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Army Electromagnetic Spectrum Management Operations

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Preface

This manual provides an overview of electromagnetic spectrum management operations, hereafter referred to as spectrum management, for the Army at the strategic, operational, and tactical levels. This manual also provides direction, guidance, and techniques necessary to meet the needs of Army spectrum management in a joint, interagency, and multinational environment. In addition, this guide describes the roles and functions of international, national, host nation, and military organizations. It provides a comprehensive look at installation frequency coordination. The target audience for this manual is the spectrum manager, but it is also useful for signal leaders and supervisors to gain an understanding of spectrum management.

This publication applies to the Active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the United States Army Reserve (USAR) unless otherwise stated.

The proponent for this publication is the United States Army Training and Doctrine Command (TRADOC). Send comments and recommendations on DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) directly to Commander, United States Army Signal Center and Fort Gordon, ATTN: ATZH-CDD (Doctrine Branch), Fort Gordon, Georgia 30905-5075 or via e-mail to signal.doctrine@us.army.mil or doctrine@gordon.army.mil. Key all comments and recommendations to pages and lines of text to which they apply. Provide a rationale for your comments to ensure complete understanding and proper evaluation.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

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Chapter 1
Spectrum Management Overview

This chapter provides a broad overview of spectrum management and its importance to military operations.

WHAT IS SPECTRUM MANAGEMENT?

1-1. Spectrum management is often addressed as an afterthought in both the acquisition and operational processes. Part of the mission of those that perform this function is to educate others on the value of spectrum management. This is particularly important at the tactical level, where the wireless portion of the network is the key enabler of the network enabled force. Commanders must realize that spectrum is a resource just like fuel or ammunition but cannot be touched or seen. The use of spectrum must be addressed early and throughout the planning process in order to insure that the Army maintains information dominance.

1-2. Spectrum management is the planning, coordinating, and managing the use of the electromagnetic spectrum through operational, engineering, and administrative procedures. The goal of spectrum management is to enable electronic systems to perform their functions in the intended environment without causing or experiencing unacceptable interference. Spectrum managers are concerned with the process of obtaining regulatory access to spectrum resources and influencing the development of statutory and regulatory policy, rules, regulations, and procedures. It involves coordination of new and emerging Army spectrum requirements, participation in national and international spectrum regulatory bodies, radiation hazard protection, and development of long-range spectrum management plans. Spectrum management requires active participation in all phases of the combat development and materiel development cycle. Spectrum management centers on obtaining access to the spectrum and managing it primarily through the establishment of frequency allocations and frequency allotments.

1-3. The primary focus of spectrum management, at the tactical level, is to obtain an approved frequency license from the controlling authority at the international, national, host nation, unified command, allied, or military department-level. This process includes the application of operational, engineering, and administrative procedures to allotted radio frequency bands to maximize reuse and sharing of the available spectrum area. The process also enables electronic equipment to perform their functions in their intended environment using electromagnetic compatibility (EMC) measures, without suffering degradation from or causing unacceptable degradation to other equipment. It centers on managing discrete frequencies or frequency bands through use of frequency allotments and frequency assignments; assuring compliance with local radio regulatory policy, rules, and procedures; application of sound EMC practices; resolution of harmful interference at the lowest operational level possible; and timely reporting of incidents of harmful interference that cannot be resolved locally.

ENABLING THE FORCE

1-4. The Army's transition to the Future Force is based on the premise that information dominance will provide the advantage to allow a lighter force to operate in non-contiguous engagements and provide the same lethality as a heavier contingent. We are trading mass for information. In order to insure information dominance the Army is moving towards Command, Control, Communications, and Computer (C4) Operations systems that have the ability to network amongst themselves and to provide seamless sensor to shooter capabilities, situational awareness, and on the move command and control. The spectrum is a resource, and while non-expendable, it is finite. A limited number channels, or frequencies, can be accommodated at any given time in a given area. While it is true that emerging systems are more efficient

users of bandwidth they also use more bandwidth to pass larger amounts of data which leads to frequency congestion because never before have so many emitters been present in an area of operations. Spectrum managers must have the ability to manage and monitor the spectrum for both communications systems and non-communications systems. This includes radars, sensors, and robots to name a few. This must also encompass all dimensions of the battlespace including airborne platforms such as surrogate satellites, unmanned aerial systems (UASs), space platforms and subterranean systems.

Chapter 2

International, National, and Host Nation Spectrum Management

This chapter provides an overview of international and national organizations and agencies that are primarily responsible for policy concerning spectrum use. Spectrum management at this level is strategic in nature. Since both operational and tactical spectrum management policy and decisions are based on international and national policy, it is important to understand the organizations and processes involved in spectrum management at this level.

