Antijam, circuit discipline, use approved operating techniques, security, harden, move, improve equipment, report, plan, train

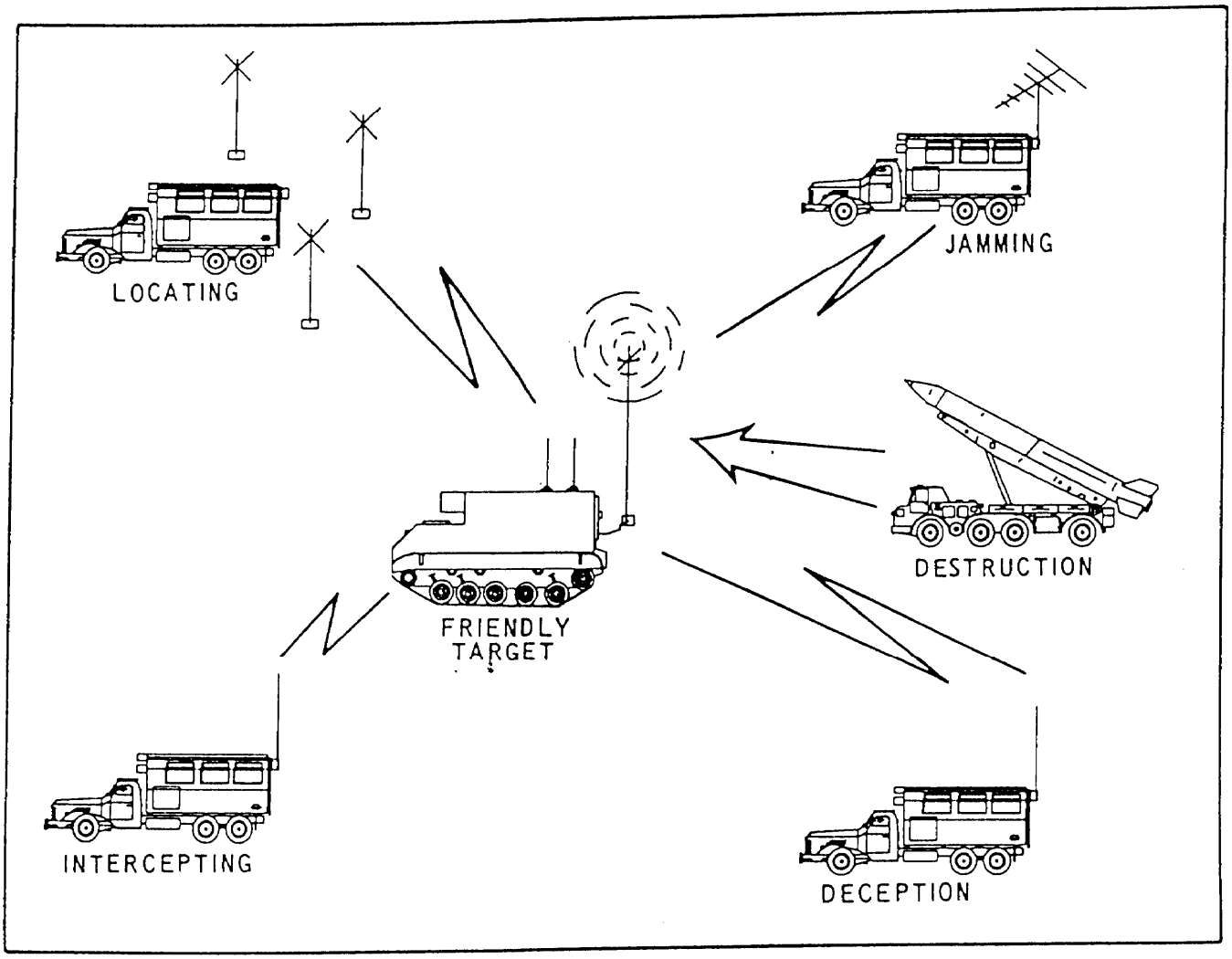

Figure 11–1. Threat radioelectronic combat (REC) cycle.

risk disclosing our troposcatter operations. The Threat monitors intercepted signals and performs traffic analysis to provide a variety of information which can be exploited, such as–

(1) Supported CP identification.

(2) Location of troposcatter terminals.

(3) Tracking of unit movements.

(4) Relative importance of troposcatter to command and control.

(5) Weaknesses in our command and control systems (poor operating procedures, poor COMSEC, lack of redundant or alternate systems, and overloaded networks).

b. Location of emitters. A primary REC threat is the Threat force's ability to locate key communications through radio direction finding (RDF). The Threat's goal is to limit, delay, or nullify our command, control, and intelligence systems during the critical combat periods. RDF is especially effective against CPs which rely heavily on radios with omnidirectional antennas. Through the RDF technique, the troposcatter terminals themselves may be placed in jeopardy. After loeating a friendly communications emitter, the Threat determines if it is a primary target. Once an emitter becomes a primary target, disruption may take the form of destruction, jamming, or deception.

(1) *Jamming.* Threat jammers attempt to disrupt our conduct of the battle by interjecting delay and confusion into the command and control communications system. These jammers operate against receivers–not transmitters. They attempt to transmit with enough power to override friendly signals before they can be received. This jamming may be subtle and difficult to detect, or it may be overt. It can be accomplished from both ground and aerial platforms. However jamming is accomplished, it is often most effective when operators become impatient and relax signal security (SIGSEC) and operations security (OPSEC) procedures, thus providing additional opportunities for deception or destruction operations. Radio operators must be familiar with this form of REC. The more common jamming signals are described in FM 32-30.

(2) *Deception.* REC attempts to deceive friendly emitters through intercepting, locating, and inserting false or misleading information. Threat REC may imitate friendly forces to gain access to our communications nets or provide incorrect or misleading information over Threat communications links. They may also establish "dummy" nets to feed false information to our forces or to simulate nonexistent forces.

11-4. Defensive electronic warfare

Communications can still operate within the REC environment just described. To do this, it is necessary to maximize the efficiency of available equipment and use sound, common-sense countermeasures. Communications discipline, security, and resourcefulness underlie countermeasures to shield emissions. COMSEC techniques give the commander confidence in the security of communications materiel and communications. ECCM techniques provide some degree of confidence in the continued use of communications in a hostile EW environment. The two are closely related–many COMSEC techniques also serve an ECCM role. Thus, the more effective the Tropo Company is in COMSEC, the more effective it is in ECCM.

a. Communications security techniques.

(1) COMSEC is a component of SIGSEC. It protects communications through the use of security measures and techniques such as those shown in Table 11-2.

(a) Physical security safeguards COMSEC materiel and information from access or observation by unauthorized personnel through physical means.

(b) Crypto security protects radio communications through the use of technically sound cryptosystems.

(c) Transmission security is designed to protect transmissions from hostile intercept and exploitation.

(d) Emission security involves studies, investigations, and tests to control compromising and inadvertent emissions from equipment.

(2) Most TCS(A) circuits are protected by COMSEC equipment. However, orderwire and internal Company command and control nets may not be secure. Technical discussions between operators can contain information of vital importance to the Threat forces. The very nature of any communications mission gives them access to critical information on commanders, organizations, and locations of headquarters. This information, although gained casually "on the job," is sensitive and must be protected.

(3) COMSEC must be a function of everyone who uses C-E equipment. It begins with command emphasis. FM 34-62 covers overall SIGSEC and contains detailed information on COMSEC measures and techniques.

b. Electronic counter-countermeasures techniques.

(1) ECCM are taken to protect against Threat attempts to detect, deceive, or destroy friendly communications. The first line of defense against REC is a well-trained and alert operator because, as mentioned earlier, many COMSEC techniques are equally ECCM techniques. To combat Threat REC efforts, operators must use ECCM techniques identified in OPSEC surveys and unit SOPs, or as outlined in table 11-2.

(2) Unit SOPs must include actions to be taken against jamming and deception. Specific techniques are described in troposcatter technical manuals. Prearranged plans and frequent exercises are mandatory. Operators must follow SOPs to maintain or restore communications.

(3) Other ECCM actions that will lessen our vulnerability to a Threat REC effort are–

(a) Preparing backup systems–orderwire, messenger, and HF radio.

(b) Preparing to operate with the minimum amount of communications.

(c) Moving CPs frequently.

(d) Using state of the art equipment and ap-

TABLE 11–2
COMSEC MEASURES AND TECHNIQUES

Physical Security	Crypto Security	Transmission Security	Emission Security
Facility approvals	Machine crypto	Emission control	Site surveys
Facility inspections	Nonmachine crypto	Change of frequencies and call signs	Engineering
Materiel control systems	Electronic crypto	Authentication codes and brevity lists	Inspections Studies
Transportation security		Protective deception Site masking	Tests
Storage security		Power variation Directional antennas	

plying authorized modifications to equipment.

