Headquarters,
Department of the Army

FIELD MANUAL
24-2

Spectrum Management

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Spectrum Management

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Unless otherwise stated, whenever the masculine gender is used, both men and women are included.

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Preface

Purpose and Scope

This publication is a guide for US Army personnel engaged in spectrum management at all levels of command. It describes battlefield spectrum management responsibilities and functions from the international level down to the tactical battlefield level. It stresses management at the tactical field level. Electromagnetic spectrum saturation is most critical at this point. This publication stresses the continuing need for international understanding and cooperation in spectrum management and use.

User Information

The proponent of this publication is HQ TRADOC. Send comments and recommendations on DA Form 2028 directly to Commander, United States Army Signal Center and Fort Gordon, ATTN: ATZH-DTL, Fort Gordon, Georgia 30905-5075. Key comments and recommendations to pages and lines of text to which they apply. If DA Form 2028 is not available, a letter is acceptable. Provide reasons for your comments to ensure a complete understanding and proper evaluation.

This publication implements the following international standardized agreement(s): QSTAG 679, Millimeter Waves and Lasers (30 GHz and above); QSTAG 715, Battlefield Spectrum Management HF (1.5 - 30 MHz Band); QSTAG 716, Battlefield Spectrum Management VHF (30 - 88 MHz Band); QSTAG 718, Battlefield Spectrum Management UHF (225 - 400 MHz Band); QSTAG 719, Battlefield Spectrum Management Tactical Radio Relay and Tropospheric Scatter Systems; QSTAG 721, Battlefield Spectrum Management: Radar, Position Navigation, Tactical Sensor System and Multifunction Information Distribution System; QSTAG 723, Battlefield Spectrum Management: Deconfliction; STANAG 6004, MIJI Reporting.

Chapter 1

International Spectrum Management

1-1. Introduction

All nations share the electromagnetic spectrum and reserve their right to its unlimited use. However, for international telecommunications cooperation to support trade, transportation, communications, and mutual protection against interference, they have agreed to an International Telecommunications Convention. This serves as the basic instrument of the International Telecommunications Union (ITU) and its supporting bodies. This chapter covers this organization and relationship with the US.

1-2. The ITU

The United Nations recognizes the ITU as the specialized agency in the telecommunications field. The ITU maintains cooperation to improve all telecommunications. The ITU allocates the international radio frequency (RF) spectrum, registers frequency assignments, and coordinates resolving interference. Upon ratification by member nations, ITU regulations have treaty status. Each ITU member nation imposes regulatory measures within its administration. These measures must comply with the current Radio Regulations (RR) unless expressly excluded by either footnotes or by special arrangements.

1-3. The ITU Organization

The Plenipotentiary Conference is the supreme agency of the ITU. It formulates general policies, establishes budgetary guidelines, elects members, and concludes agreements between the ITU and other international communications organizations. The ITU has three organizations or agencies that directly affect Army spectrum management: the World Administrative Radio Conference (WARC), the International Frequency Registration Board (IFRB), and the International Radio Consultative Committee (CCIR).

A WARC may deal with all of the radiocommunications services, or it may deal with specific radiocommunications services such as space, maritime, or aeronautical. Each WARC updates the RRs which allocate radio spectrum use on a worldwide basis except where regional requirements differ and are agreed. Figure 1-1 shows the three recognized regions. In addition, the tropical area centered on the equator has additional provisions to offset its higher electrical noise. Figure 1-2 shows all the uses of radio spectrum that are managed by services. Exceptions to these allocations may be footnotes for specific countries or reservations made by that country at the WARCs.

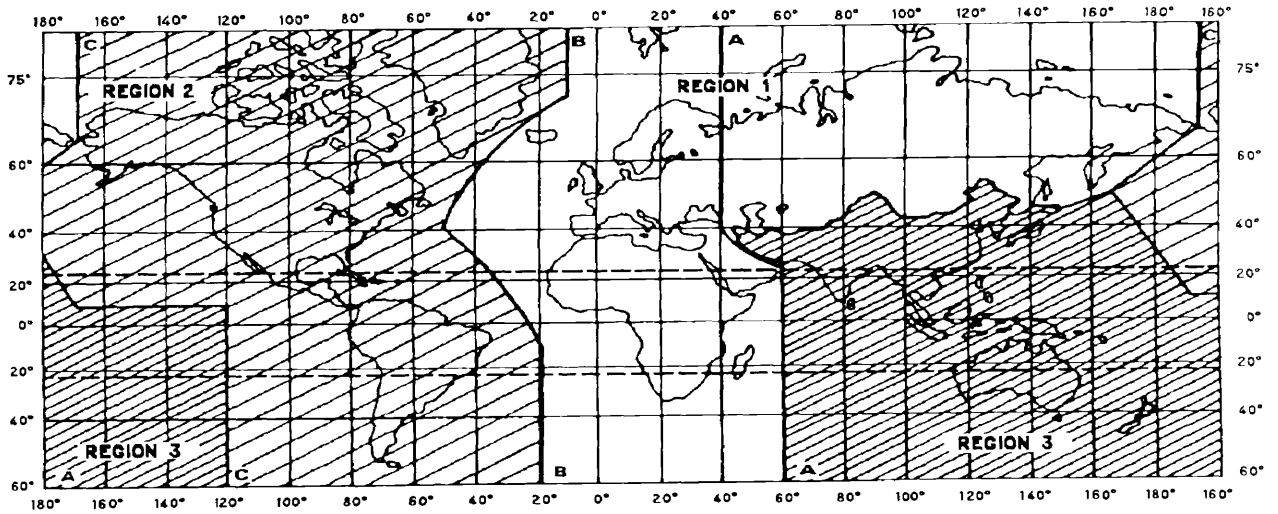


Figure 1-1. Spectrum use regions.

The lFRB records ITU member nation frequency assignments. It advises the WARCs and member nations on technical matters on harmful interference and radio spectrum use. The IFRB serves as the office of record of frequency assignments in priority and adjudicates interference conflicts among member nations.

The CCIR provides technical criteria on frequency sharing and examines technical and operational questions about international radio use. It also addresses technically related questions pertinent to ITU member nations and forthcoming WARCs. The findings of the CCIR serve a significant influence on the state-of-the-art and as a basis for RRs. However, these findings are recommendations rather than having an obligatory treaty status. The CCIR is organized into study groups. The United States Study Groups (USSGs) submit their investigations or findings through the National Committee. This is described in the next paragraph. In addition to study groups on radio propagation, the Army is concerned with the study group on the mobile radiocommunications services.

1-4. The Department of State

Bilateral and multilateral negotiations and agreements concerning telecommunications and spectrum use are essential to foreign relations. The Department of State is responsible for such negotiations. It also reviews and directs the US positions using personnel and experts in government, industry, and academic fields. It also relies on the recommendations of the National Telecommunications and Information Administration (NTIA), the Federal Communications Commission (FCC), other government agencies, and private sector organizations when designating delegations to international or regional ITU conferences or meetings. The State Department governs US participation in the CCIR, and it chairs a United States National Committee (USNC). The USNC consists of representatives of federal government agencies with a vested interest in telecommunications. The USNC gives final approval on all US contributions to the CCIR. USSGs have been set up by charter to review foreign contributions to the CCIR. This review helps US delegations prepare summaries, critiques, and impact assessments for international meetings.

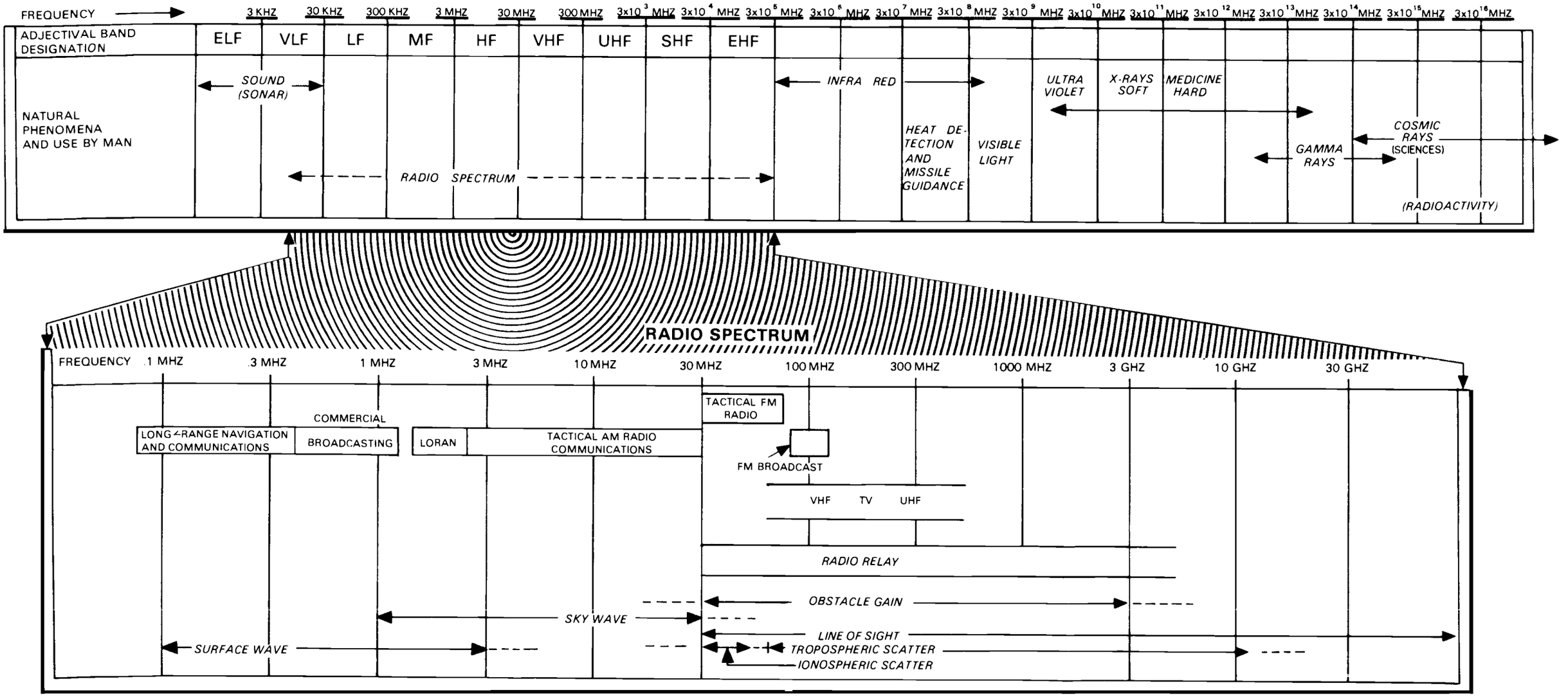


Figure 1-2. The electronmagnetic spectrum with the radio portion highlighted.

Chapter 2

National Spectrum Management

2-1. Introduction

The Communications Act of 1934, as amended, governs radio spectrum use in the United States and its possessions (US&P). The act established duality in spectrum management in the US between the President for federal government stations and the FCC under the direction of Congress. The FCC regulates the spectrum use of nonfederally operated radio stations, common carriers, and private organizations or individuals. By Executive Order 12016 of 1978, the President delegated his functions under the act to a new organization created as the NTIA and placed them under the Secretary of Commerce. This chapter discusses these agencies and their functions in national spectrum management.

2-2. The NTIA

The Communications Act of 1934 gave control of government radio stations to the President. The President, through the NTIA, will--

- Control all frequency resources in the US&P.
- Authorize foreign governments to construct and operate fixed service radio stations at their embassies. (Frequencies are assigned to these stations if it is in the national interest and if foreign governments grant reciprocal privileges to the US.)

Two committees advise the NTIA and serve essential spectrum management functions.

The Frequency Management Advisory Council, established in 1965, consists of experts from the civil sector who meet when necessary to make recommendations on spectrum management and electromagnetic compatibility (EMC).

The Interdepartmcnt Radio Advisory Committee (IRAC), established by Presidential Order in 1922, is the policy-making agency of the NTIA. Most often, spectrum managers deal with this committee. Figure 2-1 shows the representatives from government departments or agencies which make up the IRAC.

Four subcommittees carry out the IRAC's daily functions. These are the Frequency Assignment Subcommittee (FAS), the Spectrum Planning Subcommittee (SPS), the Technical Subcommittee (TSC), and the International Notification Group (ING).

The FAS recommends approval of frequency assignments for government radio stations to the Director of NTIA. The Aeronautical Assignment Group (AAG) and the Military Assignment Group (MAG) make up the FAS.

The Federal Aviation Administration (FAA) chairs the AAG. The Navy, Air Force, and Army make up this group. The AAG approves frequency assignments for aeronautical operations.

The MAG has the same members and is chaired by the Air Force. The MAG approves frequency assignments for nonaeronautical operations.

The SPS supports the IRAC and the NTIA in planning RF spectrum allocations for established or developmental radio services. The SPS maintains a direct liaison with the FCC.

The TSC assists the Director of NTIA on using signal equipment and techniques and in establishing performance standards for equipment. It also researches ways of ensuring effective RF spectrum use.

The ING is responsible for all correspondence with the ITU on US frequency assignments.

2-3. The FCC

The Communications Act of 1934 created the FCC as an independent government agency directly responsible to Congress. The FCC regulates nonfederal government telecommunications.

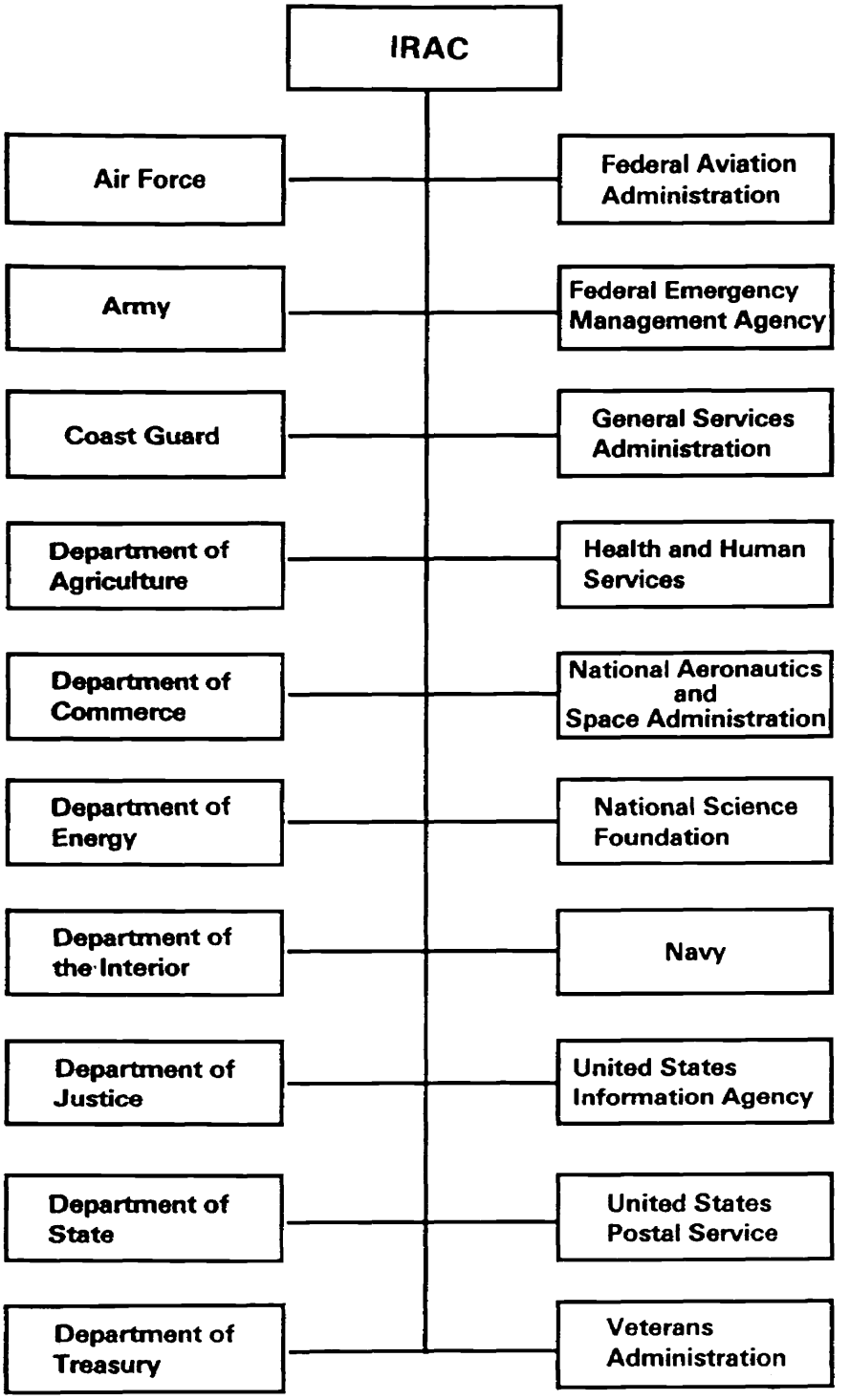


Figure 2-1. IRAC.

The FCC maintains a liaison at all IRAC meetings and works with its subcommittee even though the FCC is not an IRAC member. The liaison is the crossover point for spectrum management actions requiring FCC coordination.

The FCC conducts its management functions under the Administrative Procedures Act. Rule-making processes are administrated with full public knowledge and are subject to hearings. The FCC will only act on or accept formal statements from Headquarters, Department of the Army. However, the FCC will consider personal matters of Army personnel.

The radio spectrum within the US is divided between exclusive government, exclusive FCC, and bands shared by both. An example of an exclusive government band is 225 to 400 MHz and is designated for military use. Exclusive FCC management is shown in broadcasting bands. Government and nongovernment users share 60 percent of the radio spectrum (up to 5000 MHz).

2-4. Office of Management and Budget

Following Executive Order 12016, the Army's right of appeal to an unacceptable radio spectrum decision by the NTIA or IRAC is to the Director of the Office of Management and Budget (OMB).

OMB Circular A-11 directs that before acquiring spectrum-dependent equipment, RF supportability shall be documented as early as possible during concept exploration, demonstration, and validation stages. This is reflected for Department of Defense (DOD) agencies in DOD Directive 4650.1.

Chapter 3

DOD Spectrum Management

3-1. Introduction

The DOD and each military service have their own spectrum management agencies. This chapter identifies and describes the functions of these agencies.

3-2. The DOD

The deputy under secretary for command, control, communications, and intelligence (C3I) is responsible for DOD spectrum management policy. Within the US&P, the three military services representatives coordinate spectrum management through the IRAC. Outside the US&P, these services coordinate spectrum management through military channels.

3-3. Military Communications-Electronics Board

The Military Communications-Electronics Board (MCEB) is the main coordinating agency for signal matters among DOD components, between the DOD and other government departments and agencies, and between DOD and foreign nations. (See Figure 3-l.) The MCEB functions under the policies and directives of the Secretary of Defense and the Joint Chiefs of Staff (JCS). The MCEB guides the DOD in preparing and coordinating technical directives and agreements and in allocating spectrum allotments from the NTIA. DOD directives state that DOD components will obtain MCEB guidance before assuming contractual obligations for developing or procuring telecommunications equipment purposely designed to radiate or receive electromagnetic energy. Table 3-1 lists the members comprising the MCEB.

Table 3-1. The MCEB.

Director, Command, Control, and Communications Systems (C3S), Office of the Joint Chiefs of Staff, the chairperson.
Director, Defense Communications Agency (DCA).
Army Director of Information Systems for Command, Control, Communications, and Computers (DISC4).
Director, Naval Communications Division, US Navy.
Assistant Chief of Staff for Information Systems, US Air Force.
Director, Command, Control, Communications, and Computers (C4) Systems Division, Headquarters, US Marine Corps.
Director, Joint Tactical Command, Control, and Communications Agency (JTC3A).
Director, National Security Agency (NSA) or the representative.

3-4. The Joint Frequency Panel

The joint frequency panel (JFP) is the principal DOD coordinating agency for spectrum management. This panel works closely with the IRAC's FAS. The JFP reviews, develops, coordinates, and implements DOD directives, studies, reports, and recommendations for the MCEB. Study areas include RF engineering and management, radio wave propagation, and EMC. With the addition of the Coast Guard, membership in the JFP is the same as the MCEB.

3-5. DOD Area Frequency Coordinators

DOD area frequency coordinators (AFCs) coordinate field use of RFs within designated frequency ranges and geographic areas. Frequencies used in these areas must be coordinated with the appropriate DOD AFC before making a frequency assignment. See Appendix C for additional information.

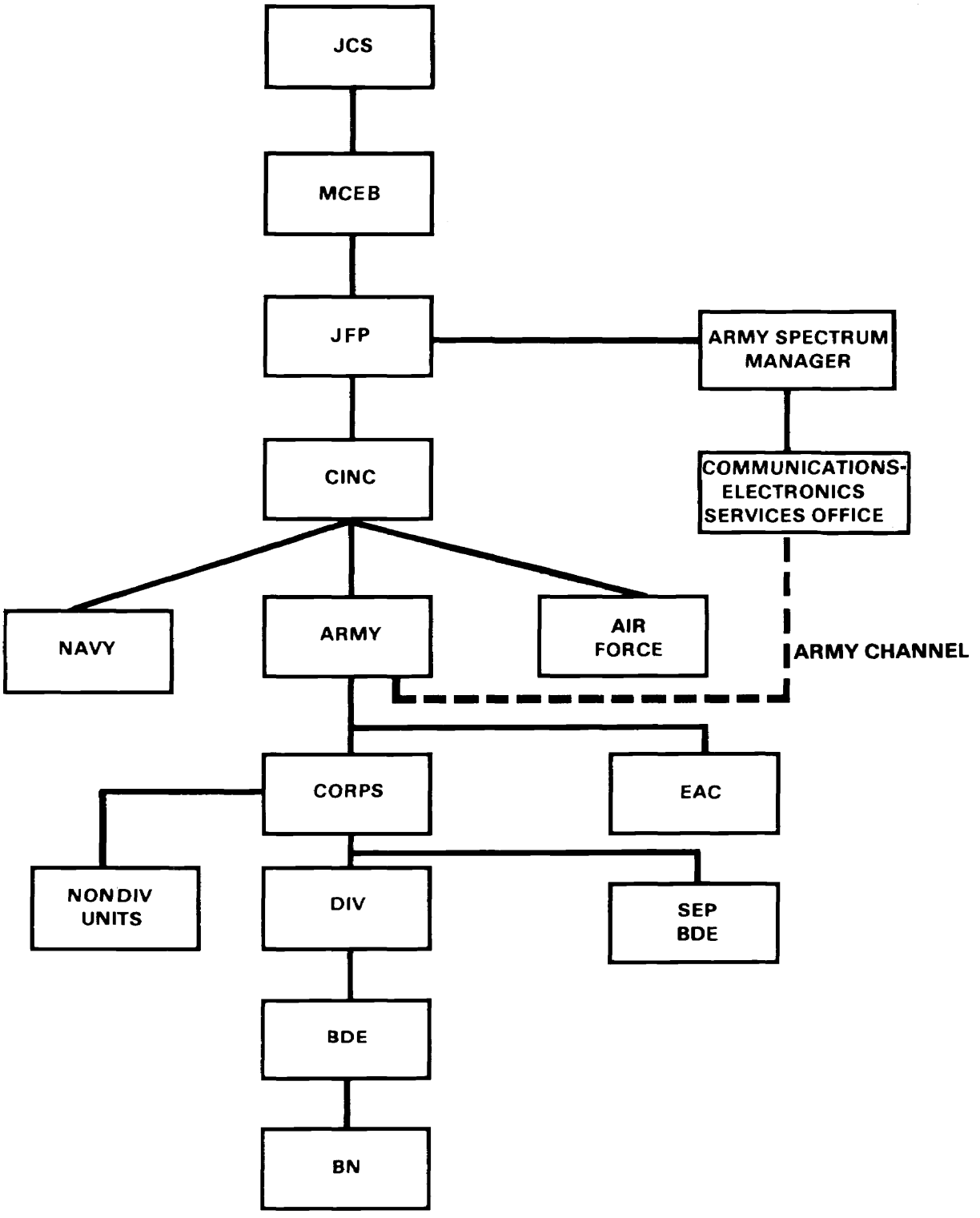


Figure 3-1. US military spectrum management channels when deployed outside the continental United States.

3-6. Electromagnetic Compatibility Analysis Center

The Electromagnetic Compatibility Analysis Center (ECAC) advises and assists the Secretary of Defense, the JCS, military departments, other DOD components, and civilian agencies on EMC matters. The ECAC maintains the data bases and mathematical and computer analysis techniques for investigating DOD and interservice EMC problems.

3-7. Army Spectrum Management

The Army spectrum manager in the office of DISC4 has the functional responsibility for Army spectrum management. The Communications-Electronics Services Office and close coordination with major Army commands directly support the Army spectrum manager. (See AR 5-12.)

The Communications-Electronics Services Office provides the major coordination and frequency planning at the Department of the Army (DA) level with the Army spectrum manager. It also supervises the operation of the Army Frequency Management Office-Continental United States (AFMO-CONUS) at Fort Sam Houston, Texas which consolidated the regional frequency coordination offices in 1989. Army participation in the national radio regulatory structure is accomplished at departmental levels with the NTIA, the FCC, and other federal departments through the IRAC and its subcommittees.

Army spectrum management is decentralized through major commands, posts, camps, stations, and operating forces. United States Army Information Systems Command (USAISC) personnel manages frequency assignment requirements locally at posts, camps, and stations. This is normally done through the Director of Information Management (DOIM) and forwarded to AFMO-CONUS or the Communications-Electronics Services Office for action. The installation manager is the first level of coordination for spectrum managers at CONUS Army installations. Coordination includes frequency, equipment, power, emission, and location.

By OMB and DOD directives, frequency allocation for Army development and acquisitions must document frequency supportability before procurement. This is done through the JF-12 process using DD Form 1494 and nationally through the IRAC's SPS. This task is delegated to the United States Army Materiel Command (AMC), and by it, to the Army Communications-Electronics Command (CECOM). Because of its impact with operational frequency assignment, the plans and engineering branch of the Communications-Electronics Services Office participates in the allocation to equipment process with CECOM. Frequency allocations to equipment defines the frequency characteristics of equipment being procured and indicates its frequency supportability. Operating this equipment requires the additional step of frequency assignment for use in the intended operational environment. EMC is the process of predicting and controlling potential interference in allocations planning for new equipment and for frequency sharing of the equipment in its operating environment.

Figure 3-2 shows the Army organization for spectrum management.

3-8. Unified/Specified Commands, Treaty Organizations, and Other Foreign Areas

The electromagnetic spectrum is a natural resource within any sovereign nations boundaries and can be used only with that nation's consent. Except forced entry, the Status of Forces Agreement (SOFA) made with host nations defines frequency provisions and procedures to be followed in all frequency and radio regulatory matters.

Unified commands are normally established for missions requiring significant assigned components of two or more services. Specified commands are normally established for missions requiring a force consisting primarily of units from a single service. The highest command present controls spectrum management. The MCEB provides policy guidance. Unified and specified commanders, subject to host nation agreements, have overall management and control responsibility for all US military electromagnetic spectrum use within their operational zones. Through the Combined Communications-Electronics Board (CCEB), direct military channels have been established between the US and the United Kingdom, Canada, New Zealand, and Australia. Unified and specified commanders make frequency assignments for certain intracommand communications provided--

- Coordination has been accomplished with the government of the host nation, with local US government agencies such as the FAA, the FCC, or Army, and DOD AFCs.
- National or international protection is neither desired nor required.
- NTIA and FCC jurisdictional areas are not involved.

- Harmful interference with authorized users registered with the NTIA, the IFRB, or the host nation will not result.

The Allied Radio Frequency Agency (ARFA) is responsible for all North Atlantic Treaty Organization (NATO) plans, policies, and signal requirements engineering. The US has a permanent ARFA representative at Headquarters, United States Commander-in-Chief Europe (USCINCEUR). A deputy representative (at NATO headquarters in Brussels, Belgium) is the contact point for all US signal requirements at ARFA headquarters.

In Korea, the US Forces Korea, J6 is responsible for US military frequency management. He has direct liaison with the Korean government through the Joint Military Frequency Committee. This committee handles spectrum matters for all allied forces in the Republic of Korea.

There is no equivalent to the ARFA or the Joint Military Frequency Committee in other treaty organizations. Each military department's headquarters plans spectrum use and forwards such plans to other administrations through diplomatic or military channels.

3-9. Electromagnetic Environmental Effects

The increasing electromagnetic density of users and the higher powers in weapon radar systems and communications have impacts on electronic controls and devices that may cause malfunctions, desensitization, and other undesired effects. These include detonation of firing squibs, explosives, or harmful effects on personnel. This is electromagnetic environmental effects (E3). In view of its significant impacts and threats to safety, this area previously included in spectrum management was established as a separate program in 1989.

Army E3 matters are defined in Interim Guidance for the E3 Program. It was published by the Army Acquisition Executive. The E3's goal is to ensure that material will accomplish its intended mission in the electromagnetic environment created by strong radio/radar emitters (friendly and hostile), electrical noise pulses, or natural effects in peace and war.

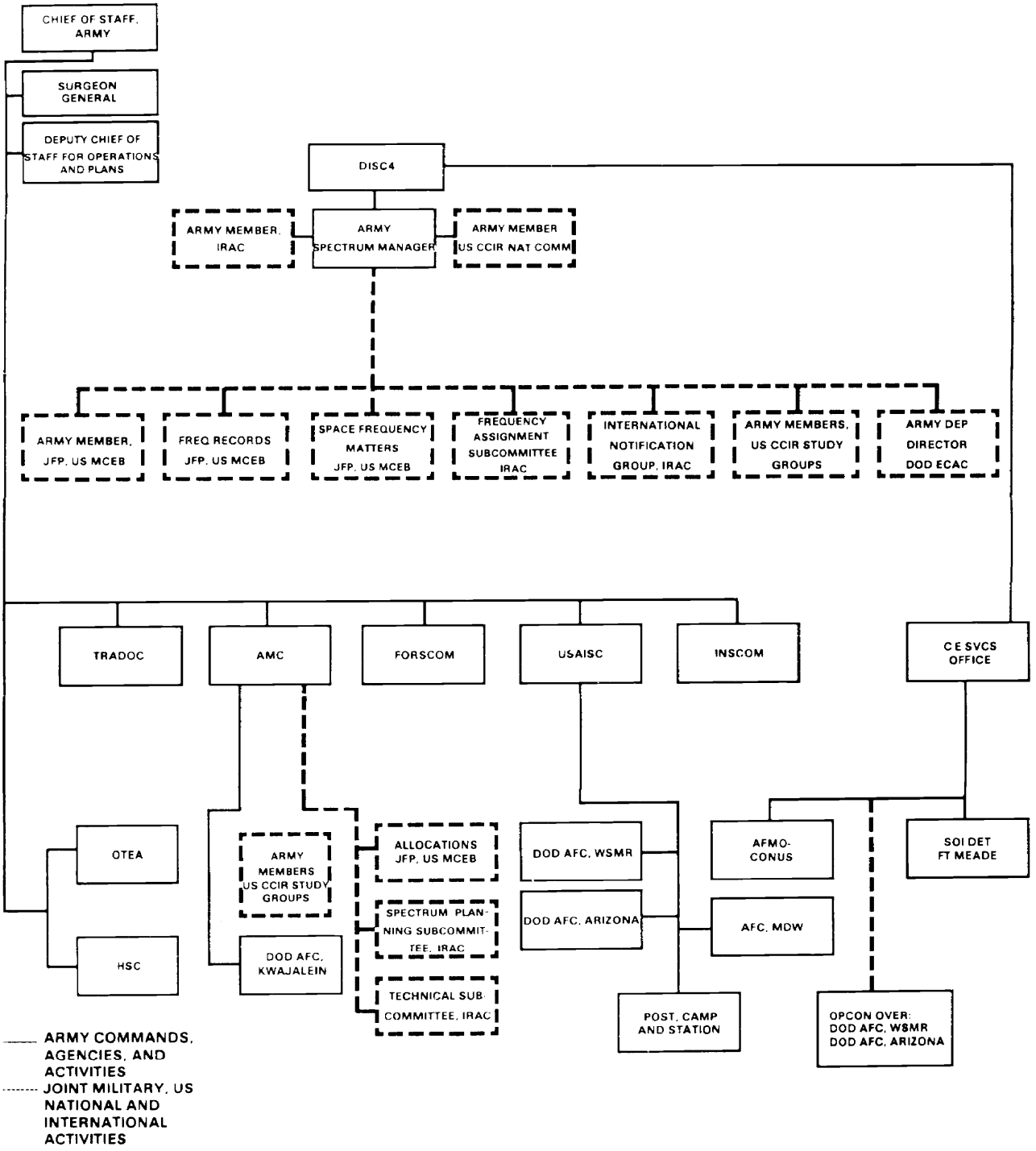


Figure 3-2. Army spectrum management organization.

Chapter 4

Tactical Battlefield Spectrum Management

4-1. Introduction

Tactical battlefield spectrum management (BSM) is the systematic planning, managing, engineering, and coordinating electromagnetic spectrum use by units engaged in combat and training for combat. At each level, the signal officer is responsible to the commander for spectrum management. At division, corps, and echelons above corps (EAC) levels, specially trained members of the signal staff section perform the day-to-day BSM functions. The spectrum manager is responsible for coordination with higher, subordinate, and adjacent units and with other staff sections.

4-2. Tactical BSM Problems

On the modern battlefield, an unprecedented number of sophisticated systems support the commander to win the first battle. Most of these systems rely on the electromagnetic spectrum.

The electromagnetic spectrum is an increasingly limited resource. Most likely without proper management the electromagnetic spectrum will quickly reach saturation and will seriously degrade mission performance.

Electromagnetic spectrum management was associated mainly with selecting proper operating frequencies. On the modern battlefield, spectrum management must consider shared use not only by communications systems, but also by intelligence/electronic warfare (IEW), data, navigational, radar, and sensor systems. Due to the potential adverse effects, spectrum management must be an area of command interest.

In developing to the greatest extent possible a conflict-free electromagnetic spectrum usage plan, comprehensive and current information on emitter characteristics and frequency availability is essential. Currently, spectrum management is largely a manual process. However, with the arrival of automated systems, maintenance of the data base for this information becomes a simpler and easier task and a more efficient process.

4-3. Importance of Spectrum Planning

The primary mission of BSM is to ensure that spectrum-dependent systems will function as intended. The management process to support and control these systems is not limited to providing frequency assignments, resolving conflicts, and developing equipment. It also includes advising the commander on methods to reduce his unit's electromagnetic signature.

Coordination is the key to effective spectrum management. By direct coordination with higher, lower, and adjacent elements, the spectrum manager can reduce or omit harmful interference from friendly forces. Coordination with the spectrum manager having assignment authority for a specific frequency or frequency band is required before conducting IEW operations. This coordination reduces any adverse impact on friendly forces and helps to increase effectiveness of friendly IEW.

Spectrum management must be involved in developing spectrum-dependent equipment. To ensure new systems can perform as designed, EMC analysis and other procedures must be followed as described in AR 5-12. Systems, especially tactical systems, must be designed to operate in any of the ITU's three regions. The frequency allocation tables of nations where systems can reasonably be expected to be deployed must be considered during the development phase.

4-4. BSM Functional Tasks

At each tactical level, the signal officer is responsible to the commander for BSM. At division, corps, and EAC levels, the signal officer relies on the signal staff section to perform the day-to-day spectrum management functions. These functions are broken down into four basic categories. They are--

- Spectrum apportionment.
- Data base maintenance.

- Interference resolution.
- Spectrum signature assessment.

The spectrum manager with the electronic warfare officer (EWO) establishes and updates a joint restricted frequency list (JRFL). This list is based on the G3 priorities from the commander's guidance. (See Appendix J.)

The traditional perception of spectrum management is that it consists solely of apportioning spectrum to the user's equipment. On the modern battlefield, this continues to be important. The five subfunctions of spectrum apportionment are--

- Determining spectrum requirements.
- Obtaining required resources.
- Matching resources to requirements.
- Distributing resources to the user.
- Evaluating and optimizing spectrum use.

Battlefield spectrum requirements are determined by the user's operational needs. Based on doctrine and experience, the spectrum manager must make a good estimate of a unit's spectrum requirements. The operation and the equipment available determine the actual requirement. This data is drawn from operation orders (OPORDs), standing operating procedures (SOPs), and coordination with unit signal officers. The data will be categorized as follows:

- VHF-FM.
- VHF-AM.
- UHF-AM.
- UHF-FM.
- HF ground wave.
- HF sky wave.
- Multichannel communications.
- Satellite.
- Radar.
- Jammers.
- Air ground.
- Data links.
- Data distribution systems.
- Navigational aids.
- Sensors.
- Directed-energy weapons.

Frequency restrictions - All radios for a particular net must be able to operate on the same frequency. Net frequencies must be assigned with primary consideration given to the older series radio's tuning capabilities. This also applies to channel spacing. For example, the older series of VHF-FM radios has a channel every 100 kHz, the current series every 50 kHz, Single-Channel Ground and Airborne Radio System (SINCGARS) and the new squad radio (AN/PRC-126) every 25 kHz. Nets involving different radios must consider these differences.

COMSEC considerations - The AN/VRC-12 series can operate with the KY-8/38 (NESTOR) or KY-57 (VINSON). The SINCGARS series only operates with VINSON. Therefore, nets with different COMSEC devices or mode of operation cannot operate in the SECURE mode.

Frequency resources are obtained from elements at EAC. Normally, a corps receives its resources from the theater spectrum management authority; a division receives its resources from the corps. The earlier the planner identifies the spectrum requirements, the easier it is for the spectrum manager to obtain the necessary resources. Every effort is made to obtain and pass on resources with the fewest restrictions allowing users maximum flexibility.

Resources are matched to requirements through coordination, allocation, allotment, and assignment. Coordination is a never-ending process and is essential to an effective spectrum management program. Allocation, allotment, and assignment have distinctly different meanings than they might have in normal use.

Allocation is establishing frequency bands for specific functions or radio services such as broadcast, fixed, and mobile. When authorizing more than one type of service in

a band, rank services as primary, permitted, or secondary. Primary and permitted services have equal rights except in preparing frequency plans. The primary service has first choice of frequencies. Secondary services are on a noninterference basis (NIB).

Allotment is establishing specific bands or frequencies within a prescribed nationally or internationally allocated band.

Assignment is the authorization given by the proper authority for a radio station to use an RF or radio channel under specified conditions. Assignment is the main method of matching resources to requirements.

Once resources are matched to requirements, the assignments are distributed to the users. FM 24-16 details the formats for disseminating signal information. The primary means of distributing VHF-FM, VHF-AM, and UHF-AM assignments is the signal operation instructions (SOI). MSE LOS multichannel system assignments within the division are done by the division signal battalion. Within the corps, assignments are done by the corps signal brigade.

Constant review optimizes spectrum use. System efficiency, effective spectrum use, and changes in the unit mission are analyzed ensuring the tactical commander receives the required support.

4-5. Spectrum Apportionment Tasks

Most requirements are identified at division level and passed to the division spectrum manager. If the division spectrum manager does not have the resources to fill the requirement, he requests support from the corps spectrum manager. Similarly, if corps does not have the resources, the request is passed to EAC. At EAC, many variations occur in the spectrum manager's processing of the request. The EAC spectrum manager does not necessarily represent one level or agency. He can be located at post, camp, stations, theater Army, unified command, Army, or DOD levels.

The ITU recognizes that the electromagnetic spectrum of each sovereign nation is, within its territory, as much a natural resource as any mineral, and is therefore subject to that nation's regulation. The ITU publishes allocation tables in which member nations should adhere. Most ITU member nations (and even nonmember nations) stay fairly close to the ITU tables when developing national allocations. A commonality of 80 percent or more is normally found between the ITU tables and those of a given nation. However, a nation may use its spectrum resources in any way as long as it does not interfere with spectrum users outside its national borders.

In most nations, only one agency allocates and assigns frequencies such as a communications ministry or the agency controlling the post and telecommunications or its equivalent. The two agencies within the US&P are: the NTIA/IRAC for federal government users and the FCC for civil and nonfederal government users. Military assignment actions that take place in the US&P fall under the NTIA/IRAC umbrella. In the US Army, assignment authority is seldom found below the division level.

In the ITU region 2 (North and South America), the band 225 to 328.6 MHz has a primary allocation to the fixed and mobile services with a small allocation (267 to 273 MHz) to the space operation (telemetering) service. The US tables have a government-only allocation to the fixed and mobile services throughout the entire band with no accommodation for space operation or civil use. The US tables are footnoted to limit operations primarily to the military services. The NTIA manual gives the MAG management authority for the band. The military departments, in their MCEB role, have collaborated on an allotment plan that segments the band into 25 kHz channels. Each channel is designated for MAG use or for a functional use (such as joint radio relay). The DlSC4 has recorded several of the Army designated channels in the IRAC government master file as group assignments (for example, 234.700 MHz US-wide). This group assignment gives the US Army authority to use 234.700 MHz anywhere within the CONUS. The Army AFCs may then be authorized to manage this frequency within their respective geographic regions. The AFCs may delegate this assignment authority to corps in their region, who may further delegate the authority to subordinate divisions.

Spectrum requirements must be determined as early as possible during operation planning or during equipment development stages. Obtaining frequency resources can be a complex and time-consuming process. It can take a few days to several months. Frequency support may take years to coordinate. Examples are newly developed signal systems, satellite systems, and American Forces Network stations. These actions usually begin at levels above corps.

Sometimes, short notice requests are not fulfilled at all, or the resources provided are less than optimal.

The accuracy of a frequency request can make the difference between mission success and failure. The preparer must ensure that all necessary data is included and correct. This data includes radio emission designators (Appendix D) and station classes (Appendix I). Next, the preparer must justify the requirement is mission essential. Nice-to-have requests cannot be supported in the increasingly congested radio spectrum. Spectrum managers at EAC, and especially those at national levels, must insist on knowing the operations - why it is needed and how it will be used.

At all levels of spectrum management, the spectrum manager must be sure to submit accurate and complete frequency requests. Introducing inaccurate or incomplete frequency requests into coordination channels can result in delays and denials. The requesting spectrum manager also risks losing credibility. Future requests will be met with increased scrutiny by the coordinating/approving agencies. Credibility loss is particularly damaging when dealing with host nations. Spectrum managers must be extremely conscientious in maintaining credibility.

Spectrum management is basically a bottom-top-bottom process. The spectrum requirements are identified at lower echelons. Then, the frequency request is forwarded up through spectrum management channels until it reaches a level where resources are available. The frequency assignment notification is then sent down through those same channels until it reaches the requestor. Appendix A contains baseline BSM tasks.

4-6. Data Base Management

Equipment technical characteristics are required to apportion the spectrum and to resolve interference. These characteristics include equipment tuning range, emission, channelization, and method of tuning (crystal, continuous). Outputs of the apportionment process (such as SOI, multichannel diagrams, and other frequency use records) are basic to the whole concept of effective BSM. Through the data base, the spectrum manager should have a complete list of spectrum-dependent equipment in his area.

A spectrum manager's database may include frequency assignment records, documents containing signal equipment parameters, frequency allocation tables, lists, and indexes, equipment allocation documents, ITU and national RRs, military regulations, manuals, and pamphlets, and various other tools of the trade. Assignment records require maintenance on a continuous basis. Maintenance of the spectrum manager's data base requires maintenance on an as-needed basis.

The spectrum manager uses several documents as frequency assignment records. The EAC spectrum manager issues the current assignment list. It reflects all permanent frequencies authorized for use by the unit. However, it does not contain specific uses for all frequencies listed. The SOI provides a record of assignments in certain bands. The NSA organization net list and sequential frequency list show the SOI assignments in different formats. Non-SOI frequencies may be kept in several different forms. These can include multichannel diagrams, assignment messages, memorandums, handwritten or typed lists, or even 3 by 5 cards. There is no standard. Likewise, methods and techniques for maintaining the records are not standardized.

Records maintenance is primarily done by manual methods. However, maintenance automation should become the norm rather than exception. Spectrum management requires spectrum managers to be computer literate. Plus, automation resources should be available for data base management to aid the spectrum manager to effectively apportion limited resources.

4-7. Interference Resolution

Interference is defined as the radiation, emission, or indication of electromagnetic energy, unintentionally causing degradation, disruption, or complete obstruction of the designated function of the electronic equipment affected. (See Appendix B.)

Interference resolution is handled at the lowest level possible. The spectrum manager is the final authority of interference. Interference may come from signal devices (such as unintentional friendly and unfriendly radios and radars) and from nonsignal devices (such as welders or vehicle engines).

After being informed of unresolved interference, the spectrum manager or a member of his staff can--

- Seek the EWO's assistance in identifyng the source.

- Advise physical relocation of the affected user.
- Advise tolerance of the interference (working through it).
- Make appropriate changes in assignments.

The EWO or G2 may detect hostile interference or jamming before it is recognized and reported to the spectrum manager. In such cases, the coordination of interference should be initiated in reverse to ensure that ineffective signal functions are recognized and corrected. A Meaconing, Intrusion, Jamming and Interference (MIJI) report may be initiated. AR 105-3 details MIJI procedures. FM 24-33 contains further information on interference and hostile jamming.

Commands handle MIJI actions differently. Some commands have the electronic warfare (EW) staff element primarily responsible for MIJI actions, while others have the spectrum manager responsible for MIJI actions. In some commands, the initial MIJI report is sent directly to the Joint Electronic Warfare Center (JEWC). Others require the initial report be reviewed by either or both the EW and BSM staff before forwarding to the JEWC.

The first three elements of MIJI, MIJ, are of primary interest to the EW community. The fourth element, I, is of concern to the spectrum manager. In most commands, the EW staff, in cooperation with the spectrum manager and other staff elements, takes the lead in resolving MIJ incidents. The spectrum manager directs interference resolution efforts.

The initial MIJI report should be sent to the battlefield spectrum manager. He has the data base to check quickly friendly frequency assignments. He may go to the next higher level spectrum manager for assistance. He determines whether the action will be handled as MIJ or I. If MIJ is determined, action is normally transferred to the EW element. MIJ actions are diagrammed separately from I actions. (See Appendix A.)

The skill of signal systems operators and maintenance personnel can mean the difference between minor inconvenience and complete system disablement. On experiencing harmful interference, the operator should be able to discern whether the interference is coming from natural phenomena or man-made sources.

If natural phenomena are the cause, the operator should try to work through the interference. Should it persist, a BSM coordinated frequency change may be in order.

If the operator suspects man-made interference, he makes an internal equipment check to exclude equipment malfunctions. In many cases, improper alignment, degraded components, antenna disorientation, or poor maintenance is the culprit. After the operator has ruled out internal causes, a check with other friendly units in the area may reveal incompatibilities between operations. If a compromise cannot be worked out between the units, the case is referred to the spectrum manager at the next higher echelon.

If interference cannot be identified through local checks, a MIJI report is submitted to the JEWC and Army addressees, as directed. The spectrum manager then continues to take whatever actions required to resolve or minimize the interference.

The JEWC analyzes the report and submits an analysis back to the reporting unit and intermediate addressees. This aids in resolution. However, the JEWC is not responsible for resolution. Resolution responsibility lies with the local unit and its higher headquarters. If outside technical assistance is required, it can be requested through the United States Army Information Systems Engineering Command (USAISEC) at Fort Huachuca, Arizona. Natural-phenomena interference and frequencies assigned as NIB are not reported to the JEWC. (See Appendix F.)

Deconfliction is the process of optimizing the use of the electromagnetic spectrum. It incorporates the requirements of the battlefield spectrum managers and the IEW community. The BSM function is basically one of planning; in contrast the IEW management functions are mainly concerned with taking advantage of combat opportunities. The spectrum manager must manage the electromagnetic spectrum and be responsive enough to permit IEW missions to be conducted against opportunities if they arise with minimum constraints.

The spectrum manager must know the characteristics of friendly force intelligence systems and EW emitters. He must be an integral part in the planning and operating of IEW missions for deconfliction to work.

The JRFL only protects against cochannel interference. For deconfliction to work, BSM requires automation capability together with the technical characteristics of emitters to do adjacent channel, harmonic and intermodulation to prevent interference to friendly forces.

Before beginning the deconfliction process, assemble the following data:

- Formation orders of battle.
- Tactical grouping for current and future operations.
- A comprehensive diagram of every communication and electronics net used. (This includes equipment types, antenna types, and frequency requirements.)
- A list of nets showing the power used and ranges over which they should operate.
- The frequency list allotted by higher headquarters, including power and/or restrictions.
- Mutual interference, characteristics of potential communications-electonics (CE) equipment to be deconflicted (intermediate frequencies are of particular importance).
- A list of known bad frequencies (frequencies which exist in the electromagnetic environment which are beyond the direct control of the commanders).
- A list of frequencies or bands planned to be used by friendly jammers.
- Spectrum use by the enemy.
- Ground and sky wave charts for the area of operation, updated by ionospheric soundings wherever possible.
- Spectrum signature data and characteristics of the equipment the IEW units plan to deploy in support.
- An initial list of relative priorities from the G3 based on the commander's guidance. (When large numbers of spectrum dependent equipment will be located within close proximity, it may not always be possible to assign noninterfering frequencies to all users. Thus, it is essential to establish a system of priorities for frequency reassignment if such equipment becomes involved in the deconfliction process.)
- Links that are inflexible and usually use fixed frequencies (such as emergency services, international distress frequencies, and air traffic control). These must be taken into account in the JRFL. (See Appendix E.)
- A JRFL and a method of maintaining currency while operations are in progress. (The JRFL must be continually revised to include redeployment of maneuver units, changes in EW plans, and changes in enemy EW readiness.)