INTERNATIONAL SPECTRUM MANAGEMENT

2-1. All nations share the electromagnetic spectrum and reserve their sovereign right to unlimited use. International telecommunications cooperate 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. It is important to realize that the primary purpose of these organizations is for economic considerations. While most nations consider bands for military operations, the vast majority are shared with other users and may be subject to pre-emption based on national or host nation requirements.

2-2. The ITU, headquartered in Geneva, Switzerland is an international organization within the United Nations system where governments and the private sector coordinate global telecom networks and services. The ITU is composed of three main bodies: the Radio Communication Sector (ITU-R), Telecommunication Standardization Sector (ITU-T), and Telecommunication Development Sector (ITU-D). The ITU-R is the sector of most concern to spectrum management. The ITU-T and ITU-D are concerned with the standardization and development of global telecommunications.

2-3. The last decade of the 20th century witnessed extraordinary growth in the use of wireless communications systems; from cellular and cordless phones and radio-based fleet management systems to radio and television broadcasting and next-generation Web-ready personal digital assistants. At the same time, the electromagnetic spectrum has become vital for a growing number of essential public services such as navigation and global positioning systems, environmental monitoring and even deep space research. The ITU-R is responsible for determining the technical characteristics and operational procedures for a growing range of wireless services. In their role as global spectrum coordinator, the Member States of the Radio Communication Sector develop and adopt the *Radio Regulations*; a voluminous set of rules which serve as a binding international treaty governing the use of the radio spectrum by some 40 different services around the world. The sector plays a vital role in the management of the radio-frequency spectrum. It acts through its Bureau as a central registrar of international frequency use, recording and maintaining the Master International Frequency Register which currently includes approximately 1.4 million records. In addition, ITU-R is responsible for coordinating efforts to ensure that the communication, broadcasting and meteorological satellites in the world's increasingly crowded skies can co-exist without causing harmful interference to one another's services. In this role, the Union facilitates agreements between both operators and governments, and provides practical tools and services to help spectrum managers carry out their day-to-day work.

2-4. Changes to the *Radio Regulations* can only be made by a world radio communication (WRC) conference. Alterations are made on the basis of negotiations between national delegations, which work to reconcile demands for greater capacity and new services with the need to protect existing services. If a

country or group of countries wishes a frequency band to be used for a purpose other than the one listed in the Table of Frequency Allocations, changes may be made provided that the parties concerned seek formal agreement from other nations affected by the change before any new use of the band begins. In such a case, the change may be indicated by a footnote, or authorized by the application of a *Radio Regulations* procedure. In addition to managing the Table of Frequency Allocations, WRC conferences may also adopt assignment plans or allotment plans for services where transmission and reception are not necessarily restricted to a particular country or territory. In the case of assignment plans, frequencies are allocated on the basis of requirements expressed by each country for each station within a given service. Allotment plans state that each country has allotted frequencies to be used by a given service, which the national authorities then assign to the relevant stations within that service. ITU-R prepares the technical groundwork which enables WRC conferences to make sound decisions, develop regulatory procedures and examine technical issues, plan parameters, and share criteria with other services in order to calculate the risk of harmful interference.

Note. For more information about the ITU visit: http://www.itu.int/home/

NATIONAL SPECTRUM MANAGEMENT

2-5. The Communications Act of 1934, as amended, governs radio spectrum use in the United States of America and its possessions (US&P). The act established duality in spectrum management in the US between the President for federal government stations and the Federal Communications Commission (FCC) under the direction of Congress. The FCC regulates the spectrum use of nonfederal 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 National Telecommunications and Information Administration (NTIA), and placed them under the Secretary of Commerce. See Figure 2-1 for a diagram of the organizations architecture.