(e) Reporting all known or suspected REC activities.

(f) Planning and training to counter an REC threat.

(g) Dispersing communications equipment over a wide geographical area.

(4) FM 32-30 contains appendixes that cover ECCM checks, ECCM planning, and ECCM training. It also covers EW reporting using the meaconing, intrusion, jamming, and interference (MIJI) report. AR 105-3 requires that all incidents of an electromagnetic nature that affect C-E operations be reported. Unit SOPs and other instructions must include the MIJI program. See glossary for a definition of meaconing.

c. Emission control.

(1) Emission control (EMCON) is both a COMSEC and an ECCM technique, and probably the best method to counter the Threat REC effort. Radio transmissions should be kept to the minimum required to accomplish the mission(s). Transmissions should not exceed 20-25 minutes. The Threat gains less information from a short transmission and has limited capability of locating the transmitter by RDF.

(2) EMCON can also be total or selective. Sometimes, strict radio silence is necessary. The Company commander may also designate certain nets as "free nets" and others as "on order nets." Controls, such as frequent changes in call signs and frequencies and relocation of emitters will tend to confuse Threat forces. Personnel must be taught to "think EMCON."

11-5. Electromagnetic compatibility

a. In an EW environment, we know that Threat forces will intentionally try to interfere with our communications. Self-inflicted unintentional interference is also possible. It may be caused by our own transmitted signals, faulty electronic components, poorly insulated high power lines, noise-producing equipment, and so forth. This type of interference is treated under the term "electromagnetic compatibility" (EMC). EMC is that desirable condition when all of our electronic and electrical equipment, such as radios, radars, generators, and vehicle ignition systems, operate without interfering with each other.

b. Troposcatter site planners and operators must be aware of EMC and its advantages. We do not want to assist the Threat's REC efforts. When planning the layout of the Company CP or a terminal site, EMC must be considered. Operators experiencing interference must make every effort to determine if it is intentional or unintentional. The following are some typical common-sense procedures to promote EMC:

(1) Know the technical operating characteristics of the equipment.

(2) Properly ground, operate, and maintain the equipment.

(3) Site antennas away from noise sources.

(4) Move noise-producing equipment out of transmission paths.

(5) Provide for adequate receiver-transmitter frequency separation.

CHAPTER 12

REAR BATTLE

12-1. Introduction

a. To provide continuous effective communication at EAC, the Tropo Company must be able to survive in a hostile environment. A major aspect of Threat doctrine is to disrupt rear area operations. When CPs and communications sites are located, Threat forces will try to neutralize them. Detection must be avoided to survive. Also, it may be necessary to defend terminal sites. Successful self-defense requires planning, preparing, rehearsing, and vigorous execution.

b. The Tropo Company commander must prepare personnel for defense. Plans are based on coordination with supported units. This chapter will highlight the various type threats to the Company. It will then emphasize defensive considerations. Because the subject is too broad and technical to cover completely, reference will be made to appropriate manuals to consult for details. Also, soldier's manuals for the senior skill levels within the Tropo Company list many of the tasks to be performed for specific security and defense situations.

12-2. Rear battle threat

a. The rear area is the space within a command where the majority of the combat support and combat service support functions are performed. In a fully developed theater of operations, the whole COMMZ is classed as rear area. Threat forces have the capability to initiate and support combat operations deep in the COMMZ. Their objective is to destroy critical elements, cause disruption, and degrade capabilities. The Tropo Company is usually employed in the COMMZ but may also be employed in the rear of the combat zone.

b. The threat to rear battle operations may be of low, medium, or high intensity. These three levels of threat are summarized in table 12-1. Commanders develop alert systems and response actions according to the level of threat that must be countered. Elements of the Tropo Company may face any combination of Threat forces at the same time. Other disruptive occurrences include conventional and NBC shelling and bombing and natural disasters. A detailed description of the rear battle threat can be found in FM 100-2-1.

TABLE 12-1
REAR BATTLE THREAT LEVELS AND RESPONSES

Threat Level	Threat	Response Forces
Level I	Agents, saboteurs, terrorists	Base defense
Level II	Diversionary operations and sabotage by unconventional and reconnoiter forces, raids by tactical units, special or unconventional warfare missions	Military police (Base defense)
Level III	Airborne, heliborne, amphibious, and ground forces deliberate operations, infiltration operations	Tactical combat forces (Military police) (Base defense)

12-3. Unit security and defense

a. Rear battle objectives. Company security and defense is accomplished within guidelines established by U.S. Army rear battle doctrine. The rear battle is designed to make collective use of units in the rear to prevent or minimize interruption of operations. It includes measures taken to protect the resources of rear area commands against sabotage, Threat forces activity, and natural disasters. Rear battle objectives include the following:

(1) Securing the rear area and facilities.

(2) Preventing or minimizing Threat interference with command, control, and communications.

(3) Preventing or minimizing disruption of combat support and combat service support forward.

(4) Providing unimpeded movement of friendly units throughout the rear area.

(5) Finding, fixing, and destroying Threat intrusions in the rear area.

(6) Providing area damage control (ADC).

b. Rear battle command and control. The TA commander is responsible for rear battle planning and execution at EAC. Rear battle operations are conducted through decentralized command and control systems utilized by EAC rear area operations centers (RAOCs). RAOCs are usually established at TA, TAACOM, and TAACOM Area Support Group (ASG) levels. Each echelon commander will appoint a rear battle officer to conduct rear battle operations. Where HNS agreements have been reached, certain rear battle responsibilities may be assumed by the host nation. Within a TAACOM, Tropo Company elements would be assigned to particular bases for defense purposes. The base commander provides the command and control headquarters for base defense. The base defense operations center (BDOC) is staffed and equipped by

the host and tenant units. Sometimes, base clusters are formed for mutual defense and controlled through abase cluster operations center (BCOC). The Tropo Company plans for the defense of its sites as part of base defense. Troposcatter section chiefs submit plans to the BDOC for approval. Defense plans should also include ADC considerations. See FM 90-14 for complete details on rear battle commandant control.

c. Conduct of the rear battle. Responses to Threat attacks in the rear area must be rapid and strong enough to defeat them. They must minimize disruption of friendly operations. Table 12-1 also shows rear battle responses to the various threat levels. Obviously, base defense is the cornerstone to effective conduct of the rear battle.

(1) Unit defense planning. Detailed planning is done by the dispersed troposcatter sections and teams per unit SOPs. Frequently, Tropo Company assets will be deployed to remote locations. Site defense planning should be as complete as possible but flexible. One cannot plan for every situation. Defense or security requirements beyond organic capability should be identified. When unable to defeat attacking forces, site defense forces attempt to defend the site/base until other forces can respond. Defense procedures should be simple and easy to implement. Individual responsibilities should be clearly defined. One basic plan with alternative courses of action against various threats is probably best.

(2) *Defense against air and ground attack.* Troposcatter terminal sections have a distinctive field signature. They must rely heavily on sound OPSEC. This includes taking all counter reconnaissance/surveillance actions; for example, camouflage, watching thermal signature, controlling electronic emissions, and so forth. Facilities should be camouflaged, concealed, covered, and dispersed as much as possible. See FM 5-20. Warnings against air attack are broadcast over the air warning net, which should be constantly monitored. Army counterintelligence (CI) also can provide early warning and recommend OPSEC procedures to counter Threat intrusions into the rear area. See FM 34-60. Defense against ground attack should be based on a sound site defense plan. Some actions to be taken in most defensive situations are listed below:

(a) Assign sectors of defense.

(b) Locate a focal point for command and control.

(c) Ensure individuals are familiar with their responsibilities.

(d) Prepare positions (FM 5-15).

(e) Place weapons to cover avenues of approach.

(f) Use artificial obstacles and mines as required.

(g) Coordinate with adjacent units.

(h) Hold frequent rehearsals and inspections.

(i) Practice camouflage, light, and noise discipline.

(j) Design a warning system.

(k) Establish procedures for requesting artillery and air support.

(1) Designate assembly points for reserve forces and firefighting crews.

(m) Plan for the evacuation of casualties.

(n) Plan for the destruction of equipment and supplies. Personnel are trained in their individual weapons and in defensive measures, but have a limited capability to defend themselves. The Company commander should schedule refresher training and conduct defense exercises.

d. Area damage control. The Tropo Company must plan and train for ADC operations. ADC limits damage, seals off affected areas, salvages equipment, saves lives, and restores operations. ADC activities must be included in SOPs and rehearsed to ensure individuals are certain of their responsibilities. See FM 90-14. In most cases, the dispersed Tropo Company elements should incorporate their ADC measures with those of collocated units.