The deconfliction process benefits the IEW staff with a real time and planned spectrum data base of friendly force spectrum assignments and their locale. The IEW staff uses this information to process out friendly force emitters when identifying and locating enemy emitters. Using this information, they coordinate with the spectrum manager when they recognize friendly force emitters are degrading their mission effectiveness by masking enemy emitters. By using the data base, the IEW staff detects and locates enemy electronic countermeasures (ECM) and its spectrum capabilities. It uses this information to predict and advise the spectrum manager which friendly force communications and electronics systems will not meet their mission, when they should take evasive actions, or when to activate their electronic counter countermeasures (ECCM). The spectrum manager provides guidance to friendly force communications and electronics systems personnel. In many cases, the IEW staffs advice prevents unnecessary testing by friendly force personnel in determining if they have an equipment failure or are being subjected to enemy EW.

Should there be conflict between the spectrum manager and the IEW staff on deconfliction, the G3 has final decision authority.

4-8. Spectrum Signature Assessment

A spectrum signature is the distinct pattern of spectral emanations from a device or collection of devices. These devices include signal equipment, power generators, vehicle engines, welders, and the radiation from command

post (CP) facilities. These facilities include radio parks, airfields, motorpools, and forward area rearm/refuel points. A pattern is formed by several variables: time of day, geographic area, number, type, frequency, and power of emitters. These variables make up an identifiable electromagnetic signature.

The spectrum manager is the point of contact for spectrum signature vulnerability. This is a subordinate part of his responsibilities as the emission control (EMCON) officer. EMCON also includes considering heat emanations from engine blocks that infrared devices can detect. EMCON and effective implementation of ECCM are the spectrum manager's responsibility. For example, the spectrum signature assessment portion of ECCM relates to the spectrum manager's responsibility to determine the distinguishing characteristic of the emanating patterns. ECCM procedures, the SOP, or the ECCM annex to the OPORD point out steps in preventing a sophisticated threat radio electronic combat unit from identifying targets through frequency spectrum emanations. FM 24-33 outlines ECCM procedures. Every signal system user should read and practice the techniques described in FM 24-33 and ACP 125, US Supplement 1.

The objective of spectrum signature assessment is to evaluate the degree to which the unit's facilities are identifiable by their spectrum signature and to advise the commander on ways to lessen the command's vulnerability. TRADOC Pamphlet 525-23 refers to signature assessment as a BSM responsibility.

4-9. Division BSM

The division is the largest maneuver element in the Army. The division, however, is not alone in its area of operation, and these other units impact on the division's spectrum use. The division commander, through the division signal officer (DSO), has authority over spectrum use in his area of operation. This authority does not necessarily extend to corps, EAC, other services, or allied forces in his area. Coordination is the division G6's key to success in providing effective and flexible spectrum use.

FM 11-50 contains the specific personnel responsibilities for division BSM. For this discussion, the key personnel are the DSO, the division G6 (formerly assistant division signal officer (ADSO)), the radio officer, and the spectrum management NCO.

The DSO, as the signal battalion commander, is responsible for BSM within the division. The radio officer and the spectrum management NCO serve as members of the division G6 staff. They perform the day-to-day BSM functions.

The radio officer/spectrum management NCO has staff supervision over all radio communications established in the division. The radio officer/spectrum management NCO works for the division G6. However, he coordinates closely with the division signal battalion S3 when preparing multichannel systems diagrams. The radio officer does not coordinate frequency use or frequency allocation to multichannel systems. This is the S3's duty. (See Appendix G.) The radio officer provides the S3 current and future division unit locations and circuit requirements. The S3 prepares the radio relay diagrams. The radio officer/spectrum management NCO--

- Prepares and issues radio net diagrams for the division nets.
- Maintains an RF use register and map to ensure an up-to-date RF assignment for all systems except multichannel.
- Supports the division tactical CP as the division G6 representative.
- Prepares items of the division SOI on radio matters.
- Coordinates frequency assignments to aid in frequency compatibility within the division and with adjacent divisions.
- Is responsible for distributing frequency information associated with the SINCGARS and other frequency-hopping (FH) equipment. (See Appendix H.)
- Coordinates with corps for hopsets and transmission security (TRANSEC) codes.
- Implements TRANSEC policy within the division.
- Is the point of contact for MIJI and all ECM operations.

4-10. Corps BSM

The corps is the Army's principal force in the theater of operations. Figure 4-1 shows a typical corps structure. The make up of the corps varies with mission requirements. It controls up to five and two-thirds divisions and selected combat support and combat service support units. Examples are the military police, military intelligence, psychological operations, civil affairs, and US Air Force weather units. The corps can cover an area as large as 140 kilometers wide by 250 kilometers deep. The electromagnetic spectrum management of this area includes the airspace above it. Emerging AirLand Operations doctrine is changing the corps area from linear to nonlinear. It will also greatly extend the corps area. (See Figure 4-2.)

FM 11-92 covers the specific personnel responsible for corps BSM. Their titles and general responsibilities are discussed in the following paragraphs.

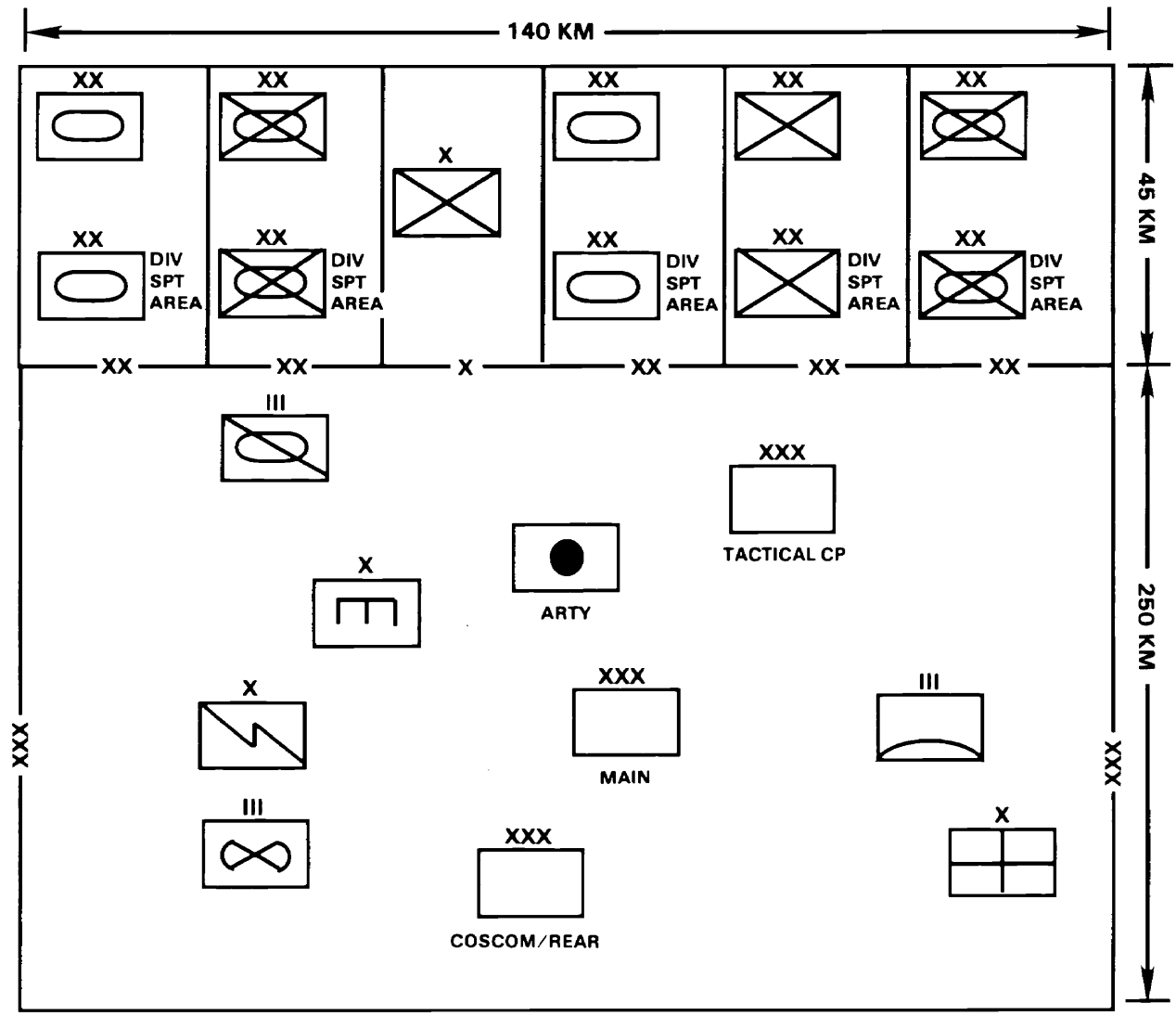


Figure 4-1. Current corps structure.

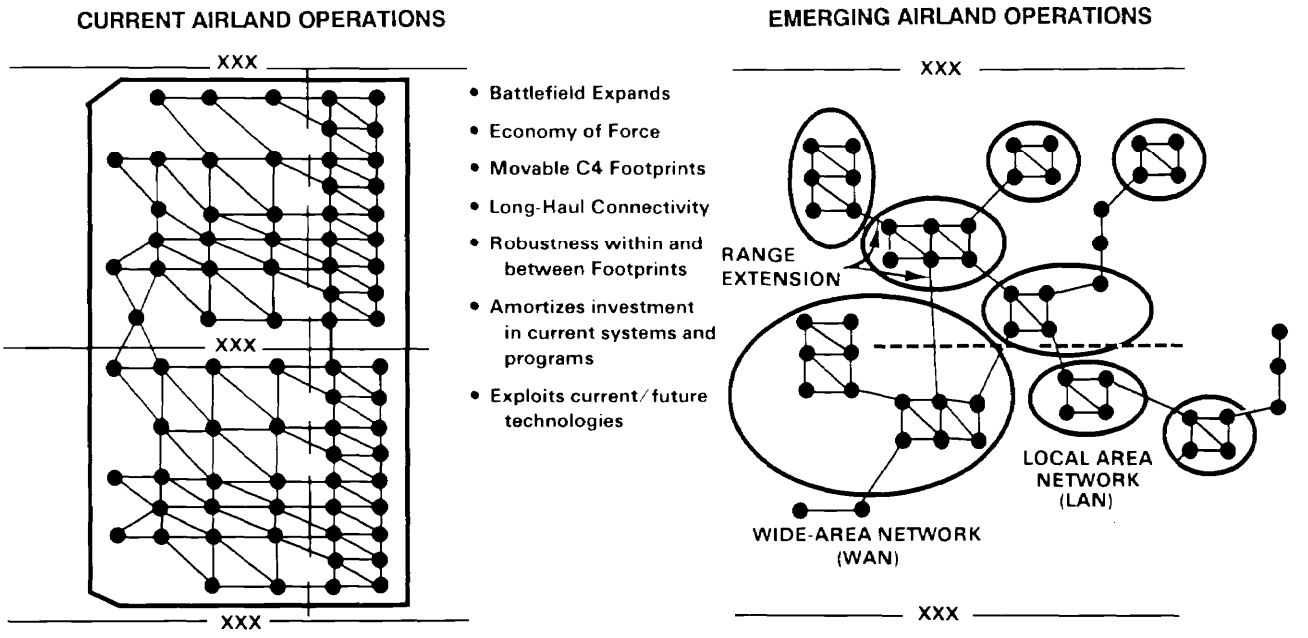


Figure 4-2. C4 coverage--current AirLand Operations versus emerging AirLand Operations.

The corps signal officer (CSO) who is the corps signal brigade commander is responsible for BSM within the corps. The CSO--

- Advises the commander of spectrum impacts of planned combat operations.
- Indicates any possible conflicts between battlefield functions based on spectrum availability and proposes appropriate solutions.
- Ensures the performance of BSM functions.
- Advises on all signal matters.
- Exercises technical staff supervision over corps signal activities.
- Coordinates frequency assignments and interference problems.
- Assists in preparing EW plans and annexes.
- Advises the corps commander on electromagnetic radiation matters.

The CS0 as the signal brigade commander--

- Commands and controls all assigned and attached signal units.
- Performs communications system planning, engineering, and control functions.

At corps level, the radio frequency officer/spectrum management NCO and the radio systems officer serve as members of the corps G6 staff. They perform the day-to-day BSM functions.

The radio frequency officer/spectrum management NCO--

- Coordinates frequency assignments.
- Serves as the point of contact for MIJI and all ECM operations.
- Prepares SOI items pertaining to spectrum management.

The radio systems officer--

- Exercises staff supervision over radio communications activities.
- Prepares SOI items pertaining to radio communications.
- Coordinates with the radio frequency officer/spectrum management NCO.
- Prepares SOIs, plans, and orders for the corps headquarters, the headquarters of major subordinate commands, and various ground liaison nets.

Specific BSM staff functions include--

- Allotting/assigning/coordinating frequencies to subordinate commands.
- Coordinating implementation of effective dates of SOI editions and time period changes to radio nets of nondivisional corps units.
- Maintaining reserve frequencies in all appropriate bands for contingency, systems restoration, and antijamming operations.
- Coordinating and implementing BSM.
- Maintaining a complete and current data base on spectrum use in the corps area of operations.

At the signal brigade headquarters, the systems engineer--

- Evaluates radio propagation data for brigade radio networks.
- Assigns frequencies to units in the brigade.
- Coordinates RF requirements.
- Maintains records, prepares reports, and initiates correspondence to corps headquarters on brigade RF matters.
- Is responsible for engineering radio communication systems.

One spectrum management NCO assists the systems engineer. The CE officer and the radio officer assist the systems engineer in preparing engineering plans.

The systems engineering staff of the corps signal brigade S3 is responsible for spectrum management to support the mobile subscriber equipment (MSE) mission and engineering its communications systems.

4-11. SOI and Spectrum Management

The SOI is a COMSEC aid and a spectrum management document. The US Army Communications Electronics Services Office SOI Detachment at Fort Meade, Maryland designs SOI based on unit input requirements for central production at the NSA. FM 24-35 contains instructions on SOI. Current DA policy limits the centrally-produced SOI to separate brigades or larger size active Army and Reserve units, except in cases authorized by Headquarters, DA, DISC4 through the US Army Communications-Electronics Services Office. Those units not authorized to receive the centrally-produced SOI will make a manually-produced SOI following FM 24-35.

The signal officer at corps, division, and separate brigades and below are responsible for the unit SOI. The work sheets for each unit are filled out in accordance with FM 24-35 and are sent to the NSA. The NSA will enter the data base from these work sheets into the required format for the computer programs. The SOI is generated from this data base, proofread for errors, corrected, regenerated if necessary, printed, packaged, and shipped by Armed Forces Courier Service (ARFCOS) or commercial carrier. It is delivered to the COMSEC account number servicing the controlling authority for the SOI. Once distributed, it is protected like all similarly classified material. The SOI contains call signs, frequencies, suffixes, expanders, and passwords which change at least once every 24 hours.

Tactical call signs are letter-number-letter combinations. Units that normally operate together in a net or nets have last-letter-unique call signs. Once a net is established, only the last letter of the call sign and a suffix are used by those units. This reduces transmission time and makes it more difficult for a threat force to identify a unit. Suffixes and expanders are used to further identify a user where confusion could otherwise result. Other SOIs may be manually produced as required with prior approval of the controlling authority. Three basic SOI are a training SOI, an operational/reserve SOI, and an exercise SOI.

A training SOI is used during routine classroom, garrison, and field training situations for which exercise SOI are not produced. At least three ten-time period (30-time period total) SOI editions should be prepared. These editions are rotated to simulate operational use and are reused until replaced. Replacement is usually caused by unit reorganization, major frequency allocation, or normal wear and tear.

An operational SOI is used for daily operations. A reserve SOI is the next time period's operational SOI. The term operational/reserve refers to either SOI. However, the reserve SOI is always the contingency SOI. At least three ten-time period SOI editions should be prepared by units preparing manual SOI. Units receiving the centrally produced SOI are normally provided 180 time periods of operational/ reserve SOI.

An exercise S01 prepared as required is for field training situations where the training SOI will not suffice. At least two ten-time period SOI editions should be prepared to permit supersession/rotation actions as appropriate. Units receiving the centrally-produced SOI are normally provided at least 30 time periods (three editions) of exercise SOI.

The contents of a specific SOI depend on the requirements of the using command. The signal officer, who assumes overall managerial responsibilities of the system for the commander, determines item contents based on command mission requirements. All SOI contain standard items with each item following a standard format. The items are printed in pocket-sized books (4 1/8 by 4 3/4 inches). Each book contains ten time periods (except the Battlefield Electronic CEOI System (BECS) which has only five) of changing information.

The centrally-produced SOI is designed to meet the needs of the using command and item contents may vary accordingly. Each document normally contains--

- An index.
- Changing call signs and frequency assignments.
- Changing suffixes and expander assignments.
- Pyrotechnic and smoke signals.
- Signs and countersigns.
- Supplemental instructions for use of the above items.

(Nonchanging standard items include medical evacuation procedures, net radio interface (NRI), switchboard designators, and similar SOP items. There are 20 standard items. A unit may select any number of these items or none.)

The centrally-produced SOI has an organization net list (ONL) of all nets and their assigned frequencies for each time period. A sequential frequency list (SFL) is also produced. It contains all the authorized frequencies used in that SOI and the nets to which they are assigned for each time period. These lists may be used to identify and resolve frequency interference problems.

The corps spectrum manager manages single-channel and FH tactical combat net radios using the SOI process. He coordinates and distributes the SOI to corps assigned units, less the divisions. The signal officer is responsible for BSM support to all corps units. The SOI contains changing frequencies, call signs, and suffixes. BSM personnel manage all radio-related SOI items for corps-based units, and the frequency resources issued to divisions for inclusion in each division SOI.

Currently, all active component corps use the NSA's centrally-produced SOI. Corps BSM personnel perform a coordinating function in this automated SOI program. If corps level units produce the SOI manually, the radio frequency officer/spectrum management NCO is directly responsible for implementing the radio-related SOI items for corps-based units. The radio frequency officer/spectrum management NCO will furnish guidance to subordinate commands on frequencies, call signs, and suffixes to be used within these commands.

Because of the flexible organization of the corps, BSM techniques used may vary from those at division. Factors that determine the techniques are--

- The corps organization.
- The deployment and employment of operating maneuver forces.
- The type of operation in which the corps is engaged.
- The CE systems that support the operation.

The requirements of subordinate divisions, corps support units, higher headquarters, and units of other services in the corps area will also influence the methodology of corps BSM.

The corps spectrum manager delegates spectrum management authority for multichannel radio equipment to some units within the corps. These units include the corps signal brigade, the air defense artillery, and the air cavalry combat brigade. These particular units are allotted frequencies for line of sight (LOS) radio systems. In turn, the signal officers of those units assign frequencies from their allotments based on system engineering criteria.

There is a requirement to change call signs and frequencies (HF, 2 to 30 MHz and VHF-FM, 30 to 88 MHz) on tactical radio nets daily. The spectrum manager allots the frequencies to the divisions and assigns frequencies for corps troop units. For independent

operations by corps elements configured into task force units, the spectrum manager may choose to issue frequency allotments if the organizational area of that task organization will not conflict with the corps main area of operations.

For special signal equipment and temporary frequency assignments, the spectrum manager processes requests on a case-by-case basis. He also maintains locally generated records of each assignment for future reference. The use of weapons and special-purpose systems will be precoordinated with the spectrum manager, inputted into his data base, and used as required based on the deconfliction process.

BECS automates and decentralizes SOI production on the battlefield. It also provides automated spectrum management data for SINCGARS. BECS generates SOI data and SINCGARS spectrum management data. This data is displayed, printed, stored, and electronically loaded or transferred by SINCGARS radios. The electronic BECS SOI will eventually replace the NSA's centrally-produced paper SOI. The BECS spectrum management data generates TRANSEC key to meet the unique ECCM requirements of the SINCGARS HOPPING mode. BECS is more responsive to rapidly changing and highly mobile battlefield conditions through SOI decentralization. It is used as an integral subsystem of SINCGARS, improved high frequency radio (IHFR), short term antijam (STAJ), and other VHF (AM/FM), UHF, and HF radio systems. See FM 11-32 for further details.

4-12. Corps Area Airspace

Air Force and Navy close air support and organic Army aviation support to the ground commander present a significant additive inventory to the emitter density within the corps area of operations. The air-ground operation system includes the Army air-ground system and the Air Force tactical air control system. It extends throughout the major echelons of corps to perform reconnaissance, surveillance, fire support, and airlift. Extensive communications support to these elements is essential to ensure responsive, coordinated use of the corps airspace. Collocation of these facilities with the echelons of corps dictates their unique spectrum-dependent communications be harmonized and integrated among the competing demands for limited resources.

The corps commander is responsible for coordinating airspace activities. The spectrum manager is responsible to the commander for the electromagnetic environment within that same zone. He must be aware of any air activity which could interfere with ground maneuver unit communications. The spectrum manager can advise the corps commander on possible mutual interference and reduce any harmful effects on command and control of the corps. Coordination can increase air activity and ground actions by preventing interference. Assigned and attached Army aviation units use corps spectrum resources allotted to them. Air Force units, using frequencies in the bands allotted by EAC, require coordination with the corps BSM staff to avoid possible interference. The airspace management elements under the G3's staff supervision and the corps BSM function as focal points where airspace requirements can be met, and where airspace frequency problems can be resolved.

Another source of information for spectrum coordination is the US Air Force tactical air control center (TACC). It is responsible for airspace control, ground tactical sensor surveillance, air support, and air strike coordination and control. The airspace management liaison section at the TACC coordinates integrating Army air traffic control facilities. This coordination involves integrating flight operations centers, flight coordination centers, approach/departure control facilities, airfield control towers, and navigational aids furnished by the corps air traffic control. Thus, the TACC is another source of information and liaison for coordinating spectrum resources used by Army traffic control facilities.

The corps area is divided into a tactical operations area and a rear operations area. The dividing line between the two is defined as the rear boundary of the frontline divisions. Procedures for airspace control and coordination within the two areas are defined in terms of traffic movement and electronic control. The interface point for integrating the corps and the air forces is the battle coordination element (BCE) located at the TACC. The corps representatives in the airspace management liaison section are members of the BCE. They coordinate corps requirements to operate aircraft and/or weapon systems within the airspace over the corps. Therefore, Army representatives in the TACC help the corps spectrum manager resolve airspace electromagnctic spectrum problems.

4-13. Corps Air Defense Artillery Operations

Air defense artillery weapons use within the corps is integrated into the force commander's scheme of maneuver. Theater Army air defense artillery units (brigades and battalions) are normally placed to support the corps. It may be an Army air defense command, brigade, or battalion depending on the size of the theater of operations, the number of air defense artillery battalions assigned, and the corps commander's stated requirements. Nondivisional air defense artillery units in the corps area (HAWK, PATRIOT, SHORAD) establish internal and external radio nets, internal multichannel radio systems, semiautomatic command and control systems, and radar equipment. Their use must be coordinated with the spectrum manager. Their CPs are integral parts of the airspace control system which regulates firing of air defense weapons and prevents undue interference with other operations. The corps spectrum manager coordinates spectrum resource use and resolves competing spectrum assignments to minimize mutual interference.

4-14. Military Intelligence Combat Electronic Warfare and Intelligence

Military intelligence combat electronic warfare and intelligence (CEWI) units will be deployed throughout the theater area and will provide assistance in EW, interference, and jamming. The CEWI staff includes an EWO who can be consulted on EW matters. Military intelligence CEWI units supporting the division, corps, or theater may be requested to identify and locate an interference source.

Communications is essential to intelligence operations. With the integration of all intelligence, security, and EW assets into one unit, the military intelligence CEWI's mission dictates using the electromagnetic spectrum, plus resources for command and control of its own units. Corps G2, G3, EW, and BSM personnel must closely coordinate with each other to optimize command and control communications while effecting EW operations against the threat force. The basic task for the spectrum manager is to analyze the impact of proposed IEW operations on command designated priority command and control communications. The G3 has final decision authority should any conflict between the IEW staff and BSM staff occur.

4-15. EAC BSM

EAC command structure is normally that of a US theater. EAC may include US-only headquarters, theater Army, a joint task force, and/or a headquarters containing personnel from more than one nation. Since peacetime military forward deployments exist, US Army forces must operate within Allied command relationships to obtain host nation support which includes spectrum assets. Figure 4-3 shows a typical US national chain of command for a theater of operations. BSM coordination lines will parallel these command lines for national spectrum-related activities.

4-16. Unified Command BSM

In all overseas commands involving large geographic area and services, a unified command is established for a theater of operations. The major Army, Navy, and Air Force headquarters are component commands within the theater.

Spectrum management for US military forces in an overseas area is under the control of the highest command present. In a unified command, the JCS provide policy guidance, and the overseas commander provides theater guidance to the component commands. The theater commander exercises control over electromagnetic spectrum use within the theater through his joint staff. The J6 has primary staff responsibility for spectrum management in the theater. The J6 office includes trained spectrum management personnel who are responsible for the allotment and assignment of all frequencies used by forces within the theater or zone of operations.

In most cases, the theater of operations involves Allied forces and the unified command in a combined operation. Moreover, some allies use and manage the spectrum differently from their US counterparts. Since many variations exist in providing definitive guidance, it is essential that US Army spectrum managers realize this and prepare to adjust to the combat situation. It is also essential that agreements be made between Allied forces and issued as early as possible so proper cross attachments between spectrum managers can be made. Basic guidance is given below.

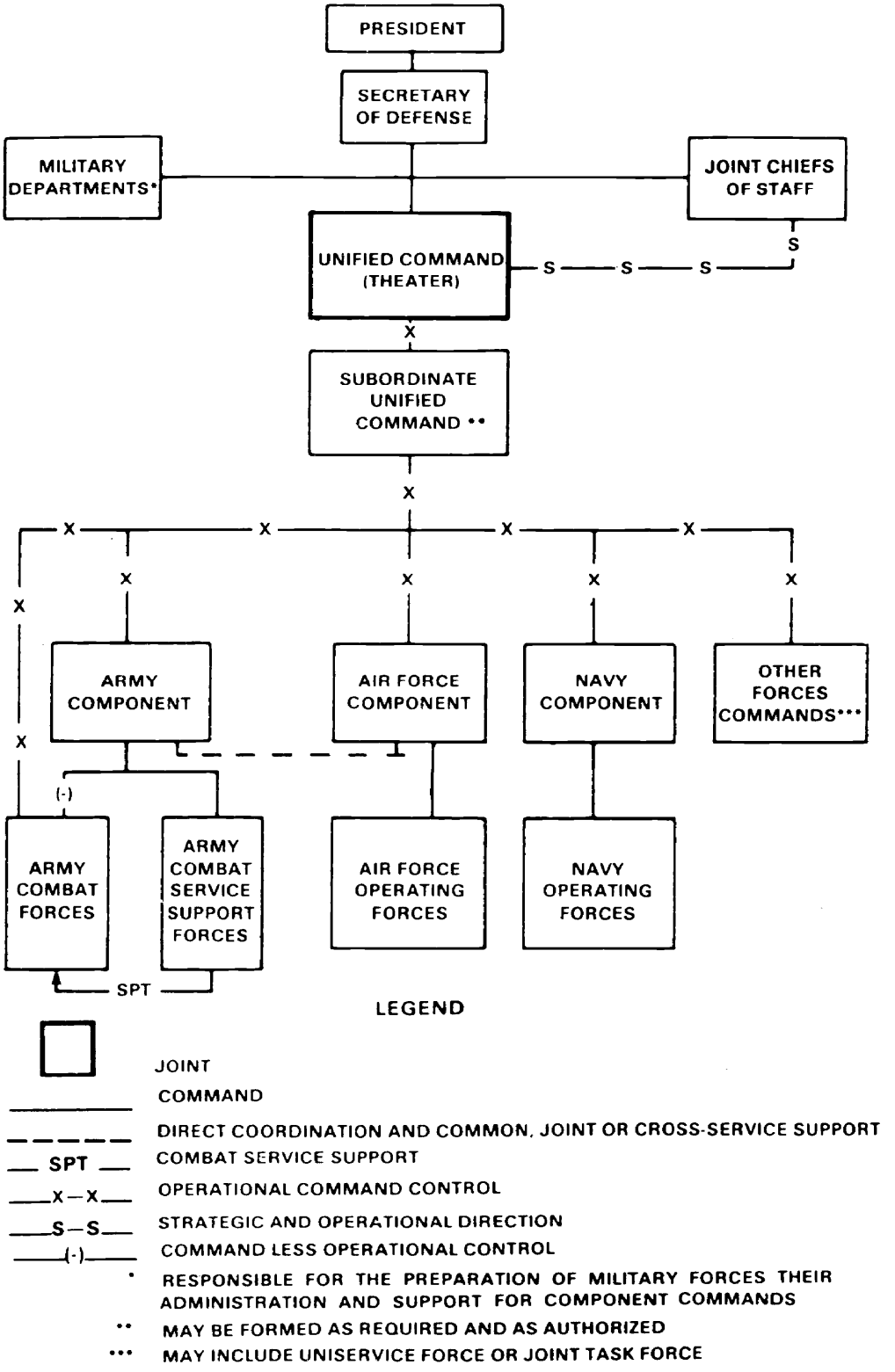


Figure 4-3. Typical chain of command for spectrum management in a theater of operations.

The spectrum management systems techniques and procedures should allow control over the resources available in that area of responsibility. The technique should also provide the flexibility needed to match a continually changing communications and electronics environment.

A higher formation is responsible for coordination with a lower formation/unit. A formation on the left is responsible for coordinating boundary requirements with the formation on the right. Frequency requirements of a supported attached formation/unit will be provided by the supported formation.

All staff levels of spectrum management will maintain an accessible database so the signal staffs can execute their portions of redeployment planning by their commanders.

Equipment characteristics should be registered and current.

4-17. Theater Army

The theater Army, as the Army component command of a US unified command, normally exercises command and/or operational control over all US Army forces in the theater before the outbreak of hostilities. The theater Army provides communication services to Army elements and to other services and agencies, and is responsible for spectrum management of all subordinate Army commands. The signal section performs frequency planning, coordinates frequency use, and publishes frequency information to subordinate commands. The signal section also maintains frequency assignment records, including a master list of frequency and call sign allocations and assignments for the entire theater Army area of operations.

At agreed on times during contingency operations, selected and earmarked theater Army combat, combat support, and combat service support units will be assigned to Allied commands. Certain operational arrangements will be set up based on the designated tactical commander's established priorities. Units in the theater remain under theater Army command until they are assigned to the operational control of the appropriate command. These units could be assigned to a corps or they could be retained by the theater Army. The spectrum manager must be aware of the signal requirements for in-theater forces and for forces that may arrive from CONUS. These forces may augment combat, combat support, and combat service support units of the corps. Phase-in of these forces may be a smooth and efficient process based on existing war plans. However, a phase-in may be dictated by the present or anticipated combat situation, resulting in unexpected spectrum requirements for these additional forces and units.

It is possible that unplanned out-of-theater reinforcements may be alerted to deploy with minimal notification. Unit predeployment planning must include early identification of operational needs and electromagnetic spectrum requirements to allow the theater signal office to respond to those needs as soon as practicable.

The theater Army signal office retains the wartime spectrum management responsibility for all EAC signal support. It is responsible for managing spectrum resources required to support all national administrative and logistic communications that support each of those corps released to the operational command of an Allied headquarters.

In the theater Army, EAC spectrum management is done by the Frequency Management Office, Operations Division, of the theater Army signal section. This branch is responsible for summarizing the electromagnetic requirements of all subordinate commands. The branch then prepares the frequency allocation lists (FAL) which are published as the frequency allocation and usage list of the unified command. Thus, the branch performs frequency planning, coordinates frequency use, and publishes frequency information to subordinate commands. The branch participates in frequency planning with higher and lower commands and helps to ensure that the policies and directives of higher commands are being followed. The branch also maintains frequency allocation records and a master list of frequency and call signs for equipment organic to its unit. They also maintain the ability to acquire rapidly the data they need from lower echelons regarding frequencies and call signs. Each element and/or echelon maintains a master list of frequencies and call signs for equipment organic to its element and/or echelon and/or area of operation.

4-18. Theater Signal Command (Army)

The Theater Signal Command (TSC) Army (A) provides command and area communications coverage in the communications zone (COMMZ), extending communications from the theater rear boundary where communications access points are established at area signal centers. The TSC(A) commander is dual-hatted as the theater Army signal officer.

In the standard command structure, the TSC(A) ranks as a major subordinate command of the theater Army. In turn, the TSC(A) apportions frequencies to other theater Army subordinate commands for operations of the TSC(A) managed theater communications systems.

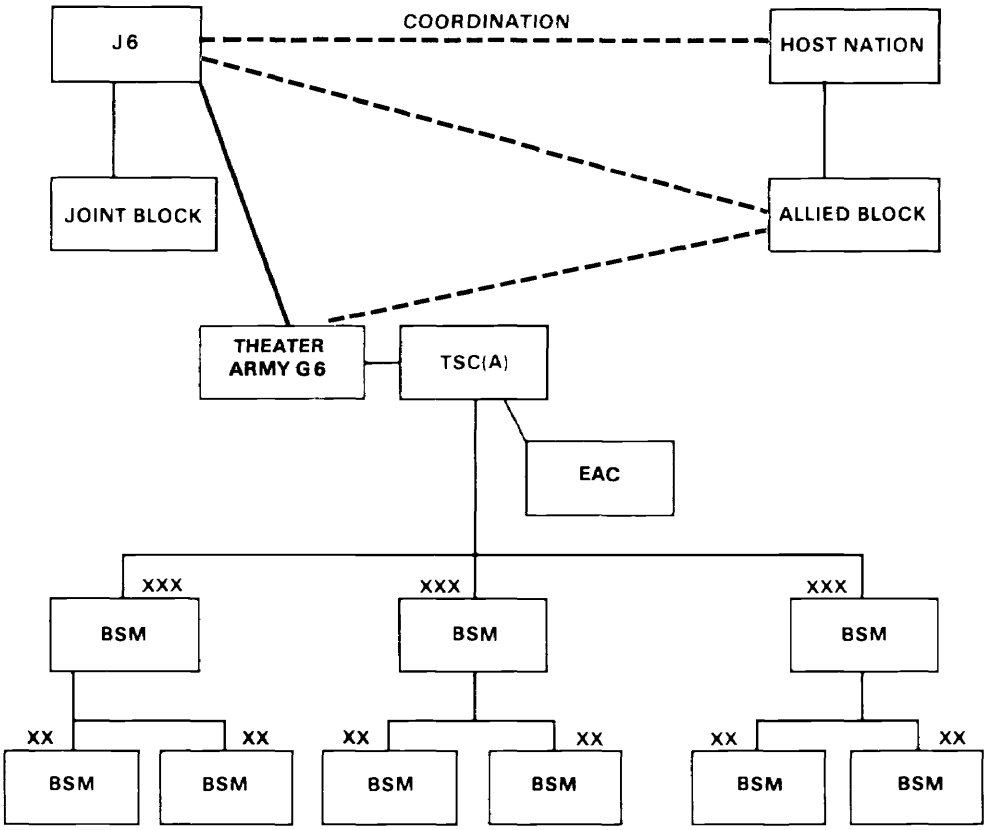


Figure 4-4. Current Army tactical BSM concept.

However, the theater Army commander may direct the TSC(A) to perform all spectrum management for theater Army units. That is, TSC(A) would not only apportion spectrum resources, but also perform direct liaison with appropriate national authorities in a friendly environment or act as sovereign spectrum management authority in a hostile nation.

Higher headquarters and the host nation may impose spectrum and spectrum-related restrictions on the theater Army. These restrictions, plus those of the theater Army commander, will be reflected in the frequency allotments and assignments to its subordinate commands. Generally, restrictions are related to the size of the theater Army area of operations, the requirements of the host nation and Allied forces, the types and quantities of equipment being operated, the electromagnetic spectrum available, and the requirements for strategic communications.

4-19. Automated BSM

The proliferation of C3I equipment and electromagnetic spectrum requirements, such as during Operation Desert Shield, often exceed the available frequency resource. Without automated spectrum management and engineering capability, compatible BSM can not happen.

BSM at all echelons of command needs to have automated tools to efficiently manage their frequency resource and to provide engineering support.

The capability must exist to allow for electronic transfer of frequency assignment data between echelons of command and/or service components.

Current Army tactical BSM, in most cases, still operates in the MANUAL mode. Operation Desert Shield revealed weakness in the overall BSM. Those units that had automated frequency engineering capability were able to quickly engineer noninterfering systems and were able to react to the dynamic battlefield. Those units that had no automated tools could not react as quickly. (See Figure 4-4.)

The proposed concept of automated BSM will allow echelons of command from division to the TSC(A) to electronically transfer frequency data between the echelons and automatically update data bases. (See Figure 4-5.)

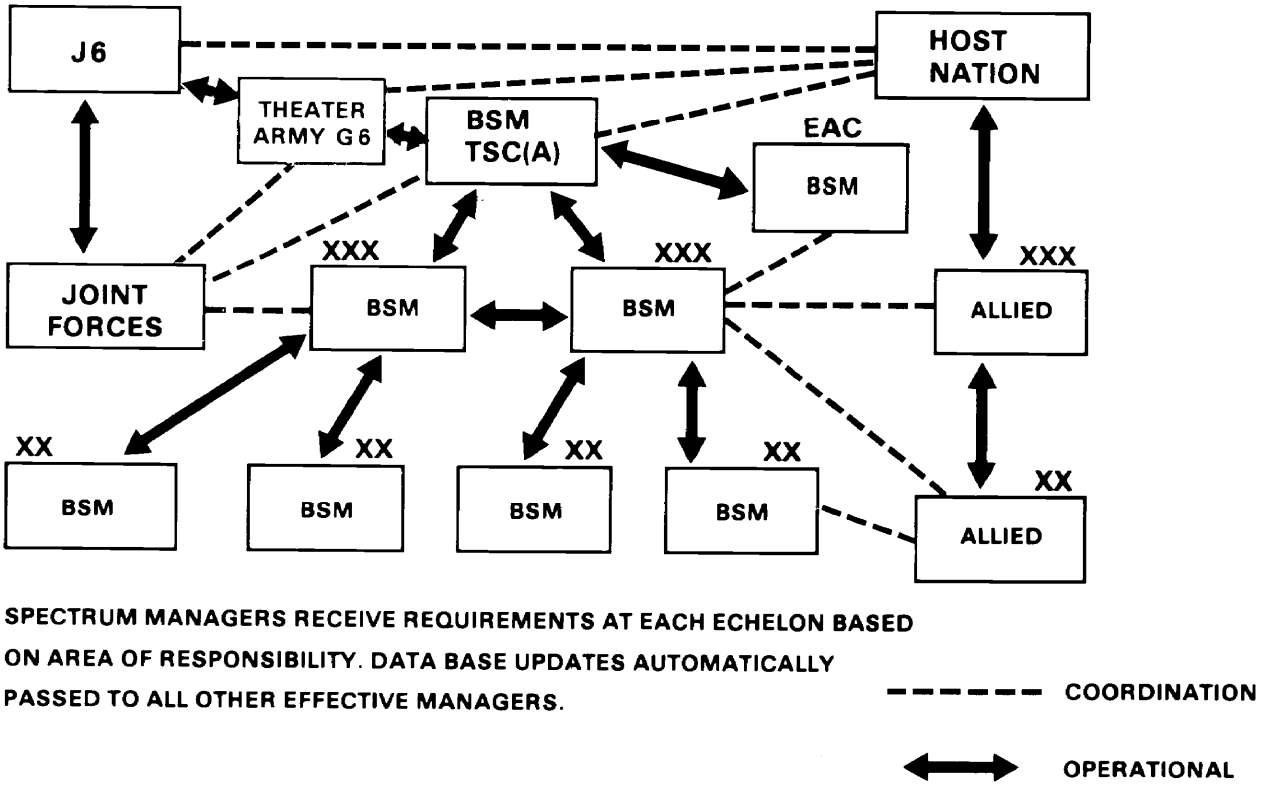


Figure 4-5. Proposed concept of tactical frequency distribution/assignment.

There are many automated frequency tools currently fielded or being developed. Some are--

- ATFES - Army Tactical Frequency Engineering System.
- SPEED - Marine Corps System Planning, Engineering, Evaluation Device.
- EMCAS - Electromagnetic Compatibility Assurance Software.
- AFES - Army Frequency Engineering Software.
- ISYSCON BSM Module - Integrated Systems Control Battlefield Spectrum Management. (See Figure 4-6.)
- BECS - Battlefield Electronic CEOI System.
- MSE SCC - Systems Control Center.
- MSE-FURIES - Frequency Utilization Resources Integrated and Engineering System.
- JSMS - Joint Spectrum Management System.

There are many personal computer (PC) based programs that have been developed to aid the spectrum manager. These automated tools with an updated database will enhance overall BSM at any level, especially at division and corps.

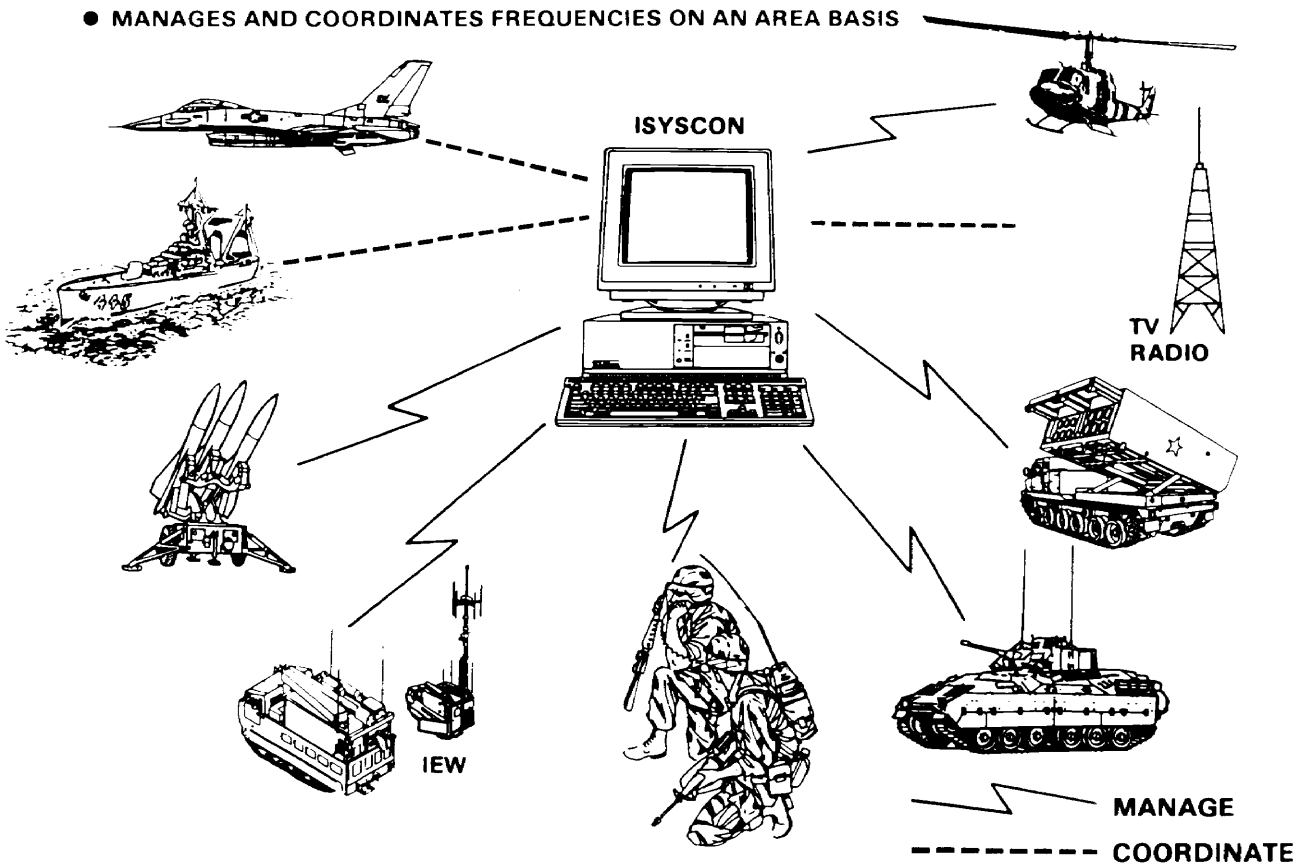


Figure 4-6. ISYSCON management responsibilities.

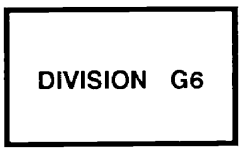
Appendix A

Baseline BSM Tasks

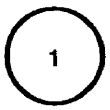
A-1. Introduction

This appendix presents baseline BSM tasks for frequency requests and other related responsibilities. These tasks appear in tabular and functional-flow diagram form. The procedural steps listed in the following paragraphs are keyed by number to the associated diagram. These numbers indicate relative sequence only some procedures can be done concurrently.

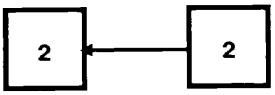
A legend for the diagram symbology is shown below.



A rectangle identifies the specific office or the individual who accomplishes the associated procedural steps.

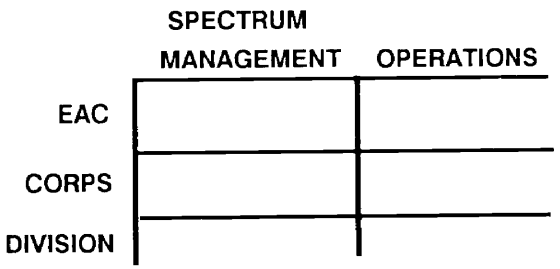


A circle indicates that the numbered procedural step is accomplished within the associated rectangle.



A small square indicates that the numbered procedural step either outputs to or receives input from another rectangle. Arrows indicate direction of flow.

The frequency request and MIJI diagrams are divided into two separate functional areas: the left side for spectrum management and the right side for operations. The functional areas are further subdivided into echelons EAC, corps, and division. These subdivisions would also apply where other echelons (for example, separate brigade) perform the same procedural steps as division.



A-2. Frequency Request for Tactical Low-Frequency Beacons

(1) In Figure A-1, the division aviation officer develops requirements for tactical low-frequency beacons (LFBs) to support division helipads, forward area rearm/refuel points, pathfinder operations, and (in coordination with the air traffic control officer) tactical airfields.

[2] The division aviation officer sends a request to the division BSM for frequencies and identifiers.

(3) The division BSM checks the request for accuracy, completeness, and validity.

[4] The division BSM sends the request to the corps BSM.

[5] The corps BSM sends the request to the EAC BSM.

(6) The EAC BSM coordinates the request.

[7] The EAC BSM sends frequency and identifier assignments to the corps BSM.

[8] The corps BSM sends the assignments to the division BSM.

[9] The division BSM sends the assignments to the division aviation officer and to the division air traffic control officer.

[10] The air traffic control officer notifies the division BSM and the division aviation officer when the tactical airfield beacon has been activated and checked.

[11] The division aviation officer notifies the corps aviation officer.

[12] The division BSM notifies the corps BSM.

[13] The corps BSM notifies the EAC BSM.

[14] The corps aviation officer notifies the EAC aviation officer.

(15) The other assignments are activated and operated within the division area of operations on an as needed basis. In some cases, prior notification is required.

In addition to its assigned frequency, each beacon has its own unique identifier (normally three alphabetical characters) which it transmits in Morse code. The unique identifier distinguishes it from any other friendly beacon that may be operating in the area.

LFBs at fixed locations remain on the same frequencies and identifiers indefinitely. In a tactical training environment, each time the beacon is moved to a new location another frequency and identifier must be obtained from the local civil aviation authority. For LFBs, the US Army uses the AN/TRN-30 which operates in the 200 to 535 kHz and 1605 to 1750 kHz bands and can output 25 to 180 watts.

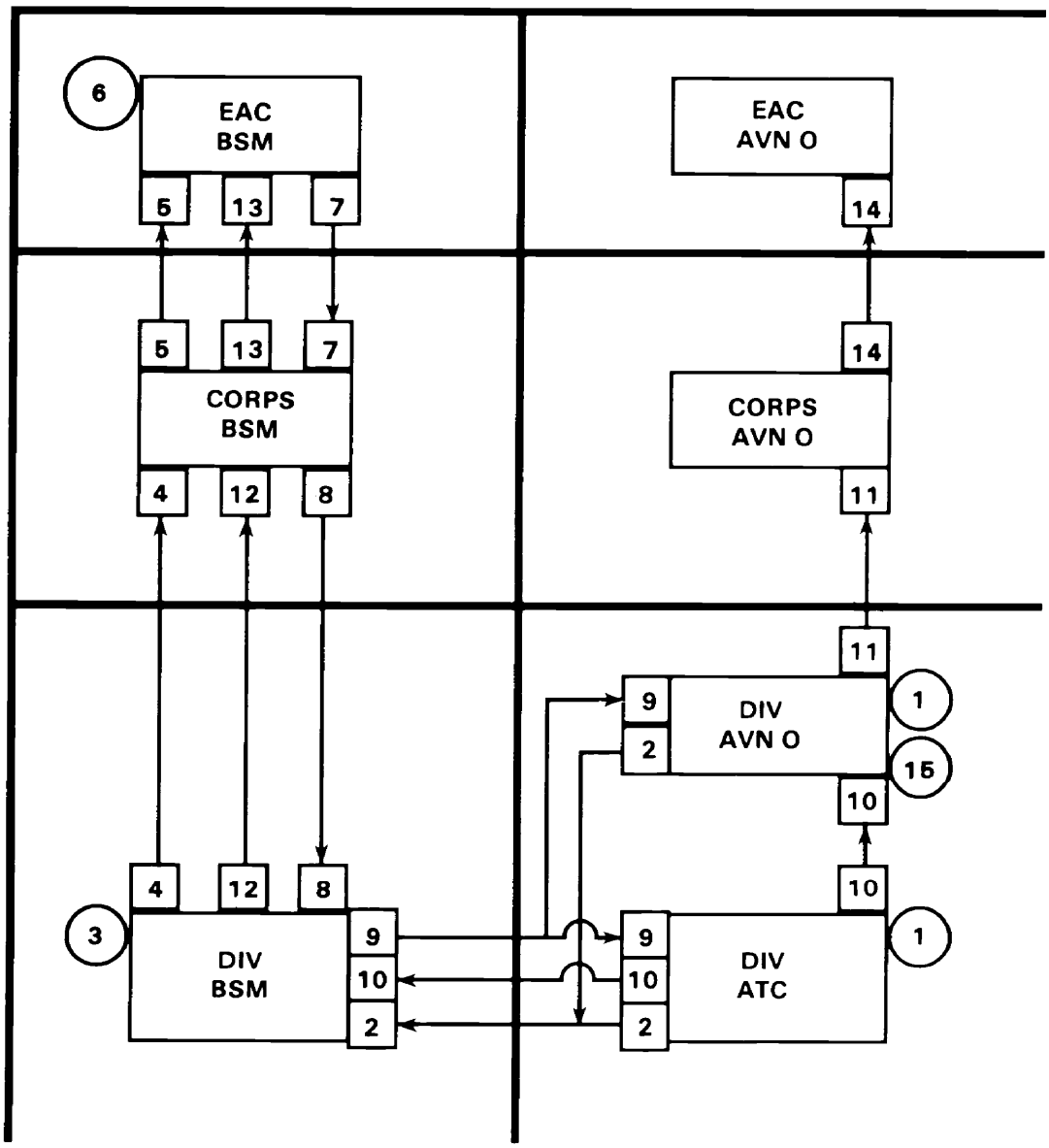


Figure A-1. LFB coordination flow.