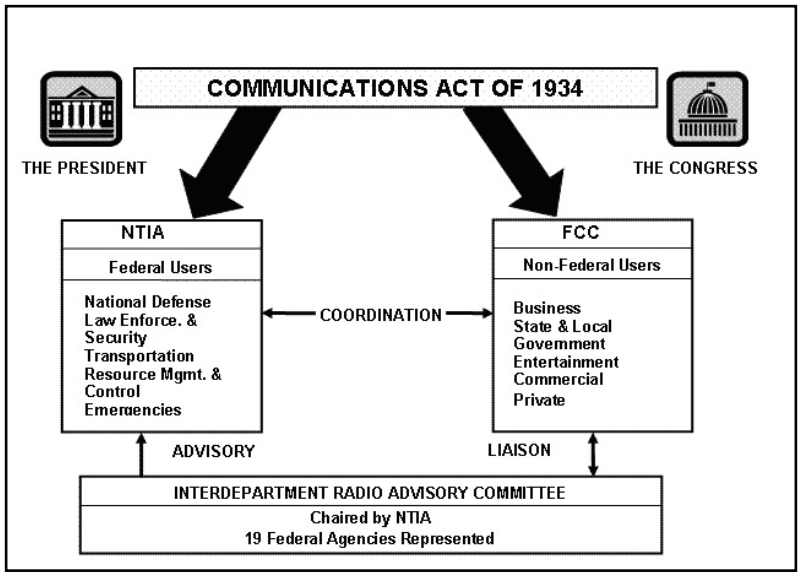

Figure 2-1. National Spectrum Management

NTIA

2-6. Through the NTIA, the President will control all frequency resources in the US&P and authorize foreign governments to construct and operate fixed service radio stations at their embassies. Frequencies are assigned to these stations only if it is in the national interest and if foreign governments grant reciprocal privileges to the US. Figure 2-2 illustrates the organization of the NTIA.

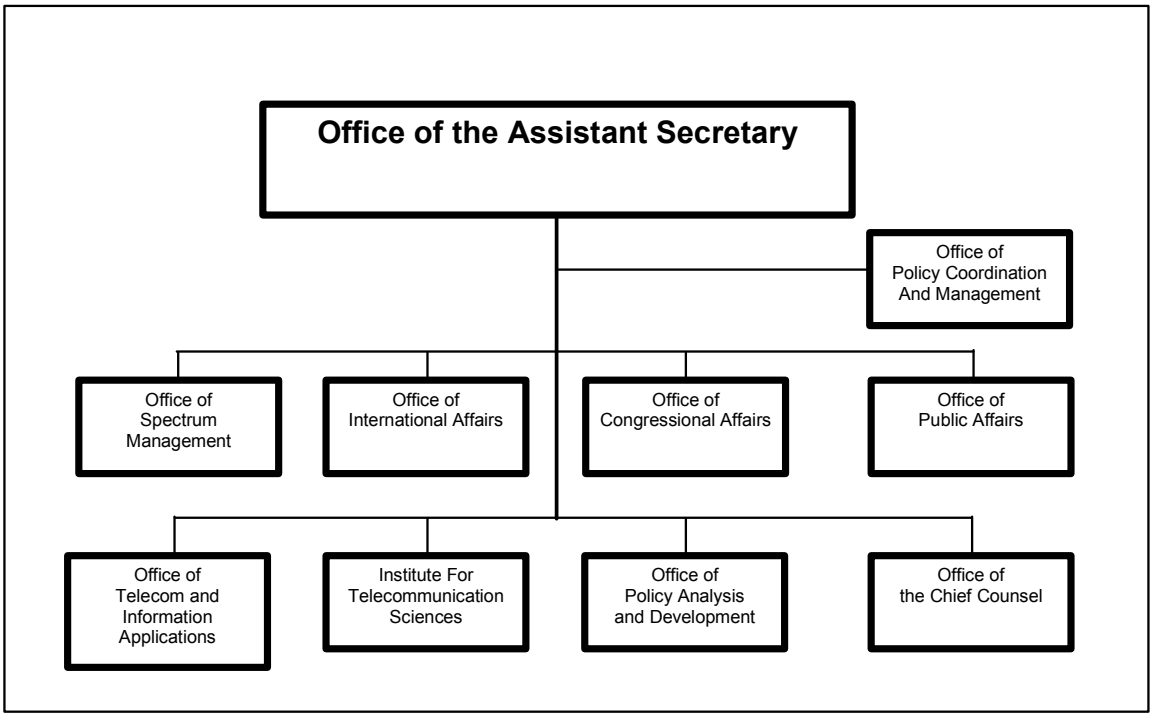

Figure 2-2. NTIA

The Office of Spectrum Management (OSM)

2-7. The OSM formulates and establishes plans and policies that ensure the effective, efficient, and equitable use of the spectrum both nationally and internationally. Through the development of long-range spectrum plans, the OSM is prepared to address future federal government spectrum requirements, including public safety operations and the coordination and registration of federal government satellite networks. The OSM also satisfies the frequency assignment needs of the federal agencies, and provides spectrum certification for new federal agency radio communication systems. See Appendix A for additional information on the spectrum certification process.

The Interdepartment Radio Advisory Committee (IRAC)

2-8. The IRAC, under the OSM, assists the Assistant Secretary in assigning frequencies to US government radio stations and in developing and executing policies, programs, procedures, and technical criteria pertaining to the allocation, management, and use of the spectrum. The IRAC consists of a main committee, six subcommittees, and several ad hoc working groups that consider various aspects of spectrum management policy.