12-4. Emergency destruction of equipment

a. Emergency destruction (ED) is a command responsibility. Sensitive equipment and crypto material are involved in all troposcatter units. Due to the lack of mobility of troposcatter elements, ED is a distinct possibility. The Company SOP must include ED plans. Plans should be simple, be capable of rapid execution, and include priorities and methods for destruction. Specific people must be designated to perform the destruction. Common methods of destruction include smashing, cutting, burning, bending, breaking, burying, and scattering. If explosives are required, people must be trained to use them. See appropriate TMs for destruction procedures.

b. Proper Authorization for ED is Required. ED is usually ordered by higher commanders as a last resort. The SOP must be specific as to what constitutes a local decision to destroy equipment. When ED is accomplished, a report should be made to higher headquarters. For more detail, see AR 380-5 and FM 5-25.

12-5. Nuclear, biological, and chemical threat

A coordinated Threat attack of the COMMZ may well include NBC warfare. Few munitions can disrupt operations as extensively as NBC. The effects cover large areas and can produce massive casualties. Nuclear weapons are also capable of causing enormous destruction. Communications centers and nodes will likely be prime targets. This paragraph will acquaint Tropo Company personnel with the severity of the threat posed by NBC munitions. Consult FM 3-100 for more complete information on the effects of NBC warfare.

a. Nuclear weapons effects. Nuclear weapons ef-

fects are classified as initial or residual. Initial effects occur within 1 minute after detonation. Residual effects, such as fallout, occur after the first minute and are primarily of long-term interest. The principal initial casualty-producing effects are blast, thermal radiation, and initial nuclear radiation. Other initial effects, electromagnetic pulse (EMP) and transient radiation effects on electronics (TREE), affect only electrical and electronic equipment. Also, blackout is an atmospheric condition which can disrupt communications for hours. Aside from the obvious devastating effects of a nuclear explosion, C-E systems are extremely susceptible to EMP, and communications transmission may be impossible in the regions affected by blackout.

(1) *Blast.* Blast is the actual explosive force of the nuclear weapon detonation and accounts for much of the physical destruction. Casualties to exposed troops will result from flying debris, troops being blown around, and over pressures which may cause injuries such as ruptured eardrums.

(2) *Thermal radiation.* Immediate intense heat starts fires in buildings and forests. The heat can also burn exposed skin at distances where blast and nuclear radiation effects are minor. The extremely bright light formed can cause temporary or permanent blindness.

(3) *Nuclear radiation.* Initial nuclear radiation is emitted within the first minute after detonation. To survive initial radiation, personnel must be in a protected position before the detonation. Residual radiation lasts after the first minute. It consists of fallout or neutron-induced radiation near the point of detonation. Fallout is the primary residual hazard.

(4) *Electromagnetic pulse.* EMP is a short duration radio frequency pulse. EMP does not affect personnel. However, radio and troposcatter equipment can be damaged or made inoperative by EMP. Unless well buried (approximately 10 feet), cable and wire have varying degrees of vulnerability to EMP. This EMP energy may be higher than the circuit and component capabilities of the equipment. The damage can range from burned out fuses, transistors, and coils to the destruction of complete power supplies. Table 12-2 provides an indication of the vulnerability of tactical equipment to EMP. EMP will vary by type and yield of burst.

(5) *Nuclear blackout.* Nuclear blackout is the result of the fireball itself and the large dust clouds which may be created. It can last from a few seconds to many hours. It affects radio and troposcatter communications by–

(a) Refraction (bending of the waves).

(b) Absorption (consuming the waves).

(c) Scattering (scattering the waves in all directions).

b. Biological agent effects. Biological agents consist of disease-producing germs and toxins. These agents may be dispersed as aerosols by generators, low-explosive shells and bomblets, venting rockets, and aircraft sprayers. The aerosol form allows them to be spread rapidly by the wind and cover large areas. Harmful germs may also be spread by the release of infected insects and rodents. Germs and toxins can be used to cause injury, death, and disease among people, animals, and plants. They also can be used to cause deterioration of materiel and supplies. Antipersonnel biological agents have little effect on electronic components. However, C-E equipment may require decontamination in order to eliminate persistent contact hazards.

TABLE 12–2
EQUIPMENT VULNERABILITY TO EMP

Equipment Categories	Probability of Damage	Equipment Included in Category
I	Very low	Artillery, tactical equipment (excluding communications equipment)
II	Low	Fire direction control equipment, nuclear warheads, missiles
III	Medium	Long-range communications equipment (greater than 100 kilometers), air defense radars
IV	High	Target acquisition radars, short-range communications equipment (less than 100 kilometers), command and control equipment

c. Chemical agent effects.

(1) Chemical agents are a significant threat to Tropo Company personnel as well as equipment. They can be disseminated by aircraft, artillery, rockets, and missiles. The severity of the effect is dependent upon the dose received. Chemical agents fall into four classes:

(a) Nerve agents that directly affect the nervous system.

(b) Blister agents that affect the eyes and lungs and blister the skin.

(c) Blood agents that affect the circulatory and respiratory systems by preventing the body's cells from using oxygen.

(d) Choking agents that affect the respiratory system by attacking the lungs.

(2) Persistent chemical agents may contaminate supplies and equipment and restrict the use of terrain and facilities for hours and days.

12-6. Nuclear, biological, and chemical defense

The Tropo Company must be prepared to function under NBC conditions. FM 11-23 directs every TCC(A) unit to become proficient in the survival techniques

and operational standards for NBC warfare. NBC defense must be fully integrated into unit planning and training programs.

a. Defense tasks and planning.

(1) The Tropo Company must plan for three basic NBC defense tasks: contamination avoidance, protection of personnel and equipment, and decontamination when necessary. The successful performance of these tasks should be the objective of the Company NBC training program.

(a) Contamination avoidance. Contamination avoidance is accomplished through NBC awareness, detection and warning of NBC hazards, and limiting the spread of contamination. Contaminated areas should be bypassed if possible. If not, personnel must use protective clothing and equipment. FM 3-3 covers the marking of contaminated areas.

(b) Protection of personnel and equipment. Personnel must be protected to maintain the integrity of Tropo Company operations. During the threat of a chemical attack, the Company commander can balance personnel safety with unit effectiveness by using a mission-oriented protective posture (MOPP). The MOPP prescribes what equipment and clothing must be worn and/or used and what operational precautionary measures must be applied. Table 12-3 shows sample requirements for protective clothing/equipment for different MOPP levels. FM 3-100 must be consulted for the detail necessary to prepare MOPP levels appropriate to the Company. FM 3-3 provides added detail to prepare nuclear contamination avoidance levels. All MOPP information should be placed in the Company SOP. Also see FM 3-4 for NBC protection measures based on a particular situation.

(c) Decontamination. Decontamination reduces casualties and improves individual and unit effectiveness. Individuals must be trained to perform emergency self-decontamination. Units must have the capability to perform personnel decontamination and partial equipment decontamination. The source of decontamination devices and trained specialists should be determined. FM 3-5 provides a guide for NBC decontamination.

(2) The NBC plan can be part of the unit defense plan or an annex to it. Dispersed Tropo Company elements must be integrated into the supported unit NBC plan. For the details needed to plan and train for NBC defense, see FM 3-100. As indicated, unit SOPs for defense against NBC are a requirement.

(3) The Company's NBC program is directed by the chemical NCO. An NBC control party is formed to plan and conduct unit NBC defense activities. Other teams should be designated as required. Each element of the Company must be made aware of its responsibilities for NBC defense.

b. Decontamination of communications equipment. Decontamination of Tropo Company equipment must be done very carefully. Ensure the power supply is disconnected to prevent injury to personnel and damage to the equipment. FM 3-5 provides instructions for the decontamination of metal, plastic, leather, and wood parts. Care must be taken not to damage electronic components with decontamination solutions. Some decontaminants, by their nature, are reactive chemicals which can seriously corrode materials. For the electronic components themselves, the use of hot air, aeration, and weathering provide the best methods of decontamination for chemical and biological agents. Some decontamination takes place from heat given off by operating the equipment. For radioactivity, little can be done except to reduce radiation levels through aging. Complete decontamination is very difficult, time consuming, and often impossible to accomplish.

c. Electromagnetic pulse and blackout defense.

(1) Protective measures taken for EMP before a nuclear attack are critical to equipment survivability. Cables, wires, antenna systems, and all other metal structures are good electrical conductors. They absorb EMP energy. Material that couples with electromagnetic energy can absorb enough EMP energy to induce voltage and currents. The key to protection is to re-

TABLE 12–3
PROTECTIVE EQUIPMENT AND CLOTHING FOR MOPP LEVELS

MOPP	Overgarment	Overboots	Mask/Hood	Gloves
0	Carried	Carried	Carried	Carried
1	Worn, opened or closed based on temperature	Carried	Carried	Carried
2	Same as MOPP 1	Worn	Carried	Carried
3	Same as MOPP 1	Worn	Worn, hood opened or closed based on temperature	Carried
4	Worn, closed	Worn	Worn, hood closed	Worn

duce EMP coupling. The best protection is to have the troposcatter terminals shut down and disconnected prior to a nuclear attack. If not possible, a portion of the equipment may be able to be off the air. Do not forget to take precautions with organic command and control C-E equipment. Protective measures may include ferrous shielding, special voltage-limiting devices, and filtering systems built into the equipment. Also, new fiber optic cable systems are EMP resistant and may be used as replacements for current video and metallic cable systems. See Table 12-4 for a listing of some EMP protective measures.