A-3. Frequency Request for Low-Power HF

1. In Figure A-2, subordinate elements submit HF frequency requests to the division G6 to support HF nets.

2. The division G6 consolidates HF requests.

3. The division G6 submits the request to the division BSM.

4. The division BSM sends the request to the corps BSM.

5. The corps BSM checks the corps frequency list to see if there are frequencies to fill the request.

6. If so, the corps BSM sends the assignment to the division BSM.

7. If not, the corps BSM sends the request to the EAC BSM.

8. The EAC BSM sends the assignment to the corps BSM.

9. The corps BSM sends the assignment to the division BSM.

10. The corps BSM notifies the corps EWO.

11. The division BSM sends the assignment to the division G6.

12. The division BSM notifies the division EWO.

HF applications within the combat zone normally use ground wave propagation and relatively low (500 watts or less) transmitter powers. Distances within the division will allow coverage by HF ground wave. Groundwave propagation charts for most areas of the world are available from the USAISEC. BSM personnel examine these charts with respect to HF net coverage and link distances. This information helps determine the frequencies range that provides proper coverage. Resources within this range may then be assigned to applicable nets. Vertically polarized or specially adapted horizontal antennas are used for ground wave applications.

High-power HF Defense Communications System (DCS) links are sometimes used in a battlefield environment, but requirement generation and frequency coordination are normally done at EAC. HF chirp sounders (AN/TRQ-35) are used to engineer ground wave and sky wave systems. This is normally done by the corps or EAC BSM staff. For more information on chirp sounder operations, see ACP 191.

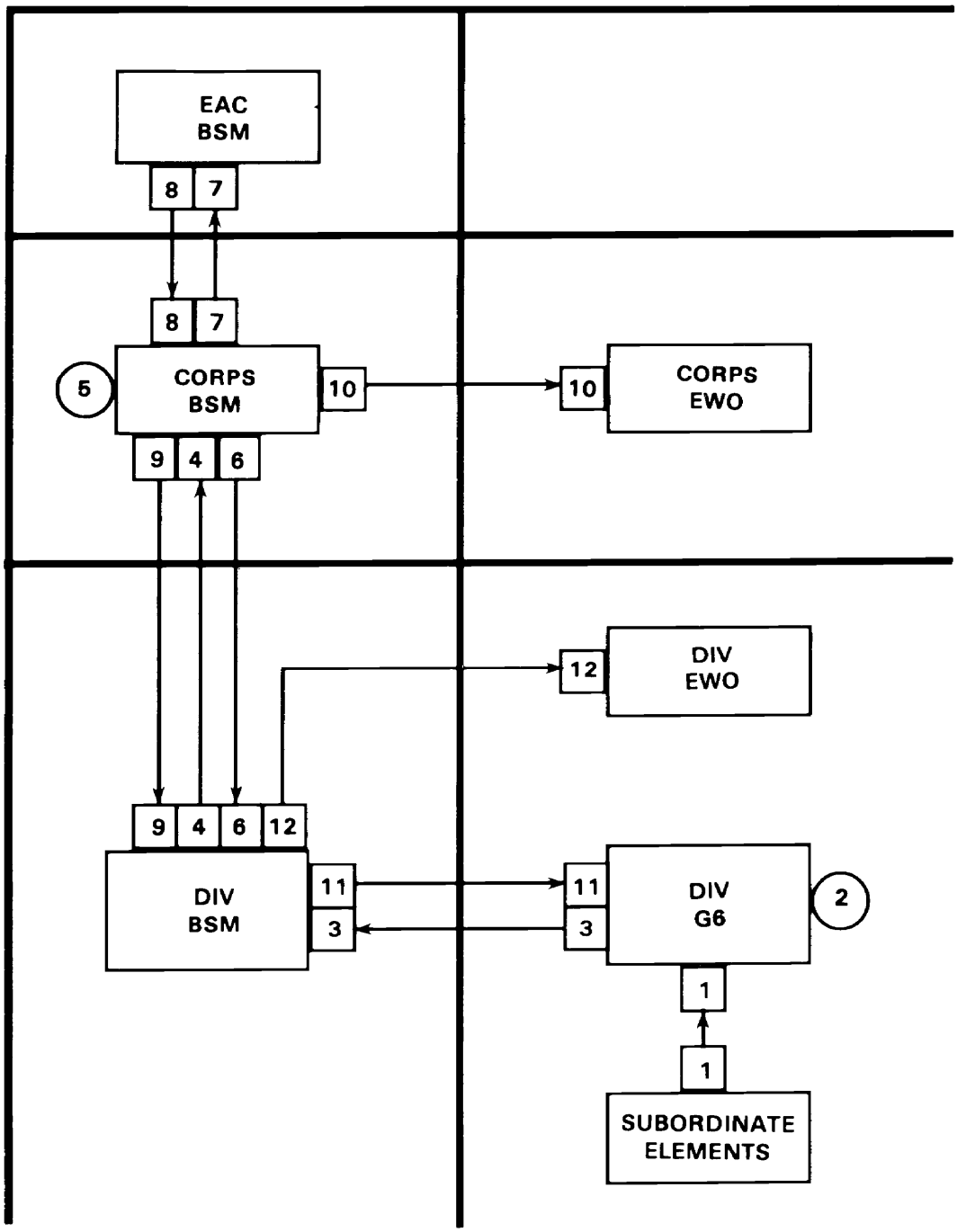


Figure A-2. Low-power HF coordination flow.

A-4. Frequency Request for VHF-FM

1. In Figure A-3, the division G6 submits the request to the division BSM for VHF-FM frequencies to support the SOI.
2. The division BSM submits the request to the corps BSM.
3. The corps BSM sends the request to the EAC BSM.
4. The EAC BSM sends the assignment to the corps BSM.
5. The corps BSM notifies the corps EWO.
6. The corps BSM sends the assignment to the division BSM.
7. The division BSM notifies the division EWO.
8. The division BSM sends the assignment to the division G6.
9. The division G6 makes up the VHF-FM list and submits it to the SOI Detachment/NSA for the VHF-FM portion of the SOI.

VHF-FM spectrum resources support combat net radio operations and MSE. Since the direction and coordination of real-time combat operations requires that every battlefield element be equipped with combat net radios, this frequency band is quite crowded. Corps combat net radio net requirements exceed spectrum availability for dedicated frequencies to support every net. Frequencies are reused or shared many times in the corps area. This sharing scheme is a major consideration of the BSM staff, and it is used as the basis for estimating requirements.

The frequency range of VHF-FM combat net radio equipment is 30 to 88 MHz. It has output powers ranging up to 50 watts depending on the transmitter used.

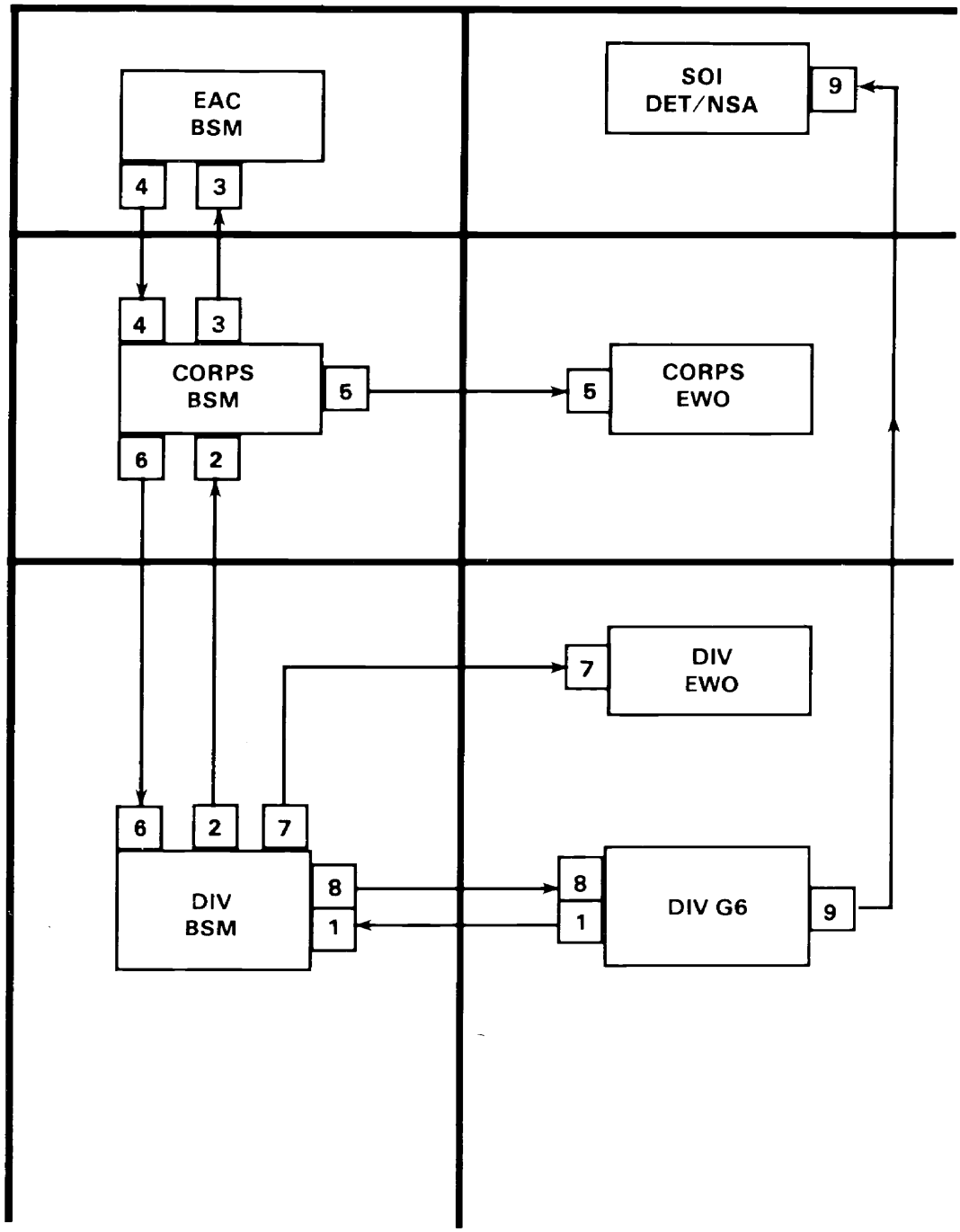


Figure A-3. VHF-FM coordination flow.

A-5. Frequency Request for Platoon Early Warning Sensors

(1) In Figure A-4, the division G6 determines the number of platoon early warning sensors (PEWS) based on TOE, TDA, or MTOE operational requirements.

[2] The division G6 submits the request to the division BSM.

[3] The division BSM sends the request to the corps BSM.

[4] The corps BSM sends the request to the EAC BSM.

[5] The EAC BSM sends the allotment to the corps BSM.

[6] The corps BSM sends the allotment to the division BSM.

[7] The division BSM sends the allotment to the division G6.

(8) The division G6 sends the allotment to the maneuver battalions operating the PEWS.

PEWS are lightweight, battery-operated, portable intrusion detection devices. Small military units (patrols, squads, or platoons) use these devices. On detection, the device electronically classifies the intruder (personnel or vehicle) and communicates the detection and target type to a remote receiver display by a radio link. Several different sensor models are available. Each model operates on a fixed frequency in the 138 to 153 MHz range.

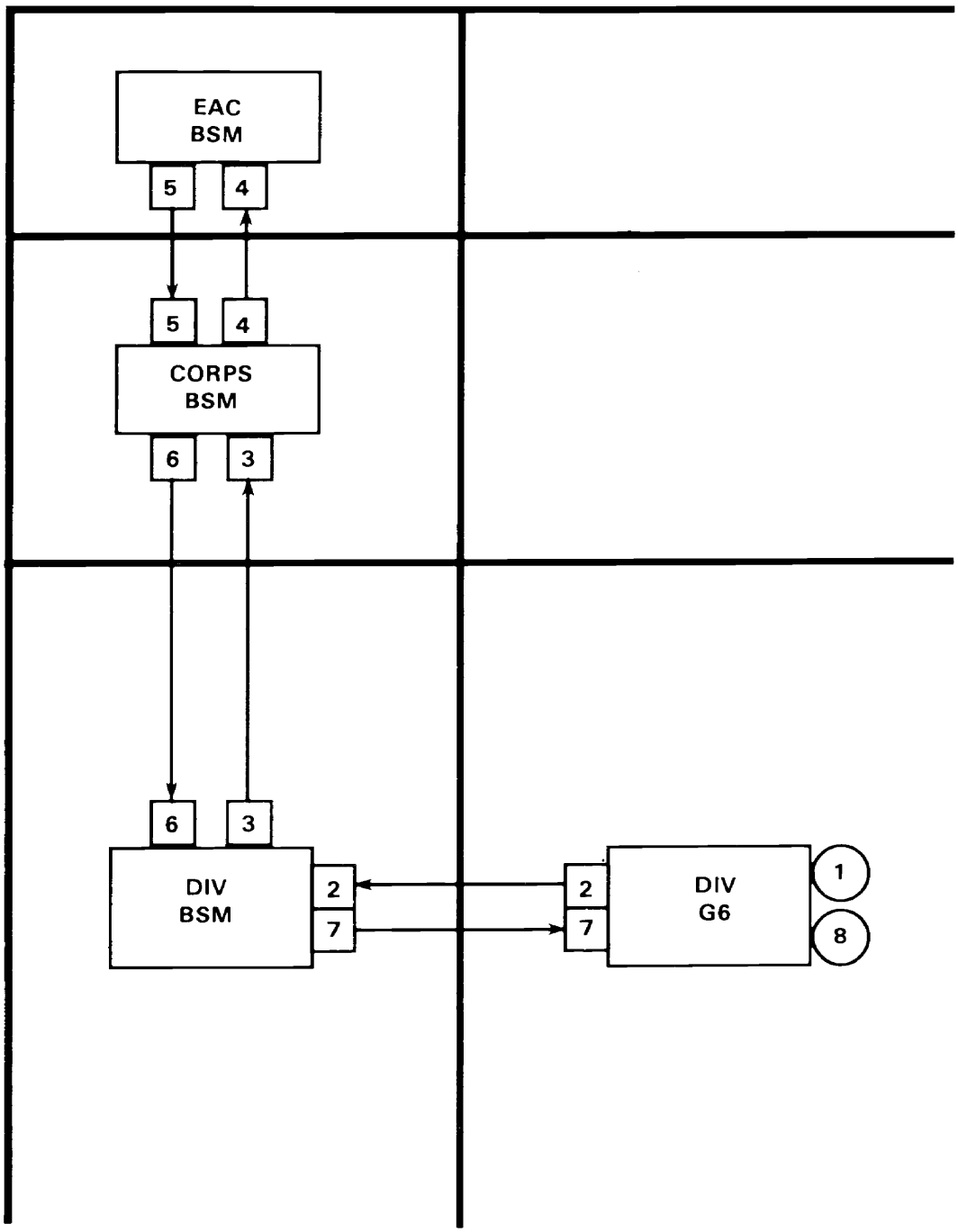


Figure A-4. PEWS coordination flow.

A-6. Frequency Request for VHF-AM

1. In Figure A-5, the division G6 submits the request to the division BSM for VHF-AM frequencies to support division aviation and air traffic control nets in the SOI.
2. The division BSM sends the request to the corps BSM.
3. The corps BSM sends the request to the EAC BSM.
4. The EAC BSM sends the assignment to the corps BSM.
5. The corps BSM notifies the corps EWO.
6. The corps BSM notifies the corps aviation officer.
7. The corps BSM sends the assignment to the division BSM.
8. The division BSM notifies the division EWO.
9. The division BSM notifies the division aviation officer.
10. The division BSM sends the assignment to the division G6.
11. The division G6 makes up the VHF-AM frequency list and submits it to the SOI Detachment/NSA for VHF-AM portion of the SOI.

The VHF-AM frequency band for military applications is 118 to 150 MHz. Small segments are allocated for exclusive military use in some countries, but most of this band is allocated to the aeronautical mobile R service. The R denotes route which implies that the band is used for communications with aircraft flying established air routes. Most governments consider R bands for communicating with civil aircraft. (Bands designated OR, for off-route, are generally limited to military use.) The R band frequency resources are normally controlled by the civil aviation authority in each country (FAA in the US).

Although Army air traffic control and aviation operations are usually conducted on VHF-FM or UHF-AM frequencies, a requirement exists for VHF-AM. Civil aircraft sometimes need to contact Army air traffic control facilities, and occasionally military aircraft are equipped with only VHF-AM radios. Additionally, VHF-AM provides a degree of redundance should VHF-FM or UHF-AM systems fail.

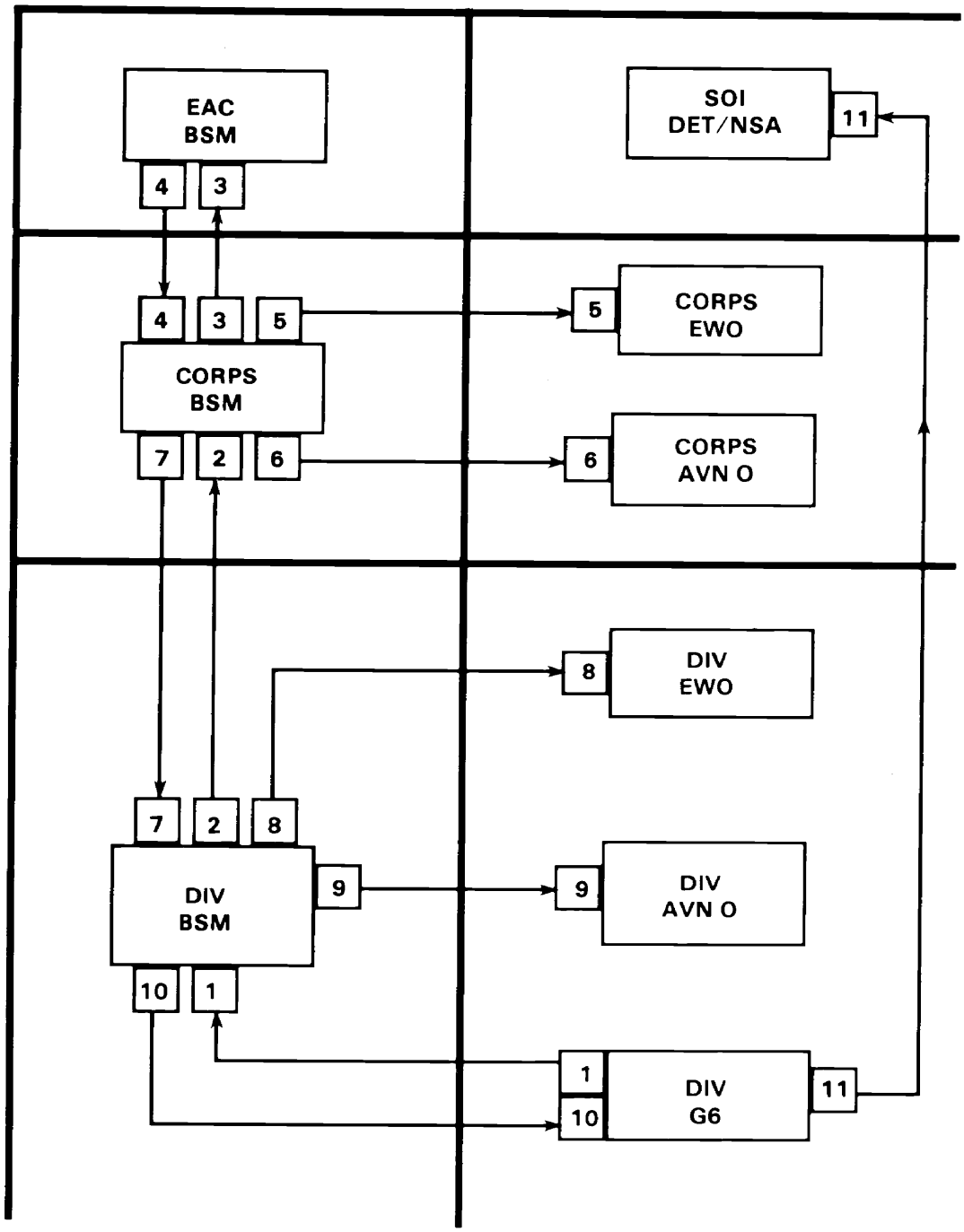


Figure A-5. VHF-AM coordination flow.

A-7. Frequency Request for UHF Air/Ground/Air Operations

1. In Figure A-6, the division G6 submits the request to division BSM for UHF frequencies to support division aviation and air traffic control nets in the SOI. These nets are listed on the net work sheets submitted by the aviation and air traffic control elements.

2. The division BSM sends the request to the corps BSM.

3. The corps BSM sends the request to the EAC BSM.

4. The EAC BSM sends the assignment to the corps BSM.

5. The corps BSM notifies the corps EWO.

6. The corps BSM notifies the corps aviation officer.

7. The corps BSM sends the assignments to the division BSM.

8. The division BSM notifies the division EWO.

9. The division BSM notifies the division aviation officer.

10. The division BSM sends the assignment to the division G6.

11. The division G6 makes up the UHF frequency list and submits it to the SOI Detachment/NSA for the UHF portion of the SOI.

In most of the free world, the 225 to 400 MHz band is allocated for military use (mainly for air/ground/air communications). The same frequency band is used for multichannel requirements in Army tactical units although multichannel and air/ground/air communications are not conducted on the same frequencies. Most of the free world has raster or channel allotment plans for this band. It designates frequencies used for air/ground/air, multichannel, and other telecommunications functions.

The Army is not the sole user of the air/ground/air 225 to 400 MHz frequencies in the combat zone other services use the air/ground /air frequencies for supplying close air support. Those agencies inform the supported Army force of the frequcncies used so they can be inserted into the SOI.

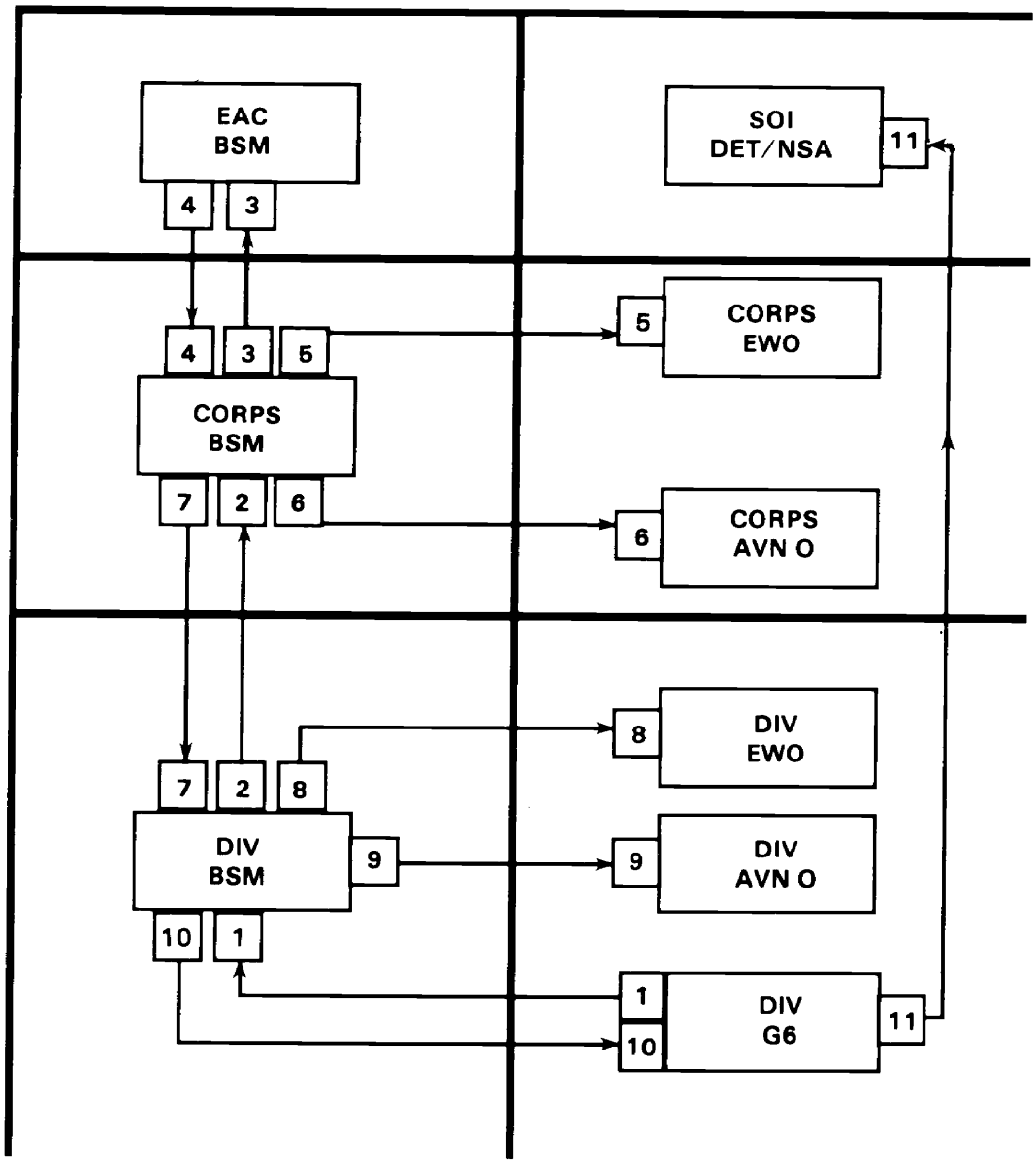


Figure A-6. UHF air/ground/air coordination flow.

A-8. Frequency Request for Division MSE LOS Systems

(1) In Figure A-7, the division signal battalion determines how many frequencies are required to support the division multichannel plan.

[2] The signal battalion requests frequencies from the division BSM.

(3) The division BSM checks the request for accuracy and validity.

[4] If the division BSM does not have authority to allot multichannel frequencies, then the request is forwarded to the corps BSM.

[5] The corps BSM allots frequencies to the division BSM.

[6] The corps BSM notifies the corps EWO of the allotment.

[7] The division BSM receives the allotment and notifies the division EWO.

[8] The division BSM sends allotment to the signal battalion.

(9) The signal battalion assigns frequencies as required to engineered systems.

In MSE LOS systems, the number of channels per link ranges from 8 to 64. The high capacity of MSE systems allows them to meet large volume demands for command and control, fire control, intelligence, and administrative traffic.

For MSE LOS purposes, the frequency spectrum is separated into three bands. Two are UHF, band 1, 225 to 400 MHz and band 3, 1350 to 1850 MHz support the internodal extension link, using the AN/GRC-226 radio. To support the shorter SHF down-the-hill (DTH) link, the AN/GRC-224(P) radio uses SHF band 2, 14.5 to 15.35 GHz.

Antennas used in multichannel systems are highly directional. For this reason, relatively low powers (15 to 35 watts) are the rule. In comparison, troposcatter systems typically use 1 kilowatt of power because of the high signal attenuation in the troposphere.

It is common to have transmitter and receiver antennas in close proximity. Also, two or more multichannel links may terminate at the same site. For these reasons, frequency separation between transmit and receive frequencies of the same link and frequency separation between different links are critical. Separation criteria vary with the type of equipment used.

The MSE links take some time to establish. MSE LOS frequencies are not included in the SOI frequency changing program. With each frequency change, the LOS link has to be reestablished. The time involved in the operation makes the MSE LOS system a poor candidate for a periodic frequency changing program.

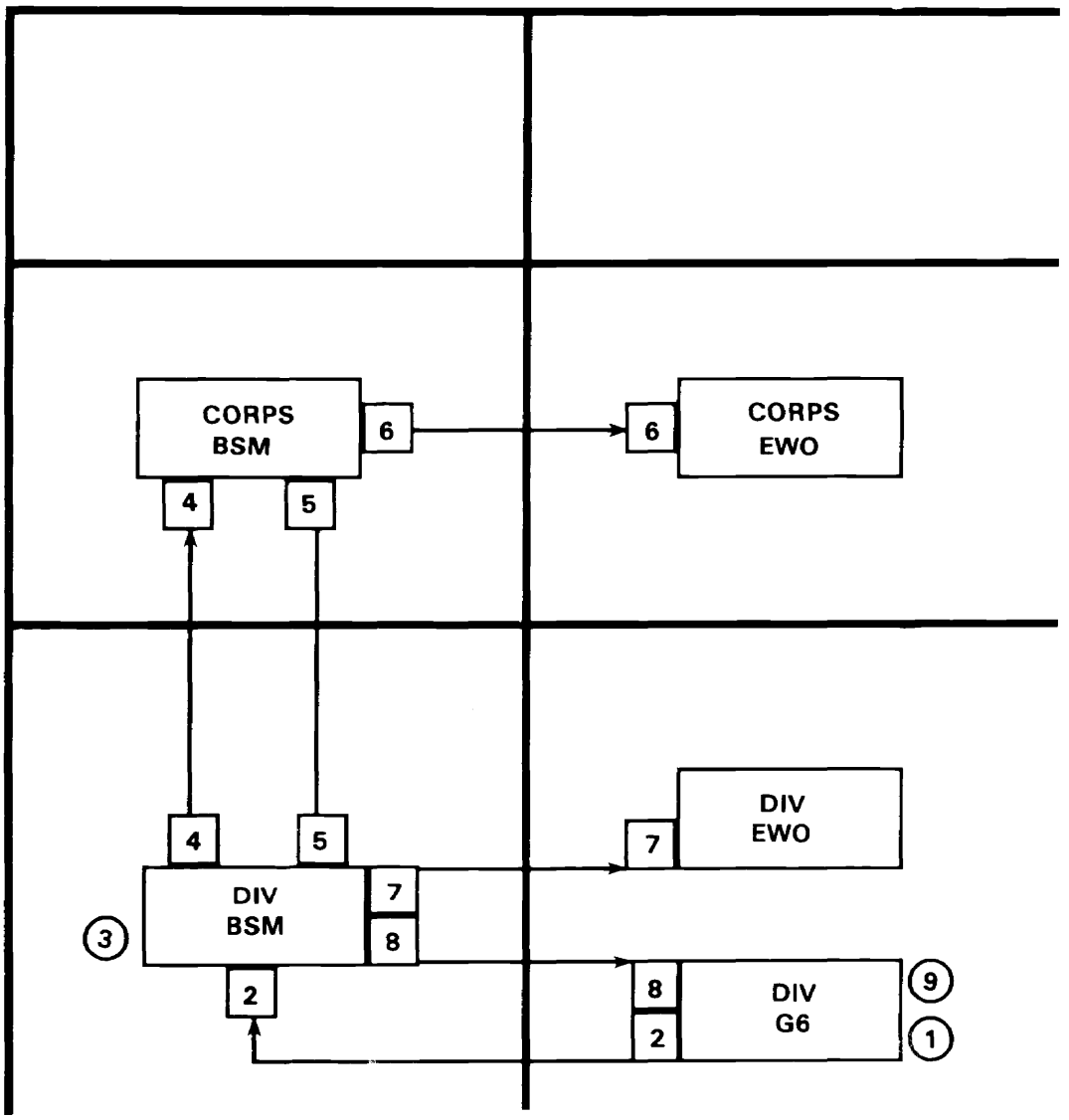


Figure A-7. Division MSE LOS system frequency coordination flow.

A-9. Frequency Request for Corps MSE LOS Systems

(1) In Figure A-8, the corps signal brigade radio officer determines how many frequencies are required to support the corps MSE LOS systems.

[2] The signal brigade requests frequencies from the corps BSM.

[3] The corps BSM requests frequencies from the EAC BSM.

[4] The EAC BSM allots frequencies to the corps BSM.

[5] The corps BSM notifies the corps EWO of allotment.

[6] The corps BSM sends the allotment to the signal brigade.

(7) The corps signal brigade assigns the frequencies to engineered systems as required.

The corps BSM normally has an allotment of frequencies available which satisfy multichannel spectrum requirements for corps and subordinate units. The Spectrum Management Office of the TSC(A) overseas and the post, camp, station in CONUS provide this allotment.

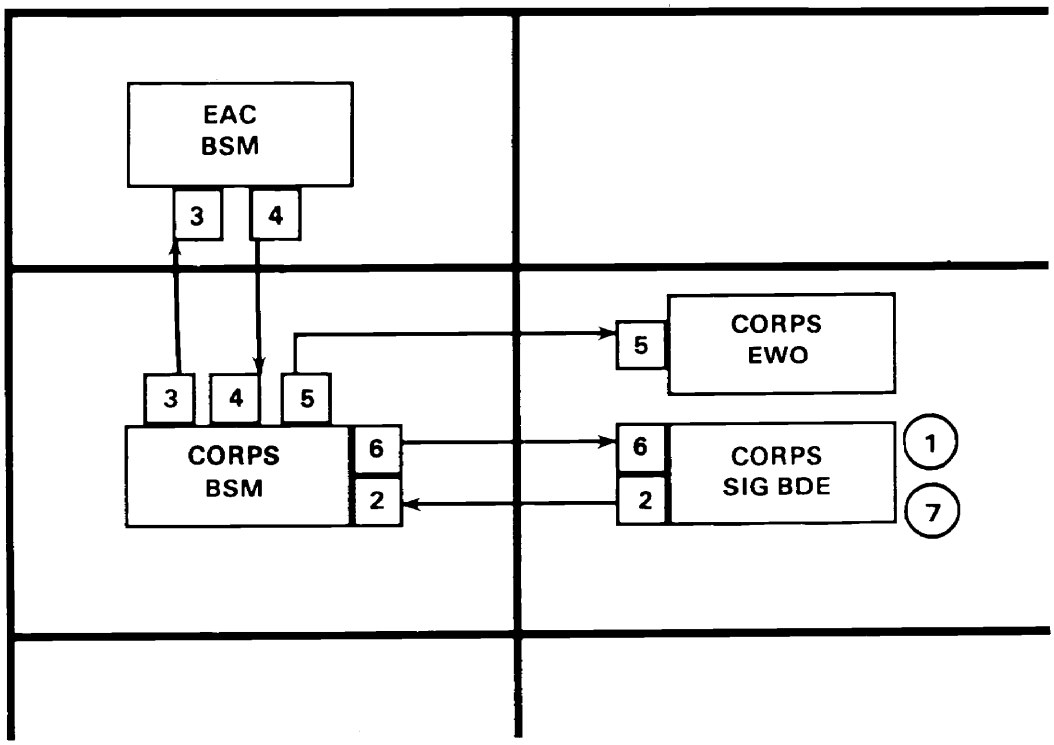


Figure A-8. Corps MSE LOS system frequency coordination flow.

A-10. Frequency Request for Meteorological Sondes

(1) In Figure A-9, the corps artillery officer determines the number of meteorological units within the corps area of operation.

2 The artillery officer sends a request for frequency support to the corps BSM.

3 The corps BSM sends the request to the EAC BSM.

4 The EAC BSM sends the allotment to the corps BSM.

5 The corps BSM sends the allotment to the corps artillery officer.

(6) The corps artillery officer gives the authorization to the units operating the equipment.

Meteorological sondes (METSONDES) are balloon-borne equipments which measure atmospheric pressure, temperature, humidity, wind speed, and wind direction in the atmosphere. This data is used primarily to support artillery operations within the corps area.

The US Army presently uses METSONDES which operate in the 1660 to 1700 MHz range. Atmospheric soundings are taken at various altitudes and the data is transmitted to a ground tracking station which receives, records, processes, and disseminates the information to users.

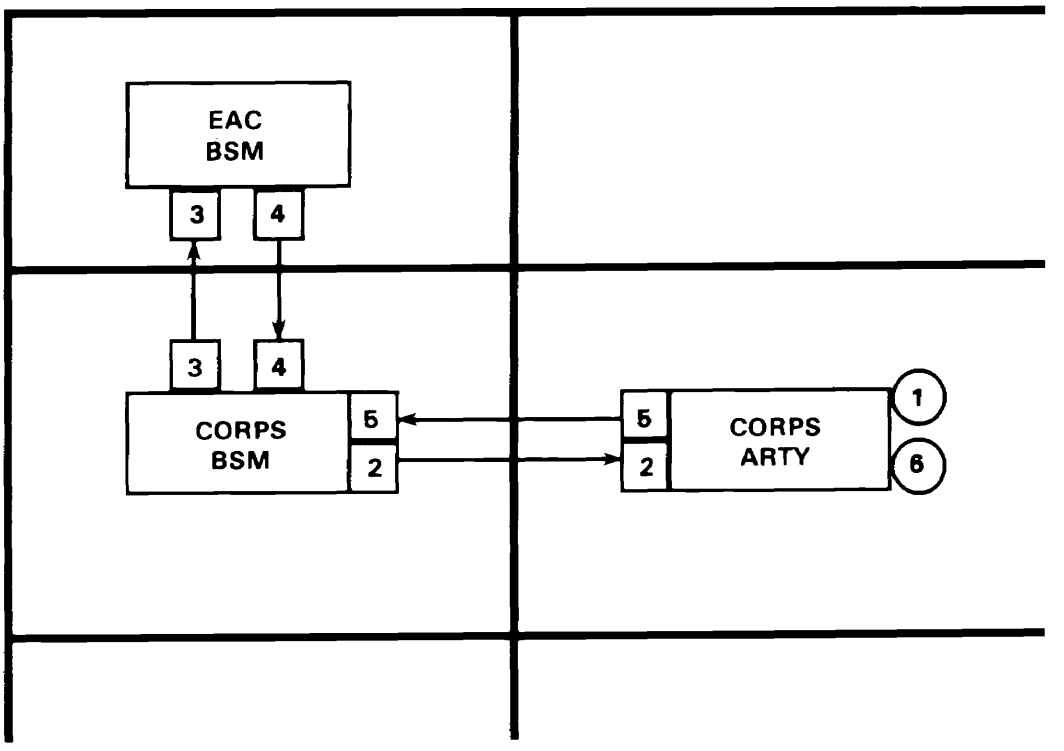


Figure A-9. METSONDES coordination flow.

A-11. Frequency Request for Ground Mobile Forces Satellite (7 to 8 GHz)

1 In Figure A-10, the division G3 and division G6 develop requirements for satellite communications.

2 The division G6 sends the satellite access request to the division BSM.

3 The division BSM checks the request for accuracy and validity.

4 The division BSM sends the request to corps BSM.

5 The corps BSM sends the satellite access request to the EAC BSM.

6 The EAC BSM sends the request to the ground mobile forces (GMF) satellite communication control subsystem (SCCS) manager for the defense communications area.

7 The GMF manager sends the up link and downlink frequencies and other pertinent information to the EAC BSM for clearance/approval and dissemination.

8 The EAC BSM sends the assignment to the corps BSM.

9 The corps BSM coordinates the assignment with the corps EWO.

10 The corps BSM sends the assignment to the division BSM.

11 The division BSM coordinates the assignment with the division EWO.

12 The division BSM sends the assignment to the division G6 for distribution to the ground forces satellite operators.

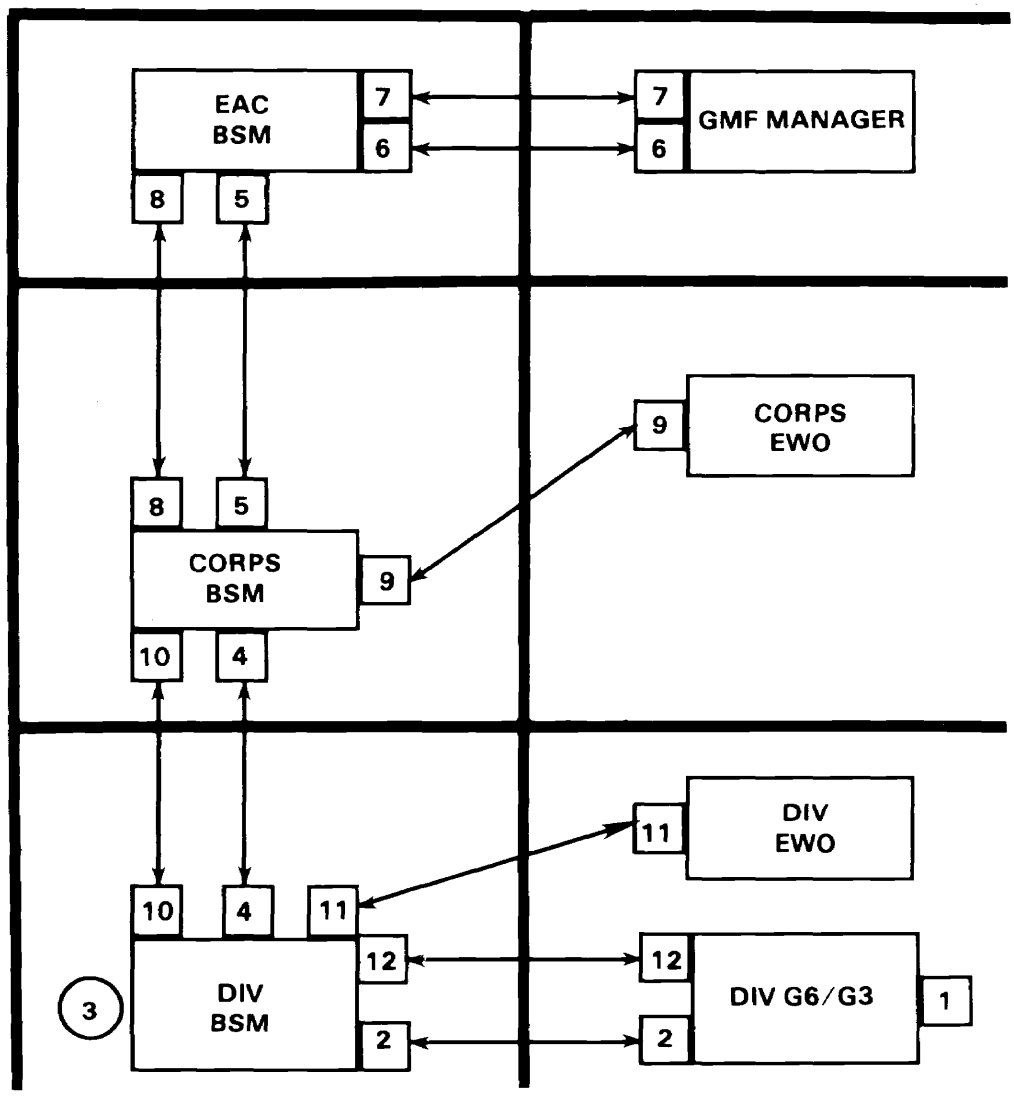


Figure A-10. GMF satellite coordination flow.

The SHF transportable GMF terminals provide multichannel communications at brigade, division, corps, and the COMMZ to support command multichannel requirements. The terminals operate with Defense Satellite Communications System (DSCS) satellites positioned in geosynchronous orbit over the equator above the Pacific, Atlantic, and Indian Oceans. Figure A-11 shows the SHF and UHF satellites and terminals.

Procedures for obtaining GMF satellite terminal authorizations are unique in that two separate and distinct approvals must be obtained before starting operations. The GMF manager grants an approved uplink and downlink frequency; however, these frequencies must be cleared through normal frequency management channels. The corps BSM ensures that frequency and satellite access approval has been received before notifying subordinate elements. See FM 24-11 for further information.

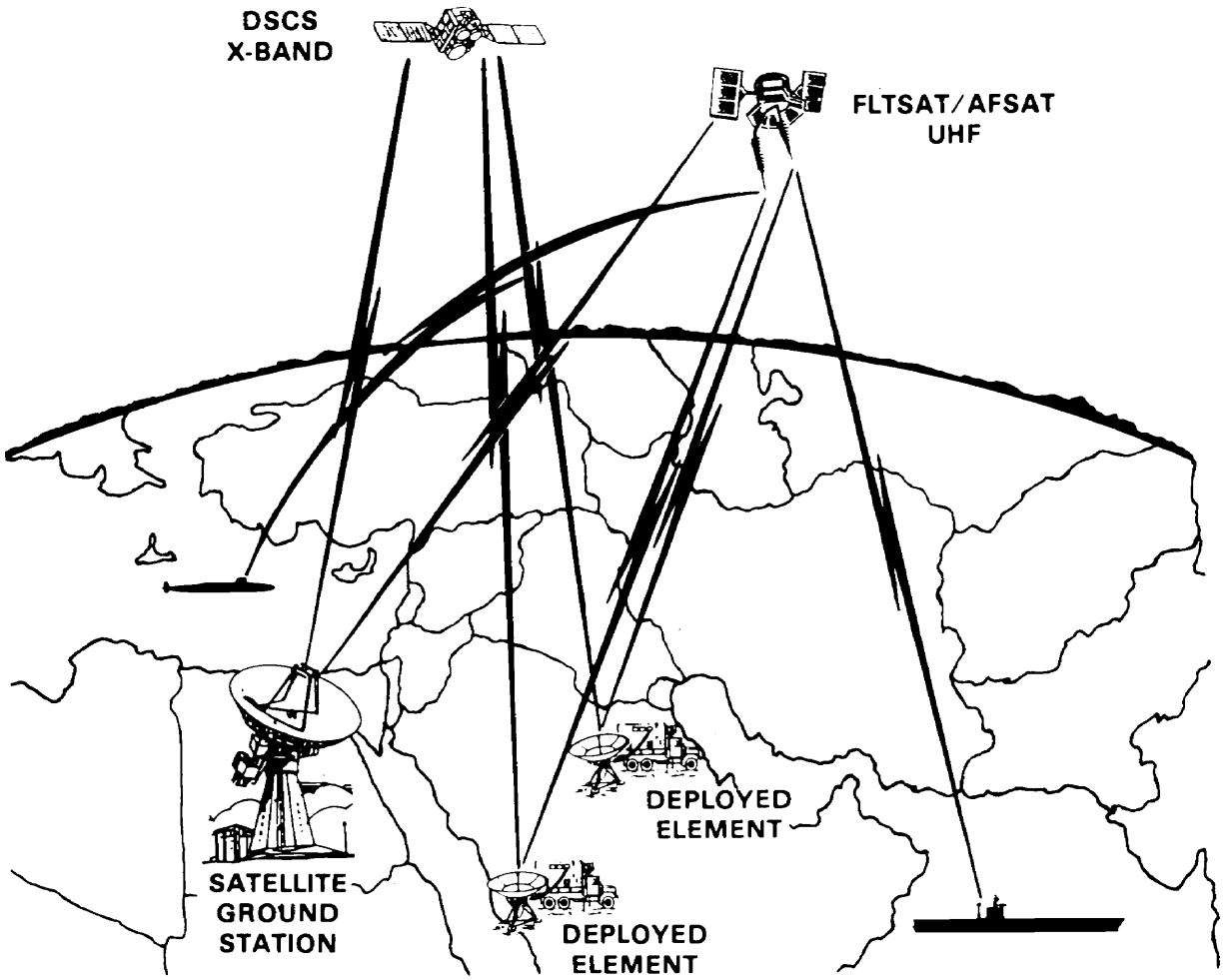


Figure A-11. Satellite communications options.

A-12. Frequency Request for UHF Single-Channel Satellite Terminal

(1) In Figure A-12, the division G3 and division G6 develop the requirements for using a single-channel satellite net.

2 The division G6 sends the request to the division BSM.

3 The division BSM sends the request for channel access to the corps BSM.

4 The corps BSM sends the request to the EAC BSM for channel access and frequency approval.

5 The EAC BSM sends the request for channel access to the appropriate satellite primary control center (PCC).

6 The satellite PCC sends the uplink and downlink frequencies and any other pertinent information to the EAC BSM for approval and dissemination.

7 The EAC BSM sends the approved uplink and downlink frequencies to the corps BSM.

8 The corps BSM coordinates the assignment with the corps EWO.

9 The corps BSM sends the assignment to the division BSM.

10 The division BSM coordinates the assignment with the division EWO.

11 The division BSM sends the assignment to the division G6.

12 The division G6 sends the assignment to the supported units.

The UHF single-channel satellite service shares the 225 to 400 MHz band with air/ground and multichannel services, among others. While multichannel and air/ground allotted channels occasionally share a channel with another service, it is rare that a channel designated for single-channel satellite has an allotment for any other service.

Most single-channel satellite terminals have the capability of a single voice channel. Some of the newer terminals have a speech plus capability, that is, one voice channel plus one teletype (low speed) channel. Normally, only high-priority command and control circuits are routed over single-channel satellite facilities.