2-9. The six current subcommittees are the—

- Frequency Assignment Subcommittee (FAS)-Responsible for functions related to the assignment and coordination of radio frequencies and the development and execution of procedures. The Aeronautical Assignment Group (AAG) subgroup of the FAS is responsible for engineering the AAG frequency assignments and determining whether or not application for frequency assignment action in the AAG bands should be approved by NTIA. The AAG is chaired by the Federal Aviation Administration. Military Assignment Group (MAG) subgroup of the FAS is responsible for determining whether or not applications for frequency assignment in the MAG bands should be approved by NTIA. The MAG is chaired by the Air Force.
- Spectrum Planning Subcommittee (SPS)-Responsible for functions related to planning for the use of the electromagnetic spectrum in the national interest to include the apportionment of

spectrum space between or among the government and non-government activities and other such matters as the IRAC directs.

- Technical Subcommittee (TSC)-Develops recommended new standards and improvements of existing standards to optimize the use of the radio spectrum in the form of technical reports.
- Radio Conference Subcommittee (RCS)-Responsible for functions that relate to preparing for ITU radio conferences, including the development of recommended US proposals and positions.
- Space System Subcommittee (SSS)-Review, modify, develop, and maintain the procedures for the national implementation of the space related provisions of the ITU Radio Regulations.
- Emergency Planning Subcommittee (EPS)-Formulate, guide, and review National Security Emergency Preparedness planning for spectrum-dependent systems.

Note. Occasionally these subcommittees are reorganized, dissolved, created, or renamed. For additional information about the IRAC and the subcommittees see the NTIA web site at http://www.ntia.doc.gov/

The Office of Policy Analysis and Development (OPAD)

2-10. The OPAD is the domestic policy division of the NTIA. OPAD supports NTIA's role as principal adviser to the Executive Branch and the Secretary of Commerce on telecommunications and information policies. They conduct research and analysis, and prepare policy recommendations. The domestic policy office generates policies that promote innovation, competition, and economic growth for the benefit of American businesses and consumers.

The Office of International Affairs (OIA)

2-11. The OIA develops and implements policies to enhance US companies' ability to compete globally in the information and communications technology (ICT) sectors. In consultation with other US agencies and the US private sector, OIA participates in international and regional fora to promote policies that open ICT markets and encourage competition.

The Institute for Telecommunication Sciences (ITS)

2-12. The ITS, is the research and engineering laboratory of the NTIA. ITS provides technical support to NTIA in advancing telecommunications and information infrastructure development, enhancing domestic competition, improving US telecommunications trade opportunities, and promoting more efficient and effective use of the radio spectrum. ITS also serves as a principal federal resource for investigating the telecommunications challenges of other federal agencies, state and local governments, private corporations and associations, and international organizations.

The Office of Telecommunications and Information Applications (OTIA)

2-13. The OTIA administers the Technology Opportunities Program, which provides matching grants to non-profit organizations and state and local governments across the United States to demonstrate innovative applications of advanced telecommunications and information technology. OTIA also manages the Public Telecommunications Facilities Program, which annually awards grants to public broadcasting and other noncommercial entities. These grants help purchase telecommunications equipment used to convert public television and radio stations to digital broadcasting.

THE FEDERAL COMMUNICATIONS COMMISSION

2-14. The FCC is an independent federal regulatory agency that directly reports to Congress. Established by the Communications Act of 1934, it is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. Its jurisdiction covers the 50 states and territories, the District of Columbia, and US Possessions. The FCC is directed by five commissioners

appointed by the President and confirmed by the Senate for five-year terms, except when filling an unexpired term. The President designates one commissioner to serve as chairman. As the chief executive officer of the commission, the chairman delegates management and administrative responsibility to the managing director. Other functions are delegated to staff units, bureaus, and committees of commissioners. The commissioners hold regular open and closed agenda meetings and special meetings. They may also act between meetings by "circulation," a procedure by which a document is submitted to each commissioner individually for consideration and official action.

2-15. The commission staff is organized by function. There are six operating bureaus and ten staff offices. The bureaus' responsibilities include: processing applications for licenses and other filings, analyzing complaints, conducting investigations, developing and implementing regulatory programs, and taking part in hearings. The offices provide support services. Bureaus and offices regularly join forces and share expertise in addressing commission issues. Additional information on the FCC organizational structure and the bureaus and office functions are described at their web site (www.fcc.gov).

HOST NATION SPECTRUM MANAGEMENT

2-16. A host nation is a sovereign nation, including the United States, in which the Department of Defense (DOD) plans or is likely to conduct military operations with the permission of that nation. Unlike the United States most nations have a single agency responsible for spectrum management. For many of these nations that office will be with the ministry of communications or some similar agency. In nations where the Army has established posts, camps, or stations there will normally be a liaison with the ministry established through which the spectrum manager will negotiate for spectrum support.