(2) There are no protective measures against blackout since it does not affect personnel or equipment. It does, however, prohibit radio transmission through affected areas. This problem can be mitigated by planning for alternate routing to bypass affected regions or by the use of other communications means (such as messenger).

TABLE 12–4
EMP PROTECTIVE MEASURES

Measure	Rationale
Remove exterior conductors	EMP can couple with external metal conductors even if they are covered with insulation. Examples of potential EMP conductors include all types of radio antennas; any wire or cable connections, to include handset, external speaker and headset cables, power cables, computer interface connectors, rechargers, telephone lines, field wire, and extension cords; and other metal conductors, such as pipes and ducts. When use is not essential, such conductors should be disconnected or removed to prevent EMP-induced currents from being transmitted into the piece of equipment and damaging critical components or upsetting the equipment by blowing fuses, tripping circuit breakers, and garbling computer memories.
Use ultrahigh frequency (UHF) and super high frequency (SHF) communications equipment in preference to very high frequency (VHF) equipment when possible.	Communications equipment operating at UHF and SHF (225 MHz and higher) is less sensitive to EMP damage than VHF (2 to 225 MHz) equipment.
Avoid the use of broadband radios when possible.	Radios operating at frequencies below UHF are particularly sensitive to EMP. Broad-band radios will receive greater voltages and currents from EMP than will narrowband radios.
Shut down and protect unneeded and redundant radio systems.	To provide high assurance that unit tactical field communications will survive EMP, any nonessential and redundant radio systems and equipment should be shut down and protected from the EMP.
Use antennas that have small radiating elements when possible.	The smaller the radiating elements, the less EMP energy will be picked up and, consequently, the less the susceptibility of the associated equipment to EMP. Wide-angle doublet or omnidirectional antennas such as the OE–254 and long-wire field-expedient or AT–984 directional antennas are good collectors of EMP energy and should be avoided when possible.
Keep cable and wire runs as short as possible.	The longer the run, the greater will be the EMP energy that is collected by the cable and wire and transmitted into the attached equipment.
Keep cable runs as straight as possible—AVOID LOOPS.	Loops or bends in cable represent potential unintentional loop antennas that will pick up more EMP energy than straight runs. This is especially important for shorter, intrasite cable runs and is true even for ground cables.
Keep cable and wire on the ground where practical.	Elevating cable and wire may increase the EMP-generated voltages and currents. Burial is usually not practical since items would have to be placed under approximately 10 feet of earth to be adequately protected.
Use shielded twisted pair cable where options in use of cable exist.	Twisted pair cable picks up significantly less EMP energy than do coaxial and unshielded cable. Such reductions with shielded twisted pair cable, however, can be obtained only if the cable and shields are properly connected and terminated at both ends.
Shield equipment when possible.	Electrical and electronic equipment can be protected from the effects of EMP if placed in a totally enclosed electrical shield. Ideally, this shield should be made out of metal (steel or aluminum). For most tactical radios, the fully closed metal case will provide adequate protection if all external conductors have been removed. Metal ammunition cans and propellant charge cans make excellent storage containers for smaller electronic items such as handheld calculators and radio components. Placing items in vehicles, vans, and underground shelters provides effective protection. Wrapping small items in metal foil will also provide a lesser degree of protection for items that do not have their own metal case, such as circuit boards and electrical components.

CHAPTER 13

TRAINING

13-1. Introduction

a. Preparing and conducting training properly is one of any commander's most difficult, but most important, responsibilities. The primary objective is to produce a well-trained unit ready for field operations. The time to do that is now. Training is the central and primary task of the Tropo Company in peacetime.

b. The Army Training System, taken as a whole, is a complicated subject. This chapter emphasizes those aspects that will assist the Tropo Company commander in accomplishing the Company's training requirements. The chapter will be oriented toward troposcatter training in general. Detailed training information must be taken from technical manuals prepared for each item of Company equipment. The need for training in the areas of C-E planning, NBC and electronic warfare, and rear battle operations has been emphasized in previous chapters. Information that guides the overall conduct of Army training is found in a series of training field manuals.

(1) FM 25-l provides overall training philosophy and doctrine for the U.S. Army.

(2) FM 25-2 describes the Army Training System and training management in units.

(3) FM 25-3 contains principles and procedures for the conduct of training in units.

(4) FM 25-4 describes how to plan, conduct, and control training exercises.

13-2. Army training concepts

Reliable long-range communications are essential for command and control by the TA commander. The Tropo Company must achieve and maintain the highest proficiency levels. It must train as it will operate under field conditions-and train continually. Adherence to two fundamental concepts of training will assist the training effort. All leaders and trainers should thoroughly appreciate and understand them. They are "decentralized training" and "performance-oriented training."

a. Decentralized training.

(1) The decentralized training concept places the authority and responsibility to organize, conduct, evaluate, and supervise training at the battalion or separate company level (Tropo Company). The training effort itself takes place at or below company level where the job is actually performed. This means that the Tropo Company commander and subordinate leaders must be able to determine specific training objectives. These are based on the supported unit's mission, available training resources, and present level of training. The principal trainers should be the first line leaders who directly supervise the soldiers and head the sections. Training is decentralized to these leaders because they–

(a) Know the soldiers and their training needs.

(b) Know the section and its training needs.

(c) Can better control what motivates the soldiers.

(d) Have much to gain from having a skillfully trained unit.

(2) The decentralized training concept also presents several advantages for the Tropo Company commander:

(a) Training can be tailored to specific unit needs.

(b) Limited resources can be applied to priority programs.

(c) Junior leaders are directly involved in managing the time and training of personnel.

(d) Responsibility for training is consistent with the commander's responsibility for unit readiness.

b. Performance oriented training.

(1) Training can be described as preparation for performance. Performance-oriented training is learning by doing. It focuses on those critical tasks that prepare soldiers to do their jobs. Proper training consists of establishing objectives, conducting training, testing, and evaluating. Think of this as a formula: EFFECTIVE TRAINING = TRAINING OBJECTIVE + TRAINING + TESTING + EVALUATING. Once this idea becomes ingrained, training that serves the needs of the Company and its soldiers can be developed.

(2) The key to effective training is the development of performance-oriented training objectives. The objectives must facilitate clear and concise thinking about training for troposcatter operations. They must contain precise statements of the task, condition(s) under which it is performed, and the training standards of acceptable performance. See Table 13-1. FM

TABLE 13–1
THREE PARTS OF A TRAINING OBJECTIVE

Task	Define what skill the soldiers being trained are expected to acquire.
Condition	Shows your soldiers the conditions under which they must be able to demonstrate the skill.
Standard	Defines how well you expect these soldiers to perform the skill.

25-3 contains a detailed explanation of how to develop performance-oriented training objectives.

13-3. Training in the Company

Training that takes place outside training centers and schools is conducted predominantly in operational units. Training in the Company includes both "individual" and "collective" training. Individual training is preparing individuals to do individual tasks to accomplish their mission and stay alive. Collective training prepares soldiers to perform those team, section, or Company tasks essential to the accomplishment of the Company's mission. FM 25-3 provides details for the conduct of training in units.

a. Individual training. Troposcatter specialists receive advanced individual training in training centers or service schools. There, they gain only a working knowledge of their military occupational specialties (MOSs). This is the essential knowledge to perform a job under supervision. Training in system employment is gained in the Tropo Company with leader supervision. Supervised on-the-job training (SOJT) is a way to complete a soldier's training. It can also be used to retrain a soldier into a new, critical shortage MOS. The complexity of troposcatter communications demands constant training for quick response to technical instructions. There are various training methods and tools to employ that focus on the mastery of mission-essential skills. It is important that Tropo Company leaders and trainers understand these and use them to the advantage of the Company.

(1) *Individual training methods.*

(a) Sustainment training is conducted to maintain skill and task performance at a required level of proficiency dictated by the Company commander. This helps to ensure that a directed level of Tropo Company readiness is maintained.

(b) Train-up training prepares soldiers to perform tasks at higher levels of responsibility. This provides the Company with experienced personnel to assist in training and prepares soldiers for promotion.

(c) Cross-training prepares soldiers for other jobs and MOSs within the section or team. This improves the Tropo Company's ability to survive in combat and contributes to the soldiers' professional development.

(d) Leader training prepares leaders to perform leadership tasks, employ the section, and make decisions. This training can be conducted through coaching, as well as in a Company school.