Like multichannel satellite terminals, two distinct separate approvals must be obtained. First, the PCC provides the satellite access uplink and downlink frequencies; however, these frequencies must be cleared through normal frequency management channels. Requests for satellite access are sent to the PCC which controls the satellite in the desired area of operations. In CONUS, corps or division spectrum managers can request satellite access from the appropriate PCC. In Europe, it is almost always an EAC spectrum manager function to 5th Signal Command. See FM 24-11 for further information.

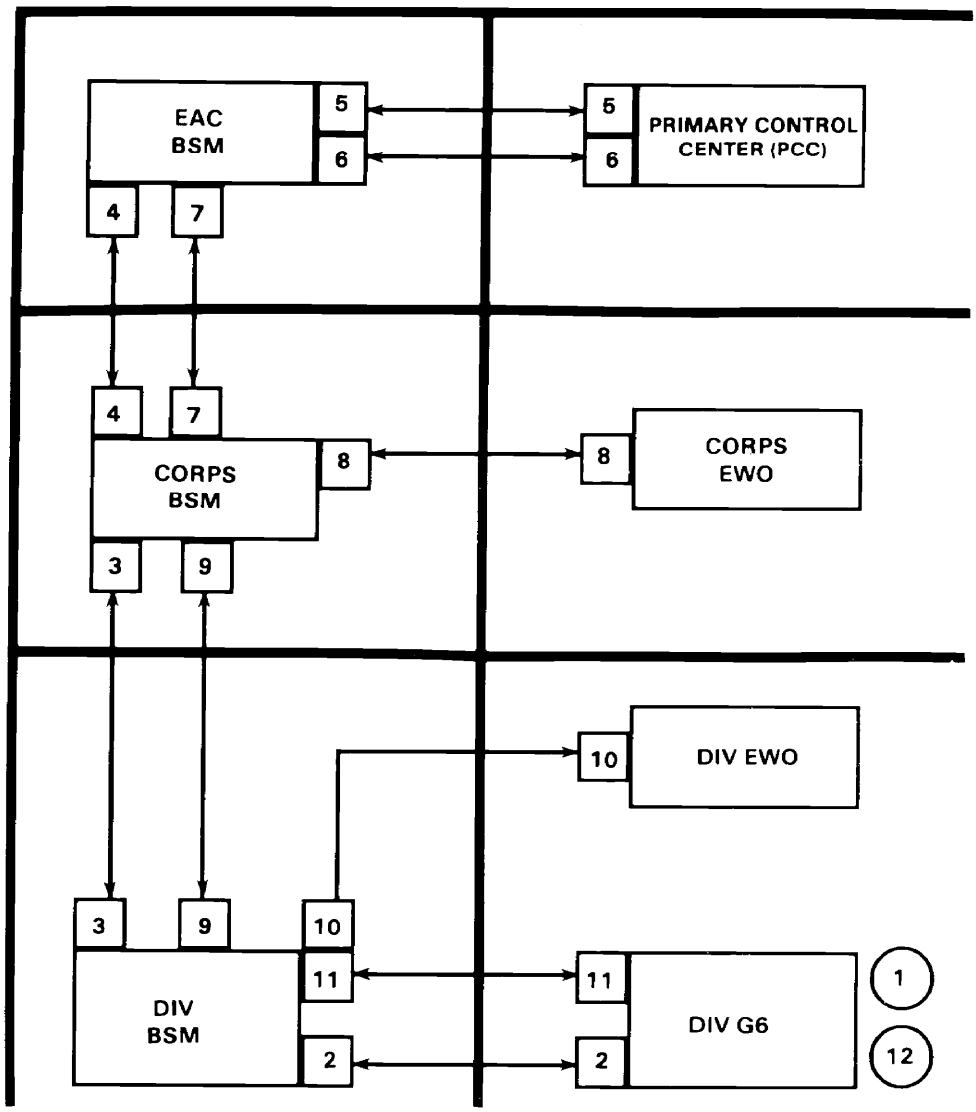


Figure A-12. UHF single-channel satellite coordination flow.

A-13. Frequency Request for Air Traffic Control Radar

(1) In Figure A-13, the air traffic control officer determines the location of the air traffic control radar.

2 The air traffic control officer requests frequencies for radar and IFF from the division BSM.

3 The division BSM sends the request to the corps BSM.

4 The corps BSM sends the request to the EAC BSM.

5 The EAC BSM sends the assignment to the corps BSM.

6 The corps BSM sends the assignment to the division BSM.

7 The corps BSM notifies the corps EWO.

8 The division BSM sends the assignment to the air traffic control officer.

9 The division BSM notifies the division EWO.

10 The air traffic control officer notifies the division aviation officer and division BSM when radar and IFF are checked and operational.

Air traffic control radar provides radar approach control and precision approach radar for aircraft during adverse weather conditions and high density aircraft operations. The AN/TPN-18 is used for primary radar and the AN/TPX-44 is used for secondary or IFF radar. The two equipments work together. Primary and IFF returns are adjacently displayed on the same scope. The two equipments are normally integral parts of an AN/TSQ-71A landing control central configuration. The AN/TPN-18 operates in the 9.0 to 9.6 GHz band while the AN/TPX-44 operates in the 990 to 1040 MHz band.

Within CONUS, short-term frequency assignments can sometimes be obtained from the supporting Army frequency coordinator's office, thus avoiding time-consuming frequency clearance procedures at the national agency level.

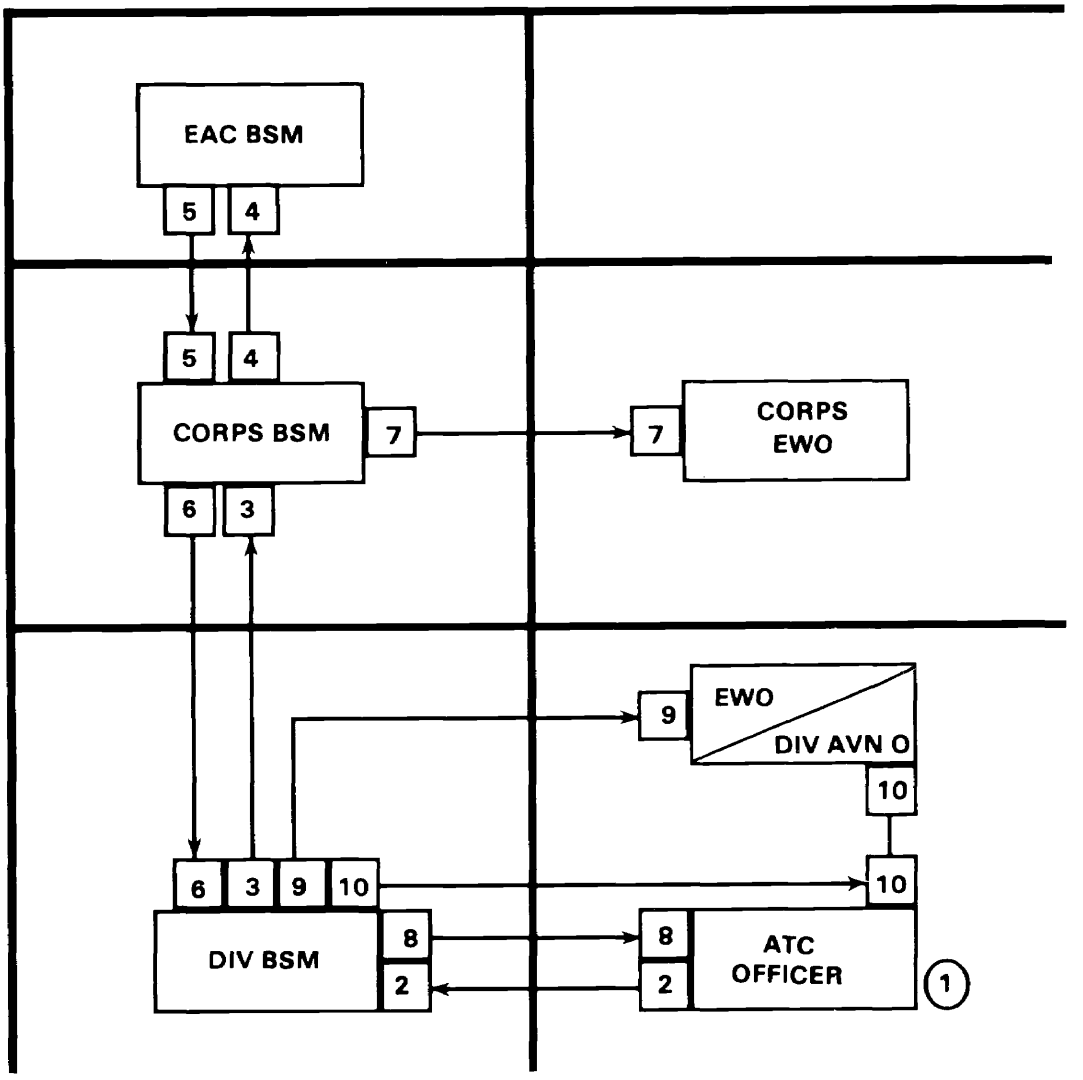


Figure A-13. Air traffic control radar coordination flow.

A-14. Frequency Request for Forward Area Alerting Radar

1. In Figure A-14, the air defense artillery sends the request for frequency support (maximum of six channels) of forward area alerting radar to the division G6.
2. The division G6 sends the request to the division BSM.
3. The division BSM sends the request to the corps BSM.
4. The corps BSM sends the request to the EAC BSM.
5. The EAC BSM sends the assignment to the corps BSM.
6. The corps BSM notifies the corps EWO.
7. The corps BSM sends the assignment to the division BSM.
8. The division BSM notifies the division EWO.
9. The division BSM sends the assignment to the division G6.
10. The division G6 sends the assignment to the air defense artillery battalion.
11. The air defense artillery battalion assigns channels to individual radars according to the SOP.

The forward area alerting radar system consists of an acquisition radar, an IFF for initial identification, and an RF data link to transmit data to a target alert data display set to support SHORAD weapons (for example, CHAPARRAL, VULCAN, and REDEYE). The AN/TPQ-32 or AN/MPQ-49 is used when equipment is vehicle mounted (tuning range is classified). The air defense artillery battalion requests frequencies for the radar and IFF from the division BSM. Frequencies to support the data links are found in the division SOI.

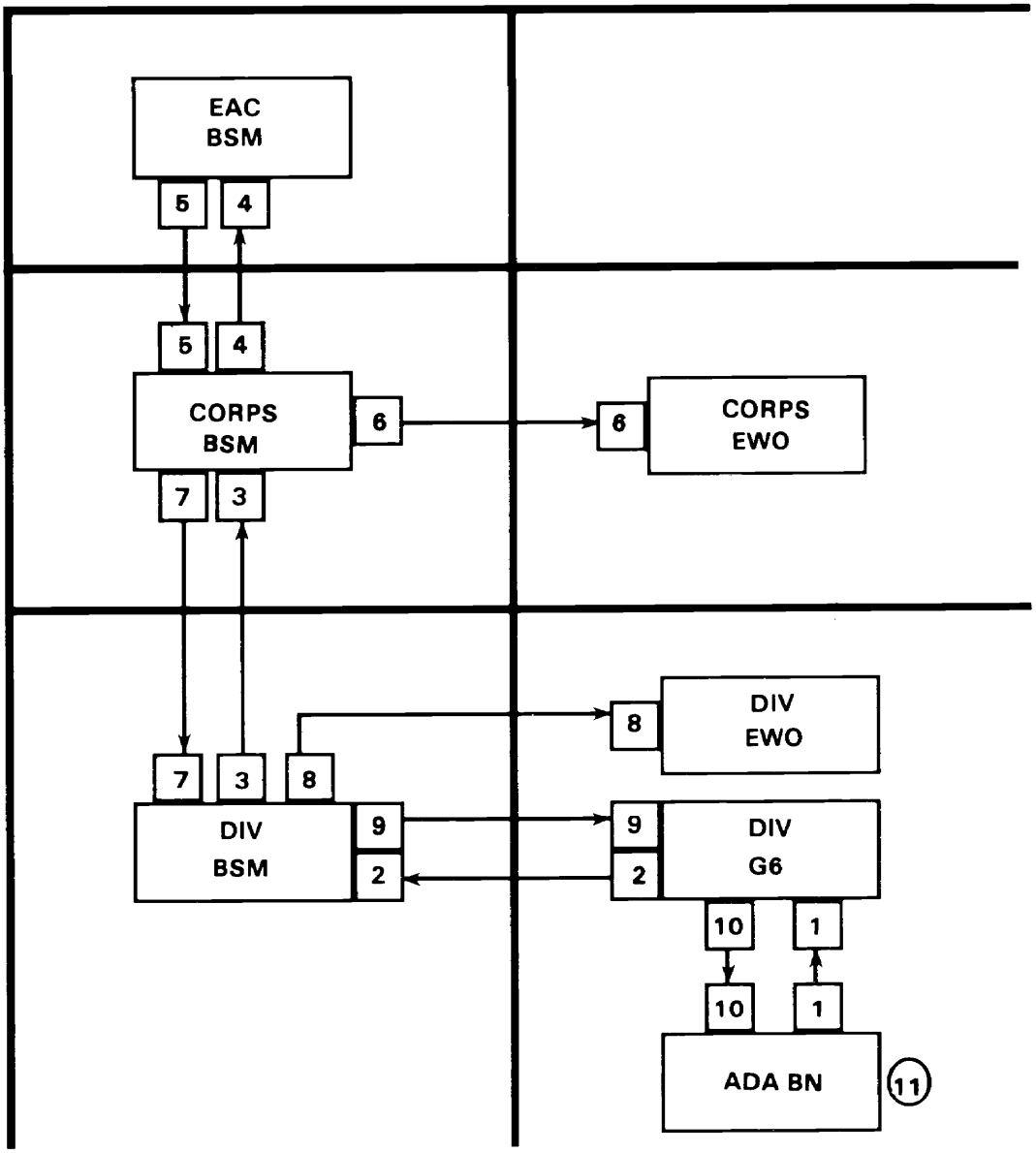


Figure A-14. Forward area alerting radar coordination flow.

A-15. Frequency Request for VULCAN Radar (AN/VPS-2)

1. In Figure A-15, the air defense artillery battalion sends a request for frequencies and a pulse repetition frequency (PRF) to support CHAPARRAL/VULCAN operations to the division G6.
2. The division G6 sends the request to the division BSM.
3. The division BSM sends the request to corps BSM.
4. The corps BSM sends the request to the EAC BSM.
5. The EAC BSM sends the assignment to the corps BSM.
6. The corps BSM notifies the corps EWO.
7. The corps BSM sends the assignment to the division BSM.
8. The division BSM notifies the division EWO.
9. The division BSM sends the assignment to the division G6.
10. The division G6 sends the assignment to the air defense artillery battalion.
11. The air defense artillery assigns frequencies to individual radars.

The range-only-radar, AN/VPS-2, is part of the VULCAN air defense system and is used in the fire control system for antiaircraft artillery guns against low-flying subsonic tactical aircraft. The radar can track aircraft moving at range rates between 10 and 310 meters per second to a maximum range of 5,000 meters. The radar operates in the 9150 to 9250 MHz range with a peak power of 1.5 kilowatts. The entire tuning range is allotted.

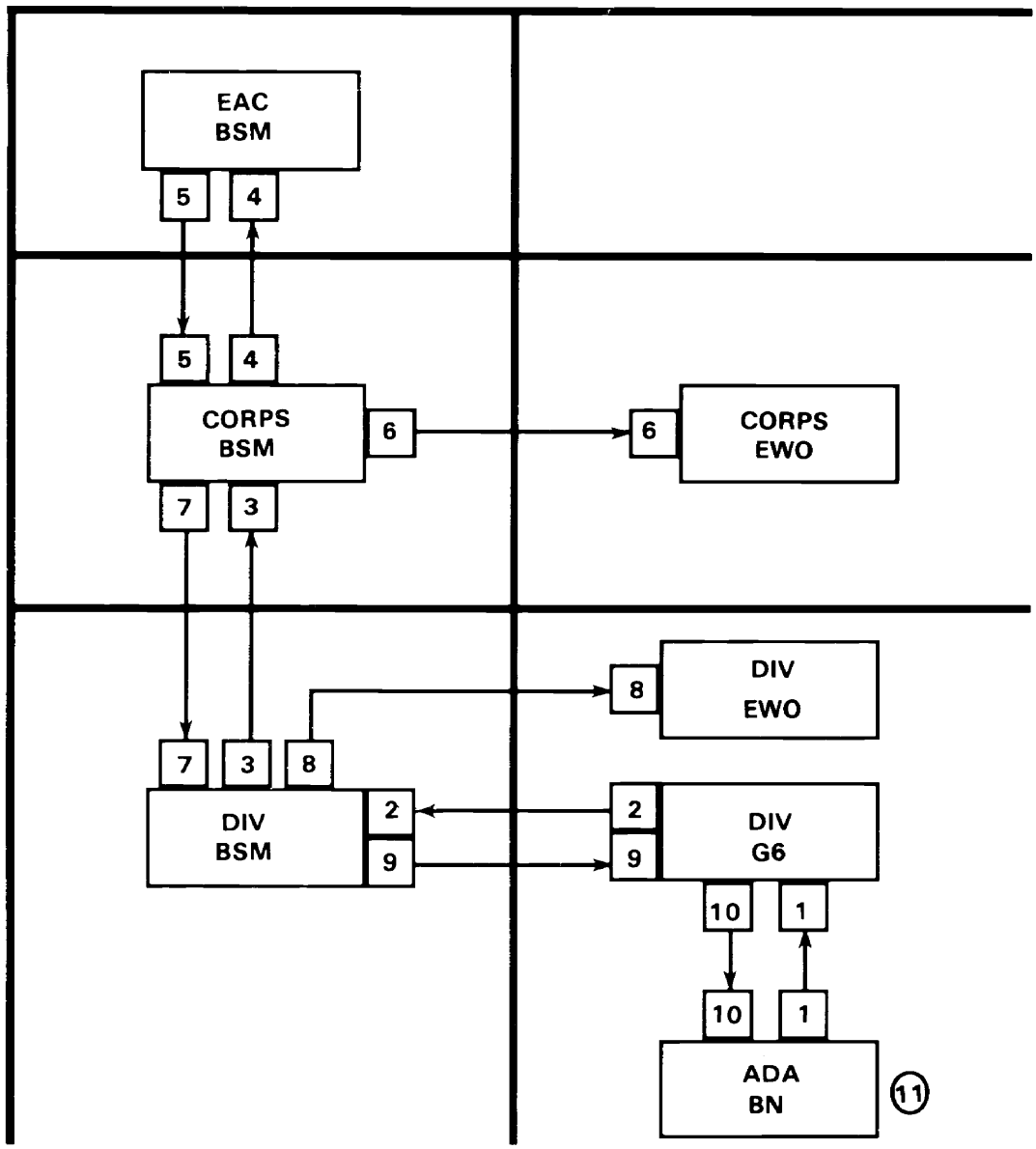


Figure A-15. VULCAN radar coordination flow.

A-16. Frequency Request for Moving Target Locating Radar

(1) In Figure A-16, the requirement for moving target locating radar is developed at the CEWI battalion and the target acquisition battery.

[2] The CEWI battalion and target acquisition battery send the frequency request to the division BSM.

[3] The division BSM sends the request to the corps BSM.

[4] The corps BSM sends the request to the EAC BSM.

[5] The EAC BSM sends the allotment to the corps BSM.

[6] The corps BSM sends the allotment to the division BSM.

[7] The division BSM sends the allotment to the CEWI battalion and the target acquisition battery.

(8) The CEWI battalion and target acquisition battery send the allotment to the ground surveillance radar (GSR) platoon and GSR section.

The ground surveillance company of the division CEWI battalion and the target acquisition battery operate the moving target locating radar.

The moving target locating radar is deployed near the FLOT and detects moving targets (vehicles and personnel). Equipments used are the AN/TPS-25 and AN/TPS-58. Frequencies are allotted for the frequency range of the equipment (9400 to 9600 MHz).

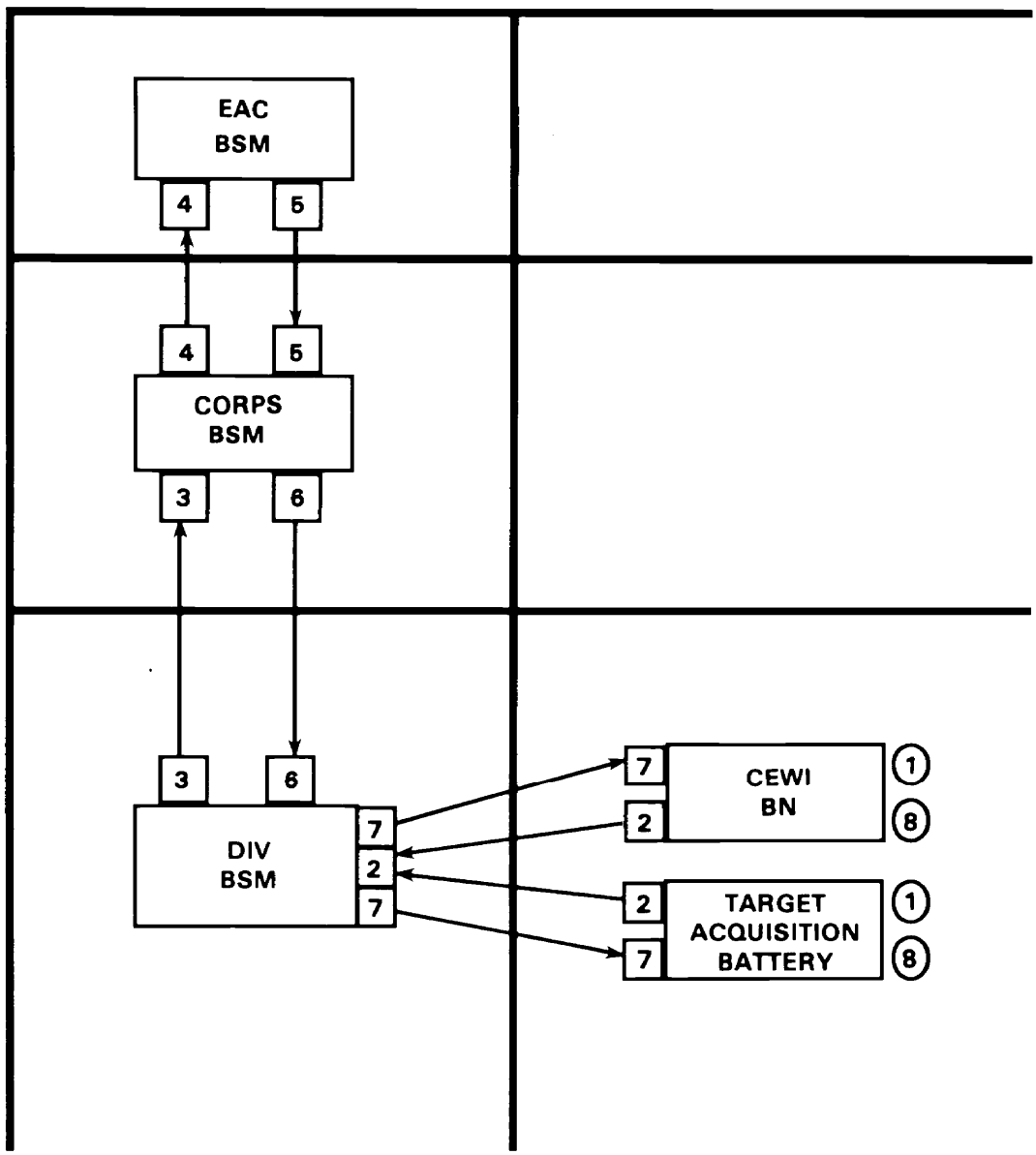


Figure A-16. Moving target locating radar coordination flow.

A-17. Frequency Request for Counter Mortar and Counter Battery

1. In Figure A-17, the requirement at division for counter mortar and counter battery is based on TOE and MTOE allowances on hand or planned to be on hand. Requests for frequency support are sent to the division G6 by the target acquisition battery for counter mortar and counter battery. Equipments used are the AN/TPQ-36, AN/TPQ-37, and AN/MPQ-4.

2. Requests for frequency support are received by the division BSM and checked for validity and accuracy. The division artillery signal officer identifies requirements to the division BSM. (This includes cross attached corps artillery assets controlled by division artillery.)

3. The division BSM sends the request to the corps BSM.

4. The corps BSM sends the request to EAC BSM.

5. The EAC BSM sends the frequency assignments to the corps BSM.

6. The corps BSM notifies the corps EWO.

7. The corps BSM sends the assignments to the division BSM.

8. The division BSM sends the assignments to the requesting elements.

9. The division BSM notifies the division EWO.

Counter mortar and counter battery radars are usually located along the FLOT looking toward the enemy. The radar locates cannons, mortars, and rockets by detecting the position of the in-flight projectile at two points in space and extrapolating this trajectory to its point of origin. The radar is usually turned off when enemy mortar and artillery fire is not occurring to reduce its vulnerability to direction finding. Frequencies are normally allotted for the frequency range of the radar.

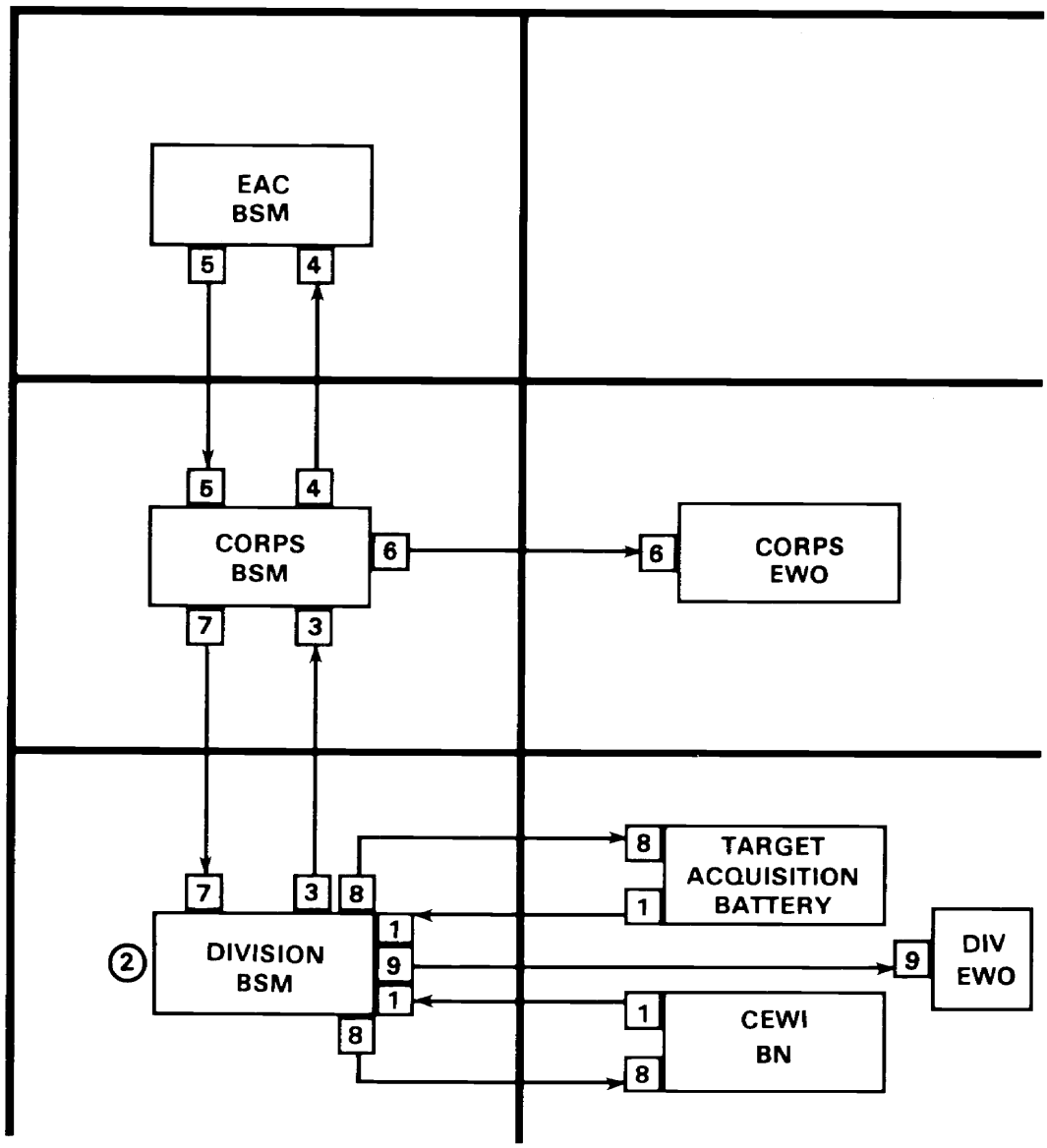


Figure A-17. Counter mortar and counter battery coordination flow.

A-18. Frequency Request for GSR

(1) In Figure A-18, the requirements for GSR are developed by division/corps G2 and the CEWI battalion.

[2] The division/corps CEWI battalion sends the frequency request to the division/corps BSM.

[3] The division BSM sends the request to the corps BSM.

[4] The corps BSM sends the request to the EAC BSM.

[5] The EAC BSM sends the allotment to the corps BSM.

[6] The corps BSM sends the allotment to the corps CEWI battalion.

[7] The corps BSM sends the allotment to the division BSM.

[8] The division BSM sends the allotment to the division CEWI battalion.

(9) The CEWI battalion sends the allotment to the GSR platoons.

GSR is operated at division level by the division CEWI battalion. At corps and separate brigades, the military intelligence group provides support. Frequencies are allotted for the entire tuning range.

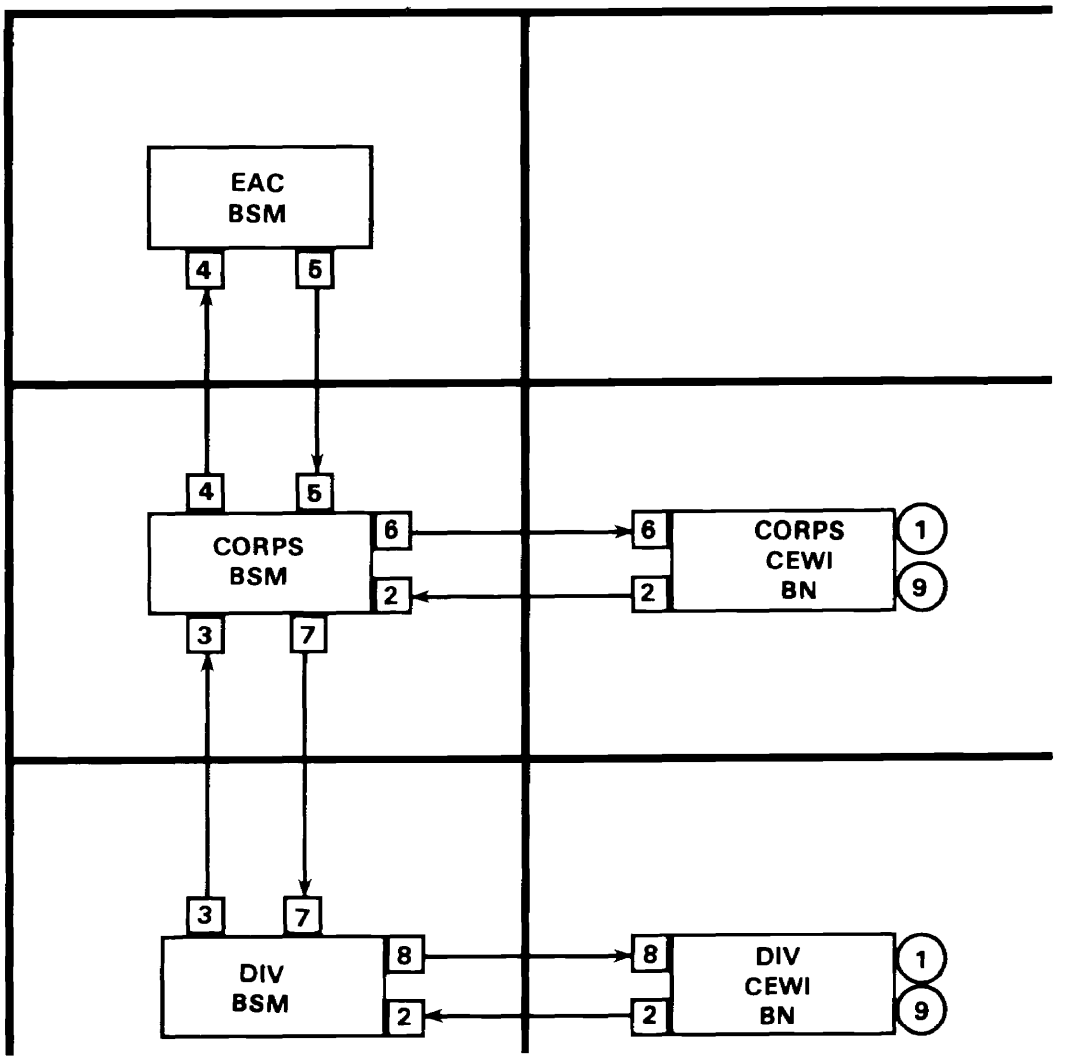


Figure A-18. GSR radar coordination flow.

A-19. Frequency Request for SINCGARS (VHF-FM FH)

1. In Figure A-19, the division G6 submits the division FH net list to the division BSM for VHF-FM frequencies to support the division combat net radio FH nets.
2. The division BSM submits the request to the corps BSM.
3. The corps BSM sends the request to the EAC BSM.
4. The EAC BSM sends the assignments and lockout information the corps BSM.
5. The corps BSM coordinates frequency assignment information with the corps EWO.
6. The corps BSM sends frequency assignments, frequency lockouts, and net IDs to the division BSM by fill device/disk, if applicable.
7. The division BSM coordinates frequency assignment information with the division EWO.
8. The division BSM sends frequency assignments, frequency lockouts, and net IDs to the division G6.
9. The division G6 performs SINCGARS SOI generation and distributes the SOI to all subordinate units by fill device/disk.

VHF-FM spectrum resources (30 to 88 MHz) along with the decentralized automated support system (BECS) is required to support effective SINCGARS operation on the battlefield. The BECS generates, manipulates, prints, stores, displays, and transfers the information required to operate the SINCGARS in the FH/SINGLE-CHANNEL mode. A hopset is a given number of frequencies which the SINCGARS can hop or transmit. A hopset can be any number of frequencies from 1 to 2320. As with single-channel radio operation, certain civilian radio services continue to be factors in obtaining and distributing frequency resources. Frequencies used for these services continue to be protected from interference by SINCGARS.

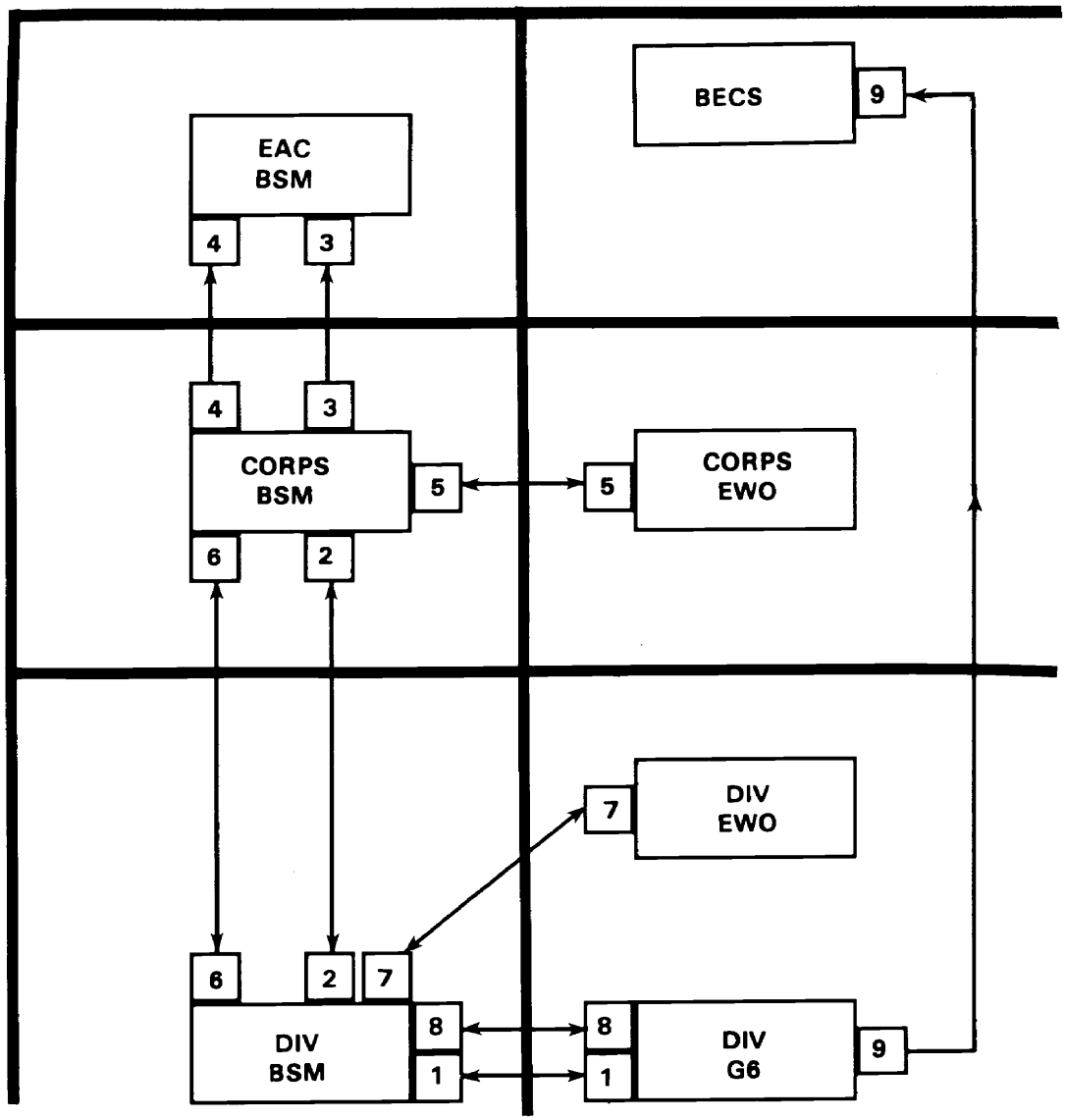


Figure A-19. VHF-FM SINCGARS coordination flow.

A-20. Request for ECM Jamming Authorization

(1) In Figure A-20, the CEWI battalion develops the ECM plan to include the list of frequencies to be jammed and the point of contact information.

2 The CEWI battalion sends the request to the division BSM.

3 The division BSM sends the request to the corps BSM.

4 The corps BSM sends the request to the EAC BSM.

5 The EAC BSM sends the authorization for jamming, frequencies cleared for jamming, and any restrictions to the corps BSM.

6 The corps BSM sends the authorization to the division BSM.

7 The division BSM sends authorization to the CEWI battalion.

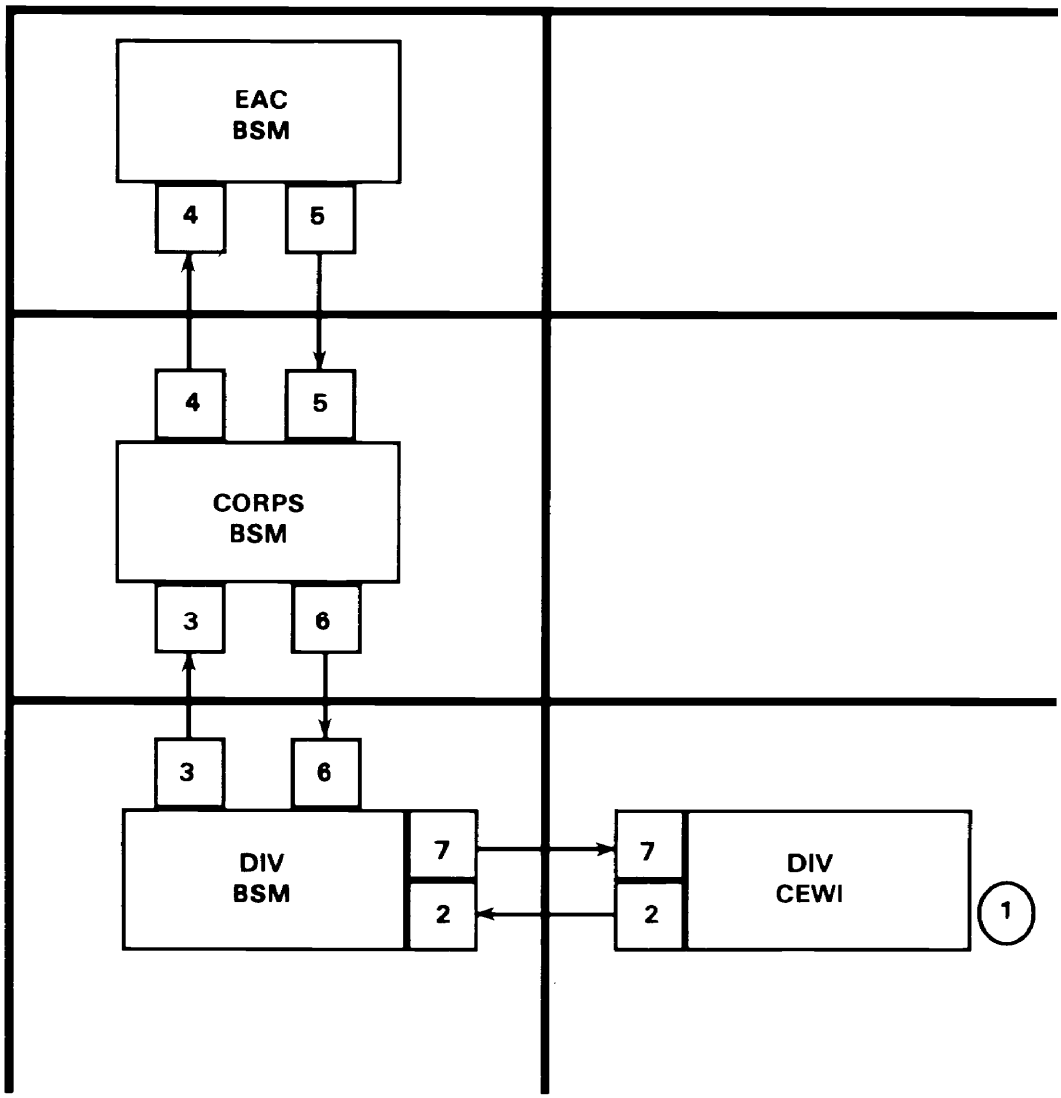


Figure A-20. ECM jamming coordination flow.

A-21. MIJI - Part I. Meaconing, Intrusion, and Jamming

(1) In Figure A-21, the operator detects abnormal operation of the receiving equipment.

(2) The operator checks the equipment to ensure that the abnormal operation is not being caused by an equipment malfunction.

(3) The operator checks with adjacent units to determine if that is the source of the problem.

[4] If the operator determines that the abnormal operation is caused by an outside source, the operator initiates a MIJI report and sends it to the BSM.

(5) The division BSM and division EWO evaluate the MIJI report to determine whether the problem is caused by friendly or unfriendly sources. The corps BSM and EWO and the EAC BSM and EWO may also evaluate the report depending on what level the report is initiated.

(6) If the source is determined to be unfriendly, the EWO will attempt to locate it, identify it, and if determined to be a serious threat, target it for destruction or neutralize its effect.

(7) The BSM, with command guidance and in coordination with the EWO, will require the equipment to continue operating to conceal that MIJ is affecting its operation. The BSM may assign alternate frequencies to allow the affected unit to operate a second piece of equipment so the mission can continue.

[8] If the source cannot be determined, a follow-up MIJI report is sent with all available information to the JEWC and other addressees as required.

(9) The JEWC will enter the information into the data base and attempt to determine the source of the problem.

[10] The JEWC notifies the reporting unit and other addressees of its findings.

(11) The appropriate units take any remaining resolution actions.

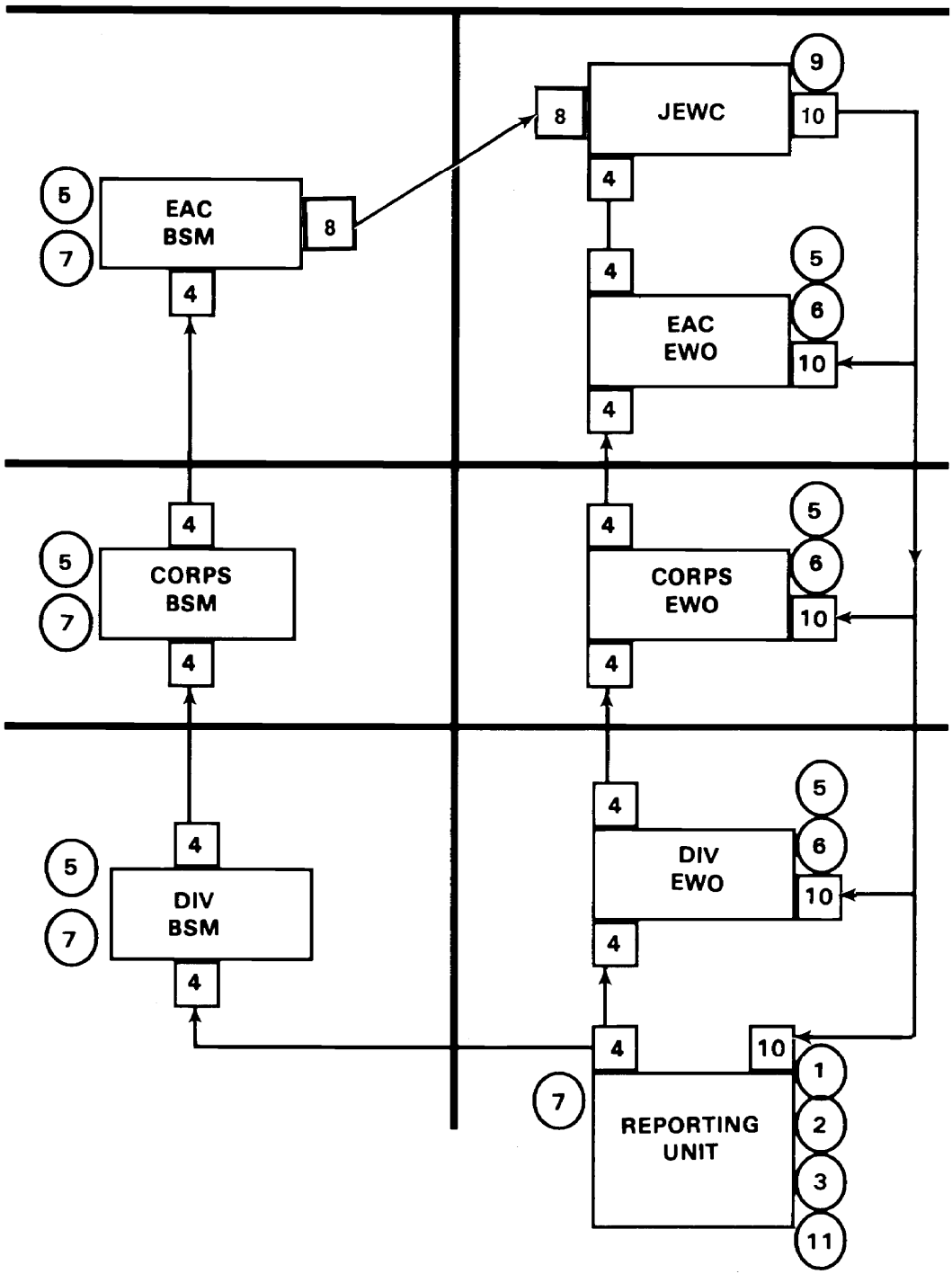


Figure A-21. MIJI-MIJ resolution flow.

A-22. MIJI - Part II. Interference

(1) In Figure A-22, the operator detects abnormal operation of the receiving equipment.

(2) The operator checks the equipment to ensure that the abnormal operation is not being caused by an equipment malfunction.

(3) The operator (or the NCOIC, OIC, or signal officer) checks with adjacent units to determine if that is the source of the problem.

[4] If the operator determines that the abnormal operation is caused by an outside source, the operator initiates a MIJI report and sends it to the BSM.

(5) The division BSM and division CEWI evaluate the report to determine whether the problem is caused by friendly or unfriendly forces. The corps BSM and CEWI and the EAC BSM and EWO may also evaluate the report as required.

(6) If the source is friendly and it can be found, the problem can be resolved locally or through liaison with the source unit.

[7] If the source cannot be determined, a follow-up MIJI report is sent with all available information to the JEWC and other addressees as required.

(8) The JEWC will enter the information into the data base and attempt to determine the source of the problem.

[9] The JEWC notifies the reporting unit (and other addressees) of the findings.

(10) The reporting unit takes the necessary action to eliminate or mitigate the problem. The unit may have to request technical assistance.