2-17. A useful tool to assist the spectrum manager in determining whether or not a piece of equipment may be supportable in a given region is the Host Nation Spectrum Worldwide Database (HNSWD) . HNSWD was conceived to resolve a DOD wide deficiency identified in the Oct 98 DOD IG audit. The deficiency identified, enabled worldwide visibility of a host nation radio frequency (RF) spectrum. HNSWD automates the distribution of host nation coordination requests and combatant command (COCOM) submission of host nation supportability comments (data). After the Military Departments EPS review and approve comments associated with a particular system, HNSWD provides the spectrum manager with near real-time updates of equipment supportability as well as any restrictions that are placed on usage. HNSWD is designed to facilitate warfighter deployment and communications planning thereby reducing the time required to research host nation supportability of spectrum requirements and provide accurate supportability status. This software will also enable acquisition managers to determine the historical supportability of similar system's RF spectrum. This should enable informed design decision-making concerning frequency bands, thereby mitigating the risk of acquiring a potentially unsupportable RF dependant system. To request a HNSWD download contact the Joint Spectrum Center at www.jsc.mil .

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Chapter 3
DOD Spectrum Management

This chapter describes the functions and relationship of DOD spectrum management organizations. For more information concerning DOD spectrum management see DOD Directive 4650.1, *Policy for the Management and Use of the Electromagnetic Spectrum*.

OVERVIEW

3-1. Spectrum management within DOD is a cooperative process that is divided into three elements. The Office of the Assistant Secretary of Defense (OASD) for networks and information integration (NII) is responsible for carrying out the policy, planning, and oversight functions associated with DOD spectrum matters. The Defense Spectrum Organization (DSO) , which reports to the Defense Information Systems Agency (DISA), is responsible for providing the resources to coordinate joint spectrum matters, and assists OASD NII in strategic spectrum planning. The spectrum management offices of the services manage the spectrum for their respective services and interact with both civil and military agencies to coordinate joint issues. Figure 3-1 shows the relationships of these organizations.

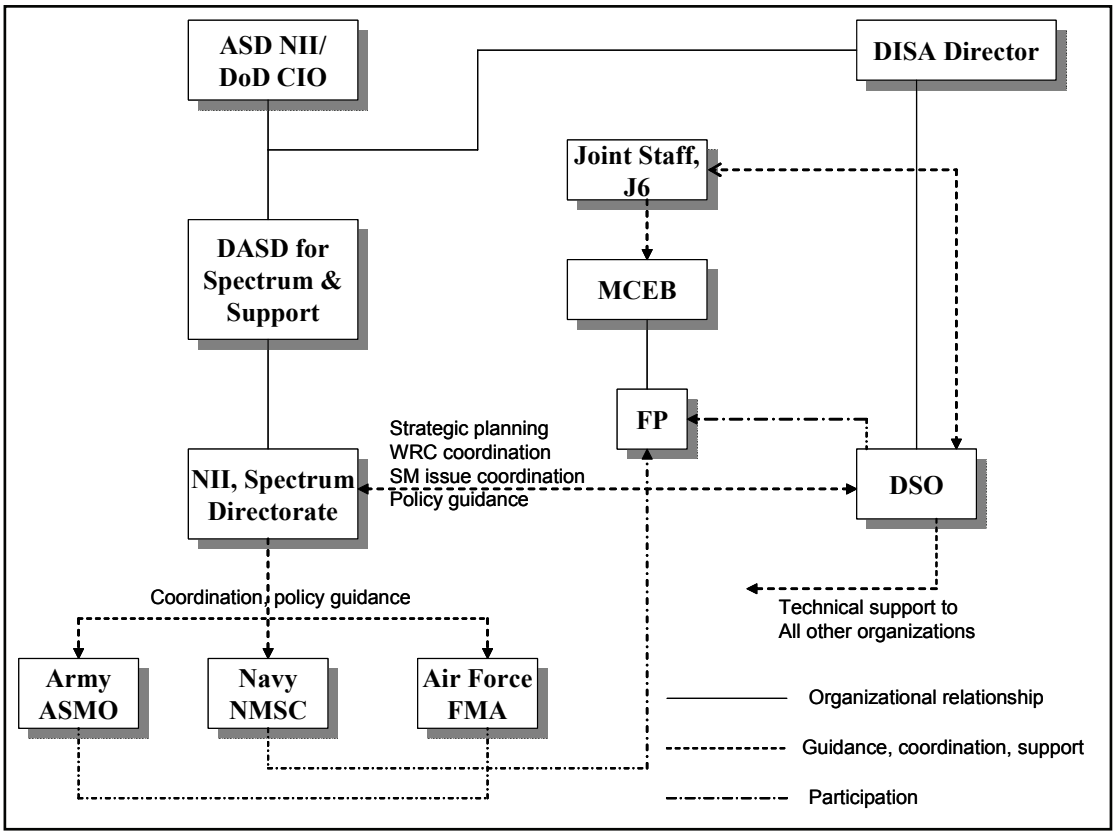

Figure 3-1. DOD Spectrum Management

THE OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE FOR NETWORKS AND INFORMATION INTEGRATION

3-2. The Assistant Secretary for Defense (ASD) for NII is the chief information officer (CIO) for the DOD. The secretary serves as the principal staff assistant and advisor to the Secretary and Deputy Secretary of Defense on spectrum related matters. Within the OASD, the Deputy Assistant Secretary of Defense for spectrum and support provides day-to-day policy oversight and guidance to the DOD spectrum management community.