(2) *Individual training tools.* Training managers and trainers have numerous tools at their disposal. These include the familiar soldier's manuals (SMs), trainer's guides (TGs), job books, a variety of extension training materials (ETMs), and the Individual Training and Evaluation Program (ITEP) (AR 350-37). The tools are used for analyzing, training, and evaluating, and provide the basis for allocating resources. In a limited resource environment, making proper use of the tools is a must.

b. Collective training.

(1) Collective training is where teamwork comes in. It is every bit as important as individual training. In a Tropo Company, this training should involve the entire unit so that total impact of using all terminals is involved. The success of the Company mission depends on how well all sections do their jobs together. The Company Army Training and Evaluation Program (ARTEP) serves as the basis for developing collective training. It is important that training derived from the ARTEP be as realistic as possible.

(2) Special emphasis must be placed on field training exercises to practice section proficiency. Only by constant practice will leaders be able to perfect what is expected of them. The supported headquarters may conduct a command post exercise to refine command, control, and communications procedures. They are an effective vehicle to teach commanders and staffs how to operate together without using troops as training aids. Real equipment is used and interaction takes place with personnel in a tactical configuration. The Tropo Company may conduct its own signal field exercise (SFX). The Company commander should ensure each section is involved in live equipment exercises as often as possible. Logistical support for terminal sections or teams during an exercise may require support from other units. Detailed planning and support arrangements must be completed. Each element of the Company should have a defined objective to accomplish before an exercise is terminated.

13-4. Training management

The Army training management system is the framework within which the Tropo Company is trained. It incorporates concepts, responsibilities, and tools to achieve and sustain a high state of training readiness. The system is responsive to individual and collective training needs. This section provides only a brief overview of training management. FM 25-2 provides the details.

a. Training responsibilities. Training responsibilities are established by commanders. This requires the Tropo Company commander and subordinate leaders to be abreast of current training techniques and EAC communications doctrine. Leadership emphasis and active supervision are essential to execute the Company's training program. Training responsibilities are divided between the training manager (the commander) and the trainers. The Company commander works with higher signal headquarters to develop and implement a specific company training program. Company officers and NCOs, as both supervisors and train-

ers, must ensure their platoons and sections can perform training objectives successfully. Each must be thoroughly knowledgeable of the soldier's individual tasks. The officers are primarily oriented toward collective training. The NCO is the principal individual trainer. Each individual soldier is responsible for keeping up his or her skill level. In team training, one soldier should learn to assist the other.

b. Training management systems.

(1) The Army's Battalion Training Management System (BTMS) is designed to standardize and teach the latest in training methodology. It is the system the Tropo Company uses for training management. It covers the planning, preparation, conduct, and evaluation of training. See FM 25-2 for a detailed description of BTMS.

(2) Other programs that Tropo Company trainers must use include the–

(a) Army Standardization Program (ASP), a program to ensure that common tasks, drills, and procedures will be performed in a single prescribed manner throughout the Army (AR 350-1, Chap 5).

(b) Common Military Training (CMT) Program, a program that identifies selected DA training requirements (AR 350-1, Table 4-l).

(c) New Equipment Training (NET), training conducted by a material developer or contractor to provide training on new equipment.

c. Training phases.

(1) Training management is a continuous process o f –

(a) Planning training to achieve desired proficiency.

(b) Providing resources for planned training.

(c) Conducting the training.

(d) Providing evaluation feedback.

(2) This four-phased process is depicted graphically in Figure 13-1. The process is described in detail in FM 25-2. One of the most important steps in planning training is to find out which tasks soldiers, sections, and the Company already know how to do. By analyzing training results, strengths and weaknesses can be identified. A list of training objectives can then be developed as described earlier. The training program is based on these objectives.

d. Training support.

(1) Training support provides the foundation for Army training. Trainers must be able to obtain the training materials and resources needed to conduct individual and collective training. Locally, training materials are obtained as follows:

(a) The unit learning center (LC) is the trainer's primary source. The trainer can get training aids, films, training extension course (TEC) lessons, television equipment, and training materials. The LC should have a library of ARTEPs, SMs, FMs, and training

(b) The Training Aids Support Center (TASC) usually serves an Army post or geographical area. The TASC has access to audiovisual materials. It can also order certain types of custom-made training aids. TASCs publish a periodic catalog of the materials they have available. The unit LC should keep an updated copy of this catalog available. The TASC is also the storage and issue facility for simulation devices.

(c) Training funds, fuel, terrain, and ammunition are essential training resources managed by the higher signal commander and staff. Tropo Company trainers and leaders must provide their requirements for resources to the Company commander. The Company commander must ensure training resource needs are made known. Resources must be requested early enough to be reasonably sure of receiving them.

(2) There are other programs and materials to help train soldiers to perform individual tasks to standard. The Army training system provides a variety of extension (nonresident) training materials (ETMs) that are exportable to units. These include TEC lessons, SMs, FMs, and graphic training aids (GTAs). Published training materials exportable to units are found in ETM catalogs in the 350-100 series of DA pamphlets. DA Pamphlet 350-100 provides a one-source listing of all applicable and available ETM for all Army MOSs. Other 350-100 series catalogs list ETMs for various type signal units. The last chapter in each catalog explains how to order the training materials. Additionally, DA Pamphlet 351-20 lists correspondence course programs and materials available to Company personnel.

13-5. Training tips

A Tropo Company provides a service to other units. While the supported unit is training, troposcatter sections are essentially operating to make that training a success. Therefore, the bulk of troposcatter training must take place before supporting an exercise. This means that the Company commander must maximize the use of what little training time is available. Be imaginative. Good training is accurate, well-structured, efficient, effective, realistic, and safe.

a. Realistic training. Conduct realistic training to develop full readiness. Avoid the classroom setting as much as possible. Troposcatter radio operators need to experience the power level, synchronization, frequency, and interference problems that occur in live operations. They must learn to take direction and be coordinated by the Company Operations Center. Realistic training includes realistic problem solving. This will aid personnel to overcome difficult situations they are sure to meet in the field. Instead of learning lessons the hard way, practice field skills such as the following:

(1) Operate under stressed conditions, such as in an EW jamming environment.

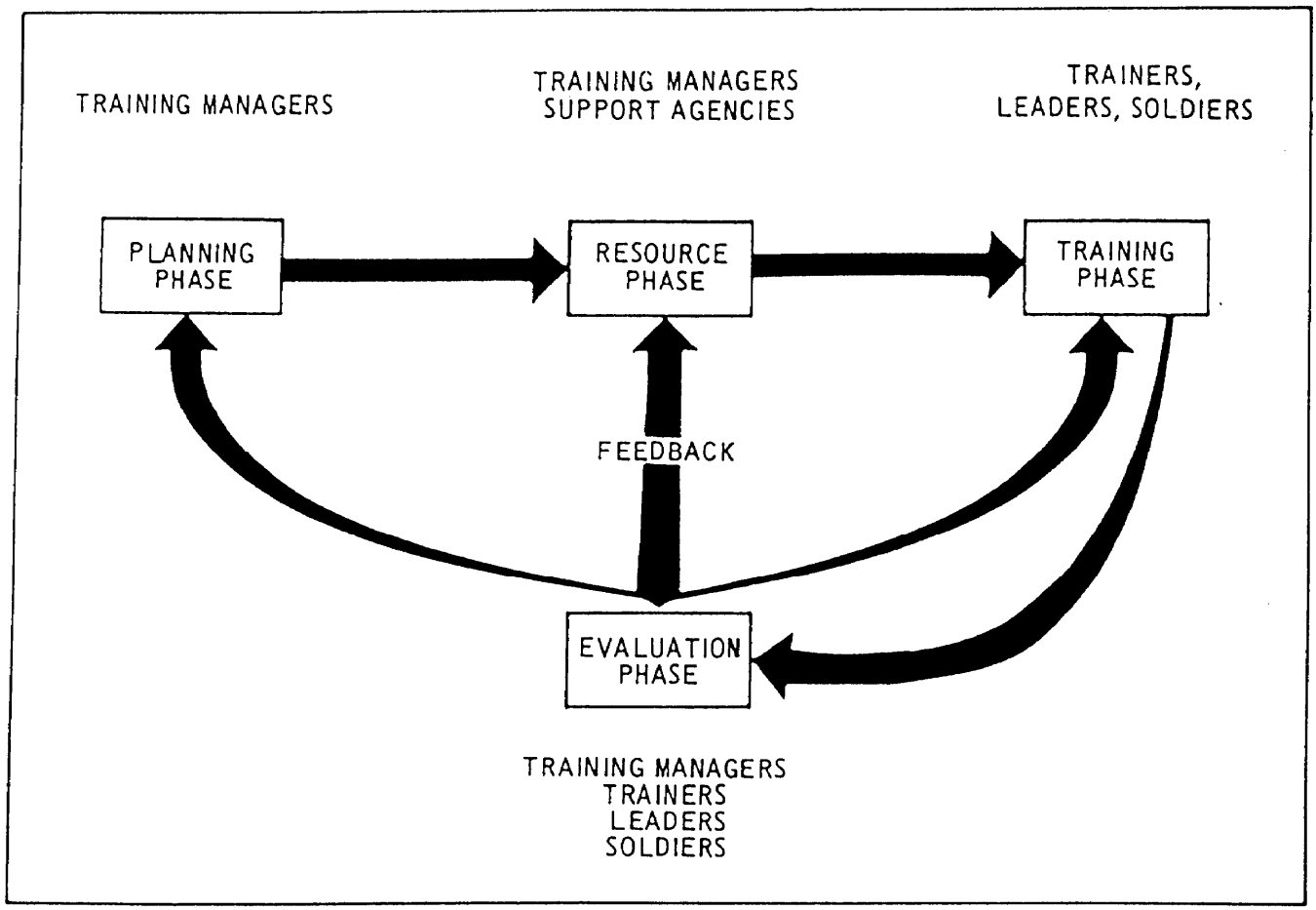

Figure 13–1. Phases of training management in units.