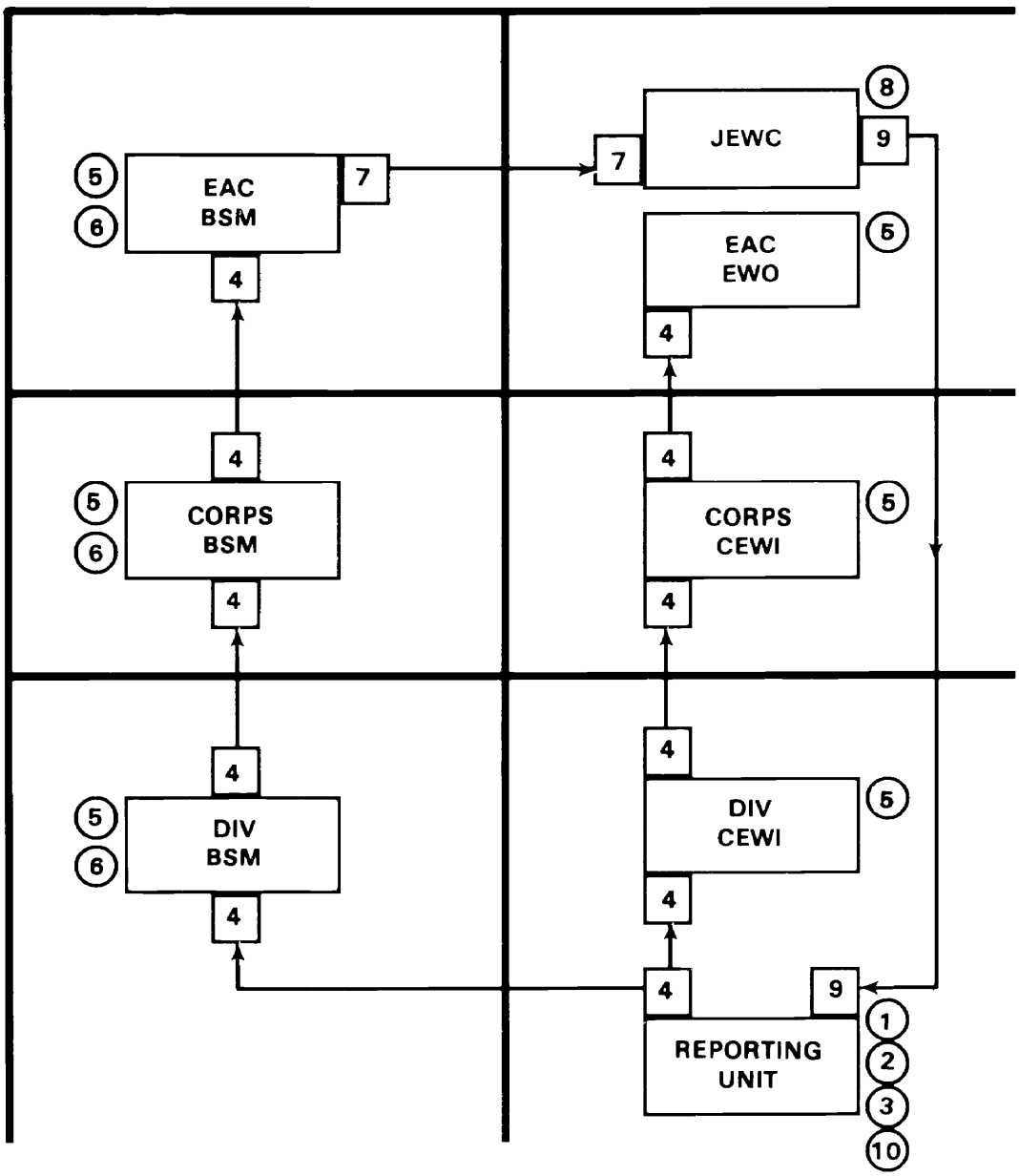


Figure A-22. MIJI interference resolution flow.

Appendix B

Interference Charts

B-1. Description and Use

The interference charts in this appendix can be used in determining the distance separation required for cochannel and adjacent channel operation. Distance separation charts indicate the spacing needed between stations under different conditions of transmitter power output and types of emission. Interfering equipment is referred to as the undesired transmitter. Equipment interfered with is called the receiver and desired transmitter.

The following services are covered by the charts: AM SSB voice, teletype, and FM voice/data. Two charts are shown for each type of service. One chart is for use when the desired and undesired transmitters are on the same frequency; the other chart is used when the undesired transmitter is on an adjacent channel separated by the frequency indicated.

B-2. Sample Problem

Problem.

A desired transmitter and the desired receiver are operating an FM voice net on low power (8 watts) located 3 miles apart. What is the minimum distance a high power (35 watts) FM transmitter operating on the same frequency can be placed from the desired receiver without causing interference?

Solution.

Since the desired signal is FM voice, the desired transmitter and receiver are operating on low power. The undesired transmitter is operating on high power and all are on the same frequency (Figure B-1).

The ratio of the undesired transmitter power to the desired transmitter power is 35 to 8 (about 4 to 1).

Enter the chart on the horizontal scale at the 3-mile point and extend a vertical line from this point until it meets the curve corresponding to a ratio of 4 to 1.

The curve corresponding to a ratio of 4 to 1 is not shown on the chart, but its position is found by interpolating between the 1 to 1 and 10 to 1 curves.

From this point, a horizontal line is drawn to the left until it intersects the vertical scale which indicates a distance of 6 miles.

Therefore, the minimum distance that the 35-watt undesired transmitter must be separated from the receiver is 6 miles.

NOTE: Interpolation is logarithmic between curves and gridlines.

B-3. Special Considerations

The adjacent channel charts are for 5-kHz separation (using 11 MHz frequency for SSB-voice AM equipment) and 50-kHz separation (using 53 MHz frequency for FM equipment). Any interfering equipment with less channel separation from the receiver than indicated in these charts results in a greater required distance separation from the desired receiver, and should be sited using the same-channel charts.

Figures B-1 and B-2 are charts for FM equipment based on the characteristics of the AN/VRC-12 series radio. These charts apply to equipment having similar characteristics as to maximum frequency deviation, selectivity, and frequency stability. Figures B-3 and B-4 are interference charts for SINCGARS versus SINCGARS. Figures B-5 through B-12 are interference charts for SINCGARS versus AN/VRC-12 series radio. Figure B-13 is an interference chart for AN/PRC-77 versus SINCGARS. Figures B-14 through B-17 are charts for SSB equipment based on the characteristics of the AN/GRC-106 radio set. These charts apply to equipment having similar characteristics as to modulation, selectivity, and frequency stability.

Only ground wave and direct wave transmissions were considered in preparing these charts. Propagation over a smooth spherical earth and using 15-foot vertical whip antennas were considered, based on cochannel signal-to-interference thresholds of AN/VRC-12, 6 dB; AN/GRC-106, SSB, 4 dB; and AN/GRC-106, teletype, 9 dB.

Mutual interference problems often result when FM transmitters operating on different frequencies are situated in the same locale. The problem can occur between AN/VRC-12 series radios and also between these radios and low power FM radios. These radio sets include the AN/PRC-25, AN/PRC-77, and the vehicular versions of these radios. These interference problems can be effectively reduced when the following basic assignment standards are followed.

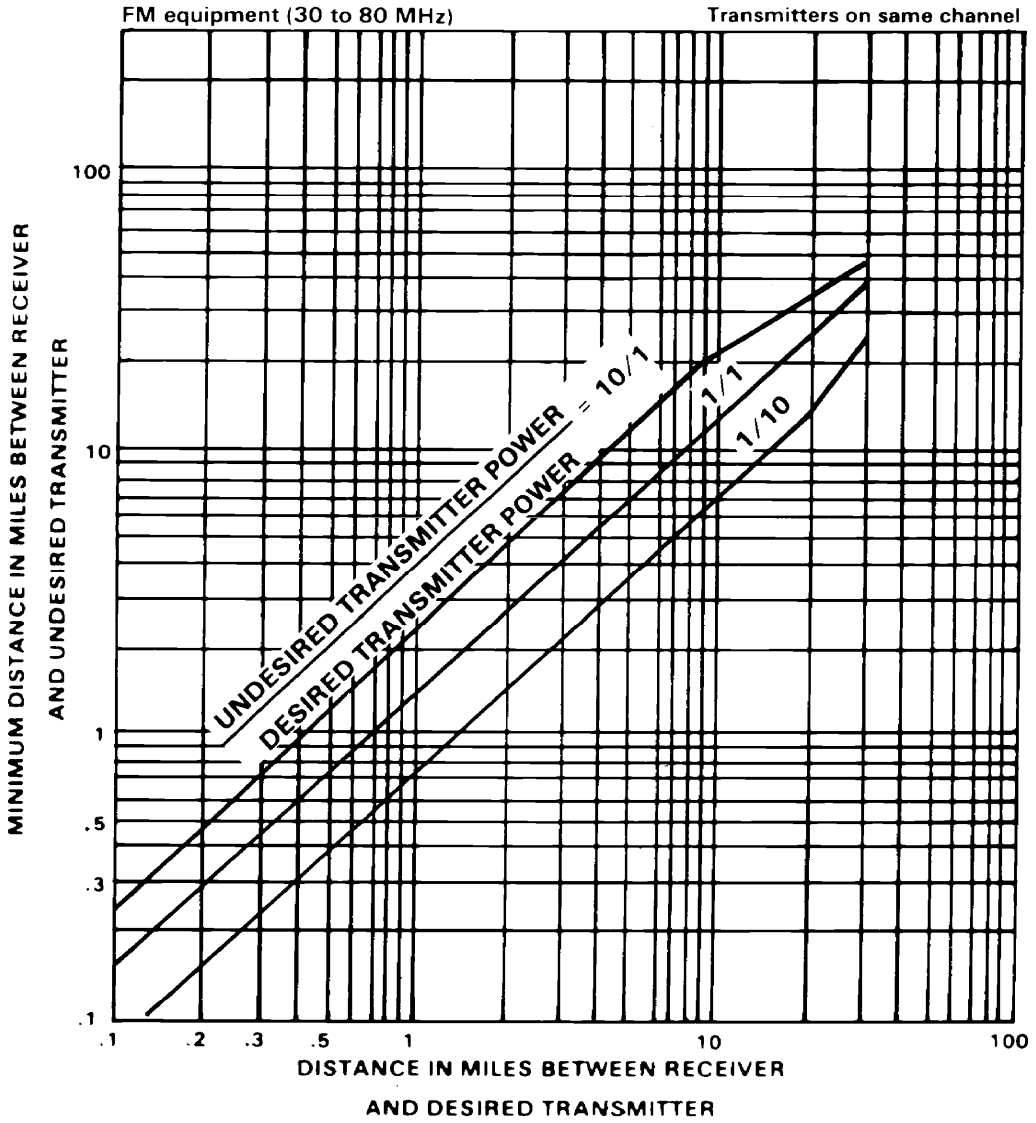


Figure B-1. Interference chart (FM same channel) for AN/VRC-12 series radios.

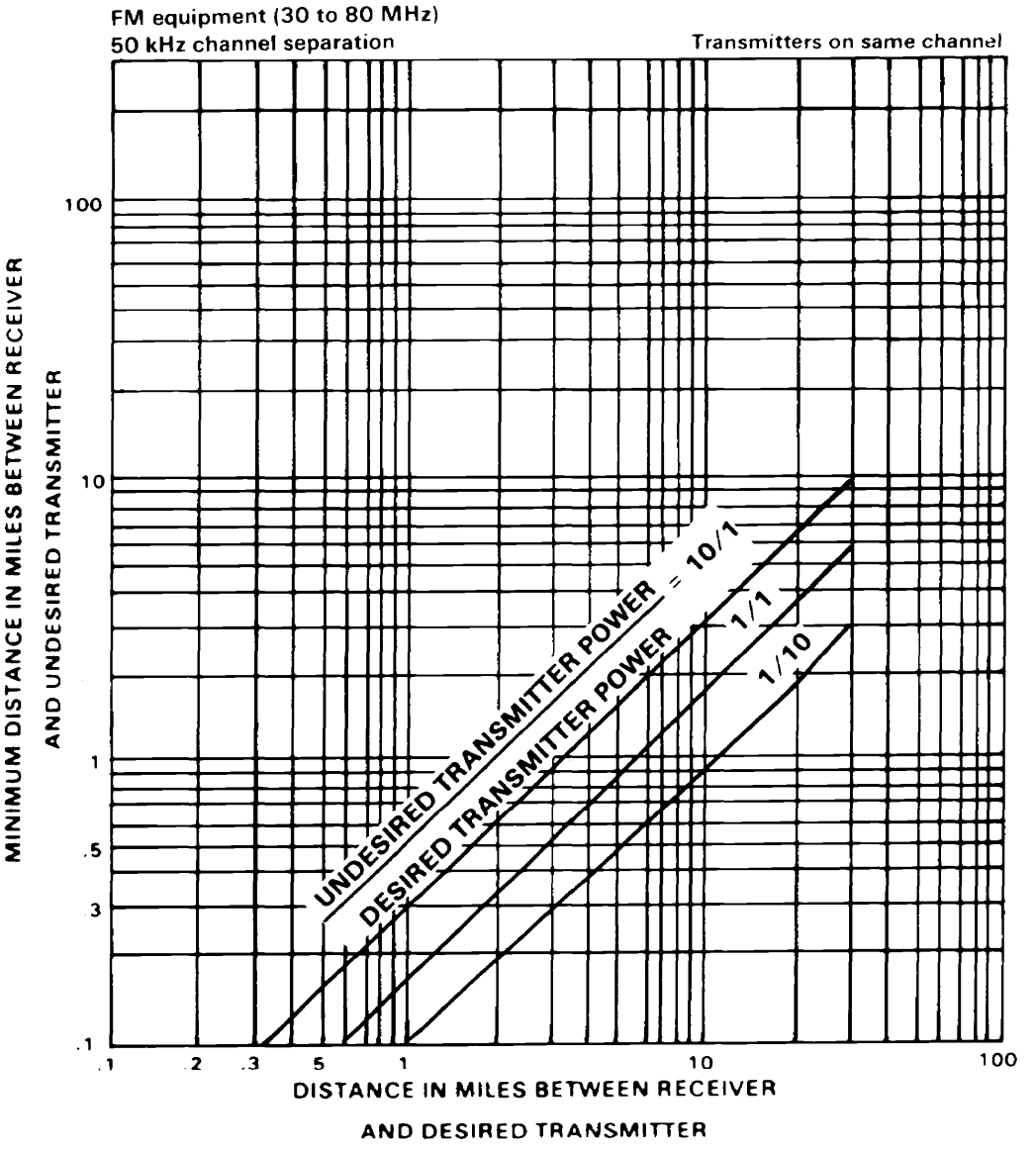


Figure B-2. Interference chart (FM adjacent channel) for AN/VRC-12 series radio.

	Undesired Transmitter	Desired Link
1	SINCGARS Pa Mode	SINCGARS Med Power
2	SINCGARS Hi Power	SINCGARS Med Power
3	SINCGARS Pa Mode	SINCGARS Hi Power
	SINCGARS Pa Mode	SINCGARS Pa Mode
4	SINCGARS Hi Power	SINCGARS Hi Power
	SINCGARS Med Power	SINCGARS Med Power

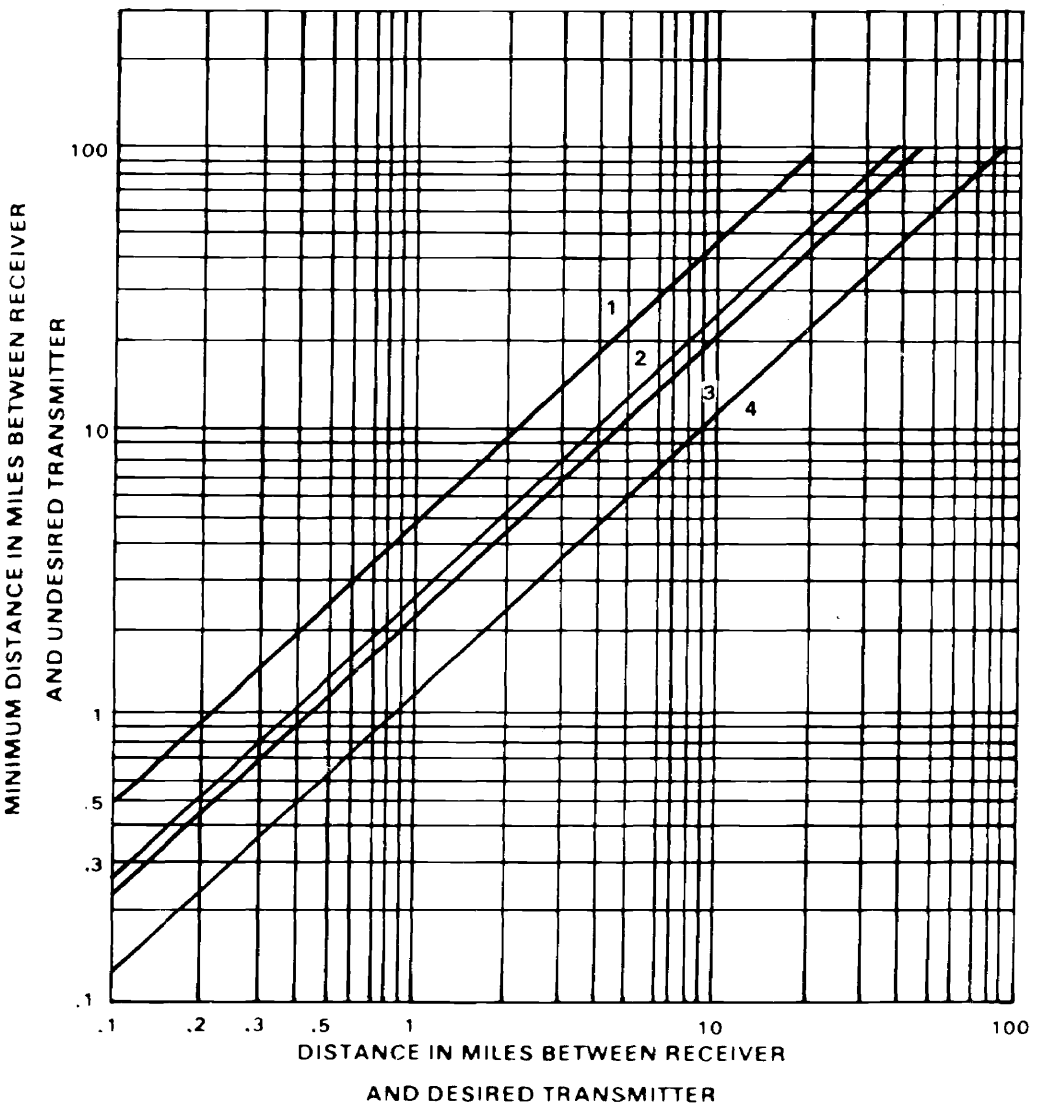


Figure B-3. Interference chart for SINCGARS versus SINCGARS (cochannel).

	Undesired Transmitter	Desired Link
5	SINCGARS Hi Power	SINCGARS Pa Mode
6	SINCGARS Med Power	SINCGARS Hi Power
7	SINCGARS Med Power	SINCGARS Pa Mode

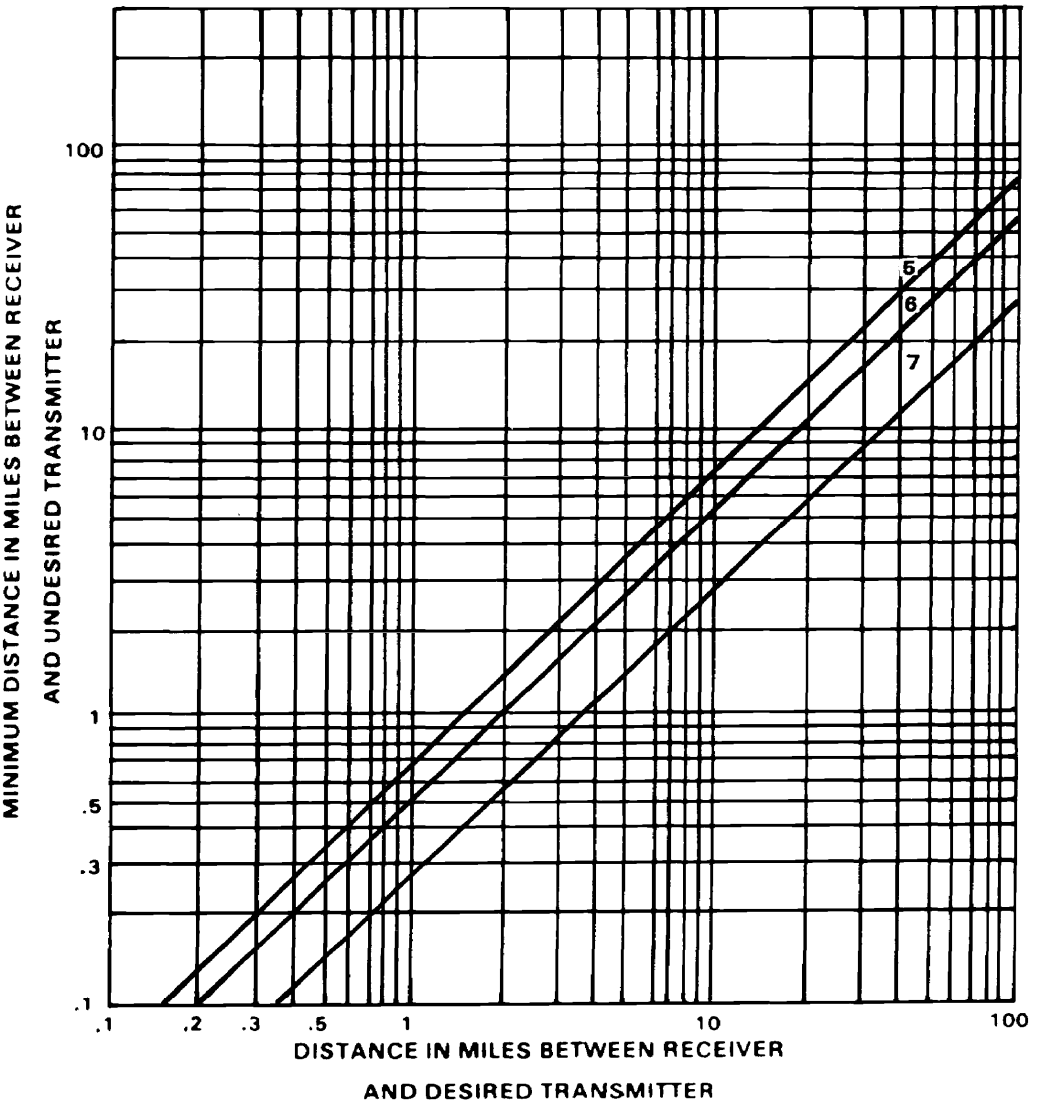


Figure B-3. Interference chart for SINCGARS versus SINCGARS (cochannel). (continued)

	Undesired Transmitter	Desired Link
1	SINCGARS Hi Power	SINCGARS Pa Mode
2	SINCGARS Med Power	SINCGARS Hi Power
3	SINCGARS Med Power	SINCGARS Pa Mode

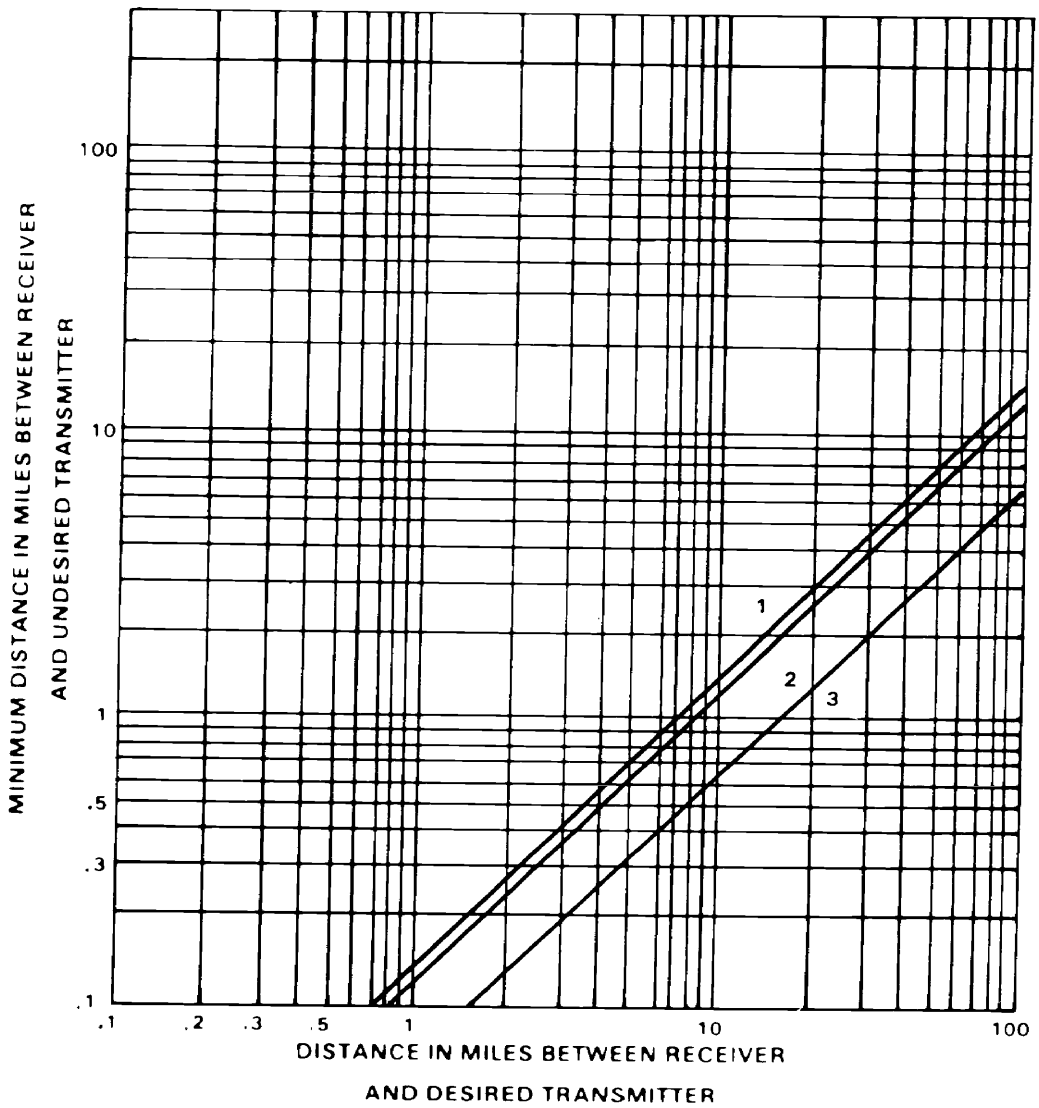


Figure B-4. Interference chart for SINCGARS versus SINCGARS (adjacent channel, 25 kHz spacing).

	Undesired Transmitter	Desired Link
4	SINCGARS Pa Mode	SINCGARS Med Power
5	SINCGARS Hi Power	SINCGARS Med Power
6	SINCGARS Pa Mode	SINCGARS Hi Power
7	SINCGARS Pa Mode	SINCGARS Pa Mode
7	SINCGARS Hi Power	SINCGARS Hi Power
7	SINCGARS Med Power	SINCGARS Med Power

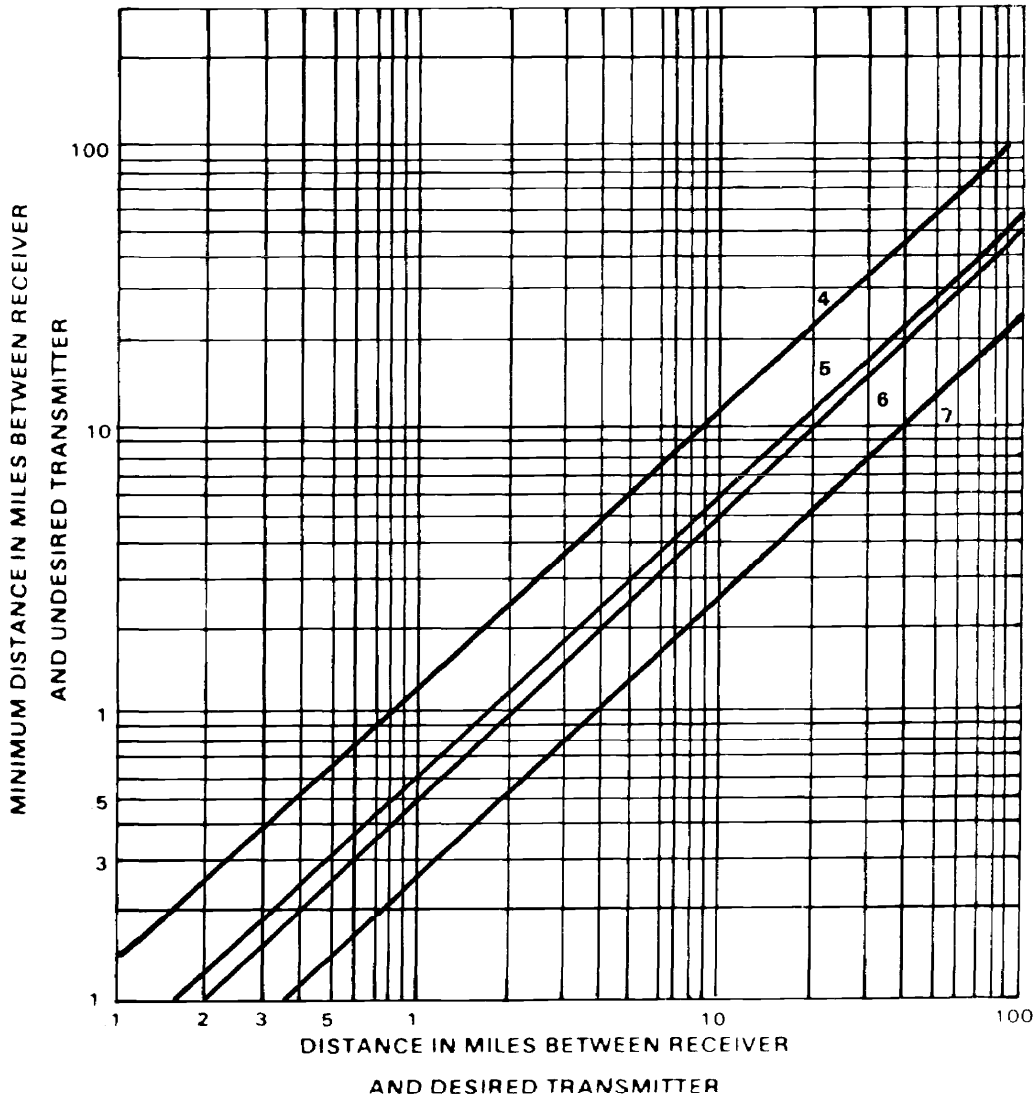


Figure B-4. Interference chart for SINCGARS versus SINCGARS (adjacent channel, 25 kHz spacing). (continued)

	Undesired Transmitter	Desired Link
1	SINCGARS Pa Mode	VRC-12 Lo Power/PRC-77
2	SINCGARS Hi Power	VRC-12 Lo Power/PRC-77
3	SINCGARS Med Power	VRC-12 Lo Power/PRC-77

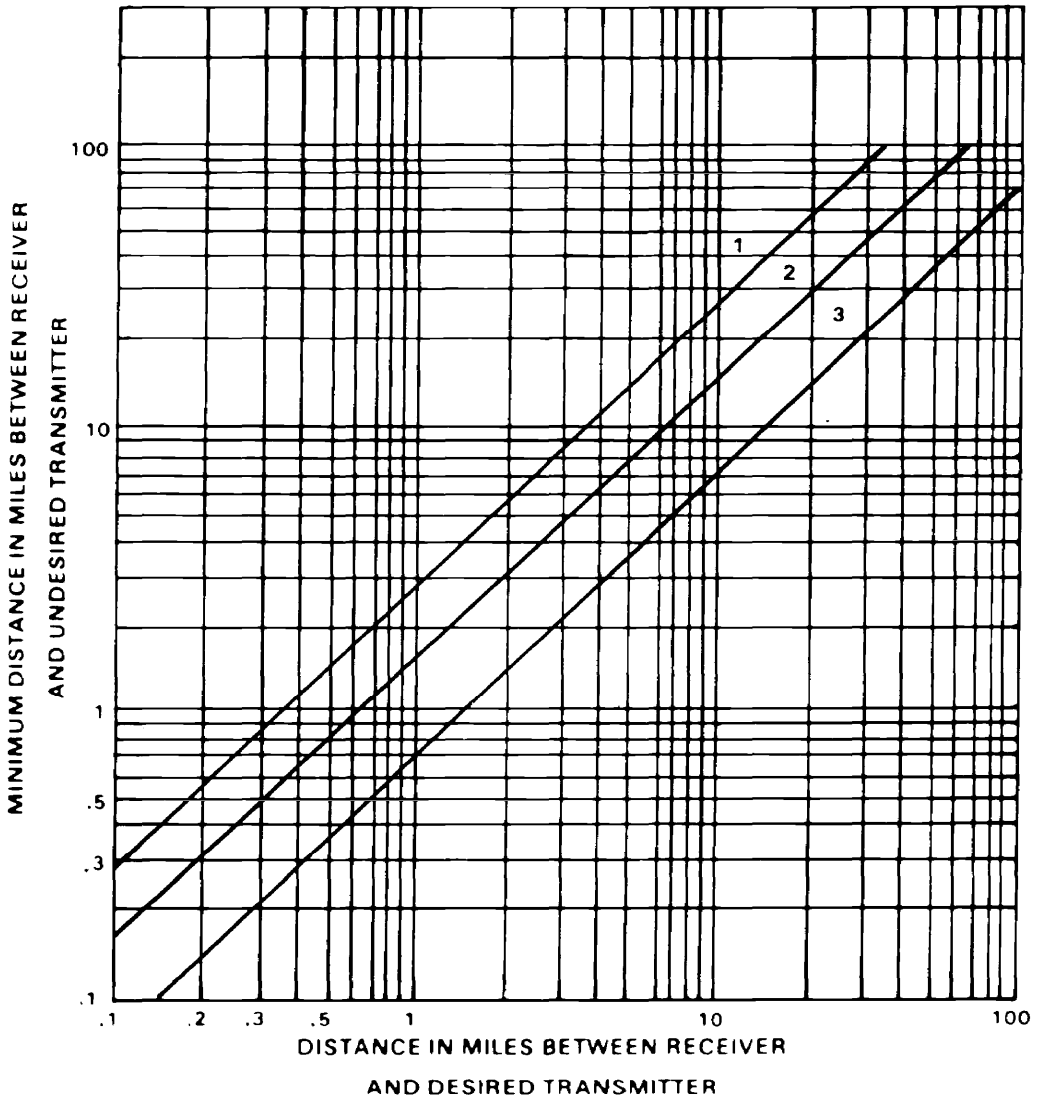


Figure B-5. Interference chart for SINCGARS versus AN/VRC-12 low power (cochannel).

	Undesired Transmitter	Desired Link
1	SINCGARS Pa Mode	VRC-12 Hi Power
2	SINCGARS Hi Power	VRC-12 Hi Power
3	SINCGARS Med Power	VRC-12 Hi Power

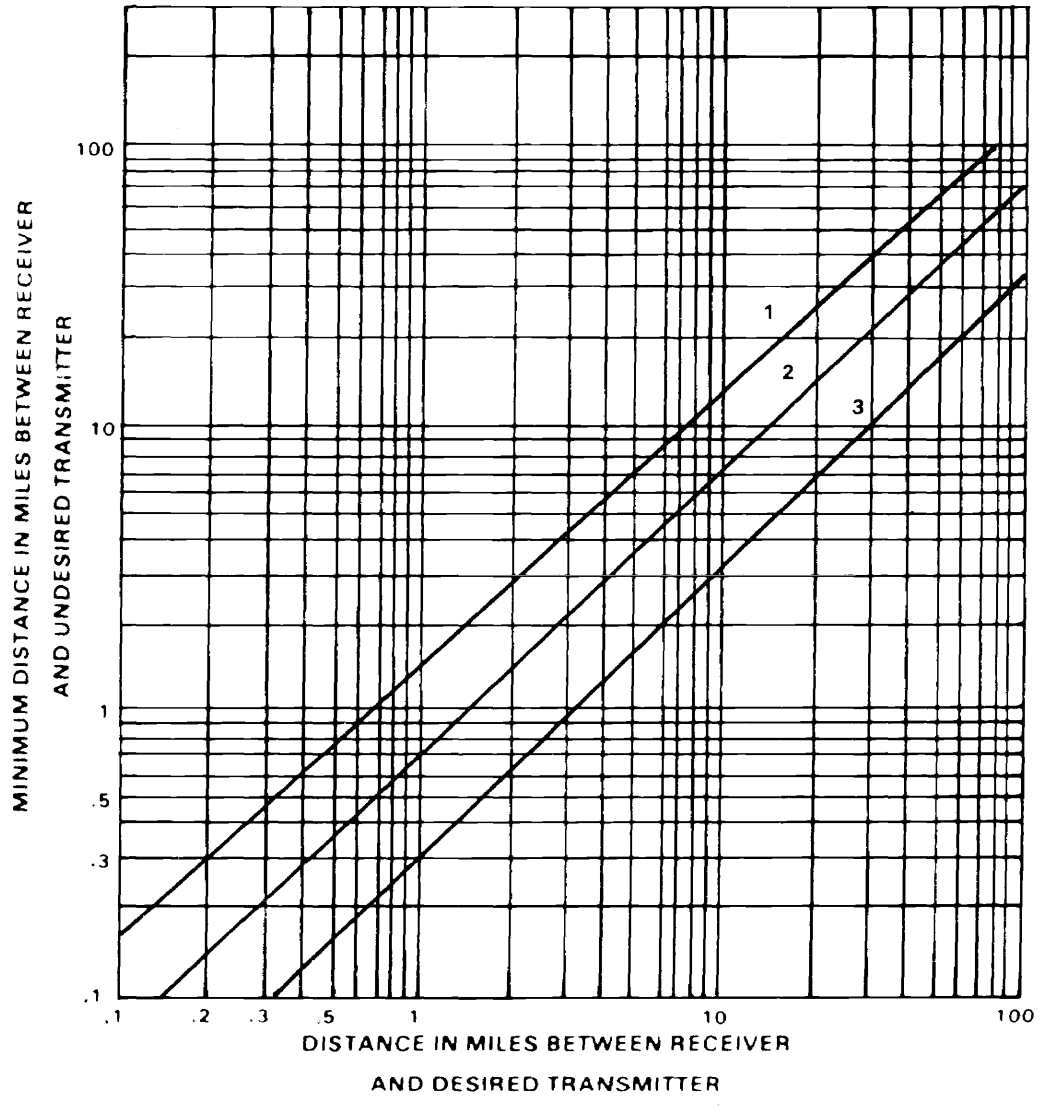


Figure B-6. Interference chart for SINCGARS versus AN/VRC-12 high power (cochannel).

	Undesired Transmitter	Desired Link
1	AN/VRC-12 Lo Power/PRC-77	SINCGARS Med Power
2	AN/VRC-12 Lo Power/PRC-77	SINCGARS Hi Power
3	AN/VRC-12 Lo Power/PRC-77	SINCGARS Pa Mode

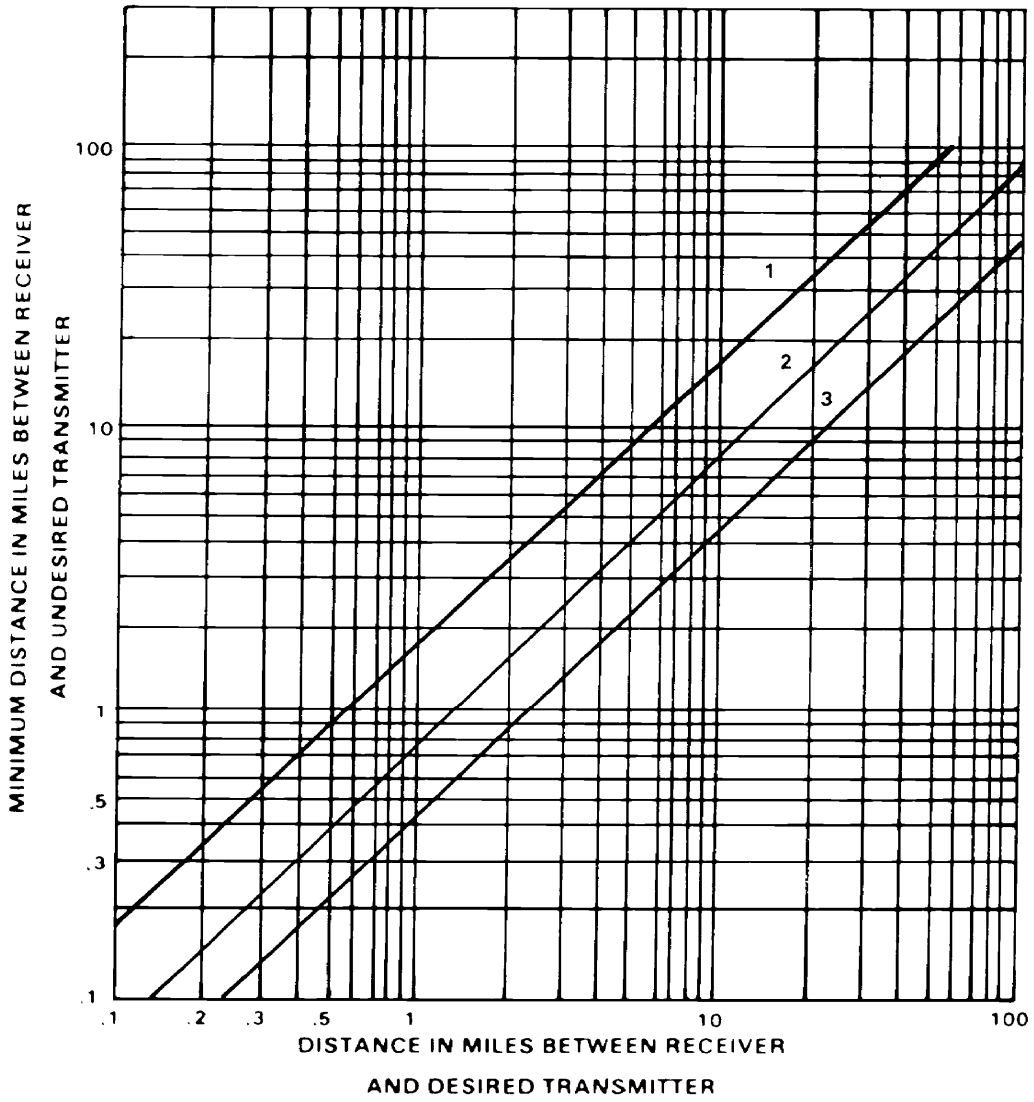


Figure B-7. Interference chart for AN/VRC-12 low power versus SINCGARS (cochannel).

	Undesired Transmitter	Desired Link
1	AN/VRC-12 Hi Power	SINCGARS Med Power
2	AN/VRC-12 Hi Power	SINCGARS Hi Power
3	AN/VRC-12 Hi Power	SINCGARS Pa Mode

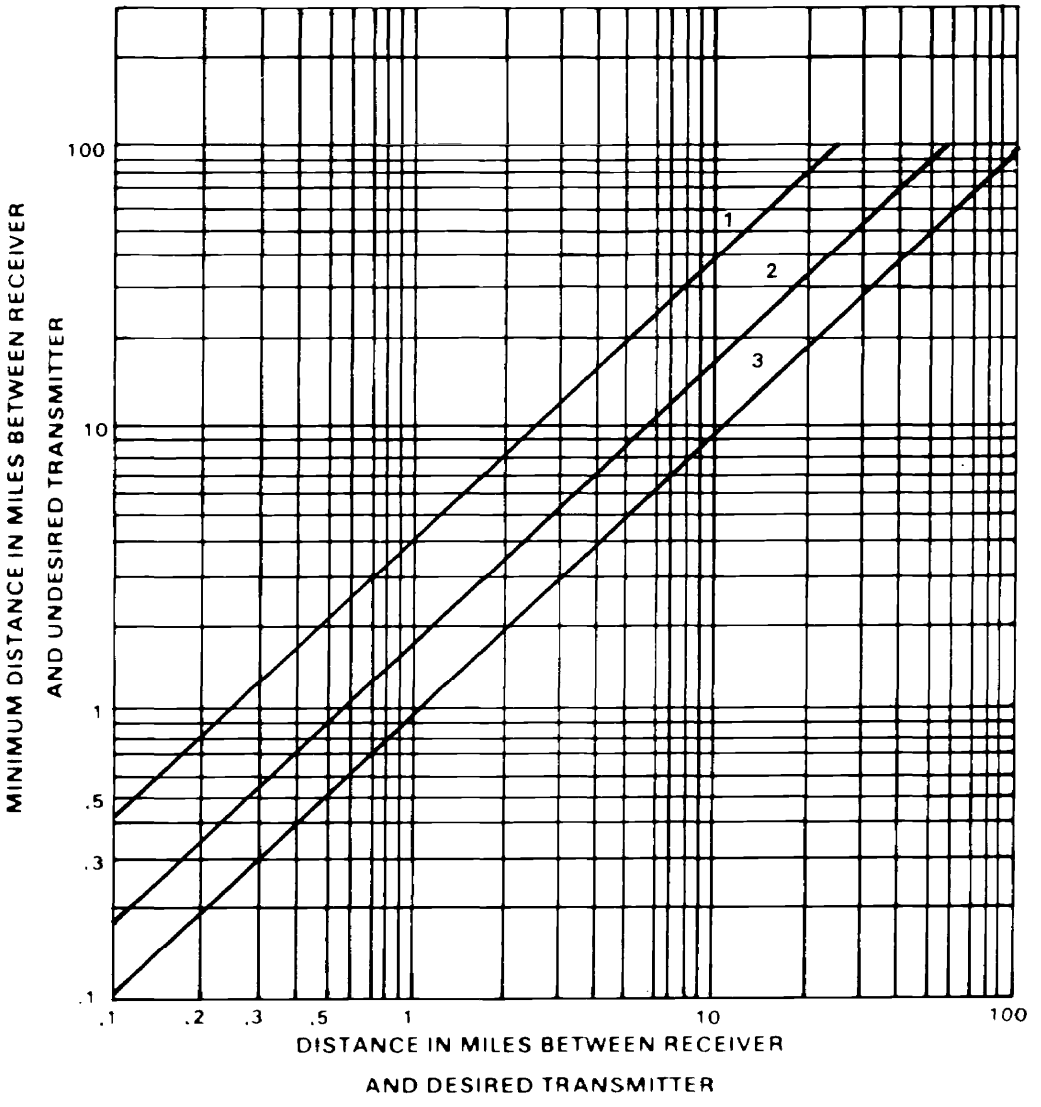


Figure B-8. Interference chart for AN/VRC-12 high power versus SINCGARS (cochannel).

	Undesired Transmitter	Desired Link
1	AN/VRC-12 Hi Power	SINCGARS Med Power
2	AN/VRC-12 Hi Power	SINCGARS Hi Power
3	AN/VRC-12 Hi Power	SINCGARS Pa Mode

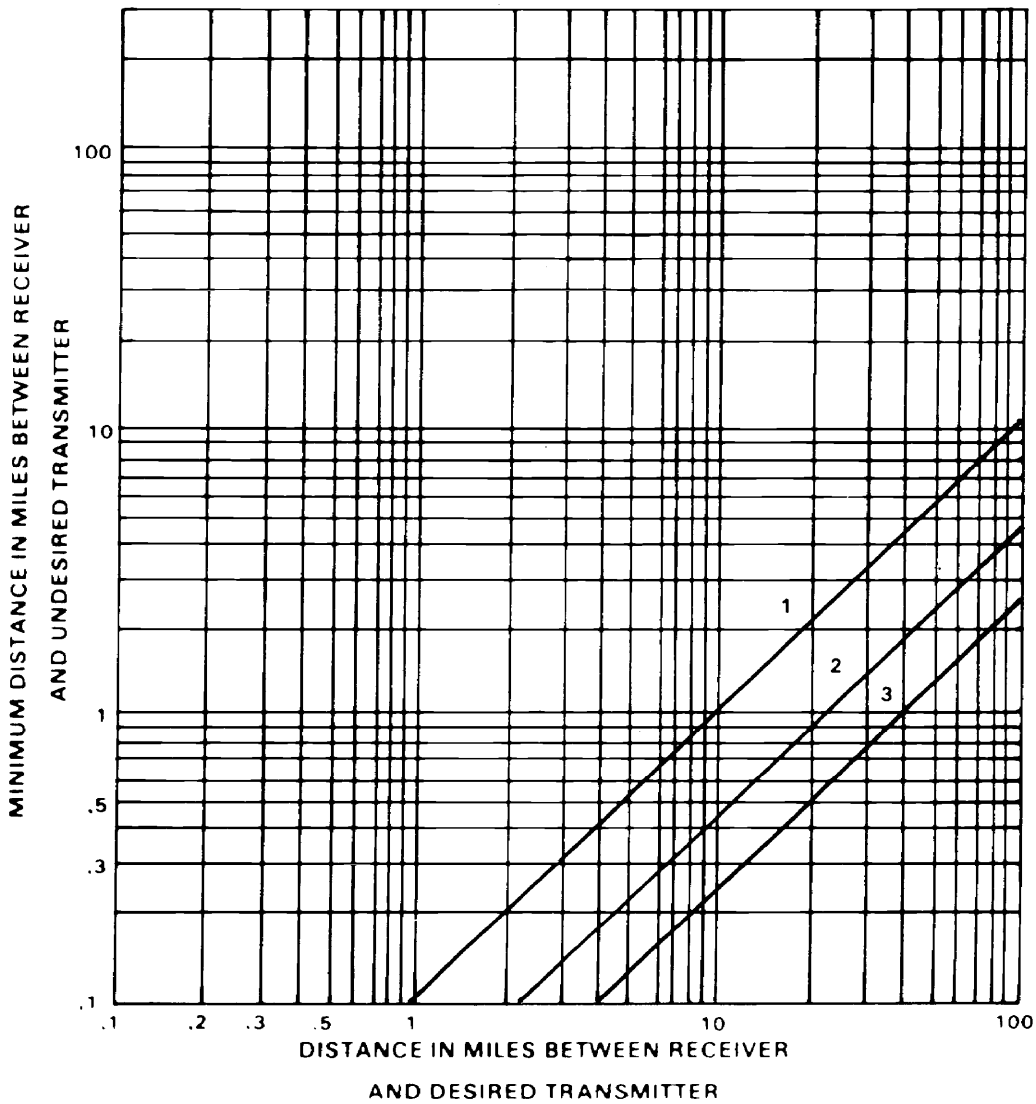


Figure B-9. Interference chart for AN/VRC-12 high power versus SINCGARS (adjacent channel, 50 kHz spacing).