DEFENSE SPECTRUM ORGANIZATION

3-3. The DSO is an office of the DISA. The DSO is responsible for developing comprehensive and integrated spectrum planning and long-term strategies for DOD spectrum access. The purpose of the DSO is to continually maximize global spectrum access for US forces now and for the future. The DSO is the DOD focal point for participation in national spectrum issues, international spectrum coordination, and for pursuing emerging spectrum efficiency technologies in DOD acquisitions. The DSO also includes a technical arm that provides services such as spectrum planning guidance, electromagnetic environmental effects (E3) , modeling and simulation, operational support, and spectrum management software development. These services are provided to the unified commands, military departments, and defense agencies. These services may also be provided to federal and local government activities and foreign nations when DOD interests are served.

UNITED STATES MILITARY COMMUNICATIONS-ELECTRONICS BOARD (USMCEB)

3-4. USMCEB, commonly referred to as the MCEB, is the main coordinating body for signal matters among DOD components. The MCEB functions under the policies and directives of the Secretary of Defense and the Joint Chiefs of Staff. The MCEB guides the DOD in preparing and coordinating technical directives and agreements and in allocating spectrum allotments from the NTIA. Its mission is three-fold:

- Coordinate between DOD components, DOD and other government agencies, and between DOD and foreign nations.
- Provide guidance and direction to DOD components.
- Furnish advice and assistance as requested.

3-5. Membership of the MCEB is composed of the Director of Joint Staff, J-6 who also serves as chairman, representatives of each service, the Coast Guard, DISA, Defense Intelligence Agency, National Security Agency, and the Vice Director of J-6 who represents the combatant commanders. Other DOD elements may participate when appropriate.

3-6. The majority of DOD operational spectrum issues are processed through the Joint Frequency Panel (JFP) of the MCEB which is the principle DOD coordinating agency for spectrum management. The JFP consists of a panel of experts drawn from the components that are represented on the MCEB. The JFP reviews, develops, coordinates, and implements DOD directives, studies, reports, and recommendations for the MCEB. Specific spectrum issues are addressed by permanent working groups.

JOINT SPECTRUM CENTER

3-7. The Joint Spectrum Center (JSC) is a DISA field activity that provides services such as spectrum planning guidance, E3, modeling and simulation, operational support, and spectrum management software development. These services are provided to the unified commands, military departments, and defense agencies. These services may also be provided to federal and local government activities and foreign nations when DOD interests are served.

SERVICE LEVEL OFFICES

3-8. The Army Spectrum Management Office (ASMO), currently located in Alexandria, VA is the Army service level office for all spectrum related matters. The ASMO coordinates radio frequency spectrum policy and guidance. It also represents the Army in spectrum negotiations with civil, military, national and international regulatory organizations. The Army Spectrum Manager (ASM) directs Army-wide spectrum management activities, develops and implements spectrum management policy, and allocates frequency resources (frequency assignment) to support the Army. The ASM serves as the principal advisor to the Director of Network Enterprise Technology Command/9th Army Signal Command in regard to radio frequency spectrum management and radio regulatory matters. The other services are also represented by service level offices which are currently collocated in Alexandria, VA. These offices are the Air Force Frequency Management Agency and the Naval Electromagnetic Spectrum Center.

3-9. The Army Frequency Management Office (AFMO)-Continental United States (CONUS) is the Army's principal field office providing spectrum management support for all unit installation and special case Army customers requiring tactical, non-tactical, communications and non-communications frequencies. For CONUS related matters this is the tactical spectrum manager's primary resource. CONUS is broken down by region and assigned an area frequency coordinator (AFC).

AFC

3-10. AFCs are responsible for coordination of spectrum use within a geographic area of responsibility. DOD AFCs have a special responsibility to coordinate all use of spectrum resources within DOD test ranges and facilities. The AFC has the authority to negotiate band sharing, and mediate spectrum conflicts and radio interference directly with all area government and civil activities. This decentralized organizational structure allows maximum flexibility for test operations, and avoids lengthy processing at the national level.