(2) Test alternate means of communications.

(3) Train everyone connected with communications to use communications.

(4) Communicate with the other services.

(5) Operate under adverse conditions, such as bad weather, threat of enemy attack, and/or NBC warfare.

(6) Accomplish required maintenance under field conditions.

(7) Logistically support communications elements in the field.

(8) Deploy maintenance support teams on "no notice" situations.

(9) Select and lay out sites, and move to new positions during day and night.

(10) Establish troposcatter links at night.

b. Motivation for good training. Realistic, effective training enables a unit to accomplish its mission. For a Tropo Company, that mission is to provide reliable troposcatter communications. There are other payoffs to consider. When the Company is well trained, the amount of equipment loss and replacement will probably be reduced. Repair and maintenance are kept to a minimum and spare parts can be conserved. C-E equipment will be there when it is needed. Cross-training and train-up contributes to increased flexibility. For 24-hour operations, an operator must master a variety of skills with a lot of different equipment. Team members are often diverted for site preparation, improvement, and defense. Most important, increased morale is a byproduct of good collective training. A soldier will give more when a member of a skilled team.

c. Comprehensive evaluation of training.

(1) The final step in conducting effective training is to complete a training evaluation. This is much more than supervision of training by the Company commander, subordinate leaders, and trainers. Supervisors can assist and encourage soldiers. Supervising also helps determine soldier performance of intermediate objectives. Training evaluation is more comprehensive. The overall training must be evaluated from two viewpoints–"training effectiveness" and "training efficiency." They are different and both are important.

(a) Training effectiveness relates to how well the soldier performs the overall training objectives.

(b) Training efficiency relates to how well resources are used to conduct the training.

(2) Always remember–the right things must not only be done well, they must be done well in the right way.

d. Training in support type units. The Tropo Company commander must consider the unique aspects of training in a support type unit. The training environment must be studied to determine training variables. This analysis will result in a list of actions that guide the planning and management of training. For a start, a few general hints are suggested here:

(1) Be sure supported commanders know your unit's mission uniqueness, capabilities, and special training needs.

(2) Carefully coordinate training with the diverse nature of troposcatter operations.

(3) Identify skill qualification test (SQT) tasks performed on the job. Identify remaining tasks for individual or collective training.

(4) Integrate training on the job, in the motor pool, in the field-wherever possible.

(5) Plan SOJT. Soldiers are seldom adequately trained for signal support operations in Army schools.

(6) Plan consolidated training on common subjects for isolated sections or shift workers.

(7) Conduct signal support operations under field conditions to evaluate your unit's proficiency.

(8) Study ways to minimize your unit's signature.

(9) Insist on the same high standards for training both in garrison and in the field.

(10) Visit as many training sessions as possible. Involve yourself personally in both signal and common subject training.

GLOSSARY

Section I. Abbreviations

ACACS	Army Command and Area Communications System
ACP	Allied Communications Publication
ADC	area damage control
ARTEP	Army Training and Evaluation Program
ASG	Area Support Group
ASP	Army Standardization Program
ATC	air traffic control
AUTOCOMM	Automation Communications Network
BCOC	base cluster operations center
BDOC	base defense operations center
BER	bit error rate
BTMS	Battalion Training Management System
C-E	communications-electronics
CEMS	Communications-Electronics Management System
CEOI	Communications-Electronics Operating Instructions
CFC	Combined Forces Command
CI	counterintelligence
CMT	common military training
CNCE	communications nodal control element
COMMZ	communications zone
COMSEC	communications security
CP	command post
CSCE	communications system control element
CSPE	communications system planning element
CUCV	commercial utility cargo vehicle
DCS	Defense Communications System
DS	direct support
EAC	echelons above corps
ECM	electronic countermeasures
ECCM	electronic counter-countermeasures
ED	emergency destruction
EMC	electromagnetic compatibility
EMCON	emission control
EMP	electromagnetic pulse
ESM	electronic warfare support measures
ETM	extension training materials
EW	electronic warfare
FLOT	forward line of own troops
FRAGO	fragmentary order
GS	general support
GTA	graphic training aids
HF	high frequency
HMMWV	high mobility multipurpose wheeled vehicle
HNS	host nation support
INSCOM	Intelligence and Security Command
ITEP	Individual Training and Evaluation Program
JANAP	Joint Army-Navy-Air Force Publication
LC	learning center
LOC	line of communications
LOS	line of sight
MHz	megahertz
MI	military intelligence
MIJI	meaconing, intrusion, jamming, and interference
MOPP	mission-oriented protective posture
MOS	military occupational specialty
MP	Military Police
NATO	North Atlantic Treaty Organization
NAVAIDS	navigational aids
NBC	nuclear, biological, and chemical
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NET	New Equipment Training
NRI	net radio interface
OIC	officer in charge
OPORD	operation order
OPSEC	operations security
PLL	prescribed load list
POL	petroleum, oils, and lubricants
QRA	quick reaction antenna
RAOC	rear area operations center
RDF	radio direction finding
REC	radioelectronic combat
SFX	signal field exercise
SHF	super high frequency
SIGSEC	signal security
SM	soldier's manual
SOJT	supervised on-the-job training
SOP	standing operating procedure
SQT	skill qualification test
SSB	single sideband

STANAG	standardization agreement
TA	Theater Army
TAACOM	Theater Army Area Command
TACSAT	tactical satellite
TACSATCOM	tactical satellite communications
TASC	Training Aids Support Center
TCC(A)	Theater Communications Command (Army)
TCS(A)	Theater Communications System (Army)
TEC	technical extension course
TG	trainers guide
TOE	table of organization and equipment
TREE	transient radiation effects on electronics
TRI-TAC	Tri-Service Tactical Communications System
Tropo	tropospheric scatter
UHF	ultrahigh frequency
USAISC	United States Army Information Systems Command
VHF	very high frequency
W/E	with equipment

Section II. Terms

Area signal node

A signal facility that provides communications to units within its assigned geographical area of responsibility. This ties the units into the TCS(A) and supplements their organic means for communications with higher, subordinate, or adjacent headquarters.

Army training system

The system within which the Army develops, manages, and conducts training. System components are institutional training, unit training, and training support.

Authentication

A security measure designed to protect a communications system against fraudulent transmissions.

Base

A unit or multiunit position that has a definite perimeter. Army, other services, or host nation units may make up a base.

Base cluster

Support and combat service support units in the rear area grouped together for rear battle operations or mission-related purposes. A base cluster has no clearly defined perimeter.

Base defense operations

Defense measures taken by a base to provide internal and perimeter security. Measures include organizing and preparing personnel and equipment in an effective manner to defend themselves until military police and, if needed, tactical combat forces can respond. A base defense operations center is established to coordinate base defense and area damage operations.

Brevity code

A code which provides no security but which has as its sole purpose the shortening of messages rather than the concealment of their contents.

Call sign

Any combination of characters or numbers or pronounceable words which identifies a communications facility, command, authority, activity, or unit. It is used primarily for establishing and maintaining communications.

Circuit

In communications, an electronic path between two or more points capable of providing a number of channels. In engineering, a number of conductors connected together for the purpose of carrying an electrical current.

Code

Any system of communications in which arbitrary groups of symbols represent units of plain text of varying length. Codes are provided primarily for one of three purposes: (1) In the broadest sense, coding is a means of converting information into a form suitable for communication and encryption; (2) brevity codes are used to reduce the length of time necessary to transmit information; or (3) security codes are used to provide some degree of cryptographic protection for the information being transmitted.

Collective training

The preparation of soldiers to perform those team or unit tasks essential to the accomplishment of a unit's TOE or operational mission.

Command and control

An arrangement of personnel, facilities, and means for information acquisition, processing, and dissemination employed by a commander in planning, directing, and controlling operations.