	Undesired Transmitter	Desired Link
1	SINCGARS Pa Mode	AN/VRC-12 Hi Power
2	SINCGARS Hi Power	AN/VRC-12 Hi Power
3	SINCGARS Med Power	AN/VRC-12 Hi Power

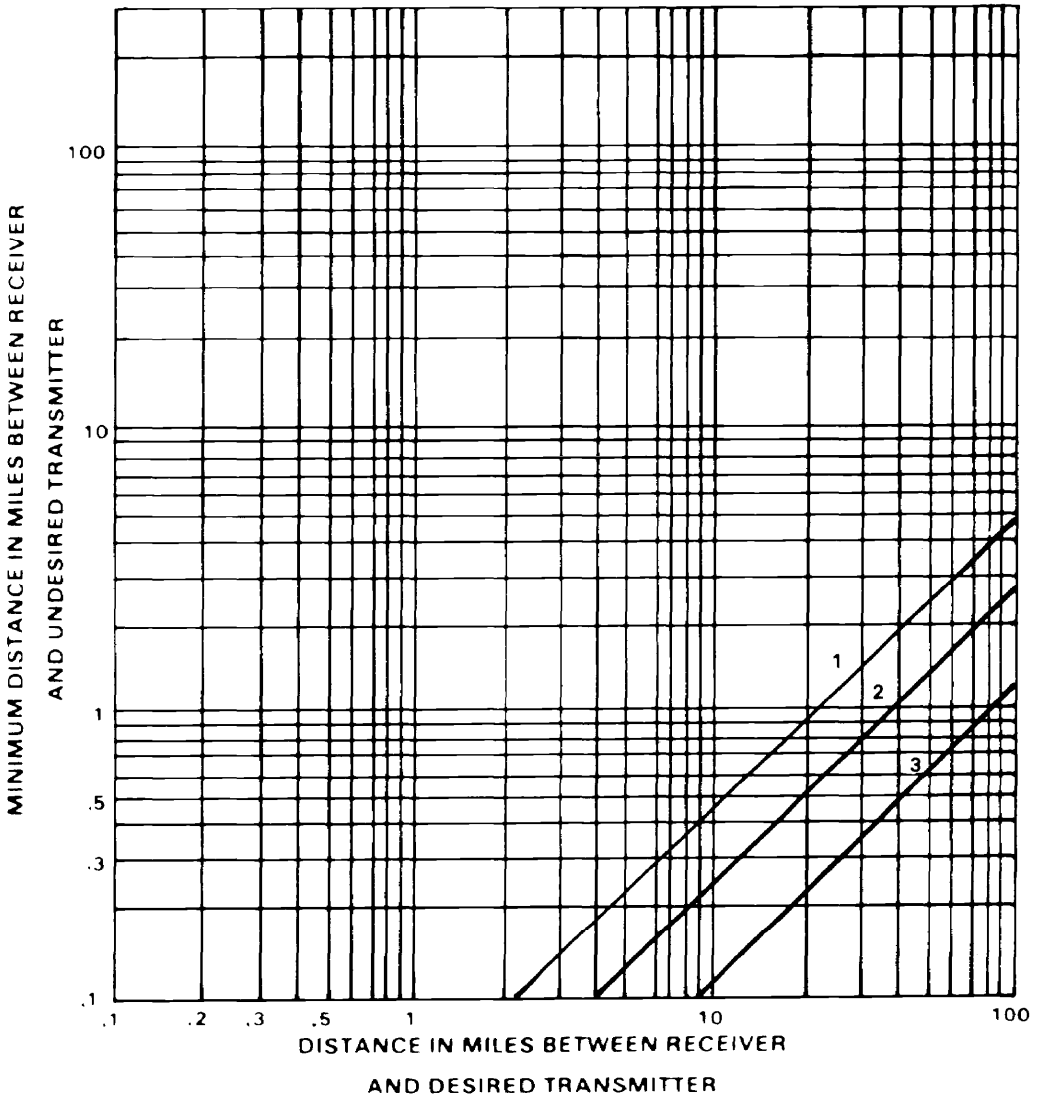


Figure B-10. Interference chart for SINCGARS versus AN/VRC-12 high power (adjacent channel, 50 kHz spacing).

	Undesired Transmitter	Desired Link
1	AN/VRC-12 Lo Power	SINCGARS Med Power
2	AN/VRC-12 Lo Power	SINCGARS Hi Power
3	AN/VRC-12 Lo Power	SINCGARS Pa Mode

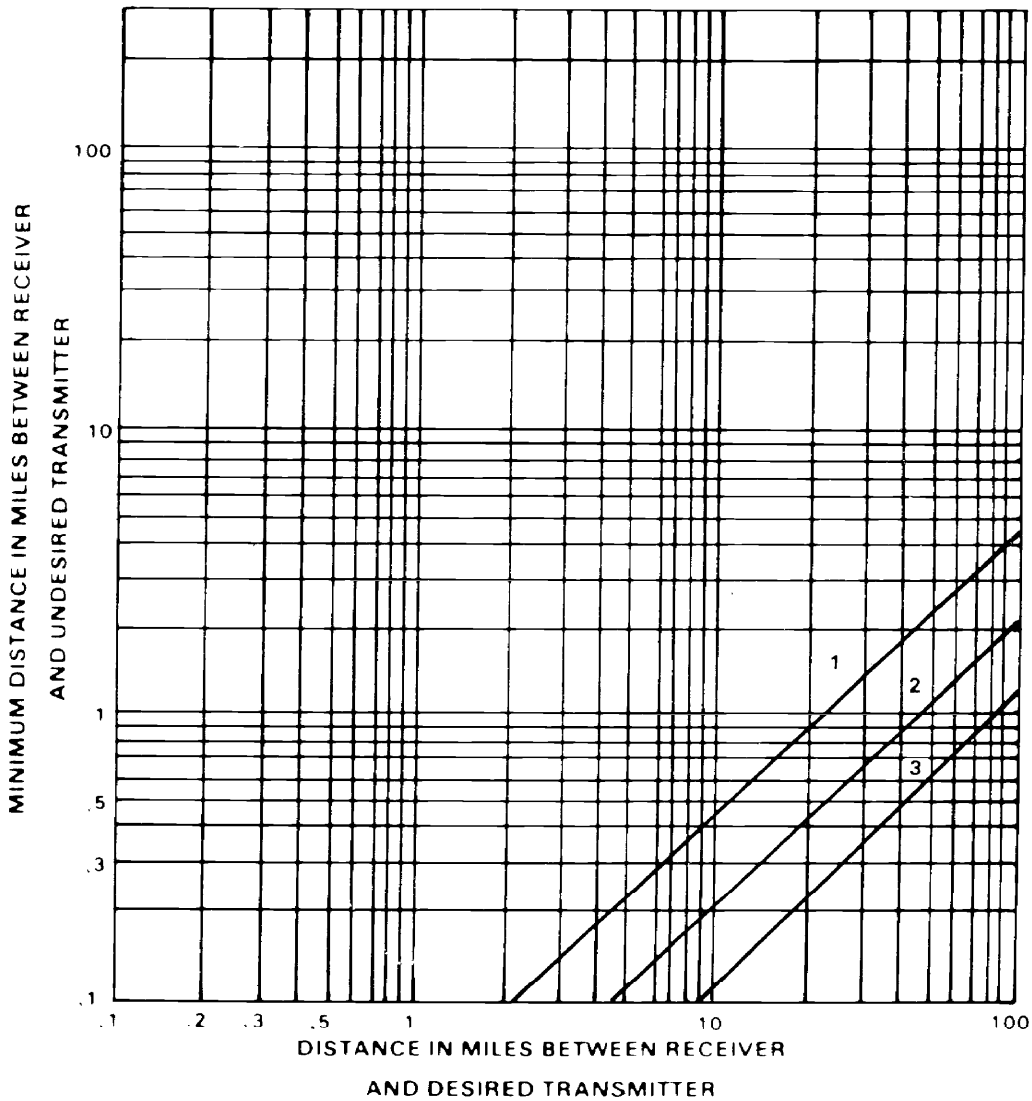


Figure B-11. Interference chart for AN/VRC-12 low power versus SINCGARS (adjacent channel, 50 kHz spacing).

	Undesired Transmitter	Desired Link
1	SINCGARS Pa Mode	AN/VRC-12 Lo Power
2	SINCGARS Hi Power	AN/VRC-12 Lo Power
3	SINCGARS Med Power	AN/VRC-12 Lo Power

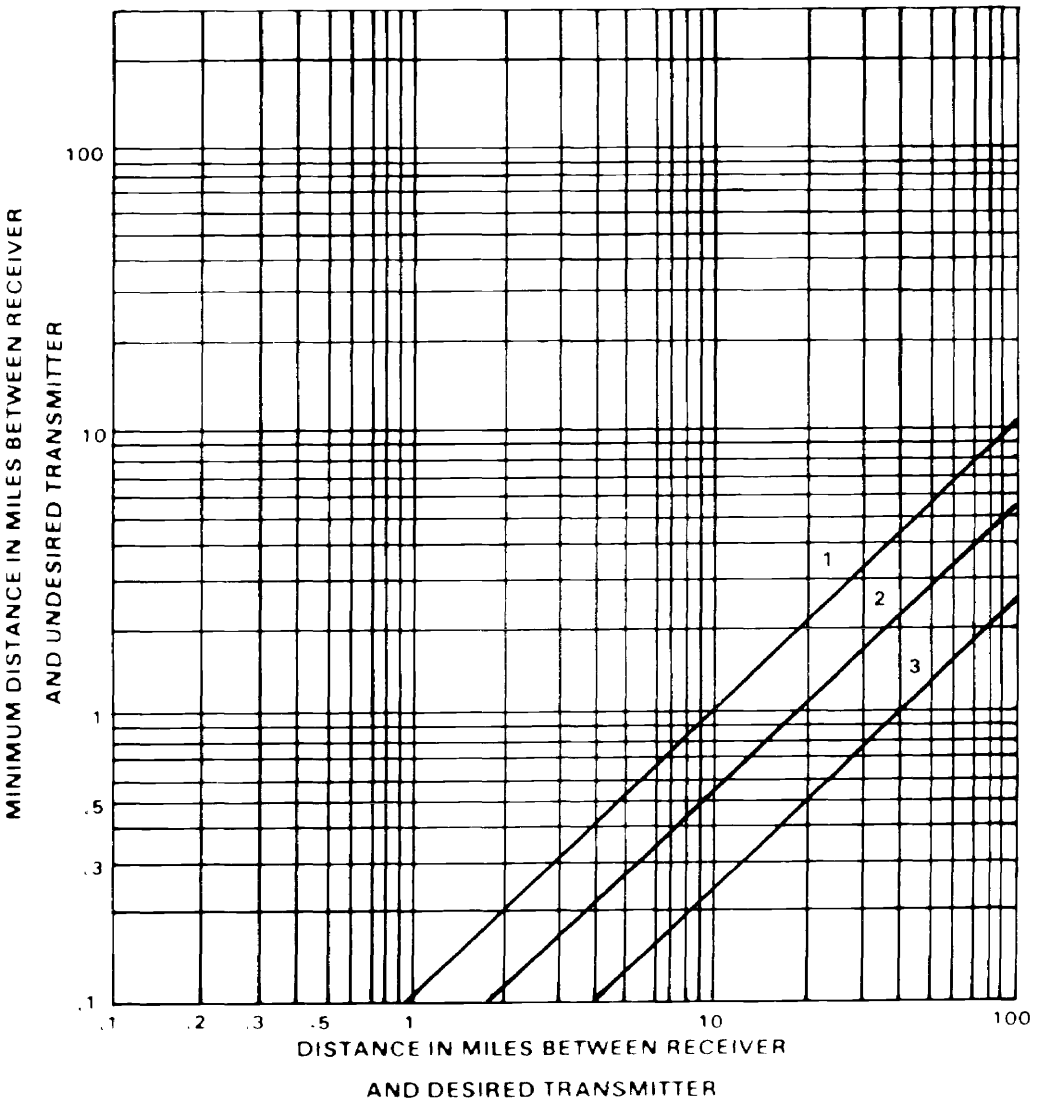


Figure B-12. Interference chart for SINCGARS versus AN/VRC-12 low power (adjacent channel, 50 kHz spacing).

	Undesired Transmitter	Desired Link
1	AN/PRC-77	SINCGARS Med Power
2	AN/PRC-77	SINCGARS Hi Power
3	AN/PRC-77	SINCGARS Pa Mode

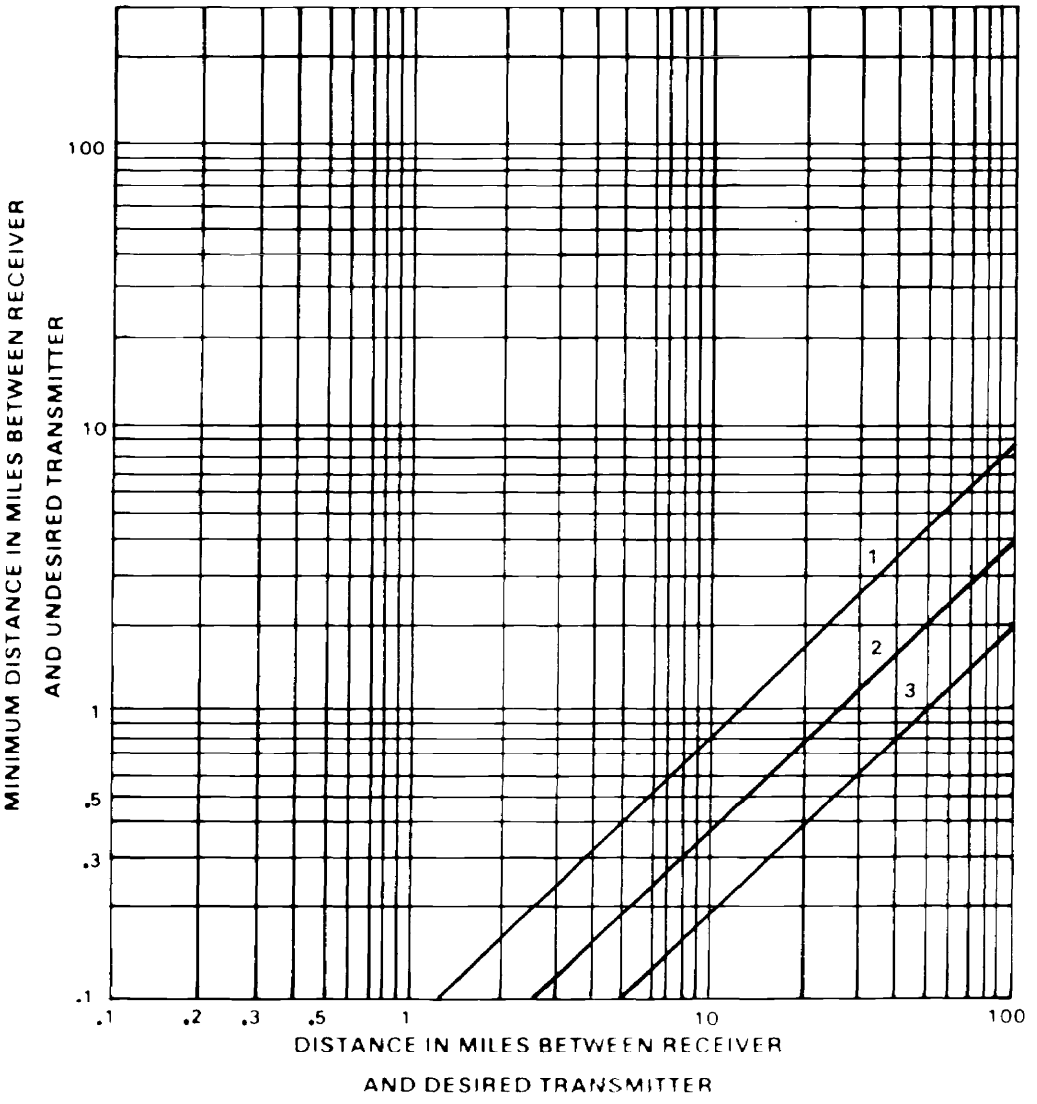


Figure B-13. Interference chart for AN/PRC-77 versus SINCGARS (adjacent channel, 50 kHz spacing).

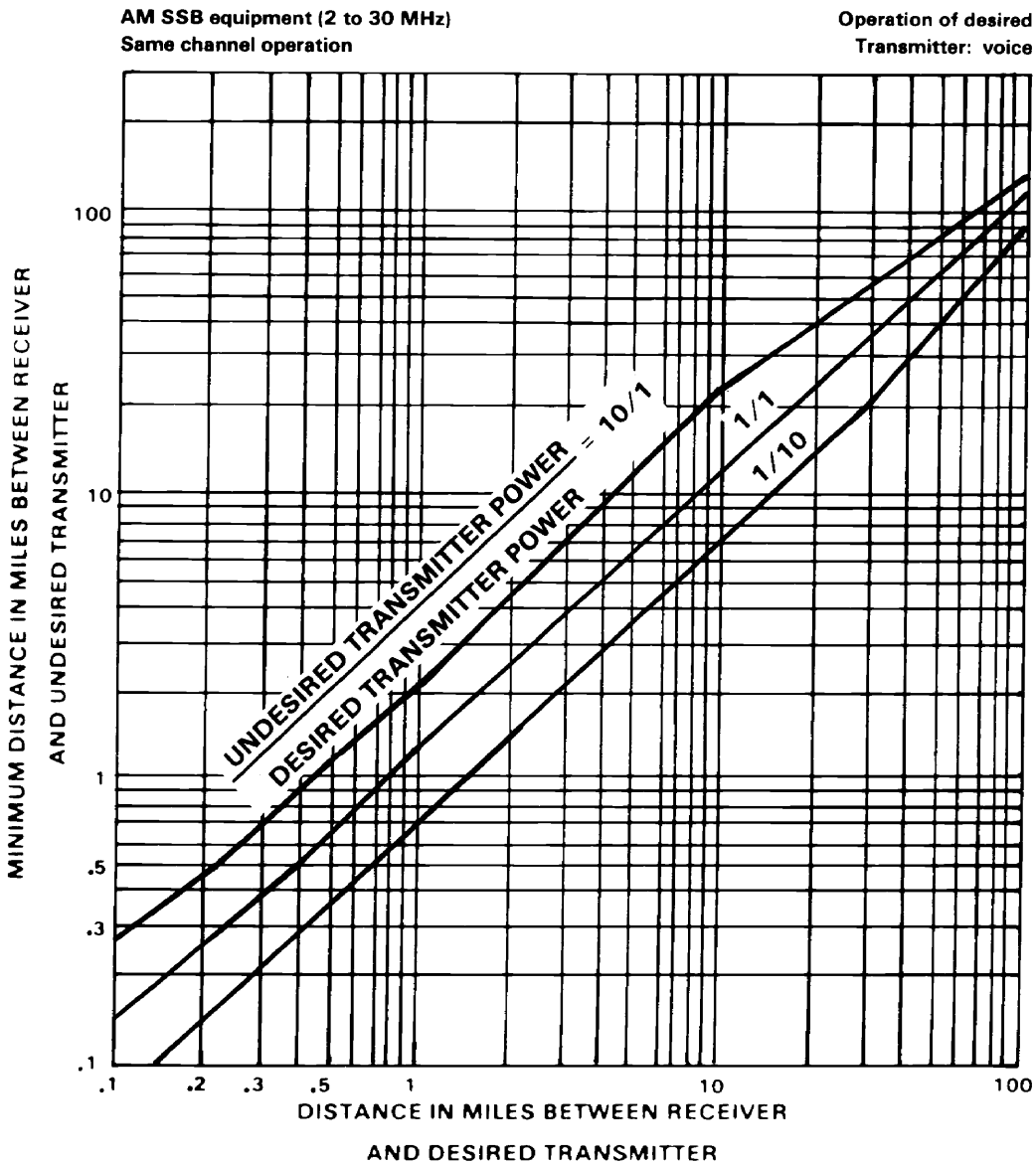


Figure B-14. Interference chart (AM SSB, voice, same channel).

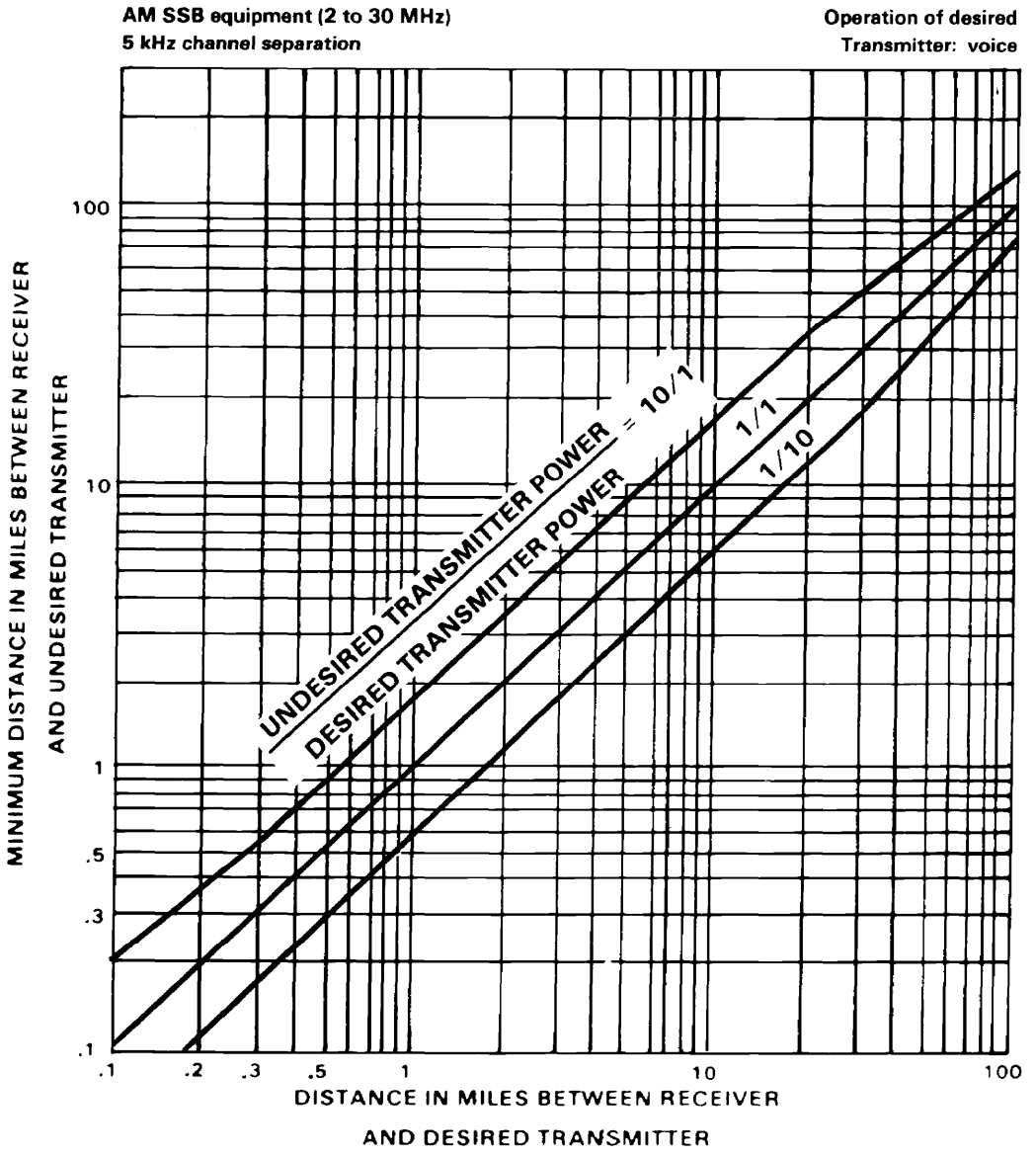


Figure B-15. Interference chart (AM SSB, voice, adjacent channel).

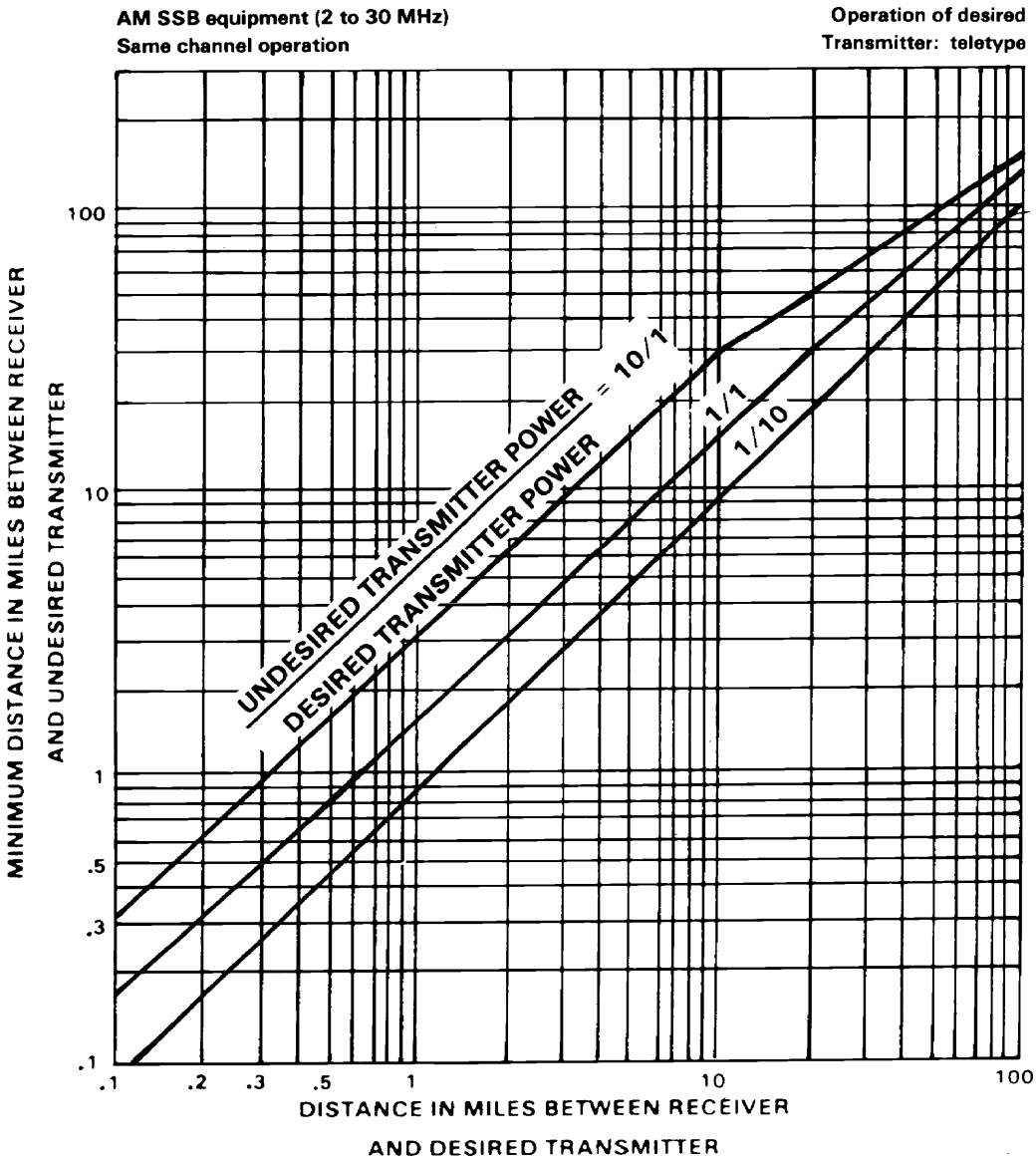


Figure B-16. Interference chart (AM SSB, teletype, same channel).

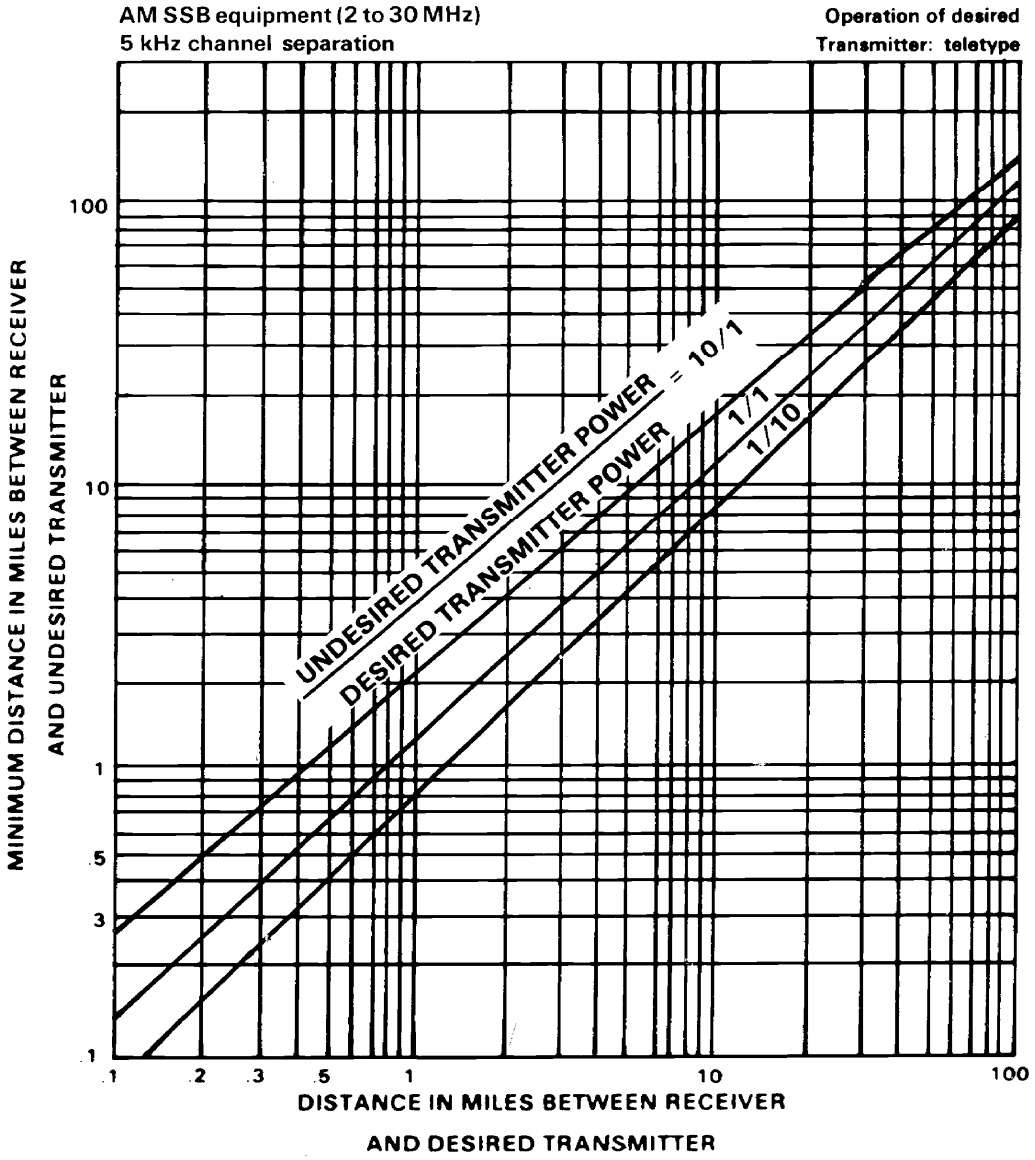


Figure B-17. Interference chart (AM SSB, teletype, adjacent channel).

When using the AN/VRC-12 series radio, avoid using frequencies that are harmonically related. For example, frequencies that are separated by exactly 5.75 or 23.00 MHz.

Do not assign frequencies to collocated nets that are on the order of the second harmonic. For example, the frequency setting of 30.00, 32.65, and 35.00 MHz will possibly interfere with a radio using 60.00,65.30, and 70.00 MHz, respectively.

Observe the recommended minimum frequency versus distance restrictions given in Table B-1.

High frequency AM nets experience fewer interference problems than VHF, FM nets; however, some interference may result when these radios are operated in the same vicinity. Therefore, collocated HF nets should be assigned frequencies at least 100 kHz apart. RATT nets operating in the FULL-DUPLEX mode, with the transmitter and receiver on different frequencies, require a frequency separation of at least 400 kHz.

Table B-1. Minimum antenna distance separation.

Minimum Frequency Separation Required	Between AN/VRC-12 Series Radio on HIGH Power	Between AN/VRC-12 Series Radios on LOW Power; or AN/PRC-25 and AN/PRC-77
10 MHz	5 feet	5 feet
7 MHz	60 feet	10 feet
4 MHz	150 feet	50 feet
2 MHz	400 feet	200 feet
1 MHz	800 feet	350 feet

Appendix C

Procedure for Field Level Selection and Coordination of RF Use

C-1. FAA Coordinators

FAA coordinators and geographical areas of responsibility for the frequency 1030 MHz and the bands 1215 to 1400 MHz, 2700 to 2900 MHz, and 9000 to 9200 MHz are shown below. (See Figure C-l).

Northwest Mountain Region

Spectrum Management Officer, ANM-464
Federal Aviation Administration
17900 Pacific Highway South C-68966
Seattle, Washington 98168
Telephone: 206-431 -2407/2473/2503/2464
Colorado; Idaho; Montana; Oregon; Utah; Washington; Wyoming.

Western Pacific Region

Spectrum Management Officer, AWP-406
Federal Aviation Administration
P.0. Box 92007
Los Angeles, California 90009
Telephone: 213-297- 1165/1685/1342/1164/1872/0214/0510/0276
Arizona; California, including all offshore islands; Nevada.

Central Region

Spectrum Management Officer, ACE-433
Federal Aviation Administration
601 12th Street
Kansas City, Missouri 64106
Telephone: 816-426-5036/5647
Iowa; Kansas; Missouri; Nebraska.

Southwest Region

Spectrum Management Officer, ASW-465
Federal Aviation Administration
Fort Worth, Texas 76193-0465
Telephone: 817-624-5466/5465/5458/5467/5469
Arkansas; Louisiana; New Mexico; Oklahoma; Texas.

Great Lakes Region

Spectrum Management Officer, AGL-423
Federal Aviation Administration
2300 East Devon Avenue
Des Plaines, Illinois 60018
Telephone: 312-694-7332/7363/7616/7842/7071
Illinois; Indiana; Michigan; Minnesota; North Dakota; South Dakota; Ohio; Wisconsin.

Southern Region

Spectrum Management Officer, ASO-465
Federal Aviation Administration
P.O. Box 20636
Atlanta, Georgia 30320
Telephone: 404-763-7385/7386
Alabama; Florida; Georgia; Kentucky; Mississippi; North Carolina; Puerto Rico; South Carolina; Tennessee; US Possessions in the Caribbean; Virgin Islands.

Eastern Region

Spectrum Management Officer, AEA-435
Federal Aviation Administration
Fitzgerald Federal Building
JFK International Airport
Jamaica, New York 11430
Telephone: 718-917-1191
Delaware; District of' Columbia; Maryland; New Jersey; New York; Pennsylvania; Virginia; West Virginia.

New England Region

Spectrum Management Officer, ANE-461
Federal Aviation Administration
12 New England Executive Park
Burlington, Massachusetts 01803
Telephone: 617-273-7160/2408/7197
Connecticut; Maine; Massachusetts; New Hampshire; Rhode Island; Vermont.

Alaskan Region

Spectrum Management Officer, AAL-464B
Federal Aviation Administration
701 C Street, P.O. Box 14
Anchorage, Alaska 99513-0087
Telephone: 907-271-5343
Alaska.

Western Pacific Hawaii Region

Spectrum Management Officer, AWP-406H
Federal Aviation Administration
Diamond Head SFO
4204 Diamond Head Road
Honolulu, Hawaii 96816-4420
Telephone: 808-734-6627
Hawaii; US Possessions in the Pacific Ocean.

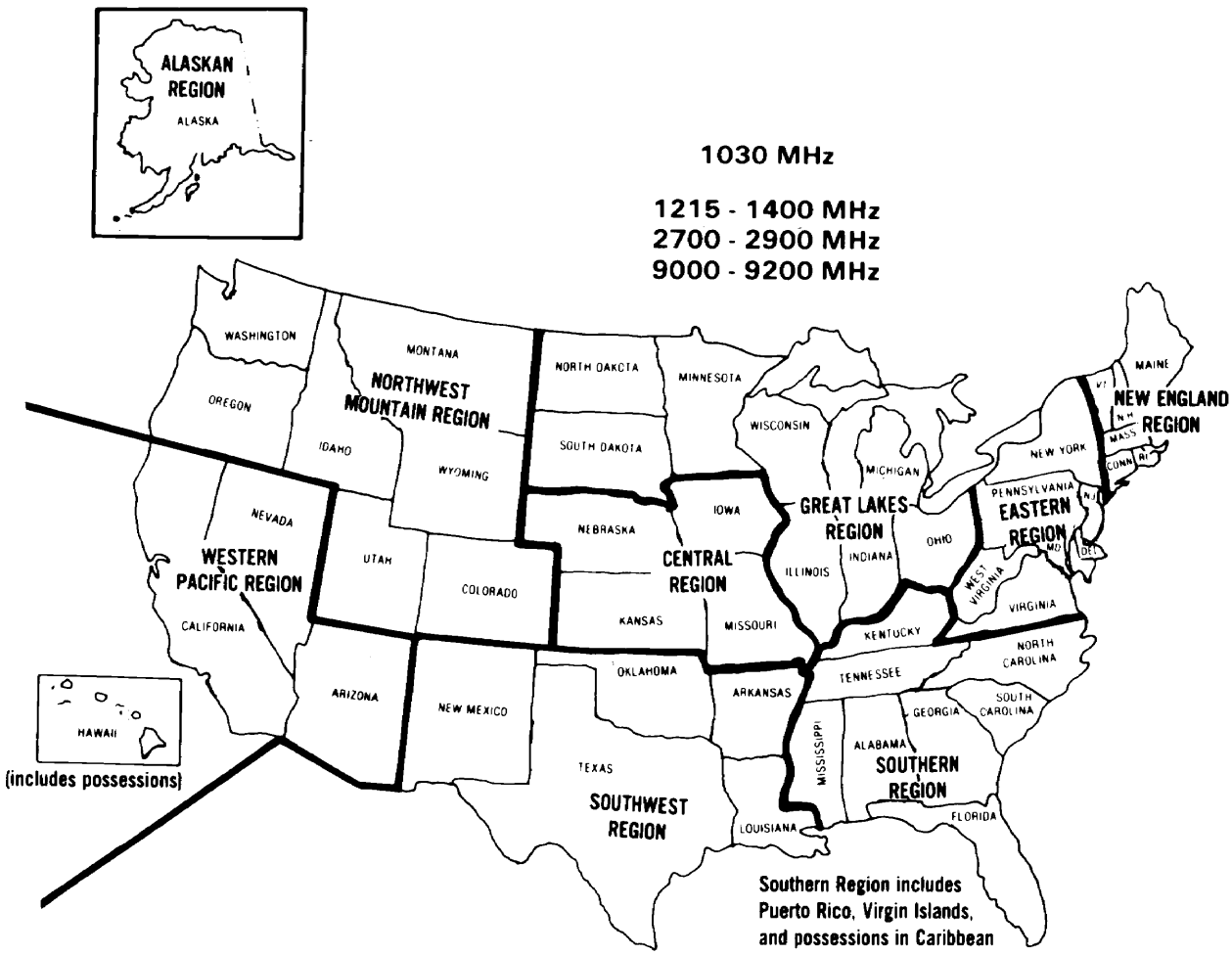


Figure C-1. FAA geographic areas of responsibility.

Table C-1 shows the designated heavily used areas in the 2700 to 2900 MHz band. Figure C-2 is a geographic presentation of these areas.

Table C-1. Heavily used areas (2700-2900 MHz).

AREA	LATITUDE degrees-min-sec	LONGITUDE degrees-min-sec
A	41-30-00	69-45-00
	43-15-00	69-45-00
	43-15-00	71-00-00
	41-30-00	72-00-00
B	40-30-00	71-30-00
	41-30-00	71-30-00
	41-30-00	76-00-00
	40-30-00	76-00-00
C	38-30-00	74-00-00
	40-30-00	74-00-00
	40-30-00	77-45-00
	38-30-00	77-45-00
D	38-00-00	76-00-00
	38-30-00	76-00-00
	38-30-00	77-45-00
	38-00-00	77-45-00
E	36-30-00	75-15-00
	37-30-00	75-15-00
	37-30-00	76-45-00
	36-30-00	76-45-00
F	30-00-00	81-20-00
	31-00-00	81-20-00
	31-00-00	82-20-00
	30-00-00	82-20-00
G	25-00-00	80-00-00
	26-30-00	80-00-00
	26-30-00	80-45-00
	25-00-00	80-45-00
H	40-45-00	80-00-00
	42-20-00	80-00-00
	42-20-00	82-00-00
	40-45-00	82-00-00
I	39-30-00	82-30-00
	40-20-00	82-30-00
	40-20-00	83-30-00
	39-30-00	83-30-00

Table C-1. Heavily used areas (2700 to 2900 MHz). (continued)

AREA	LATITUDE degrees-min-sec	LONGITUDE degrees-min-sec
J	38-45-00	83-30-00
	40-20-00	83-30-00
	40-20-00	85-00-00
	38-45-00	85-00-00
K	30-15-00	86-00-00
	31-00-00	86-00-00
	31-00-00	88-00-00
	30-15-00	88-00-00
L	41-00-00	82-40-00
	43-40-00	82-40-00
	43-40-00	87-00-00
	41-00-00	87-00-00
M	41-00-00	87-00-00
	43-00-00	87-00-00
	43-00-00	89-30-00
	41-00-00	89-30-00
N	38-15-00	89-40-00
	39-30-00	89-40-00
	39-30-00	91-00-00
	38-15-00	91-00-00
O	34-40-00	89-40-00
	36-30-00	89-40-00
	36-30-00	90-30-00
	34-40-00	90-30-00
P	35-00-00	97-00-00
	36-00-00	97-00-00
	36-00-00	98-00-00
	35-00-00	98-00-00
Q	33-00-00	111-30-00
	34-20-00	111-30-00
	34-20-00	112-40-00
	33-00-00	112-40-00
R	37-00-00	121-00-00
	39-00-00	121-00-00
	39-00-00	123-00-00
	37-00-00	123-00-00
S	32-15-00	116-30-00
	36-20-00	116-30-00
	36-20-00	118-45-00
	32-15-00	118-45-00

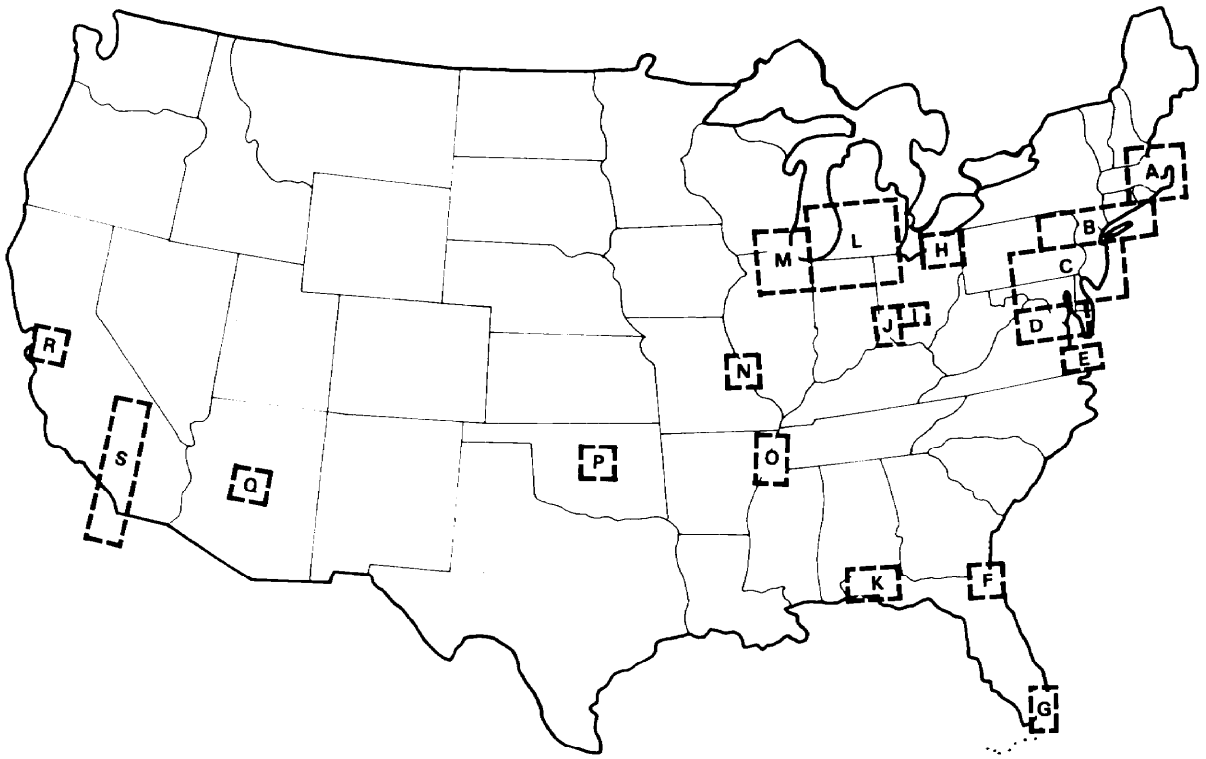


Figure C-2. Designated heavily used areas in the 2700 to 2900 MHz band.

C-2. Field Level Coordinators

Government area frequency coordinators and geographical areas of responsibility for bands 1435 to 1535 MHz and 2310 to 2390 MHz are shown below. (See Figures C-3 and C-4.)

Area Frequency Coordinator
Nellis AFB, Nevada 89191
Telephone: 702-643-3608
DSN: 682-3608
Nevada; Utah west of 1ll°W; Idaho south of 44°N.

Area Frequency Coordinator
State of Arizona
Fort Huachuca, Arizona 85613-5000
Telephone: 602-538-6423
DSN: 879-6423
Arizona.

Area Frequency Coordinator
White Sands Missile Range,
New Mexico 88002-5526
Telephone: 1505-678-5417
DSN: 258-3702
Colorado west of 108°W; New Mexico; Texas west of 104°W; Utah east of lll°W.

Gulf Area Frequency Coordinator
Elgin AFB, Florida 32542
Telephone: 904-882-4416
DSN: 872-4416
Alabama south of 33°30'N; Florida west of 83°W, Georgia west of 83°W, south of 33°30'N; Louisiana east of 90°W; Mississippi east of 90°W, south of 33°30'N.

Eastern Area Frequency Coordinator
Patrick AFB, Florida 32925
Telephone: 305-494-5366
DSN: 854-5366
Florida east of 83°W; Georgia east of 83°W, south of 31°30'N.

Mid-Atlantic Area Frequency Coordinator
Department of the Navy
Naval Air Test Center
Patuxent River, Maryland 20670
Telephone: 301-863-1188
DSN: 356-1188
That area of the eastern US and the Atlantic Ocean south of 41°N; east of a line starting at the intersection of 41°N and 75°30'W running southwest to the intersection of 33°30'N and 83°W, then south to the intersection of 31°30'N and 83°W; north of 31°30'N; west of 68°40'W.

Army Frequency Coordinator
Military District of Washington
Military District of Washington, DC 20319-5050
Telephone: 202-693-5154
DSN: 223-5154
District of Columbia; county of Arlington (less Fort Belvoir but including Davison AAF) and the city of Alexandria in the state of Virginia; counties of Montgomery and Prince Georges in the state of Maryland.

Commander
USAISC - Alaska
ATTN: CCNA-AK-CE
Fort Richardson, Alaska 99505
Telephone: 317-862-6294
DSN: 863-6294
Alaska.

Commander
US Army Pacific
ATTN: APCE
Fort Shafter, Hawaii 96858
Telephone: 808-438-2261
Hawaii.

Area Frequency Coordinator (Air Force)
Headquarters Alaskan Air Command/DCT
Elmendorf AFB, Alaska 99506
Telephone: 907-752-2283
DSN: 317-752-2283
Alaska; established DOD area frequency coordinator for all frequency use within the state of Alaska.

Area Frequency Coordinator
Department of the Air Force
USAF Frequency Management Center
Washington, DC 20330-6431
Telephone: 202-475-1825
DSN: 335-1825
Alabama north of 33°30'N: Connecticut: Kentucky; Maine; Massachusetts; Mississippi less east of 90°W, south of 33°30'N; New Hampshire; New Jersey north of 41°N; New York north of 41°N; Ohio; Rhode Island; Tennessee; Vermont; West Virginia; and those areas of the following states west of the Mid-Atlantic AFC area: Georgia north of 33°30'N; Maryland; North Carolina; Pennsylvania including that north of 41°N; South Carolina; Virginia.