3-11. The Army is responsible for spectrum coordination at the White Sands Missile Range (WSMR) and associated ranges and test facilities and within the State of Arizona where there are multiple military test facilities and installations. The DOD AFC, WSMR and DOD AFC, Arizona report directly to the Army Spectrum Manager/Director of US Army Communications-Electronics Services Office. The National Training Center (NTC) in Southern California experiences extremely high congestion of the electromagnetic spectrum. The NTC Spectrum Management Division (SMD) has authority to coordinate spectrum use within the area of the NTC. The NTC SMD reports directly to the NTC Operations (G-3).

3-12. A complete list of Area Frequency Coordinators is maintained in Annex D of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management. This publication is commonly referred to as the "NTIA Redbook" or simply the "Redbook" (The NTIA Redbook is available on-line from the Department of Commerce, NTIA, and Office of Spectrum Management at http://www.ntia.doc.gov/osmhome/redbook/redbook.html.)

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Chapter 4
Joint Spectrum Operations

This chapter provides an overview of the planning, coordination, and control of the spectrum in a joint environment. See CJCSM 3320.01B, *Joint Operations in the Electromagnetic Battlespace* and CJCSI 3320.01B, *Electromagnetic Spectrum Use in Joint Military Operations* for a detailed explanation of joint spectrum operations.

JOINT SPECTRUM ENVIRONMENT

4-1. The use of the electromagnetic spectrum is essential to military operations at all levels of command. Military operations conducted today generally involve more than one service. In a joint environment the services often compete for use of the spectrum in order to accomplish their mission. Joint operations require precise coordination and establishment of operating procedures. These tasks are done for military operations and host nation coordination in order to most effectively use this finite resource. The selection of a command organization to execute a contingency operation or crisis action depends primarily on the mission to be accomplished and the objectives to be attained. The use of a joint task force (JTF) is considered the most appropriate for short-notice, time-sensitive, contingency, crisis action, or special operations expected to be of limited duration.

4-2. Military operations rely heavily on equipment using the limited resources of the electromagnetic spectrum. In joint military operations, requirements may exceed the amount of spectrum available. As a result, efficient use and control of the spectrum are critical to national security in terms of information operations (IO) , combat operations, and electronic warfare (EW) . Effective spectrum management is essential to sound defensive IO, command and control protection, and offensive EW. This ensures that operations can be conducted with minimal unintentional interference and without negative E3.

4-3. The increased demand for frequencies is attributed to the rapid growth of sophisticated weapons systems, intelligence, operations, and communications systems. Lack of proper, preplanned frequency coordination and consideration of E3 will have an adverse effect upon friendly competing users. Spectrum availability is further constrained by national legislation, designed to protect the rights of sovereign governments, by requiring approval prior to transmission in any portion of the spectrum that lies within a particular country's national borders. Joint and combined force operations must also consider the needs of coalition forces.

ELECTROMAGNETIC SPECTRUM PLANNING, COORDINATION, AND CONTROL

4-4. By their very nature joint operations are complex and difficult to manage from a spectrum perspective. Proper planning, coordination, and control of the spectrum will allow the commander usage of resources at critical times and increases combat effectiveness.

JOINT SPECTRUM ASSIGNMENT PLANNING

4-5. Planning for use of the spectrum resource and the assigning of spectrum management responsibilities must be fully integrated into the Joint Operation Planning and Execution System process. The complexity of effective joint spectrum use and management requires advance planning for scenarios of expected military operations. Each joint and subordinate component command must establish planning procedures to address all spectrum-dependent systems used in support of an operations plan and any other requirements of friendly forces that impact the use of the electromagnetic spectrum. Spectrum managers must be fully

integrated into the planning process at the initial and subsequent planning stages. Planning must be done in a consistent manner with each joint command. Without advance spectrum-use planning, the operational constraints from electromagnetic interference (EMI) and radiation hazards may become a severe limitation to rapid deployment and employment of forces.

JOINT SPECTRUM COORDINATION

4-6. To use the spectrum successfully, all users must work together by exchanging vital spectrum information from the beginning of the joint planning process through an approved DOD data exchange architecture. Coordination and control of the joint military usage of the electromagnetic spectrum is generally assigned to the operations directorate of a joint staff (J-3), intelligence directorate of a joint staff (J-2), plans directorate (J-5), and command, control, communications, and computer systems directorate of a joint staff (J-6). To minimize unacceptable EMI among all emitters and receivers and to address E3 issues such as hazards of electromagnetic radiation to ordnance in joint operations, these three functional areas must work together. Additionally, automated spectrum management systems at the joint and component levels require vertical and horizontal interoperability.