Command post

A unit's headquarters from which command and control is centrally exercised.

Common-user circuit

A circuit allocated to furnish communications paths between switching centers to provide communications service on a common basis to all connected stations or subscribers.

Communications-electronics (C-E)

The design, development, installation, operation, and maintenance of electronics and electromechanical systems associated with the collecting, transmitting, storing, processing, recording, and displaying of data and information associated with all forms of military communications.

Communications-electronics operating instructions (CEOI)

A series of orders issued for the technical control and coordination of the signal communications activities of a command.

Communications equipment support element (CESE)

An element of the C-E system—radio, switch, multiplex, wire teams, maintenance, and so forth.

Communications nodal control element (CNCE)

A dual-function facility that incorporates both facilities control and technical control requirements. The technical control element of the CNCE contains patching, testing, conditioning, and monitoring equipment and provides technical control of circuits in and through the facility. The management element of the CNCE provides management and control of C-E functions within the node.

Communications system control element (CSCE)

The actual focal point for dynamic control which acts as operations center for command system, and directs organic and subordinate C-E systems. It maintains the data base.

Communications system planning element (CSPE)

The staff and operational planners at each element which provide all the long-range planning.

Communications zone (COMMZ)

The portion of the theater of operations that begins at the corps rear boundary and extends rearward to include the area necessary to provide support to forces in the combat zone. The combat zone begins at the corps rear boundary and extends forward to the extent of the corps commander's area of influence.

Cross-training

The systematic training of the soldier on tasks related to another job within the same MOS or tasks related to a secondary MOS within the same skill level.

Decentralized training

The process whereby authority and responsibility for the detailed planning, organizing, conducting, evaluating, and supervising of training is delegated to the lowest command element having the capability to manage effective training.

Echelons above corps (EAC)

Those headquarters and organizations that normally operate within the theater of operations and provide the interface between the deployed corps and higher operational, lateral, and/or support headquarters, and respective national control authorities, to include service components as required. The term is generic in nature and does not refer to a specific level of command. Functions provided and controlled at EAC may be operational, administrative, logistical, or any combination of the above.

Electromagnetic emission control

The control of friendly electronic emissions (for example, radio and radar transmissions) for the purpose of preventing or minimizing their use by unintended recipients.

Electronic counter-countermeasures (ECCMs)

That division of EW involving actions taken to ensure friendly effective use of the electromagnetic spectrum.

Electronic countermeasures (ECMs)

That division of EW involving actions taken to prevent or reduce the effectiveness of enemy equipment and tactics employing or affected by electromagnetic radiations, and to exploit the enemy's use of such radiations.

Electronic deception

The deliberate radiation, reradiation, alteration, absorption, or reflection of electromagnetic energy in a manner intended to mislead an enemy in the interpretation of use of information received by the enemy's electronic systems. There are three categories of deception: manipulative, imitative, and simulative.

Electronic jamming

The deliberate radiation, reradiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment, or systems being used by an enemy.

Electronic warfare (EW)

That division of the military use of electronics involving actions taken to prevent or reduce an enemy's effective use of radiated electromagnetic energy, and actions taken to ensure our own effective use of radiated electromagnetic energy.

Electronic warfare support measures (ESMs)

That division of EW involving actions taken to search for, intercept, locate, record, and analyze radiated electromagnetic energy for the purpose of exploiting such radiations in support of military operations. ESMs provide a source of EW information required to conduct ECM, ECCM, threat detection, warning, avoidance, target acquisition, and homing.

Individual training

Training received that enables officers, NCOs, and soldiers to perform the specific duties and tasks related to their MOS and duty position.

Institutional training

Training, either individual or collective, conducted in schools (Army service school, U.S. Army Reserve school, NCO academy) or Army training centers. Institutions which conduct this training are referred to as part of the training base.

Link

The existence of communications facilities between two points.

Meaconing

A deliberate effort to mislead pilots who depend on navigational aids for geographic orientation. Normally, meaconing is accomplished by blotting out the desired signal and establishing a false beacon from another location.

Military occupational specialty (MOS)

A grouping of duty positions possessing such close occupational or functional relationship that an optimal degree of interchangeability among persons so classified exists at any given level of skill.

Net

An organization of stations capable of direct communications with each other using a common frequency or channel.

Net control station (NCS)

A station designated to control traffic and enforce circuit discipline within a given net.

Network

In communications, an organization of stations capable of intercommunication but not necessarily on the same channel. In engineering, two or more interrelated circuits.

New equipment training (NET)

Training to transfer knowledge gained during materiel development to trainers, users, and support personnel during development and fielding of new equipment. It has the purpose of training unit soldiers and leaders on operating, maintaining, and tactically employing the new equipment. Numbers and type of personnel and units to be trained are determined on a system-by-system basis during the NET planning process.

New Manning System

Name applied to the concept for the replacement of U.S. Army personnel. It consists of two reinforcing subsystems: the Cohesion, Operational Readiness, and Training (COHORT) Unit Replacement System and the U.S. Army Regimental System.

Performance-oriented training

Learning by doing. Performance to standard is required.

Radio direction finding (RDF)

Radio location in which only the direction of a station is determined by means of its emission. Since this technique can be used against all electronic emitters, it is sometimes simply referred to as direction finding (DF).

Rear area operations center (RAOC)

Rear area staff responsible for planning, coordinating, directing, and monitoring the rear battle.

Rear area

The area to the rear of the main battle area where supply, maintenance support, communications centers, and administrative echelons are located. The rear area extends from the brigade rear boundary to the theater rear boundary.

Systems approach to training

A logical process for effectively and efficiently determining what, where, when, and how tasks should be taught. It consists of the five interrelated phases of evaluation, analysis, design, development, and implementation.

Supervised on-the-job training (SOJT)

A training process whereby students or trainees acquire knowledge and skills through actual performance of duties under competent supervision, in accordance with an approved, planned program.

Table of organization and equipment (TOE)

A document which prescribes the normal mission, organizational structure, personnel, and equipment requirements for a military unit and is the basis for an authorizations document.

Telecommunications

Any transmission, emission, or reception of signals, signs, writings, images, sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems.

Telecommunications center

An agency charged with the responsibility for acceptance, preparation for transmission, receipt, duplication, and delivery of messages.

Text

That part of a message which contains the thought or idea which the originator desires to be communicated.

Traffic (communication)

All transmitted and received messages.

Train-up training

Training that prepares an individual to perform tasks at a higher skill level in the same career management field.

Tropospheric scatter

The propagation of radio waves by scatter as a result of irregularities or discontinuities in the physical properties of the troposphere.

Type B organization

An organization with personnel positions that can be filled by non-U.S. personnel. The type B column of a TOE lists those positions which must be filled by U.S. military personnel. Vacancies in this column indicate those positions that may be filled by non-U.S. personnel in support of the Army OCONUS.

Unit category

A category designated in section I of the unit TOE that applies to the assignment of secondary missions (AR 310–31).

a. Category I TOE. In consideration of the primary mission, tactics, and normal employment of category I units, category I TOE will include secondary missions in exceptional cases only. The secondary missions must be directly related to, and extensions of, the assigned primary missions.

b. Category II TOE. Category II TOE will include limited secondary missions when the nature of the primary missions are such that the units using the TOE will not be employed full time in preparing for, or accomplishing, the primary missions. The secondary missions must be related to, and extensions of, the assigned primary missions.

c. Category III TOE. Category III TOE will include secondary missions whenever possible. The secondary missions must be directly related to, and extensions of, the assigned primary missions.

Unit training

Training, individual or collective, conducted in a unit.