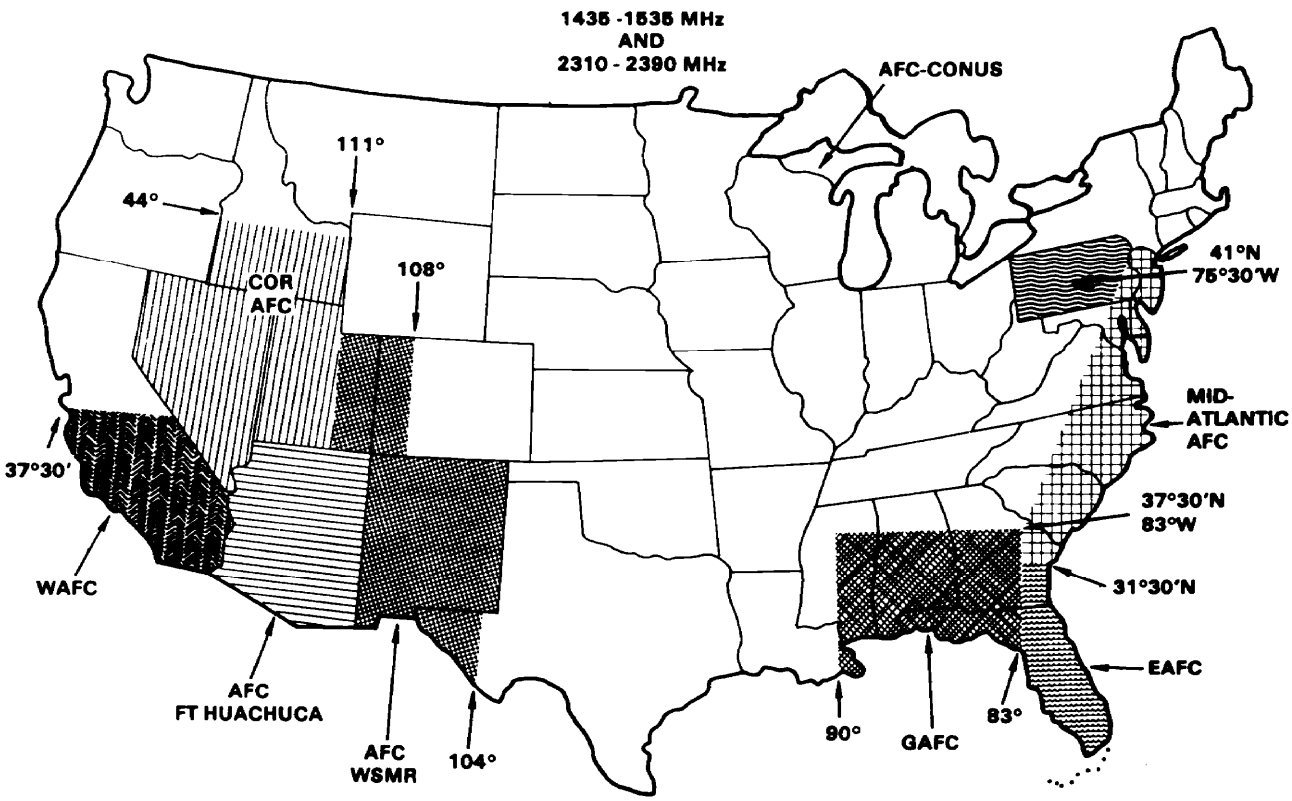


Figure C-3. Government/nongovernment field level coordinators.

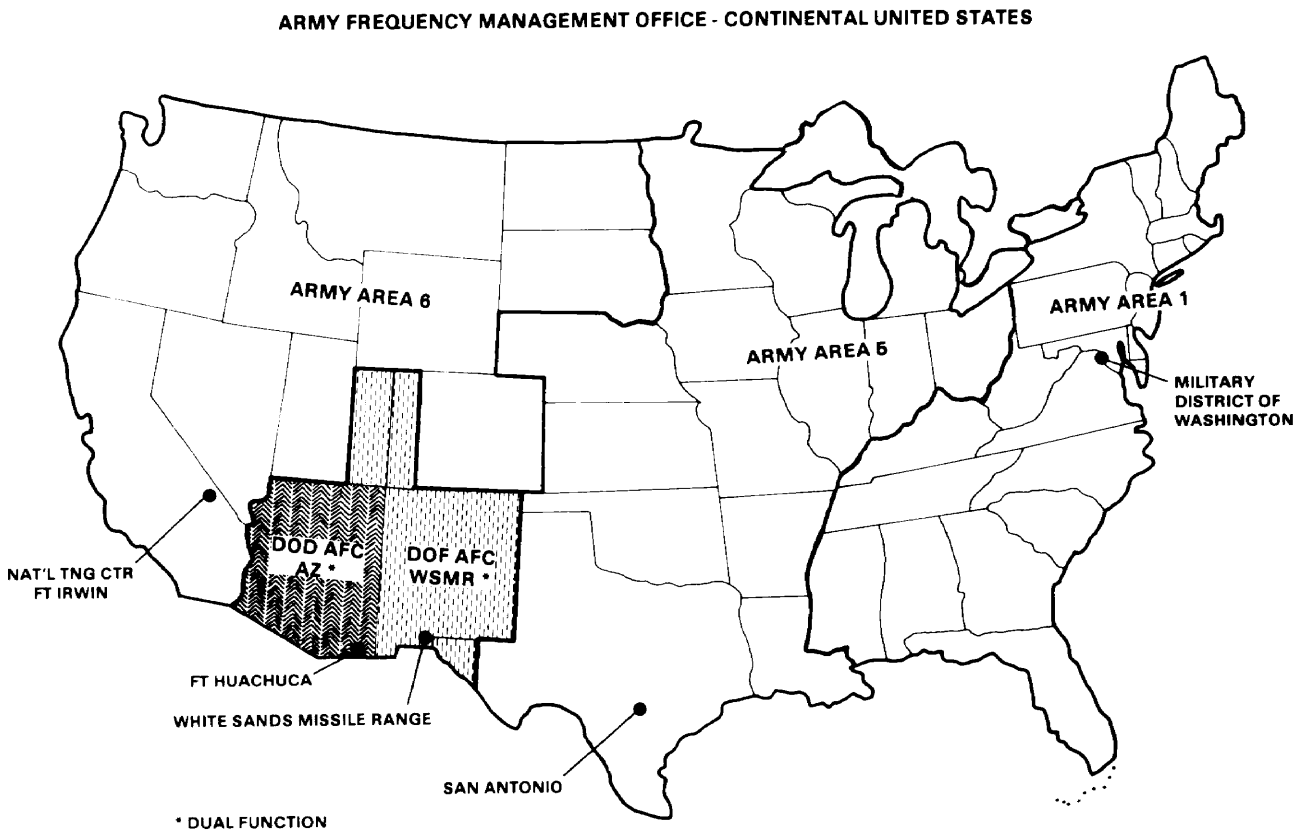


Figure C-4. Army areas and areas of responsibility of Army frequency coordinators.

Army Frequency Management Office
Continental United States
ATTN: SFIS-FAC-SC
Fort Sam Houston, Texas 78234-5000
Telephone: 512-221-7050/2820
DSN: 471-7050/2820
Alabama, Arkansas, California (less units located on or conducting training of the Army National Training Center, Fort Irwin, CA), Colorado, (less the area west of 108°W), Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland (less certain areas which are included in the Military District of Washington), Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas (less Fort Bliss and US Territory within 150-mile radius of White Sands Missile Range), Utah (less the area east of 111 'W), Vermont, Virginia (less certain areas which are included in the Military District of Washington), Washington, West Virginia, Wisconsin and Wyoming.

Commander, USAISC
AT TN: ASQNA-IRW-CO
Fort Irwin, CA 92310-5000
Telephone: 619-386-3280
DSN: 470-3280
Coordinates directly with units scheduled for rotation training at the Army National Training Center to define frequency requirements and to coordinate closely with the western area frequency coordinator, Point MUGU and AFMO-CONUS in the final coordination process.

Commander, USA Kwajalein Atoll (USAKA)
P.O. Box 26
APO San Francisco, 96555-008
DSN: 254-2111
Coordinates frequencies enclosed within a 200-mile radius of the Headquarters Building, USAKA.

The nongovernment Aerospace and Flight Test Radio Coordinating Council (AFTRCC) coordinator is shown below.

Aerospace and Flight Test Radio Coordinating Council
P.0. BOX 718
Hawthorne, California 90251
Telephone: 213-970-6563

Appendix D

Radio Emission Designator

The emission designator consists of the necessary bandwidth and emission classification symbols. The symbols are shown below.

- First symbol - Indicates the type of modulation of the main carrier. (See Table D-1.)
- Second symbol - Indicates the nature of signal(s) modulating the main carrier. (See Table D-2.)
- Third symbol - Indicates the type of information transmitted. (See Table D-3.)
- Fourth symbol - Indicates the details of the signal (Optional - recommend use when applicable). (See Table D-4.)
- Fifth symbol - Indicates the nature of multiplexing (Optional - recommend use when applicable). (See Table D-5.)

Table D-1. Main carrier modulation.

SYMBOL	TYPE OF EMISSION
	UNMODULATED
N	Emission of an unmodulated carrier.
	AMPLITUDE-MODULATED
	Emission in which the main carrier is amplitude-modulated (including cases where subcarriers are angle-modulated).
A	Double-sideband.
B	Independent sidebands.
C	Vestigial sideband.
H	Single-sideband, full carrier.
J	Single-sideband, suppressed carrier.
R	Single-sideband, reduced or variable level carrier.
	ANGLE- MODULATED
	Emission in which the main carrier is angle-modulated:
F	Frequency modulation.
G	Phase modulation.
	AMPLITUDE-MODULATED AND ANGLE-MODULATED
D	Emission in which the main carrier is amplitude-modulated and angle-modulated either simultaneously or in a preestablished sequence.

Table D-1. Main carrier modulation. (continued)

SYMBOL	TYPE OF EMISSION
	PULSE
	Emission of pulses: (See note below)
P	Sequence of unmodulated pulses.
	A sequence of pulses:
K	Modulated in amplitude.
L	Modulated in width/duration.
M	Modulated in position/phase.
Q	Carrier is angle-modulated during the period of the pulse.
V	A combination of the foregoing or produced by other means.
	COMBINATION
W	Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a combination of two or more of the following modes; amplitude, angle, pulse.
X	Cases not otherwise covered.

NOTE: Emissions, where the main carrier is directly modulated by a signal which has been coded into quantized form (for example, pulse code modulation), shall be designated as either an emission in which the main carrier is amplitude-modulated or an emission in which the main carrier is angle-modulated.

Table D-2. Modulating signals.

SYMBOL	TYPE OF EMISSION
0	No modulating signal.
1	A single channel containing quantized or digital information without using a modulating subcarrier. (This excludes time division multiplex.)
2	A single channel containing quantized or digital information using a modulating subcarrier.
3	A single channel containing voice information.
7	Two or more channels containing quantized or digital information.
8	Two or more channels containing analog information.
9	Composite system with one or more channels containing quantized or digital information, together with one or more channels containing analog information.
X	Cases not otherwise covered.

Table D-3. Information to be transmitted.

SYMBOL	TYPE OF EMISSION
N	No information transmitted.
A	Telegraphy - for aural reception.
B	Telegraphy - for automatic reception.
C	Facsimile.
D	Data transmission, telemetry, telecommand.
E	Telephony (including sound broadcasting).
F	Television (video).
W	Combination of the above.
X	Cases not otherwise covered.

Table D-4. Details of signals.

SYMBOL	TYPE OF EMISSION
A	Two-condition code with elements of differing numbers and/or durations.
B	Two-condition code with elements of the same number and duration without error-correction.
C	Two-condition code with elements of the same number and duration with error-correction.
D	Four-condition code in which each condition represents a signal element (of one or more bits).
E	Multicondition code in which each condition represents a signal element (of one or more bits).
F	Multicondition code in which each condition or combination of conditions represents a character.
G	Sound of broadcasting qualilty (monophonic).
H	Sound of broadcasting quality (stereophonic or quadraphonic).
J	Sound of commercial quality (excluding categories defined for symbols K and L below).
K	Sound of commercial quality with the use of frequency inversion or band-splitting.
L	Sound of commercial quality with separate frequency-modulated signals to control the level of demodulated signal.
M	Monochrome.
N	Color.
W	Combination of the above.
X	Cases not otherwise covered.

Table D-5. Multiplexing.

SYMBOL	TYPE OF EMISSION
N	None.
C	Code division multiplex. This includes bandwidth expansion techniques.
F	Frequency division multiplex.
T	Time division multiplex.
W	Combination of frequency division multiplex and time division multiplex.
X	Other types of multiplexing.

The emission designator shall be entered according to the rules shown below.

- To express the necessary bandwidth portion of the emission designator, enter a maximum of five numerals and one letter. The letter occupies the position of the decimal point and represents the unit of bandwidth as follows: H for hertz, K for kilohertz, M for megahertz, and G for gigahertz.

- Fractional bandwidths may be expressed to a maximum of two decimal places following the letter. The first character of the necessary bandwidth shall always be greater than zero unless the necessary bandwidth is less than 1 hertz. In such a case, the first character shall be the letter H. Express the necessary bandwidths according to the discussion below.

  Necessary bandwidths between .01 and 999.99 Hz shall be expressed in hertz using the letter H instead of the decimal. (For example, 15H is 15 Hz of bandwidth; 15H01 is 15.01 Hz of bandwidth.)

  Necessary bandwidths between 1.00 and 999.99 kHz shall be expressed in kilohertz using the letter K instead of the decimal. (For example, 2K is 2 kHz of bandwidth; 2K85 is 2.85 kHz of bandwidth.)

  Necessary bandwidths between 1.00 and 999.99 MHz shall be expressed in megahertz using the letter M instead of the decimal. (For example, 6M is 6 MHz of bandwidth; 6M25 is 6.25 MHz of bandwidth.)

  Necessary bandwidths between 1.00 and 999.99 GHz shall be expressed in gigahertz using the letter G instead of the decimal, (For example, 10G is 10 GHz of bandwidth; 10G05 is 10.05 GHz of bandwidth.)

- Enter the basic emission designator of three symbols, and if desired, two optional, additional symbols, derived from the following:

  The first symbol designates the main carrier's type of modulation. (See Table D-l.)

  The second symbol designates the nature of signal(s) modulating the main carrier. (See Table D-2.)

  The third symbol designates the type of information transmitted. In this context the word information does not include information of a constant, unvarying nature such as provided by standard frequency emissions or continuous wave and pulse radars. (See Table D-3.)

  The fourth symbol designates the details of signal(s) and is optional. (See Table D-4.)

  The fifth symbol designates the nature of multiplexing and is optional. (See Table D-5.)

Table D-6 shows examples of radio emission designators.

Table D-6. Examples of radio emission designators.

EMISSION DESIGNATOR	TYPE OF EMISSION
3K00J3E	Single-sideband, voice, suppressed carrier, 3 kHz bandwidth.
30K0F3E	FM voice, 30 kHz bandwidth.

Appendix E

Special-Purpose Frequencies

E-1. Designation

National and international agreements have designated special-purpose frequencies used for maritime distress, search, and rescue and for aeronautical distress.

E-2. Frequencies

Aircraft, ship, and survival craft stations may use the following frequencies as long as they follow the ITU RRs.

- 500 kHz Maritime distress and calling
- 2182 kHz Maritime distress and calling
- 3023 kHz Maritime search and rescue
- 4125 kHz Maritime mobile distress (voice)
- 5680 kHz Maritime search and rescue
- 6215.5 kHz Maritime mobile distress (voice)
- 8364 kHz Maritime search and rescue
- 40.5 MHz Distress calling
- 121.5 MHz Aeronautical distress
- 123.1 MHz On-scene search and rescue/auxillary aeronautical (voice)
- 156.8 MHz Maritime distress and calling
- 243 MHz Aeronautical distress
- 401.0 to 406.1 MHz Search and rescue satellite

Appendix F

Requesting Spectrum Management Assistance

F-1. Electromagnetic Interference Resolution

The multiplying signal systems in government and nongovernment sectors have created substantial spectrum congestion and have intensified competition for electromagnetic spectrum space. Electromagnetic interference (EMI) is the major threat to the continued and expanded use of the electromagnetic spectrum. Within the DOD, several agencies are tasked to assist in EMI resolution. Within the Army, requests are generally sent to the agencies shown below.

F-2. USAISEC

USAISEC provides consultation and propagation engineering services to requestors in the Army and other government agencies in the following areas:

- Electromagnetic system performance analysis.
- Electrical design and performance determination of antennas.
- Electromagnetic wave propagation advice.
- Propagation forecasts and reliability predictions.

Service requests should include enough details to permit task validation and prioritization. Requests should be addressed as shown below.

MAIL: Commander
USAISEC
ATTN: ASQB-SET-P
Fort Huachuca, Arizona 85613-5300

MESSAGE: CDR USAISC FT HUACHUCA AZ//ASQB-SET-P//

TELEPHONE: DSN 879-7685, Area Code (602) 538-7685

F-3. DOD ECAC

DOD ECAC resources are available to research and development activities and to operational commands. ECAC support areas are as follows:

- Spectrum planning.
- Emission and susceptibility characteristics evaluation.
- Deployment and siting analysis.
- Consultation services.
- Data base listings.

DOD activities are encouraged to make direct contact with the appropriate deputy director before submitting requests for ECAC services. Once needs have been defined, a written request for services should be sent to the address shown below.

MAIL: Army Deputy Director (CA)
ECAC, North Severn
Annapolis, Maryland 21402

MESSAGE: DIR ECAC ANNAPOLIS MD//CA//

TELEPHONE: DSN 281-2103, Area Code (301) 267-2103

Appendix G

Selecting Frequencies for Radio Multichannel Systems

G-1. Frequency Selection/LOS Multichannel

The method of frequency selection depends on the equipment and the configuration of the multichannel communications network. Much depends on the radio relay network. Is it a simple isolated system or a complex system? Are there more than two transmitters and receivers operating at the same location? Does the complex system have light and heavy traffic routes interconnecting and crossing of radio systems? These factors must be considered when selecting a proper, workable frequency assignment plan. Technical manuals covering that equipment describe the method used for each piece of equipment. This appendix covers the radio set, AN/GRC-103(V) band 1 since it is one of the current radios used with pulse code modulation (PCM) multiplexing equipment in radio relay systems. The frequencies used in this appendix will be those of the AFVGRC-103(V) (band 1220.0 to 404.5 MHz). MSE LOS multichannel is the newest system fielded. It uses the radio set, AN/GRC-226(V). Frequencies assigned for use are provided by automated spectrum management by the SCC.

G-2. Interference Between Transmitters and Receivers

The purpose of any frequency plan is to minimize the effects of mutual interference. With a radio set operating full duplex, the transmitting power is usually millions of times greater than the power of the receiver's signal. The receiver must be able to reject the transmitter signal and select the weak signal to which it is tuned.

To reject a transmitted signal, a receiver must be separated from the transmitter by so many channels according to the radio being used (see proper technical manual).

This separation is called a guard band. When using the AN/GRC-103(V), the transmitting frequencies at a station must be well separated from the receiver frequencies to guard against transmitter- to-receiver interference. This is done by setting up a frequency guard band of 16.5 MHz (33 channels) between the transmitter and receiver frequency.

The receiving frequencies at a station must be well separated from each other to guard against receiver-to-receiver interference. This is done by operating the receiver so at least three unused frequency channels (1.5 MHz) separate the operating frequency of any two receivers.

Two methods that reduce the required frequency separation between systems from 16.5 MHz (33 channels) to 5 MHz (10 channels) are cross-polarization and separate masts.

Sometimes antennas on neighboring masts may be cross- polarized to advantage. (loss-polarization is having one antenna polarized in one plane (horizontal or vertical) and the other antenna polarized in the other plane. Cross-polarization results in a greater isolation between antennas on the same mast or neighboring masts. It also permits the separation between transmitting and receiving frequencies on these antennas to be much smaller than with noncross- polarized antennas (Figure G-l).

In applicable systems, using separate masts for transmitters and receivers at a station reduces the transmitter-to-receiver interference at that station. This isolation can be further improved by using vertical polarization for one antenna and horizontal polarization for the other.

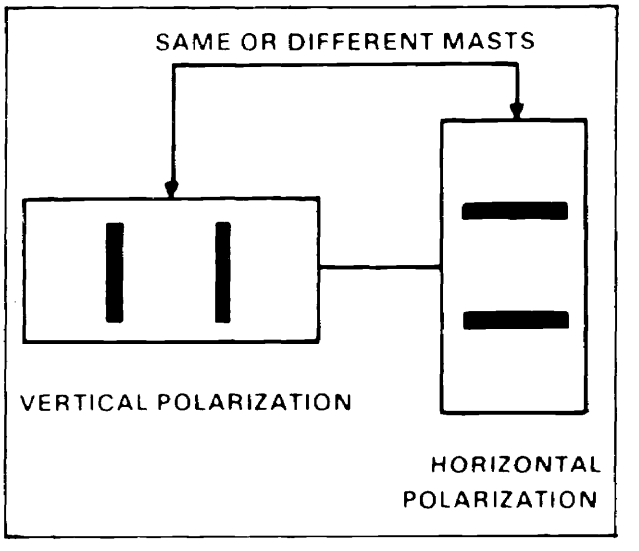


Figure G-1. Cross-polarization.

G-3. Two-Block Frequency Assignment Plan

The two-block plan is used for simple isolated systems. An isolated route is one which does not cross or connect with any other radio-relay routes. For example, a system may consist of two terminals and three repeaters (Figure G-2) with the radios operating between 220.0 and 404.5 MHz.

To set up a two-block plan, arrange the frequencies in numerical sequence (lowest to highest). Divide the available frequencies into two blocks that contain equal numbers of frequencies. Arrange them so each frequency in the first block may be paired with a frequency in the second block which is separated from the lower frequency (Block I) by at least 16.5 MHz (Figure G-3).

Assign transmitting frequencies beginning at terminal A by selecting a frequency from Block I and then from Block II (Figure G-3). Assign all transmitting frequencies in an A to B direction; then assign frequencies in the same manner from a B to A direction (Figure G-4).

Ensure to maintain the minimum required receiver-to-receiver separations at all sites where two or more receivers are located. In this case, it would be the three repeaters that would have to be checked for proper receiver-to-receiver separation. For this reason, frequencies from a specific block may not always be assigned consecutively.

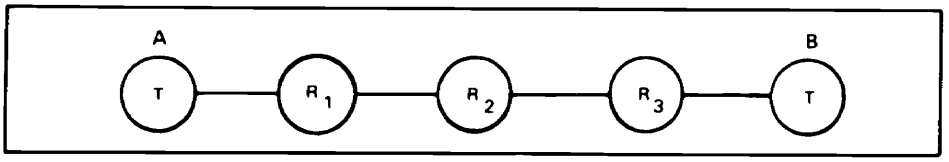


Figure G-2. Simple isolated route.

BLOCK I	BLOCK II
222.0	247.5
225.5	249.0
229.0	253.5
233.5	256.0
236.0	259.5
240.5	263.0
244.0	267.5

Figure G-3. Frequencies divided into two blocks.

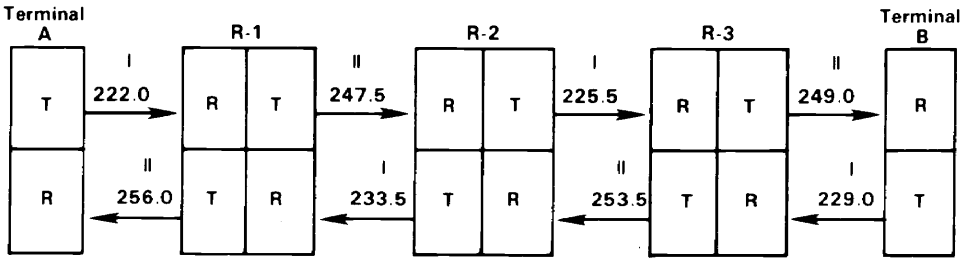


Figure G-4. Two-block frequency assignment.

The two-block plan can be used for a simple parallel system. Tangent systems from any site in the parallel system to other sites maybe established. This is possible because from any site in a paralleled system all transmitter frequencies are from one block, and the distant transmitter would transmit on a frequency from the opposite block. The two-block plan does not provide for alternate routing or operating among three different sites. When systems become too complex, the six-block ABM frequency assignment plan should be used.

G-4. Six-Block ABM Frequency Assignment Plan

The six-block ABM plan is used for a complex system with two or more transmitters and two or more receivers at the same location (Figure G-5). (The letters A, B, and M have no significant meaning.)

The ABM plan divides a broad frequency assignment list (all or a large part of a band allocated) into six frequency blocks (or lists) of suitable widths. Frequencies obtained are divided equally among the six blocks. The basic planning is then done in terms of these blocks. Advantages of the six-block plan are shown below.

- Any station can be connected with almost any other station with minimum effect on the rest of the network.
- Planning is simplified.
- Quick frequency changes can be accomplished without any trouble.
- By dividing all frequencies into six blocks all assigned frequencies are usable.
- The necessary guard band between the transmitter and receiver frequencies is obtained.

To use the ABM plan, designate each site with the letter A, B, or M. Be sure that sites with the same letter are not interconnected (Figure G-6). Following this rule, location A can establish radio links with locations B or M but not with another A.

Considering all possible radio links, a triangle can be drawn as shown in Figure G-7A. Radio sets used in multichannel systems do not require transmitter-to-transmitter separation; therefore, all transmitter frequencies can be taken from the same block if necessary. Considering transmitter frequencies only, six groups or blocks of frequencies are required for the triangle. These blocks of frequencies are numbered I through VI. At location A, I and II are the transmitting frequencies and IV and V are the receiving frequencies.

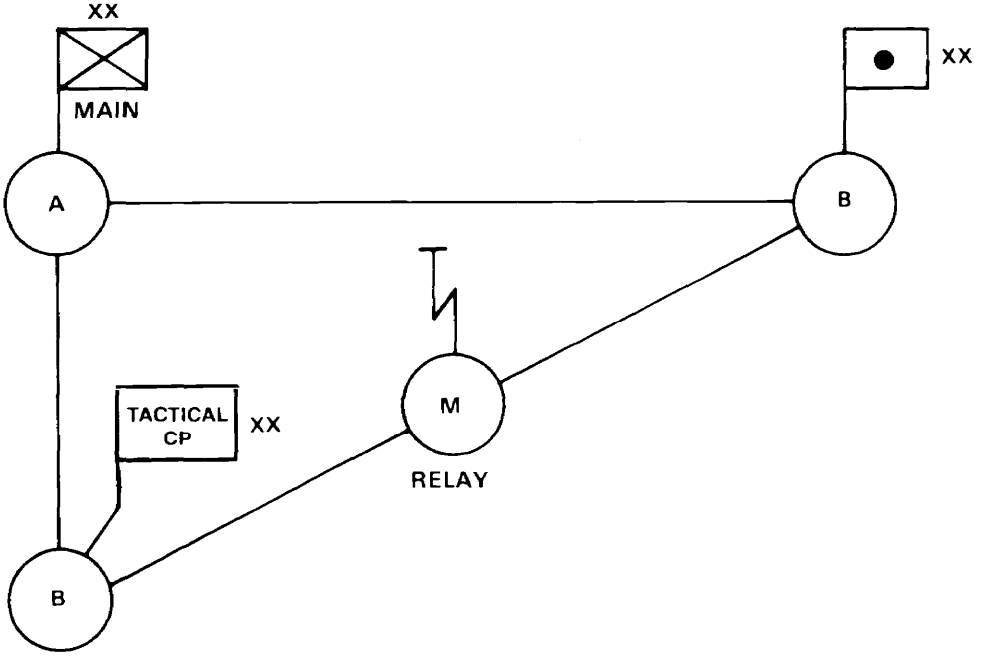


Figure G-5. Complex system.

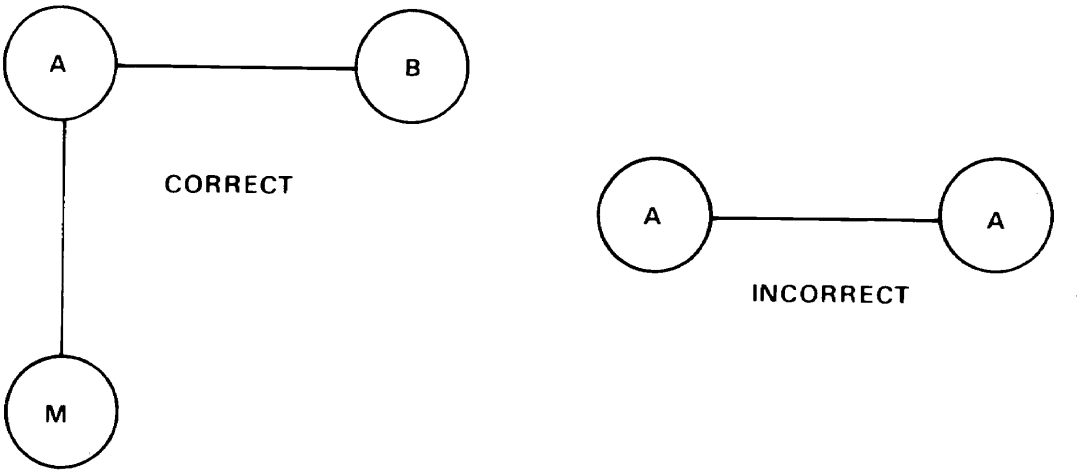


Figure G-6. Interconnections of locations.

To set up a system between A and M, the transmitter frequencies at A must be from Block I and the receiver frequencies at A must be from Block IV. Each system has a designated block from which the frequencies are taken (Figure G-7B). To set up a system from B to M, find the block where B transmits and M receives. In this case, it is VI.

Six blocks of frequencies are required when considering the six transmitter frequencies from the triangle situation. The required separations between the blocks (the transmitter separation from receiver frequency by at least 16.5 MHz or more) are also considered. From the triangle situation to a more complex situation such as Figure G-8, it is necessary to determine the number of frequencies required in each block. To do this, the system requirements must be analyzed. (We no longer just divide the frequencies equally into the six blocks.)

From Figure G-8, it can be seen that three transmitter frequencies are required for the A to M systems. Thus, a minimum of three frequencies are required in Block I for A to M. Continue the system analysis by counting Block II A to B frequencies, and then count Block III B to M frequencies. It is not necessary to determine the number of frequencies in Block IV, V, and VI because counting Blocks I, II, and III gives half the total number of frequencies for the entire system. Referring to Figures G-8 and G-9, note that in Block I a minimum of three frequencies is required in the A-M direction. Since frequencies on these systems are assigned in pairs, a total of at least three frequencies will be required in Block IV. Figure G-9 shows the requirements for the entire system.

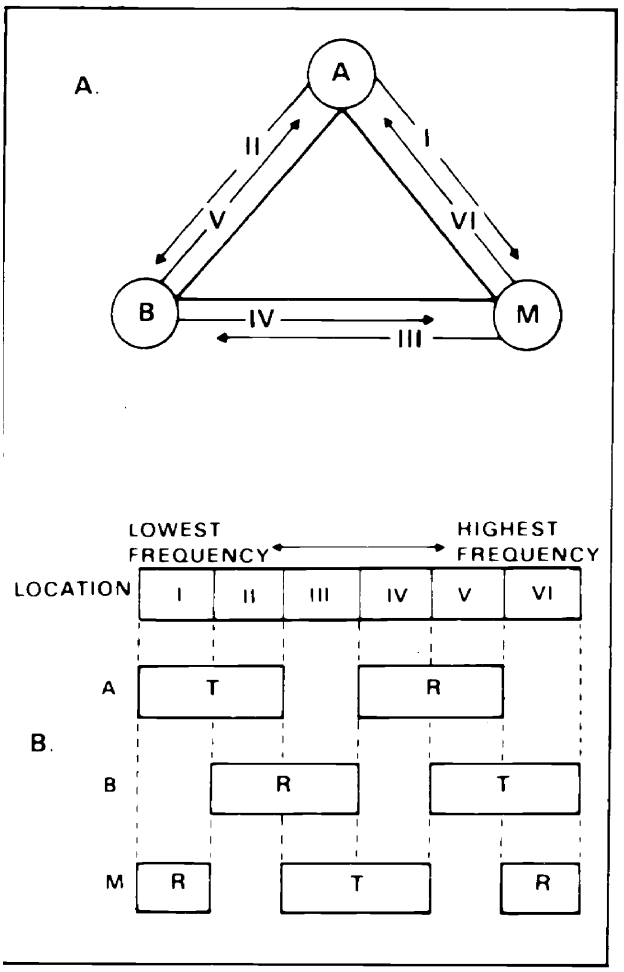


Figure G-7. Triangle situation and chart.

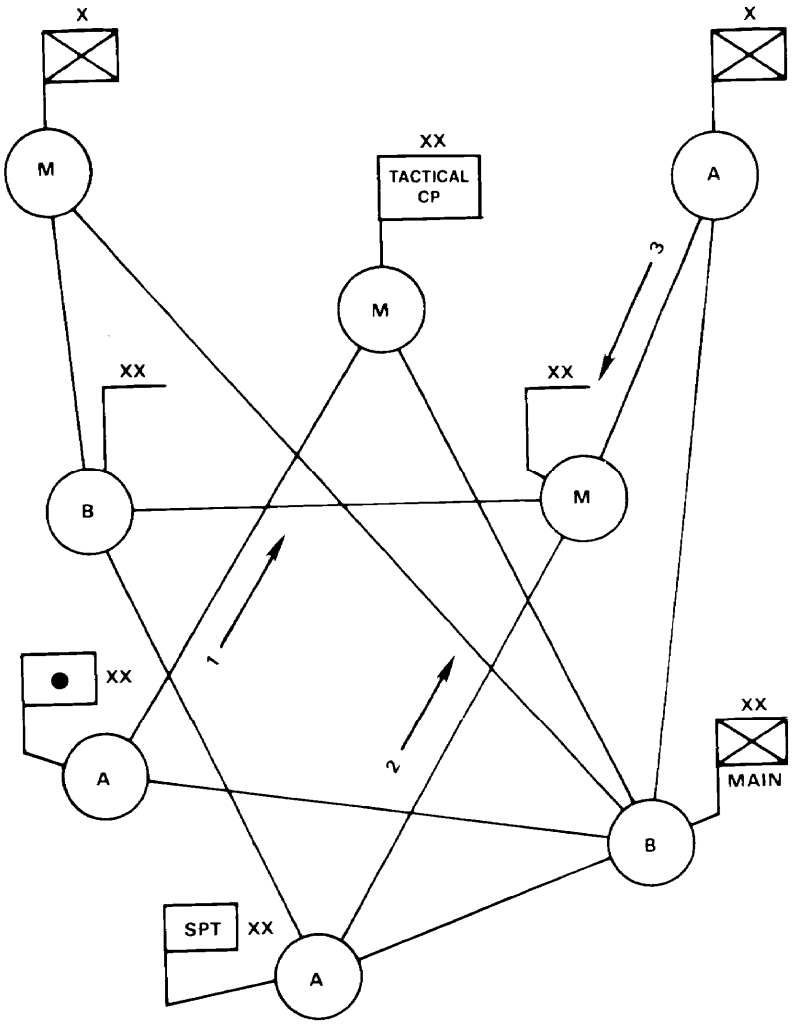


Figure G-8. Analysis of system requirements.

When spare frequencies are assigned above the required number for the systems, the spare frequencies must be kept in numerical sequence with the other assigned frequencies and divided equally among the blocks. For example, if six spares are assigned, add them to the sequential listing, then add one more frequency to each block above the requirement (that is, Block 1, four frequencies; Block II, five frequencies). These spare frequencies may be used for displacement systems or additional systems above the amount estimated for the operation.

Frequencies may then be assigned to the system (Figure G-10). The transmitting frequency is always located next to the terminal or relay symbol. Refer to the analysis of system requirements to determine what direction each system is designated, such as A-M, A-B, or M-B; frequencies will be assigned in pairs for each system. For example, in Figure G-8, the first A-M system counted was from the division artillery to the division tactical air command (TAC). From Figure G-9, assign the first frequency in Block I (222.0 MHz) to division artillery for their transmit to TAC; at the same time, assign the first frequency in Block IV (261.0 MHz) as the transmit frequency from TAC to division artillery. If this procedure is followed exactly for each system, then transmitter- to-receiver separation will not be a problem. However, care must be taken at multichannel relays and terminals to ensure that receiver-to-receiver separations (1.5 MHz) are observed. Remember, the 1.5 MHz required separation pertains only to the AN/GRC-103 in these examples. For other radio sets, check the proper technical manuals.

The suggested method of assigning frequencies to radio relay systems is to assign frequencies in the priority used for establishing systems (command links, area links, logistic

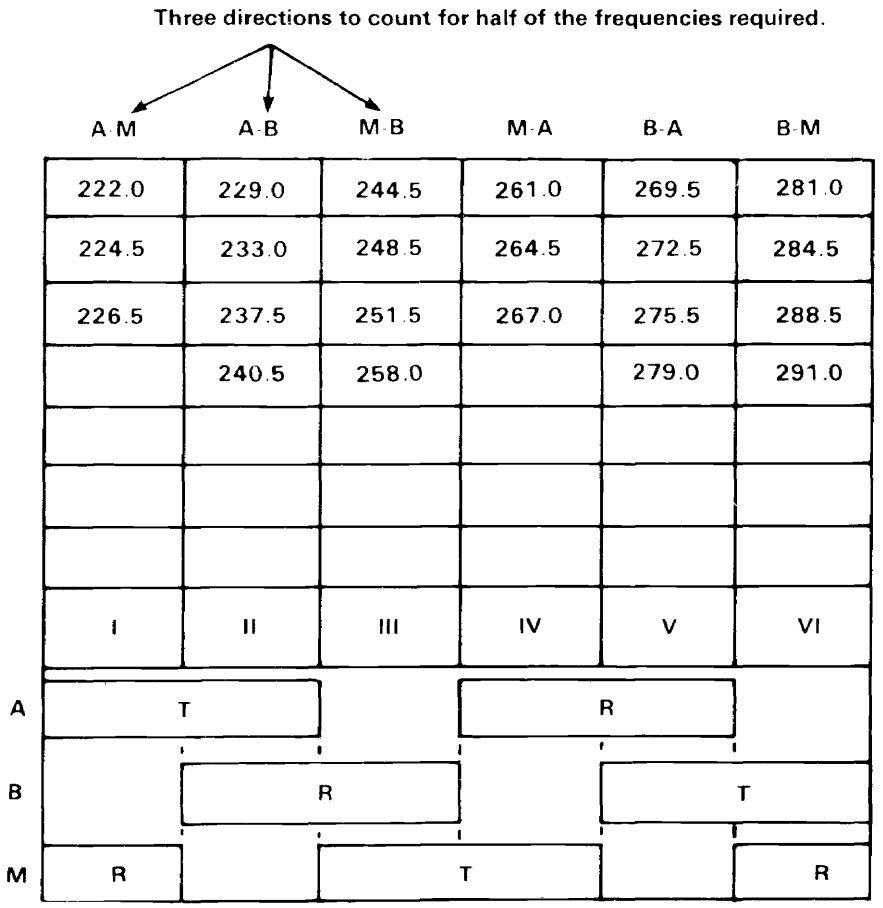


Figure G-9. ABM chart of allocated frequencies.

links, and so on). Figure G-10 shows all frequencies assigned to all systems with the proper guard bands.

G-5. Limitations of Frequency Assignment Plans

The frequency assignment plans that have been discussed have limitations. Generally, a two-block frequency plan will work for any simple isolated system regardless of the radio sets used. However, when frequencies are needed for complex systems with two or more transmitters and receivers at the same location, new problems arc often encountered.

The ABM plan is not the answer to eliminating all mutual interference problems encountered within all complex systems. When the frequencies used with some radio sets are broken down into blocks according to the ABM plan and other plans and the required frequency separations for the particular radio sets are maintained, problems with harmonics (multiple of a base frequency) are sometimes encountered. This problem can become even more complex in sophisticated frequency diversity troposcatter systems where the base band signal applies to two or more transmitters operating on different frequencies and receives on two or more receivers.

Each radio set has different sensitivity, selectivity, and other technical characteristics. When two or more systems use the same site, frequency separation between the transmit and receiver antenna on different masts becomes a critical consideration. A receiver acted on by certain base or harmonic frequencies from a transmitter located at the same location will encounter mutual interference. Because of this, a required frequency separation will have to be maintained between transmitters and receivers. Proper antenna orientation will have to be maintained between antennas. The required frequency separation between transmitters and receivers is not the same for all radio sets. When the receivers of some radio sets are located back-to-back as relay stations (repeaters), a different frequency separation may be required between the receivers than the frequency separation normally required when the receivers are located separately at the same location.

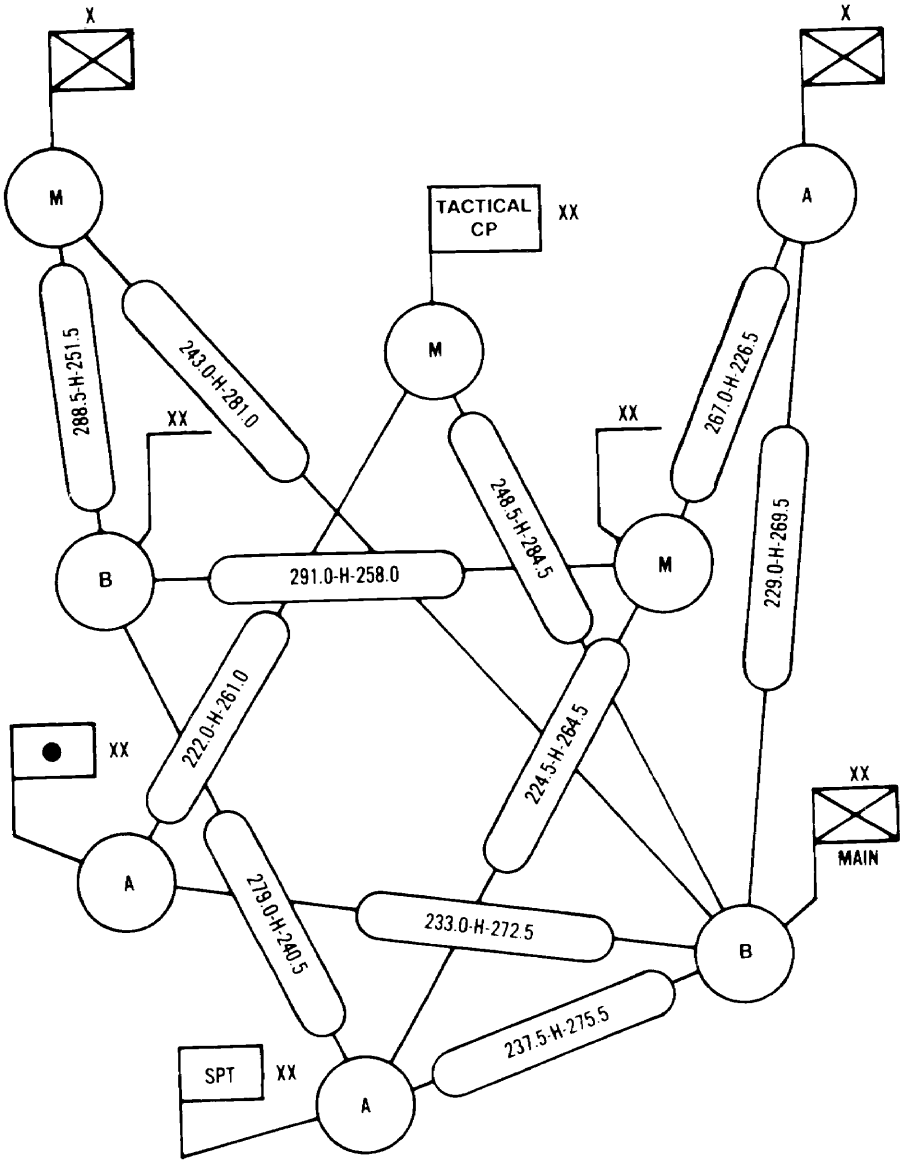


Figure G-10. Assigned frequencies in a typical multichannel system.

At times, it may be possible to use the same set of frequencies (from a block of frequencies) more than once within a particular complex communication system. Transmit frequencies that are the same or close to each other can sometimes be transmitted in opposite or near opposite directions. The effectiveness of this method will depend on the selectivity and sensitivity of the receivers used and the overall distance between them.

Generally, the only sure way to minimize the effects of mutual interference between transmitters and receivers is to follow the proper instructions on spectrum management and selection. General details are given in the proper technical manuals. This information will differ for each radio set.

Figure G-11 shows a typical, completed, armored-infantry-mechanized (AIM) division multichannel system diagram with the assigned operating frequencies using the single ABM plan.

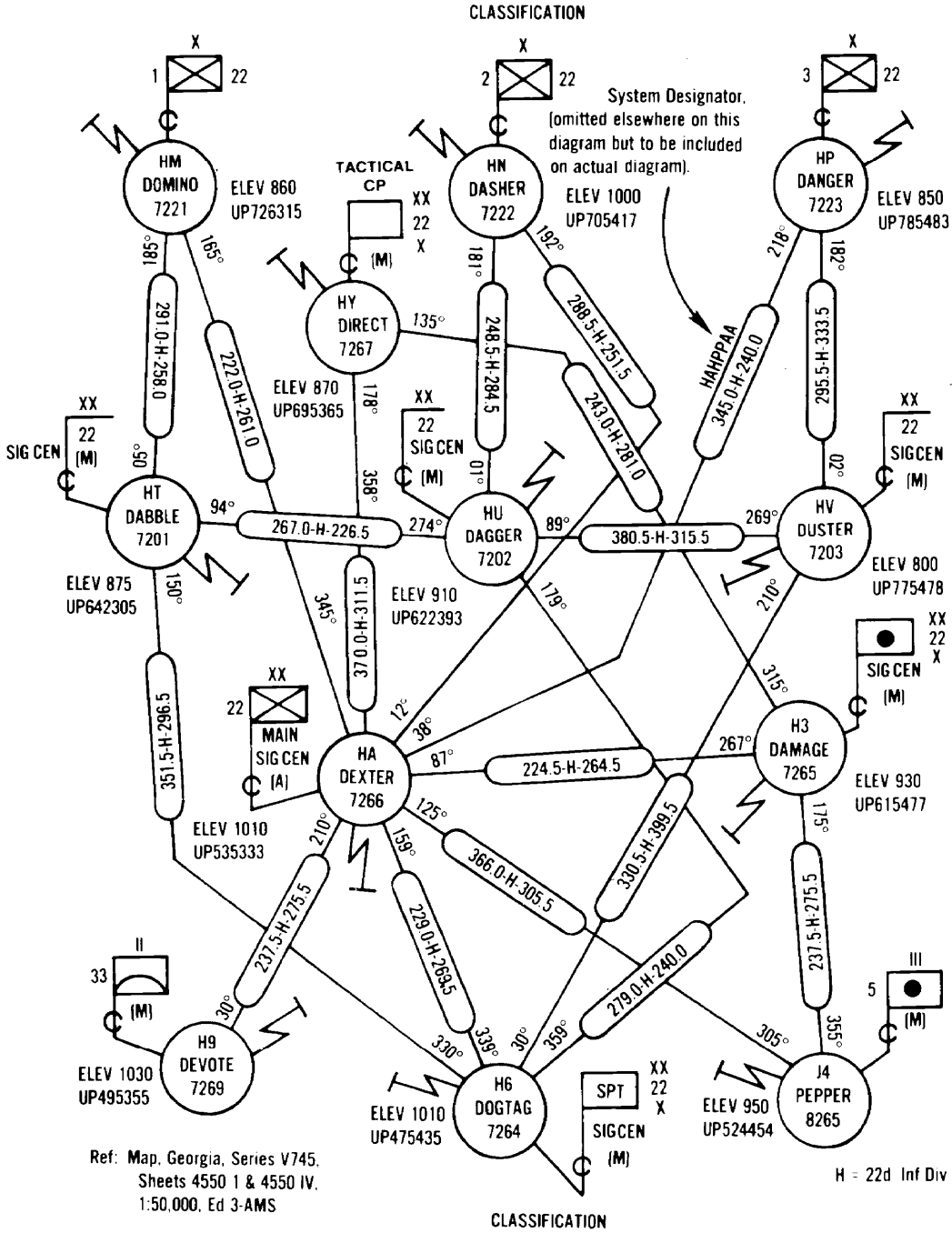


Figure G-11. Completed multichannel system diagram with assigned frequencies.

Appendix H

Hopset Construction

H-1. Introduction

A hopset is a list of frequencies the spectrum manager authorizes a particular unit to use. A list of discrete frequencies or ranges and groups of frequencies specify the hopset.

Many frequency hopping (FH) or frequency agile equipment is either fielded or under development. While not all of these are communications equipment, the factors in constructing hopsets are basically the same.

An FH or agile transmitter changes frequency within a given frequency band in either a random, pseudorandom, or fixed order. Generally, this is done as ECCM, but, in some cases, is done when the equipment senses interference on a specific frequency. The number of frequencies used within the given frequency band can range from a dozen to several thousand. Normally, the more frequencies available in the required frequency band for inclusions in the hopset, the more effectively the equipment functions.

H-2. Construction Process

For this discussion, assume a corpswide hopset is being constructed for SINCGARS. The corps G6 is the frequency assignment authority for the band being used.

The entire construction process is actually one of subtraction. The frequency resource needed by the FH or agile transmitter is normally shared with other equipment, such as between SINCGARS and MSE, and radio access units (RAUs) and mobile subscriber radiotelephone terminals (MSRTs). The spectrum manager must consider the impact of the hopper on nonhopping assignments. Possible interference to existing users must be evaluated, and if the interference is determined to be unacceptable, those frequencies must be deleted from the frequency resource. The spectrum manager must also delete all assignments that have been designated by corps, higher headquarters, or civil authorities as restricted from the frequency resource.

To develop a truly corpswide hopset, the spectrum manager must consider all restrictions on frequency use imposed by divisions within their areas of operation. It may be that all of these frequencies were considered during the process discussed above.

Any frequency restrictions that apply to corps boundary areas must be considered and coordinated with the adjacent corps. Frequencies restricted in the boundary areas may be deleted from the frequency resource.

Using FH or agile transmitter in an aircraft can impose additional restrictions. Not only does the process discussed above apply, but also due to the increase in the radio horizon, additional consideration with adjacent corps will have to be made. This could lead to more frequencies being deleted from the frequency resource. This results in a much smaller hopset.

The spectrum manager starts the planning process by compiling all the frequency requirements from the subordinate units. He combines the subordinate unit requirements with those of his echelon.

The spectrum manager assigns frequencies based on the following criteria:

- Network priority.
- Equipment in use.
- Equipment separation.
- Retransmission requirements.
- Frequency use restrictions.