Appendix
References

Section I. Required Publications

Army Regulations (ARs)

AR 105-3	Reporting Meaconing, Intrusion, Jamming and Interference of Electromagnetic Systems (RCS JCS-1066(MIN))
AR 105-31	Communications-Electronics: Message Preparation
AR 220-1	Unit Status Reporting (RCS JCS 6-11-2-1-6)
AR 350-1	Army Training
AR 350-35	Army Modernization Training
AR 350-27	Army Individual Training Evaluation Program

Field Manuals (FMs)

FM 3-3	Nuclear, Biological, and Chemical Contamination Avoidance
FM 3-4	Nuclear, Biological, and Chemical Protection
FM 3-5	Nuclear, Biological, and Chemical Decontamination (DECON)
FM 3-100	Nuclear, Biological, and Chemical Operations
FM 11-23	Theater Communications Command (Army) (TCC(A))
FM 11-24	Signal Tactical Satellite Company
FM 11-26	Signal Operations Company (Medium Headquarters)
FM 11-27	Signal Cable and Wire Company
FM 11-28	Signal Command Operations Battalion (Theater)
FM 11-29	Signal Telecommunications Battalion (Area)
FM 11-50	Combat Communications Within the Division
FM 11-92	Combat Communications Within the Corps
FM 22-100	Military Leadership
FM 24-l	Combat Communications
FM 24-16	Communications-Electronics: Operations, Orders, Records and Reports
FM 24-21	Tactical Multichannel Radio Communications Techniques
FM 24-22	Communications-Electronics Management System (CEMS)
FM 24-33	Electronic Counter-Countermeasures
FM 25-1	Training
FM 25-2	Unit Training Management
FM 25-3	Training in Units
FM 25-4	How to Conduct Training Exercises
FM 34-1	Intelligence and Electronic Warfare Operations
FM 34-62	Signal Security
FM 55-30	Army Motor Transport Unit and Operations
FM 90-14	Rear Area Protection Operations
FM 100-5	Operations
FM 100-16	Support Operations: Echelons Above Corps

Army Training and Evaluation Program (ARTEP)

ARTEP 11-367	Signal Company Troposcatter, Light and Heavy (TOE 11-367, 11-368)

Section II. Related Publications

Army Regulations (ARs)

AR 55-355	Military Traffic Management Regulation
AR 220-58	Organization and Training for Nuclear, Biological and Chemical Defense
AR 310-2	Identification and Distribution of DA Publications and Issue of Agency and Command Administrative Publications
AR 310-25	Dictionary of United States Army Terms
AR 310-31	Management System for Tables of Organization and Equipment (The TOE System)
AR 380-5	Department of the Army Information Security Program
AR 381-19	Intelligence Support

Field Manuals (FMs)

FM 5-15	Field Fortifications
FM 5-20	Camouflage
FM 5-25	Explosives and Demolitions

FM 10-14	Unit Supply Operations (Manual Procedures)
FM 10-23	Army Food Service Operations
FM 24-2	Radio Frequency Management
FM 24-17	Tactical Communications Center Operations
FM 24-18	Field Radio Techniques
FM 24-20	Field Wire and Hold Cable Techniques
FM 24-24	Radio and Radar Reference Data
FM 24-25	Wire and Multichannel Reference Data
FM 24-26	Tactical Automatic Switching
FM 34-60	Counterintelligence Operations
FM 90-2	Tactical Deception
FM 90-3	Desert Operations
FM 90-5	Jungle Operations
FM 90-6	Mountain Operations
FM 100-2-1	Soviet Army Operations and Tactics
FM 101-5	Staff Officers Field Manual: Staff Organization and Procedure
FM 101-31-2	Staff Officers Field Manual: Nuclear Weapons Employment Effects Data (U)
FM 101-313	Staff Officers Field Manual: Nuclear Weapons Employment Effects Data

Department of the Army Pamphlets (DA Pam)

DA Pam 350-100	Extension Training Materials Catalog Consolidated MOS Catalog
DA Pam 350-111-2	Signal Operations Company
DA Pam 350-1114	Headquarters and Headquarters Detachment, Signal Battalion, Signal Support and Signal Radio Operations Company
DA Pam 350-111-5	Signal Troposphere and Signal Messenger Companies
DA Pam 525-33	US Army Operational Concept for Army Air Space Management
DA Pam 710-2-1	Using Unit Supply System, Manual Procedures

Allied Communications Publications (ACPs)

ACP-1OO (Allied)	US Call Sign and Address Group System-Instructions and Assignment (U) (Initial distribution of ACPs and JANAPs will be made by TAGO as requested by CG, USAISC. Using Army units will submit requests for resupply on DA Form 4569 to Chief, U.S. Army C-E Services Office, ATTN: AS-OPS-CE-M, Washington, DC, 20310-5009 (AR 310-20).)
ACP-1OO (Allied) (Cont.)	
ACP-100, U.S. Suppl-1	Allied Call Sign and Address Group System-Instructions and Assignments (U)
ACP-11O (Allied)	Tactical Call Sign Book (U)
ACP–11O, U.S. Suppl-1 (Allied)	Tactical Call Sign Book Master Index Suppl (U)
ACP-112	Task Organization Call Sign Book (U)
ACP-112, U.S. Suppl-1	Task Organization Call Sign Book (U)
ACP-117	Allied Routing Indicator Book (U)
ACP-117, U.S. Suppl-1	Allied Routing Indicator Book
ACP-117, U.S. Suppl-2	Routing Indicator Book for Mobile Commands and Units
ACP-117, U.S. Suppl-3	Defense Communications Systems Routing General Purpose Networks
ACP-117, U.S. Suppl-4	US Special Purpose Routing Indicator Book (U)
ACP-117, U.S. Suppl-5	CONUS Military TWX/ TELEX Directory
ACP-117, CAN-U.S. Suppl-1	Allied Routing Indicator Book Canada-United States
ACP-117, NATO Suppl-1	NATO Routing Indicator Book (U)
ACP-117, SEATO Suppl-1	SEATO Tape Relay Routing Indicator Book (U)
ACP-118	Visual Call Sign Book
ACP-119	Allied Tactical Voice Call Sign System-Instruction and Assignments
ACP-121	Communications Instructions–General (U)
ACP-121, U.S. Suppl-1	Communications Instructions–General (U)
ACP-121, U.S. Suppl-2	Communications Instructions–General Air Ground
ACP-121, NATO Suppl-1	Communications Instructions–General NATO Basegram System (U)
ACP-121, SEATO Suppl-1	Communications Instructions–General (U)
ACP-122	Communications Instructions–Security (U)
ACP-122, NATO Suppl-1	Communications Instructions–Security (U)

ACP-124	Communications Instructions-Radio-telegraph Procedures (and Radio-telephone)
ACP-125, U.S. Suppl-2	Radiotelephone Procedures for the Conduct of Artillery and Naval Gunfire
ACP-125, U.S. Suppl-3	Radiotelephone Procedures for Ciphony
(CONF NOFORN)	Communications (U)
ACP-126 (Allied)	Communications Instructions–Teletypewriter (Teleprinter) Procedures (U)
ACP-126B	Communications Instructions–Radio-Teletypewriter Procedures
ACP-127 (Allied)	Communications Instructions–Tape Relay Procedures (U)
ACP-127, U.S. Suppl-1	Communications Instructions–Tape Relay Procedures
ACP-127, U.S. Suppl-1	Communications Instructions–Tape Relay Procedures (NATO-Naval Broadcast Ship-shore and Inter-RATT Procedures) (U)
ACP-127, NATO Suppl-2	Communications Instructions On-Line Cryptographic Tape Relay Procedures (U)
ACP-128	Automatic Digital Network (AUTODIN) Operating Procedures
ACP-129	Communications Instructions–Visual Signaling Procedures
ACP-131, U.S. Suppl-1	Communications Instructions–Operating Signals
ACP-134	Telephone Switchboard Operating Procedures
ACP-135	Communications Instructions–Distress and Rescue Procedures
ACP-136	Communications Instructions Panel Signaling
ACP-150	Recognition and Identification Instructions Air, Land and Sea Forces (U)
ACP-165 (Allied)	Operating Brevity Codes (U)
ACP-167	Glossary of Communications-Electronics Terms
ACP-168	Pyrotechnic Signals
ACP-177 (Allied)	Land Forces Electronic Warfare Instructions (U)
ACP-190	Guide to Frequency Planning
ACP-198	Instructions for the Preparation of Allied Communications Publications
ACP-201	Index of Allied Communications Publications

Joint Army-Navy-Air Force Publications (JANAPs)

JANAP-119	Joint Voice Call Sign Book (U) (for availability, see ACP-1OO (Allied) above)
JANAP-128	AUTODIN Operating Procedures (U)
JANAP-138 (NOFORN)	Automatic Secure Voice Communications Network (AUTOSEVOCOM) Operating Procedures (U)
JANAP-141	US Joint Military Radio Frequency Allocation Plan (U)
JANAP-194	Basic Armed Forces Communications Plan (BAFCOM) US Army Frequency Plan (U)
JANAP-195	Basic Armed Forces Communications–US Navy Frequency Plan (U)
JANAP-201	Status of Noncryptographic JANAPs and ACPs (U)
JANAP-299	US Joint Code Word Index (U)

Standardization Agreements (STANAGs)

STANAG-2014	Operation Orders, Annexes to Operation Orders, and Administrative/Logistics Orders (See DA Pam 310-35 for STANAGs of interest to the U.S. Army. Initial distribution of STANAGs will be made by TAGO as requested by CG, USAISC. Using Army units will submit requests for resupply to U.S. Naval Publications and Forms Center, Philadelphia, PA 19120 for unclassified and U.S. Army Materiel Command, ATTN: AMCIRD, 5001 Eisenhower Avenue, Alexandria, VA 22333 for classified (AR 34–l).)
STANAG-2019	Military Symbols
STANAG-2020	Operational Situation Reports
STANAG-2028	System for Field Wire Labeling
STANAG-2043	Principles and Procedures for Establishing Communications
STANAG-2047	Emergency Alarms of Hazards of Attack
STANAG-2109	Telecommunications Symbols