The spectrum manager assigns the maximum number of frequencies available in the area of operation and spreads the frequencies in the hopsets across the widest possible band to optimize ECCM capabilities. Spreading the frequencies across the frequency band is more important than increasing the total number of frequencies available. Fifty frequencies spread from 30 to 88 MHz are more effective than 100 frequencies from 35 to 40 MHz. Chances are very slight that an enemy jammer can cover the entire 58 MHz range or even a small portion of it with enough power to disrupt communications; however, a jammer could barrage jam the entire 5 MHz range.

The spectrum manager, with the signal planning element, uses the BECs computer to assign frequencies to hopsets. The computer mathematically manipulates the frequencies based on the restrictions the spectrum manager enters into the data base. The computer develops hopsets by correlating the restrictions with available resources.

Hopsets should maximize use of frequencies separate from any collocated networks. This requires knowledge of network structures and which nets are collocated. The spectrum manager must work closely with G3/S3 to minimize the effects on collocated networks.

To minimize possible interference between SINCGARS and MSRTs/RAUs, SINCGARS can be programmed to lock out certain frequencies from the hopset. Neither BECS nor the MSE SCC can engineer frequency use for both systems at the same time. The spectrum manager must plan the MSRT/RAU frequencies (up to 96 pairs) with the SCC (assigns MSRT/RAU frequencies) and enter them into the BECS computer as lockout sets. Frequency interference between the radio systems is minimized, particularly the cosite systems.

H-3. Considerations

Corps and division level communications are currently upgrading to MSE and fielding SINCGARS as a combat net radio. Both systems use the same frequency band and mutual interference has been noted.

Covehicular interference is the worst. Currently, there is no technical solution and no planned fix until MSE and SINCGARS are totally fielded. The area most affected by this interference is the brigade area. Users in this area need to be aware of the potential problem and given the operational work-arounds to overcome the interference.

There are three methods/work-arounds that help overcome the interference problem. No one method eliminates all interference. The three methods are--

- Time-sharing. The best answer to the vehicle problem is prioritize the device needed by the mission, situation, and echelon.
- Spectrum-sharing. Lock out MSRT/RAU frequencies on SINCGARS in the FH mode or delete from frequency resource for SINCGARS in the SINGLE-CHANNEL mode.
- Antenna separation. The best alternative available for the fried locations but is not possible for mobile users.

Common sense remains the best defense to resolve this interference. Standard communications principles and signal doctrine should be followed.

- Use lowest power possible to maintain combat net radio nets.
- Keep transmissions short for combat net radio and MSRT calls.
- Keep vehicles using communications systems separated during convoy and during halts.

Appendix I

Station Classes

I-1. Stations (Alphabetical by Classes)

Station and associated station class (STC) symbols are required for all frequency requests and assignments. Station classes are used to identify the service in which the transmitting station will operate.

All classes of earth stations are fixed earth stations except--

- Those which have the following letters suffixed to the STC symbol:

A The earth station is aboard an aircraft.

L The earth station is on a land vehicle.

S The earth station is on board a ship.

M The earth station is on any two or all three of the above.

- Those with the following STC symbols:

TG A Maritime Mobile-Satellite Earth Station.

TJ An Aeronautical Mobile-Satellite Mobile Earth Station.

TO An Aeronautical Radionavigation-Satellite Mobile Earth Station.

TQ A Maritime Radionavigation-Satellite Mobile Earth Station.

TU A Land Mobile-Satellite Mobile Earth Station.

The suffix R shall be added to the established STC symbol only if the station is used primarily as a repeater in the bands shown below. For this purpose, a repeater consists of a radio transmitter, a radio receiver, and coupling between the two so as to retransmit unchanged in intelligence the received signal.

- 29.89 - 50.00 MHz (Exclusive Government Bands)
- 138.00 - 144.00 MHz
- 148.00 - 149.90 MHz
- 150.05 - 150.80 MHz
- 162.00 - 174.00 MHz
- 406.10 - 420.00 MHz

The STC symbols shown below are used on US government frequency assignments as applicable. Definitions followed by (RR) come from the ITU RR, 1982 edition.

FAB Aeronautical Broadcast Station: An aeronautical station which makes scheduled broadcasts of meteorological information and notices to airmen. (In certain instances, an aeronautical broadcast station may be placed on board a ship.)

AX Aeronautical Fixed Station: A station in the aeronautical fixed service. (RR)

RLA Aeronautical Marker Beacon Station: A radionavigation land station in the aeronautical radionavigation service which employs a marker beacon.

TB Aeronautical Mobile-Satellite Earth Station: A fixed earth station in the aeronautical mobile-satellite service. (RR)

TJ Aeronautical Mobile-Satellite Mobile Earth Station: A mobile earth station in the aeronautical mobile-satellite service. (RR)

EJ Aeronautical Mobile-Satellite Space Station: A space station in the aeronautical mobile-satellite service.

RLB Aeronautical Radiobeacon Station: A radiobeacon station in the aeronautical radionavigation service intended for the benefit of aircraft.

TZ Aeronautical Radionavigation-Satellite Earth Station: A fixed earth station in the aeronautical radionavigation-satellite service.

TO Aeronautical Radionavigation-Satellite Mobile Earth Station: A mobile earth station in the aeronautical radionavigation-satellite service. (RR)

EO Aeronautical Radionavigation-Satellite Space Station: A space station in the aeronautical radionavigation-satellite service. (RR)

FA Aeronautical Station: A land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea. (RR)

FLEA Aeronautical Telemetering Land Station: A telemetering land station used in the flight testing of manned or unmanned aircraft, missiles, or major components thereof.

MOEA Aeronautical Telemetering Mobile Station: A telemetering mobile station used in testing of manned or unmanned aircraft, missiles, or major components thereof.

FLU Aeronautical Utility Land Station: A land station located at airdome control towers and used for control of ground vehicles and aircraft on the ground at airdromes.

MOU Aeronautical Utility Mobile Station: A mobile station used for communication at airdromes with the aeronautical utility land station, the airdrome control station, the Federal Aviation Administration flight service station, ground vehicles, and aircraft on the ground. (All transmissions shall be subject to the control of the airdrome control station and shall be discontinued immediately when so requested by the airdrome control operators.)

MA Aircraft Station: A mobile station in the aeronautical mobile service, other than a survival craft station, located on board an aircraft. (RR)

FAC Airdrome Control Station: An aeronautical station providing communication between an airdrome control tower and aircraft.

ROA Altimeter Station: A radionavigation mobile station in the aeronautical radionavigation service which employs a radio altimeter.

FB Base Station: A land station in the land mobile service. (RR)

EB Broadcasting-Satellite Space Station (sound broadcasting): A space station (sound broadcasting) in the broadcasting-satellite service. (RR)

EV Broadcasting-Satellite Space Station (television): A space station (television) in the broadcasting-satellite service. (RR)

BC Broadcasting Station (sound): A station (sound) in the broadcasting service. (RR)

BT Broadcasting Station (television): A station (television) in the broadcasting service. (RR)

FC Coast Station: A land station in the maritime mobile service. (RR)

TW Earth Exploration-Satellite Earth Station: An earth station in the earth exploration-satellite service. (RR)

EW Earth Exploration-Satellite Space Station: A space station in the earth exploration-satellite service. (RR)

TP Earth Station (receiving): An earth station used for receiving. (RR) (TP is not used on applications.)

TE Earth Station (transmitting): An earth station used for transmitting. (RR) (TE is not used on applications.)

XM Experimental Composite Station: An experimental station used in experimental operations of a complex nature not readily specified or used in operation which is a

composite of two or more of the established experimental categories.

XC Experimental Contract Developmental Station: An experimental station used for the evaluation or testing under government contract of electronics equipment or systems in a design or development stage.

XD Experimental Developmental Station: An experimental station used for evaluation or testing of electronics equipment or systems in a design or development stage.

XE Experimental Export Station: An experimental station intended for export and used for the evaluation or testing of electronics equipment or systems in the design or development stage.

XR Experimental Research Station: An experimental station used in basic studies concerning scientific investigations looking toward the improvement of the art of radiocommunications.

EX Experimental Station: A station utilizing radio waves in experiments with a view to the development of science or technique. This definition does not include amateur stations. (RR) (EX is not used on applications.)

XT Experimental Testing Station: An experimental station used for the evaluation or testing of electronics equipment or systems, including site selection and transmission path surveys, which have been developed for operational use.

TC Fixed-Satellite Earth Station: An earth station in the fixed-satellite service. (RR)

EC Fixed-Satellite Space Station: A space station in the fixed-satellite service. (RR)

FX Fixed Station: A station in the fixed service. (RR)

FLEB Flight Telemetering Land Station: A telemetering land station the emissions of which are used for telemetering to a balloon; to a booster or rocket, excluding a booster or rocket in orbit about the earth or in deep space; or to an aircraft, excluding a station used in the flight testing of an aircraft.

MOEB Flight Telemetering Mobile Station: A telemetering mobile station the emissions if which are used for telemetering from a balloon; from a booster or rocket, excluding a booster or rocket in orbit about the earth or in deep space; or from an aircraft, excluding a station used in the flight testing of an aircraft.

FAT Flight Test Station: An aeronautical station used for the transmission of essential communications in connection with the testing of aircraft or major components of aircraft.

RLG Glide Path (Slope) Station: A radionavigation land station in the aeronautical radionavigation service which employs the Instrument Landing System Glide Path.

FXH Hydrologic and Meteorological Fixed Station: A fixed station the emissions of which are used for the automatic transmission of either hydrologic or meteorological data, or both.

FLH Hydrologic and Meteorological Land Station: A land station the emissions of which are used for the automatic transmission of either hydrologic or meteorological data, or both.

MOH Hydrologic and Meteorological Mobile Station: A mobile station the emissions of which are used for the automatic transmission of either hydrologic or meteorological data, or both.

ES Intersatellite Space Station: A space station in the intersatellite service. (RR)

TY Land Mobile-Satellite Earth Station: A fixed earth station in the land mobile-satellite service. (RR)

TU Land Mobile-Satellite Mobile Earth Station: A mobile earth station in the land mobile-satellite service. (RR)

EU Land Mobile-Satellite Space Station: A space station in the land mobile-satellite service. (RR)

ML Land Mobile Station: A mobile station in the land mobile service capable of surface

movement within the geographical limits of a country or continent. (RR)

FL Land Station: A station in the mobile service not intended to be used while in motion. (RR)

RLL Localizer Station: A radionavigation land station in the aeronautical radionavigation service which employs an Instrument Landing System Localizer.

RLN Loran Station: A long distance radionavigation land station transmitting synchronized pulses. Hyperbolic lines of position are determined by the measurement of the difference in the time of arrival of these pulses.

FCB Marine Broadcast Station: A coast station which scheduled broadcasts of time, meteorological, and hydrographic information.

RLM Maritime Radiobeacon Station: A radiobeacon station in the maritime radionavigation service intended for the benefit of ships.

TI Maritime Mobile-Satellite Earth Station: An earth station in the maritime mobile-satellite service at a specified fried point. (RR)

TG Maritime Mobile-Satellite Mobile Earth Station: A mobile earth station in the maritime mobile-satellite service. (RR)

EG Maritime Mobile-Satellite Space Station: A space station in the maritime mobile-satellite service. (RR)

TX Maritime Radionavigation-Satellite Earth Station: A fixed earth station in the maritime radionavigation-satellite service. (RR)

TQ Maritime Radionavigation-Satellite Mobile Earth Station: A mobile earth station in the maritime radionavigation-satellite service. (RR)

EQ Maritime Radionavigation-Satellite Space Station: A space station in the maritime radionavigation-satellite service. (RR)

WXD Meteorological Radar Station: A station in the meteorological aids service employing radar.

TM Meteorological-Satellite Earth Station: An earth station in the meteorological-satellite service. (RR)

EM Meteorological-Satellite Space Station: A space station in the meteorological-satellite service. (RR)

MO Mobile Station: A station in the mobile service intended to be used while in motion or during halts at unspecified points. (RR)

OE Oceanographic Data Interrogating Station: A station in the maritime mobile service the emissions of which are used to initiate, modify, or terminate functions of equipment directly associated with an oceanographic data station, including the station itself. (RR)

OD Oceanographic Data Station: A station in the maritime mobile service located on a ship, buoy, or other sensor platform the emissions of which are used for transmission of oceanographic data. (RR)

RLO Omnidirectional Range Station: A radionavigation land station in the aeronautical radionavigation service providing direct indication of the bearing (omnibearing) of that station from an aircraft.

MAP Portable Aircraft Station: A portable station operating in the aeronautical mobile service.

MLP Portable Land Mobile Station: A portable station operating in the land mobile service.

MOP Portable Mobile Station: A portable station operating in the mobile service.

MRP Portable Radiolocation Station: A portable station operating in the radiolocation service.

MSP Portable Ship Station: A portable station operating in the maritime mobile service.

RLC Radar Beacon (racon) Station: A station which employs a radar beacon (racon).

WXB Radar Beacon Precipitation Gage Station: A transponder station in the meteorological aids

service, the emissions of which are used for telemetering.

RA Radio Astronomy Station: A station in the radio astronomy service. (RR) (This is always a receiving station.)

MOB Radio Beacon Mobile Station: A mobile station the emissions of which are used to determine its location.

TF Radiodetermination-Satellite Earth Station: A fixed earth station in the radiodetermination-service. (RR)

TL Radiodetermination-Satellite Mobile Earth Station: A mobile earth station in the radiodetermination-satellite service. (RR)

EF Radiodetermination-Satellite Space Station: A space station in the radiodetermination-satellite service. (RR)

RG Radio Direction-Finding Station: A radiodetermination station using radio direction-finding. (RR)

LR Radiolocation Land Station: A station in the radiolocation service not intended to be used while in motion. (RR)

MR Radiolocation Mobile Station: A station in the radiolocation service intended to be used while in motion or during halts at unspecified points. (RR)

RL Radionavigation Land Station: A station in the radionavigation service not intended to be used while in motion. (RR)

RLTM Radionavigation Land Test Station (Maintenance Test Facility): A radionavigation land station in the aeronautical radionavigation service which is used as a radionavigation calibration station for the transmission of essential information in connection with the testing and calibration of aircraft navigational aids, receiving equipment, and interrogators at predetermined surface locations. The primary purpose of this facility is to permit maintenance testing by aircraft radio service personnel.

RLTO Radionavigation Land Test Station (operational Test Facility): A radionavigation land station in the aeronautical radionavigation service which is used as a radionavigation calibration station for the transmission of essential information in connection with the testing and calibration of aircraft navigational aids, receiving equipment, and interrogators at predetermined surface locations. The primary purpose of this facility is to permit the pilot to check a radionavigation system aboard the aircraft prior to takeoff.

RO Radionavigation Mobile Station: A station in the radionavigation service intended to be used while in motion or during halts at unspecified points. (RR)

TN Radionavigation-Satellite Earth Station: An earth station in the radionavigation-satellite service. (RR)

EN Radionavigation-Satellite Space Station: A space station in the radionavigation-satellite service. (RR)

RLR Radio Range Station: A radionavigation land station in the aeronautical radionavigation service providing radial equisignal zones. (In certain instances a radio range station may be placed on board a ship.)

WXR Radiosonde Station: A station in the meteorological aids service employing a radiosonde.

WXRG Radiosonde Ground Station: A station in the meteorological aids service employing a ground station associated with a radiosonde.

MS Ship Station: A mobile station in the maritime mobile service located on board a vessel which is not permanently moored, other than a survival craft station. (RR)

SN Sounder Network Station: A station equipped with an ionosphere sounder used for the real-time selection of frequencies for operational communication circuits.

SP Sounder Prediction Station: A station equipped with an ionosphere sounder for real-time monitoring of upper atmosphere phenomena or

to obtain data for the prediction of propagation conditions.

TT Space Operation Earth Station: An earth station in the space operation service. (RR)

ET Space Operation Space Station: A space station in the space operation service.

TH Space Research Earth Station: An earth station in the space research service. (RR)

EH Space Research Space Station: A space station in the space research service. (RR)

ME Space Station: A station located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the earth's atmosphere. (RR) (ME is not used on applications.)

TD Space Telecommand Earth Station: An earth station the emissions of which are used for space telecommand. (RR)

ED Space Telecommand Space Station: A space station which receives emissions used for space telecommand. (RR)

TETD Space Telecommand Transmitting Earth Station: For an emergency position - indicating radiobeacon (EPIRB) in a mobile-satellite service.

TETR Space Telemetering Transmitting Earth Station: For an emergency position - indicating radiobeacon (EPIRB) in a mobile-satellite service.

TR Space Telemetering Earth Station: An earth station which receives emissions used for space telemetering. (RR)

ER Space Telemetering Space Station: A space station the emissions of which are used for space telemetering. (RR)

TK Space Tracking Earth Station: An earth station which transmits or receives emissions used for space tracking. (RR)

EK Space Tracking Space Station: A space station which transmits or receives and retransmits emissions used for space tracking. (RR)

TETK Space Tracking Transmitting Earth Station: For an emergency position - indicating radiobeacon (EPIRB) in a mobile-satellite service.

SS Standard Frequency and Time Signal Station: A station in the standard frequency and time signal service. (RR)

EE Standard Frequency and Time Signal-Satellite Space Station: A space station in the standard frequency and time signal-satellite service. (RR)

FLEC Surface Telemetering Land Station: A telemetering land station the emissions of which are intended to be received on the surface of the earth.

MOEC Surface Telemetering Mobile Station: A telemetering mobile station located on the surface of the earth and the emissions of which are intended to be received in the surface of the earth.

RLS Surveillance Radar Station: A radionavigation land station in the aeronautical radionavigation service employing radar to display the presence of aircraft within its range. (In certain instances, a surveillance radar station may be placed on board a ship.)

FAD Telecommand Aeronautical Station: A land station in the aeronautical mobile service the emissions of which are used for terrestrial telecommand.

MAD Telecommand Aircraft Station: A mobile station in the aeronautical mobile service the emissions of which are used for terrestrial telecommand.

FBD Telecommand Base Station: A land station in the land mobile service the emissions of which are used for terrestrial telecommand.

FCD Telecommand Coast Station: A land station in the maritime mobile service the emissions of which are used for terrestrial telecommand.

FXD Telecommand Fixed Station: A fixed station the emissions of which are used for terrestrial telecommand.

FLD Telecommand Land Station: A land station the emissions of which are used for terrestrial telecommand.

MLD Telecommand Land Mobile Station: A mobile station in the land mobile service the emissions of which are used for terrestrial telecommand.

MOD Telecommand Mobile Station: A mobile station the emissions of which are used for terrestrial telecommand.

MSD Telecommand Ship Station: A mobile station in the maritime mobile service the emissions of which are used for terrestrial telecommand.

FXE Telemetering Fixed Station: A fixed station the emissions of which are used for telemetering.

FLE Telemetering Land Station: A land station the emissions of which are used for telemetering.

MOE Telemetering Mobile Station: A mobile station the emissions of which are used for telemetering,

1-2. Stations (Alphabetical Symbols)

STC symbols shown below are used on US government frequency assignments as applicable.

AX Aeronautical Fixed Station.

BC Broadcasting Station (sound).

BT Broadcasting Station (television).

EB Broadcasting-Satellite Space Station (sound broadcasting).

EC Fixed-Satellite Space Station.

ECED Space Telecommand Space Station in the fixed-satellite service.

ECEK Space Tracking Space Station in the fixed-satellite service.

ECER Space Telemetering Space Station in the fixed-satellite service.

ED Space Telecommand Space Station.

EE Standard Frequency and Time Signal-Satellite Space Station.

EF Radiodetermination-Satellite Space Station.

EFED Space Telecommand Space Station in the radiodetermination-satellite service.

EFEK Space Tracking Space Station in the radiodetermination-satellite service.

EFER Space Telemetering Space Station in the radiodetermination-satellite service.

EG Maritime Mobile-Satellite Space Station.

EGED Space Telecommand Space Station in the maritime mobile- satellite service.

EGEK Space Tracking Space Station in the maritime mobile-satellite service.

EGER Space Telemetering Space Station in the maritime mobile-satellite service.

EH Space Research Space Station.

EHED Space Telecommand Space Station in the space research service.

EHEK Space Tracking Space Station in the space research service.

EHER Space Telemetering Space Station in the space research service.

EJ Aeronautical Mobile-Satellite Space Station.

EJED Space Telecommand Space Station in the aeronautical mobile-satellite service.

EJEK Space Tracking Space Station in the aeronautical mobile-satellite service.

EJER Space Telemetering Space Station in the aeronautical mobile-satellite service.

EK Space Tracking Space Station.

EM Meteorological-Satellite Space Station.

EMED Space Telecommand Space Station in the meteorological-satellite service.

EMEK Space Tracking Space Station in the meteorological-satellite service.

EMER Space Telemetering Space Station in the meteorological-satellite service.

EN Radionavigation-Satellite Space Station.

ENED Space Telecommand Space Station in the radionavigation-satellite service.

ENEK Space Tracking Space Station in the radionavigation-satellite service.

ENER Space Telemetering Space Station in the radionavigation-satellite service.

EO Aeronautical Radionavigation-Satellite Space Station.

EOED Space Telecommand Space Station in the aeronautical radionavigation-satellite service.

EOEK Space Tracking Space Station in the aeronautical radionavigation-satellite service.

EOER Space Telemetering Space Station in the aeronautical radionavigation-satellite service.

EQ Maritime Radionavigation-Satellite Space Station.

EQED Space Telecommand Space Station in the maritime radionavigation-satellite service.

EQEK Space Tracking Space Station in the maritime radionavigation-satellite service.

EQER Space Telemetering Space Station in the maritime radionavigation-satellite service.

ER Space Telemetering Space Station.

ES Intersatellite Space Station.

ESED Space Telecommand Space Station in the intersatellite service.

ESEK Space Tracking Space Station in the intersatellite service.

ESER Space Telemetering Space Station in the intersatellite service.

ET Space Operation Space Station.

ETED Space Telecommand Space Station in the space operation service.

ETEK Space Tracking Space Station in the space operation service.

ETER Space Telemetering Space Station in the space operation service.

EU Land Mobile-Satellite Space Station.

EUED Space Telecommand Space Station in the land mobile-satellite service.

EUEK Space Tracking Space Station in the land mobile-satellite service.

EUER Space Telemetering Space Station in the land mobile-satellite service.

EV Broadcasting-Satellite Space Station (television).

EW Earth Exploration-Satellite Space Station.

EWED Space Telecommand Space Station in the earth exploration-satellite service.

EWEK Space Tracking Space Station in the earth exploration-satellite service.

EWER Space Telemetering Space Station in the earth exploration-satellite service.

EX Experimental Station.

FA Aeronautical Station.

FAB Aeronautical Broadcast Station.

FAC Airdome Control Station.

FAD Telecommand Aeronautical Station.

FAT Flight Test Station.

FB Base Station.

FC Coast Station.

FCB Marine Broadcast Station.

FL Land Station.

FLD Telecommand Land Station.

FLE Telemetering Land Station.

FLEA Aeronautical Telemetering Land Station.

FLEB Flight Telemetering Land Station.

FLEC Surface Telemetering Land Station.

FLH Hydrologic and Meteorological Land Station.

FLU AeronauticaI Utility Land Station.

FX Fixed Station.

FXD Telecommand Fixed Station.

FXE Telemetering Fixed Station.

FXH Hydrologic and Meteorological Fixed Station.

LR Radiolocation Land Station.

MA Aircraft Station.

MAD Telecommand Aircraft Station

MAP Portable Aircraft Station.

ME Space Station.

ML Land Mobile Station.

MLP Portable Land Mobile Station.

MO Mobile Station.

MOB Radiobeacon Mobile Station.

MOD Telecommand Mobile Station.

MOE Telemetering Mobile Station.

MOEA Aeronautical Telemetering Mobile Station.

MOEB Flight Telemetering Mobile Station.

MOEC Surface Telemetering Mobile Station.

MOH Hydrologic and Meteorological Mobile Station.

MOP Portable Mobile Station.

MOU Aeronautical Utility Mobile Station.

MR Radiolocation Mobile Station.

MRP Portable Radiolocation Station.

MS Ship Station.

MSD Telecommand Ship Station.

MSP Portable Ship Station.

OD Oceanographic Data Station.

OE Oceanographic Data Interrogating Station.

RA Radio Astronomy Station.

RG Radio Direction-Finding Station.

RL Radionavigation Land Station.

RLA Aeronautical Marker Beacon Station.

RLB Aeronautical Radiobeacon Station.

RLC Radar Beacon (racon) Station.

RLG Glide Path (Slope) Station.

RLL Localizer Station.

RLM Marine Radiobeacon Station.

RLN Loran Station.

RLO Omnidirectional Range Station.

RLR Radio Range Station.

RLS Surveillance Radar Station.

RLTM Radionavigation Land Test Station (Maintenance Test Facility).

RLTO Radionavigation Land Test Station (Operational Test Facility).

RO Radionavigation Mobile Station.

ROA Altimeter Station.

SN Sounder Network Station.

SP Sounder Prediction Station.

SS Standard Frequency and Time Signal Station.

TB Aeronautical Mobile-Satellite Earth Station.

TBTD Space Telecommand Earth Station (fixed) in the aeronautical mobile-satellite service.

TBTK Space Tracking Earth Station (fixed) in the aeronautical mobile-satellite service.

TBTR Space Telemetering Earth Station (fixed) in the aeronautical mobile-satellite service.

TC Fixed-Satellite Earth Station.

TCTD Space Telecommand Earth Station in the fixed-satellite service.

TCTK Space Tracking Earth Station in the fixed-satellite service.

TCTR Space Telemetering Earth Station in the fixed-satellite service.

TD Space Telecommand Earth Station.

TE Earth Station (transmitting).

TETD Telecommand Transmitting Earth Station for an EPIRB in a mobile-satellite service.

TETK Space Tracking Transmitting Earth Station for an EPIRB in a mobile-satellite service.

TETR Space Telemetering Transmitting Earth Station for an EPIRB in a mobile-satellite service.

TF Radiodetermination-Satellite Earth Station.

TFTD Space Telecommand Earth Station (fixed) in the radiodetermination-satellite service.

TFTK Space Tracking Earth Station (fixed) in the radiodetermination-satellite service.

TFTR Space Telemetering Earth Station (fixed) in the radiodetermination-satellite service.

TG Maritime Mobile-Satellite Mobile Earth Station.

TGTD Space Telecommand Earth Station (mobile) in the maritime mobile-satellite service.

TGTK Space Tracking Earth Station (mobile) in the maritime mobile-satellite service.

TGTR Space Telemetering Earth Station (mobile) in the maritime mobile-satellite service.

TH Space Research Earth Station.

THTD Space Telecommand Earth Station in the space research service.

THTK Space Tracking Earth Station in the space research service.

THTR Space Telemetering Earth Station in the space research service.

TI Maritime Mobile-Satellite Earth Station.

TITD Space Telecommand Earth Station (fixed) in the maritime mobile-satellite service.

TITK Space Tracking Earth Station (fixed) in the maritime mobile-satellite service.

TITR Space Telemetering Earth Station (fixed) in the maritime mobile-satellite service.

TJ Aeronautical Mobile-Satellite Mobile Earth Station.

TJTD Space Telecommand Earth Station (mobile) in the aeronautical mobile-satellite service.

TJTK Space Tracking Earth Station (mobile) in the aeronautical mobile-satellite service.

TJTR Space Telemetering Earth Station (mobile) in the aeronautical obile-satellite service.

TK Space Tracking Earth Station.

TL Radiodetermination-Satellite Mobile Earth Station.

TLTD Space Telecommand Earth Station (mobile) in the radiodetermination-satellite service.

TLTK Space Tracking Earth Station (mobile) in the radiodetermination-satellite service.

TLTR Space Telemetering Earth Station (mobile) in the radiodetermination-satellite service.

TM Meteorological-Satellite Earth Station.

TMTD Space Telecommand Earth Station in the meteorological-satellite service.

TMTK Space Tracking Earth Station in the meteorological-satellite service.

TMTR Space Telemetering Earth Station in the meteorological-satellite service.

TN Radionavigation-Satellite Earth Station.

TNTD Space Telccommand Earth Station in the radionavigation-satellite service.

TNTK Space Tracking Earth Station in the radionavigation-satellite service.

TNTR Space Telemetering Earth Station in the radionavigation-satellite service.

TO Aeronautical Radionavigation-Satellite Mobile Earth Station.

TOTD Space Telecommand Earth Station (mobile) in the aeronautical radionavigation-satellite service.

TOTK Space Tracking Earth Station (mobile) in the aeronautical radionavigation-satellite service.

TOTR Space Telemetering Earth Station (mobile) in the aeronautical radionavigation-satellite service.

TP Earth Station (receiving).

TQ Maritime Radionavigation-Satellite Mobile Earth Station.

TQTD Space Telecommand Earth Station (mobile) in the maritime radionavigation-satellite service.

TQTK Space Tracking Earth Station (mobile) in the maritime radionavigation-satellite service.

TQTR Space Telemetering Earth Station (mobile) in the maritime radionavigation-satellite service.

TR Space Telemetering Earth Station.

TT Space Operation Earth Station.

TTTD Space Telecommand Earth Station in the space operation service.

TITK Space Tracking Earth Station in the space operation service.

TTTR Space Telemetering Earth Station in the space operation service.

TU Land Mobile-Satellite Mobile Earth Station.

TUTD Space Telecommand Earth Station (mobile) in the land mobile-satellite service.

TUTK Space Tracking Earth Station (mobile) in the land mobile-satellite service.

TUTR Space Telemetering Earth Station (mobile) in the land mobile-satellite service.

TW Earth Exploration-Satellite Earth Station.

TWTD Space Telecommand Earth Station in the earth exploration-satellite service.

TWTK Space Tracking Earth Station in the earth exploration-satellite service.

TWTR Space Telemetering Earth Station in the earth exploration-satellite service.

TX Maritime Radionavigation-Satellite Earth Station

TXTD Space Telecommand Earth Station (fixed) in the maritime radionavigation-satellite service.

TXTK Space Tracking Earth Station (fixed) in the maritime radionavigation-satellite service.

TXTR Space Telemetering Earth Station (fixed) in the maritime radionavigation-satellite service.

TY Land Mobile-Satellite Earth Station.

TYTD Space Telecommand Earth Station (fixed) in the land mobile-satellite service.

TYTK Space Tracking Earth Station (fixed) in the land mobile-satellite service.

TYTR Space Telemetering Earth Station (fixed) in the land mobile-satellite service.

TZ Aeronautical Radionavigalion-Satellite Earth Station.

TZTD Space Telecommand Earth Station (fixed) in the aeronautical radionavigalion-satellite service.

TZTK Space Tracking Earth Station (fixed) in the aeronautical radionavigation-satellite service.

TZTR Space Telemetering Earth Station (fixed) in the aeronautical radionavigation-satellite service.

WXB Radar Beacon Precipitation Gage Station.

WXD Meteorological Radar Station.

WXR Radiosonde Station.

XC Experimental Contract Developmental Station.

XD Experimental Developmental Station.

XE Experimental Export Station.

XM Experimental Composite Station.

XR Experimental Research Station.

XT Experimental Testing Station.

I-3. Services, Station Classes, and Stations

Use Table I-1 to determine the proper STC symbol to use versus the service in which the transmitting station will operate. Frequency bands are allocated to services based on the US Government Table of Frequency Allocations.

Table I-1. Services, STCs, and stations.

	SERVICE	STC	STATION
1.	Amateur	None	Amateur
2.	Broadcasting	BC BT	Broadcasting (sound) Broadcasting (television)
3.	Broadcasting-Satellite	EB EV	Space (sound) Space (television)
4.	Earth Exploration-Satellite	EW TW	Space Earth
	Meteorological-Satellite	EM TM	Space Earth

Table I-1. Services, STCs, and stations. (continued)

SERVICE		STC	STATION
5.	Fixed	FX	Fixed
		FXD	Telecommand Fixed
		FXE	Telemetering Fixed
		FXH	Hydrologic and Meteorological Fixed
	Aeronautical Fixed	AX	Aeronautical Fixed
6.	Fixed Satellite	EC	Space
		TC	Earth
7.	Intersatellite	ES	Space
8.	Meteorological Aids	WXB	Radar Beacon Precipitation Gage
		WXD	Meteorological Radar
		WXR	Radiosonde
9.	Mobile	FL	Land
		FLD	Telecommand Land
		FLE	Telemetering Land
		FLEA	Aeronautical Telemetering Land
		FLEB	Flight Telemetering Land
		FLEC	Surface Telemetering Land
		FLH	Hydrologic and Meteorological Land
		FLU	Aeronautical Utility Land
		MO	Mobile
		MOB	Radiobeacon Mobile
		MOD	Telecommand Mobile
		MOE	Telemetering Mobile
		MOEA	Aeronautical Telemetering Mobile
		MOEB	Flight Telemetering Mobile
		MOEC	Surface Telemetering Mobile
		MOH	Hydrologic and Meteorological Mobile
		MOP	Portable Mobile
		MOU	Aeronautical Utility Mobile

Table I-1. Services, STCs, and stations. (continued)

	SERVICE	STC	STATION
	Aeronautical Mobile	FA	Aeronautical
		FAB	Aeronautical Broadcast
		FAC	Airdome Control
		FAT	Flight Test
		MA	Aircraft
		MAP	Portable Aircraft
	Aeronautical Multicom	None	Aeronautical Multicom Land
		None	Aeronautical Multicom Mobile
	Land Mobile	FB	Base
		ML	Land Mobile
		MLP	Portable Land Mobile
	Maritime Mobile	FC	Coast
		FCB	Marine Broadcast
		MS	Ship
		MSD	Telecommand Ship
		MSP	Portable Ship
		OD	Oceanographic Data
		OE	Oceanographic Data Interrogating
10.	Mobile-Satellite	None	Mobile Earth
		TE	EPIRB Mobile
		EJ	Space
	Aeronautical Mobile-Satellite	TB	Earth
		TJ	Mobile Earth
	Land Mobile-Satellite	EU	Space
		TU	Mobile Earth
		TY	Earth
	Maritime Mobile-Satellite	EG	Space
		TG	Mobile Earth
		TI	Earth
11.	Radio Astronomy	None	Radio Astronomy
12.	Radiodetermination	None	Radiodetermination
		RG	Radio Direction-Finding
	Radiolocation	LR	Land
		MR	Mobile
		MRP	Portable
	Radionavigation	RL	Land
		RLN	Loran
		RO	Mobile

Table I-1. Services, STCs, and stations. (continued)

	SERVICE	STC	STATION
	Aeronautical Radionavigation	RLA	Marker Beacon
		RLB	Radiobeacon
		RLC	Radar Beacon (racon)
		RLG	Glide Path (slope)
		RLL	Localizer
		RLO	Omnidirectional Range
		RLR	Radio Range
		RLS	Surveillance Radar
		RLTM	Land Test (Maintenance)
		RLTO	Land Test (Operational)
		ROA	Altimeter
	Maritime Radionavigation	RLC	Radar Beacon (racon)
		RLM	Marine Radiobeacon
13.	Radiodetermination-Satellite	EF	Space
		TF	Earth
		TL	Mobile Earth
	Radionavigation-Satellite	EN	Space
		TN	Earth
	Aeronautical Radionavigation-Satellite	EO	Space
		TO	Mobile Earth
		RZ	Earth
	Maritime Radionavigation-Satellite	EQ	Space
		TQ	Mobile Earth
		TX	Earth
14.	Space Operation	ET	Space
		TT	Earth
15.	Space Research	EH	Space
		TH	Earth
16.	Standard Frequency and Time Signal	SS	Standard Frequency and Time Signal
17.	Standard Frequency and Time Signal-Satellite	EE	Space

Table I-1. Services, STCs, and stations. (continued)

SERVICE		STC	STATION
18.	No specific service	ED	Space Telecommand Space
		EK	Space Tracking Space
		ER	Space Telemetering Space
		SN	Sounder Network
		SP	Sounder Prediction
		TD	Space Telecommand Earth
		TK	Space Tracking Earth
		TR	Space Telemetering Earth
		XC	Experimental Contract Developmental
		XD	Experimental Developmental
		XE	Experimental Export
		XM	Experimental Composite
		XR	Experimental Research
		XT	Experimental Testing

I-4. Spectrum Designation of Frequency

Table I-2 shows that spectrum designation of frequency is a method of referring to a range or band of communications frequencies. In America, the designator is a two- or three-letter abbreviation for the name. In the ITU, the designator is numeric.

Table I-2. Spectrum designation.

FREQUENCY RANGE (Lower Limit Exclusive, Upper Limit Inclusive)	AMERICAN DESIGNATOR	ITU DESIGNATOR
Below 300 Hz	ELF	2
300 - 3000 Hz	ILF	3
3 - 30 kHz	VLF	4
30 - 300 kHz	LF	5
300 - 3000 kHz	MF	6
3 - 30 MHz	HF	7
30 - 300 MHz	VHF	8
300 - 3000 MHz	UHF	9
3 - 30 GHz	SHF	10
30 - 300 GHz	EHF	11
300 - 3000 GHz	THF	12

NOTE: The eight microwave frequency bands designated by the letters C, L, S, X, K, Q, V, and W represent the frequency ranges from 225 MHz to 100 GHz. They describe radar bands that have no official status and should not be used.

Appendix J

The Joint Restricted Frequency List

J-1. General

The JRFL is a management tool designed to minimize frequency conflicts between friendly communications/noncommunications emitters and friendly jamming equipment. More specifically, the JRFL is a time and geographical listing of prioritized frequencies essential to the conduct of the battle and restricted from targeting by friendly ECM. Consisting of taboo, guarded, and protected frequencies, the JRFL assists staff members involved in spectrum management.

J-2. Purpose

The JRFL is constructed and maintained throughout the battle to graphically depict the commander's priorities for electromagnetic spectrum use. It displays to the staff and operational forces the frequencies guarded for signal intelligence (SIGINT) use or restricted from friendly jamming due to criticality of friendly operations. Candidate nodes/nets are submitted for ECM protection of the Joint Communications-Electronics Warfare System. This submission includes net designation, frequency, type equipment, type modulation, location, time period, and a short justification. Figure J-1 shows an example of a JRFL.

J-3. Definitions

Taboo frequencies are any friendly functions/frequencies of such importance that they must never be deliberately jammed or interfered with by friendly forces. These functions/frequencies include international distress, stop buzzer, safety, and controller frequencies. These functions/frequencies are generally long-standing; however, they can be time-oriented, in that, as the combat/exercise situation changes, the restriction can be removed by the originating headquarters.

Protected functions/frequencies are those friendly functions/frequencies used for a particular operation, identified and protected to prevent them from being inadvertently jammed by friendly forces while active EW operations are directed against hostile forces. The functions/frequencies are of such critical importance that jamming is restricted unless absolutely necessary or until coordination with the using unit is made. They are time-oriented, can change with the tactical situation, and are updated periodically.

Guarded functions/frequencies are enemy functions/frequencies that are currently being exploited for combat information and intelligence. A guarded function/frequency is time-oriented, in that the list changes as the enemy assumes different combat postures. These functions/frequencies can be jammed after the commander has weighed the potential operational gain against the loss of technical and tactical information.

Table J-1. Example of a JRFL.

PRIORITY	TYPE	FUNCTION	FREQUENCY (IF KNOWN)	TIME PROTECTED	LOCATION(S)
1	Taboo	2/22 Pershing Arty Bn Cmd Net	54.00 MHz	All	MV123456 MV234567
2*	Taboo	SHAPE Cmd Ops Net	300 MHz	All	MV435675
7	Protected	5/77 Armor Bn Cmd Net	45.00 MHz	220400 to 221800Z	MV222333 to MS444776
8*	Protected	327 FTW TACS Net	35.00 MHz	220400 221800Z	III Corps Area
9	Guarded	CMTA Nets (Soviet Nuke Release)	Unknown	All	Unknown
10*	Guarded	3d Guards Army Net		221730Z to 230600Z	MV7890

*ETCETERA

NOTE: Any inclusion of SCI material in the JRFL requires that the JRFL be handled in SI channels. A sanitized JRFL will need to be produced for general dissemination at the lowest classification possible. On the sanitized version, guarded listings need only include the frequency, not the unit ID or function.

Glossary

Acronyms, Abbreviations, and Definitions

AAG Aeronautical Assignment Group

accepted interference - interference at a higher level than that defined as permissible interference and which has been agreed upon between two or more administrations without prejudice to other administrations. The terms permissible interference and accepted interference are used in the coordination of frequency assignments between administrations.

active satellite - a satellite carrying a station intended to transmit or retransmit radiocommunication signals.

active sensor - a measuring instrument in the earth exploration-satellite service or in the space research service by means of which information is obtained by transmission and reception of radio waves.

aeronautical advisory station - an aeronautical station used for advisory and civil defense communications primarily with private aircraft stations. Also called UNICOM stations.

aeronautical broadcast station - an aeronautical station which makes scheduled broadcasts of meteorological information and notices to airmen. (In certain instances, an aeronautical broadcast station may be placed on board a ship.)

aeronautical earth station - an earth station in the fixed-satellite service or, in some cases, in the aeronautical mobile-satellite service, located at a specified fixed point on land to provide a feeder link for the aeronautical mobile-satellite service.

aeronautical fixed service - a radiocommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, discontinued immediately when so requested by the airdrome control operators.) efficient, and economical operation of air transport.

aeronautical mobile-satellite service - a mobile-satellite service in which mobile earth stations are located on board aircraft; survival craft stations and emergency position-indicating radiobeacon stations may also participate in this service.

aeronautical mobile service - a mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radiobeacon stations may also participate in this service on designated distress and emergency frequencies.

aeronautical multicom service - a mobile service not open to public correspondence, used to provide communications essential to conduct of activities being performed by or directed from private aircraft.

aeronautical station - a land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located on board ship or on a platform at sea.

aeronautical utility land station - a land station located at airdrome control towers and used for control of ground vehicles and aircraft on the ground at airdromes.

aeronautical utility mobile station - a mobile station used for communication at airdromes with the aeronautical utility land station, the airdrome control station, the Federal Aviation Administration flight service station, ground vehicles, and aircraft on the ground. (All transmissions shall be subject to the control of the airdrome control station and shall be

AFC area frequency coordinator

AFES Army Frequency Engineering Software

AFMO Army Frequency Management Office

AFTRCC Aerospace and Flight Test Radio Coordinating Council

AIM armored-infantry-mechanized

allocation - the process of designating radio-frequency bands for use by specific radio services. When more than one service is authorized in a band, allocations are further categorized in order of priority. These categories are primary, permitted, and secondary.

allotment - the establishment of specific bands of frequencies within a prescribed nationally or internationally allocated band.

AMC United States Army Materiel Command

ARFA Allied Radio Frequency Agency

ARFCOS Armed Forces Courier Service

assignment - the establishment, according to allocation tables, of a specific frequency for use at a particular station and under specific operating conditions.

ATFES Army Tactical Frequency Engineering System

battlefield spectrum management - the systematic planning, management, engineering, and coordinated use of tactical electromagnetic-spectrum-dependent material in tactical units engaged in the conduct of air and land warfare.

BCE battle coordination element

BECS Battlefield Electronic CEOI System

BSM battlefield spectrum management

C3I Command, Control, Communications, and Intelligence

C3S Command, Control, and Communications Systems

C4 Command, Control, Communications, and Computers

C4S Command, Control, Communications, Computers, and Systems

carrier power - the average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle taken under the condition of no modulation.

CCEB Combined Communications-Electronics Board

CCIR International Radio Consultative Committee

CECOM Army Communications-Electronics Command

CEWI Combat Electronic Warfare and Intelligence

characteristic frequency - a frequency which can easily be identified and measured in a given emission. A carrier frequency may, for example, be designated as the characteristic frequency.

CMTA Russian Nuclear Release Net

COMMZ communications zone

coordination area - the area associated with an earth station outside of which terrestrial station sharing the same frequency band neither causes nor is subject to interfering emissions greater than a permissible level.

CSCE Communications System Control Element

CSO corps signal officer

CSPE Communications System Planning Element

deconfliction - the process of optimizing the usage of the electromagnetic spectrum incorporating both the requirements of the battlefield spectrum managers and the IEW community.

DISC4 Director of Information Systems for Command, Control, Communications, and Computers

DOIM Director of Information Management

DSCS Defense Satellite Communications System

DSO division signal officer

DTH down-the-hill

E3 electromagnetic environmental effects

ECAC Electromagnetic Compatibility Analysis Center

ECCM electronic counter-countermeasures

ECM electronic countermeasures

EHF extremely high frequency

electromagnetic compatibility (EMC) - the ability of telecommunications equipment, subsystems, or systems to operate in their intended operational environments without suffering or causing unacceptable degradation because of electromagnetic radiation or response.

electromagnetic interference (EMI) - any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like.

electromagnetic radiation hazard - hazards caused by a transmitter/antenna installation that (a) generate electromagnetic radiation in the vicinity of ordnance, personnel, or fueling operations in excess of established safe levels; (b) increase the existing levels to a hazardous level; or, (c) illuminate a personnel, fueling, or ordnance installation located in an area by electromagnetic radiation at a level that is hazardous to the planned operations or occupancy. These hazards will exist when an electromagnetic field of sufficient intensity is generated to (a) induce or otherwise couple currents and/or voltages of magnitudes large enough to initiate electroexplosive devices or other sensitive explosive components of weapon systems, ordnance, or explosive devices; (b) cause harmful or injurious effects to humans and wildlife; or, (c) create sparks having sufficient magnitude to ignite flammable mixtures of materials that must be handled in the affected area.

ELF extremely low frequency

EMC electromagnetic compatibility

EMCAS Electromagnetic Compatibility Assurance Software

EMCON emission control

EMI electromagnetic interference

emission - radiation produced, or the production of radiation, by a radio transmitting station. For example, the energy radiated by the local oscillator of a radio receiver would not be an emission but a radiation.

EPIRB Emergency Position Indicating Radiobeacon

EW electronic warfare

EWO electronic warfare officer

FAA Federal Aviation Administration

facsimile - a form of telegraphy for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

FAL frequency allocation list

FAS Frequency Assignment Subcommittee

FCC Federal Communications Commission

FH frequency hopping

frequency sharing - the common use of the same portion of the radio frequency spectrum by two or more users where a probability of interference exists.

frequency shift telegraphy - telegraphy by FM in which the telegraph signal shifts the frequency of the carrier between predetermined values.

frequency tolerence - the maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned

frequency or by the characteristic frequency of an emission from the reference frequency. The frequency tolerance is expressed in parts in 10^6 or in hertz.

FURIES Frequency Utilization Resources Integrated and Engineering System

GMF ground mobile forces

GSR ground surveillance radar

harmful interference - interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with regulations.

HSC United States Army Health Services Command

IEW intelligence/electronic warfare

IFF identification, friend or foe (radar)

IFRB International Frequency Registration Board

IHFR improved high frequency radio

ILF infra low frequency

ING International Notification Group

INSCOM United States Army Intelligence and Security Command

interference - the effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception inaradiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

IRAC Interdepartment Radio Advisory Committee

ISYSCON integrated systems control

ITU International Telecommunications Union

JEWC Joint Electronic Warfare Center

JFP Joint Frequency Panel

JRFL Joint Restricted Frequency List

JSMS Joint Spectrum Management System

JTC3A Joint Tactical Command, Control, and Communications Agency

LFB low-frequency beacon

Loran station - a long distance radionavigation land station transmitting synchronized pulses. Hyperbolic lines of position are determined by the measurement of the difference in the time of arrival of these pulses.

MAG Military Assignment Group

MCEB Military Communications-Electronics Board

METSONDES meteorological sondes

MIJ meaconing, intrusion and jamming

MIJI meaconing, intrusion, jamming, and interference

MSE Mobile Subscriber Equipment

MSRT mobile subscriber radiotelephone terminals

necessary bandwidth - for a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

NIB noninterference basis

NRI net radio interface

NSA National Security Agency

NTIA National Telecommunications and Information Administration

OMB Office of Management and Budget

ONL organization net lists

OTEA Operational Test and Evaluation Agency

PC personal computer

PCC Primary Control Center

PCM pulse code modulation

PEWS platoon early warning sensors

PRF pulse repetition frequency

priority - priority, unless specifically qualified, is the right to occupy a specific frequency for authorized uses, free of harmful interference from stations of other agencies.

QSTAG Quadripartite Standardization Agreement

radiosonde - an automatic radio transmitter in the meteorological aids service usually carried on an aircraft, free balloon, kite, or parachute, and which transmits meteorological data.

RAU radio access unit

reference frequency - a frequency having a fixed and specific position with respect to the assigned frequency. The displacement of this frequency with respect to the assigned frequency has the same absolute value and sign that the displacement of the characteristic frequency has with respect to the center of the frequency band occupied by the emission.

RF radio frequency

RR Radio Regulations

SCC system control center

SCCS satellite communication control subsystem

SCI sensitive compartmented information

SFL sequential frequency lists

SHORAD short-range air defense

SI sensitive information

SINCGARS Single-Channel Ground and Airborne Radio System

SOFA Status of Forces Agreement

SOI signal operation instructions

spectrum management - managing the use of electromagnetic spectrum resources. The goal of Army spectrum management is to support telecommunications (including weapon systems) and EW requirements. This goal will be accomplished through the acquisition of spectrum resources and the attainment of EMC.

spectrum signature assessment - the distinct pattern of spectral emanations given off by a device or collection of devices.

SPEED Marine Corps System Planning, Engineering, Evaluation Device

SPS Spectrum Planning Subcommittee

spurious emission - emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

SSB single sideband

STAJ short term antijam

STC station class

TAC Tactical Air Command

TACC Tactical Air Control Center

TACS Tactical Air Control System

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

TRANSEC transmission security

TSC Technical Subcommittee

TSC(A) theater signal command (Army)

USAISEC United States Army Information Systems Engineering Command

USAKA United States Army Kwajalein Atoll

US&P United States and its Possessions

VLF very low frequency

WARC World Administrative Radio Conference

WSMR White Sands Missile Range

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