JOINT SPECTRUM CONCEPT OF CONTROL

4-7. The supported joint force commander (JFC) or commander joint task force (CJTF) holds the authority for assigning frequencies to users through the joint frequency management office (JFMO) or joint task force spectrum management element (JSME) . The JFMO or JSME may delegate frequency assignment authority to subordinate commands, decentralizing the management of the electromagnetic battlespace. Authority to assign use of a specific spectrum resource (use of allotment plans developed by the JFMO or JSME) should be delegated to the lowest level of command possible. Selection of this authority must be consistent with the principles of sound spectrum management, spectrum use considerations, concept of operations, and the priority of mission functions as detailed in the respective service or joint publications. Subordinate commands given authority for approving spectrum use will make frequency assignments within the constraints imposed by higher authorities and report changes in spectrum assignment information to the JFMO or JSME. In order for the spectrum manager to be effective at the joint level they must have a top secret security clearance.

4-8. To ensure that critical frequencies and spectrum-dependent systems are protected from unintentional interference due to friendly operations, the JFMO or JSME will perform an interference analysis of all spectrum requests against existing frequency assignments. This helps to identify and deconflict potential interference before making a new assignment. As new requirements are identified, conflicting or competing spectrum use will occur. Conflicts within a primary functional area should be resolved at the lowest possible level by CJTF, JFC, or JFMO.

Chapter 5
Tactical Spectrum Management

This chapter describes the roles, functions, and tasks of the tactical spectrum manager.

SPECTRUM MANAGEMENT FOR THE DIVISION AND BRIGADE

5-1. The goal of tactical spectrum management is to control the electromagnetic spectrum so that it serves the needs of friendly forces while denying use to the enemy so that he is unable to command, control, or otherwise employ his forces effectively. Spectrum management at the tactical level can be a very complicated and time consuming process given the limited functionality of the tools available. Currently, the operational environment has a vast number of radios operating in all regions of the electromagnetic spectrum across the battlefield. The key to sound spectrum management is having an understanding of all emitters and being able to deconflict these systems. The commander must be aware that spectrum is a limited resource and must be utilized efficiently to multiply combat power.

5-2. Spectrum management is bottom driven for requirements while top fed for resources. The division and the brigade combat teams represent the "pointy end of the spear" and it is critical that all requirements are captured by the Assistant Chief of Staff for C4 Operations (G-6) or C4 operations officer (S-6) at each echelon to ensure the commander receives the proper resources. In the past, the bulk of spectrum management was concerned with networked communications emitters and combat net radio networks. Figure 5-1 illustrates the competing systems that cause challenges throughout the spectrum. It is the G-6 or S-6 responsibility to coordinate with all spectrum users in the area of responsibility (AOR) and to ensure all requirements for spectrum access are identified. A database of all RF emitters in the AOR must be maintained by the G-6 or S-6 to ensure that competing systems can be identified and prioritized for frequency assignments.

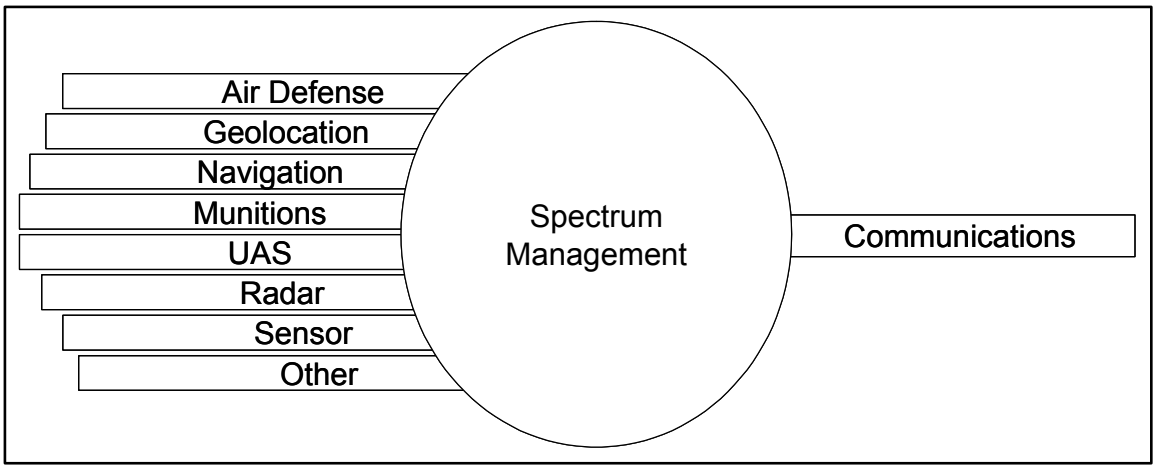

Figure 5-1. Spectrum users

5-3. The role of the division and brigade spectrum manager are nearly identical at their respective levels. The brigade spectrum manager gathers, adjudicates, and forwards requirements for all spectrum support to the division. In turn, the division forwards its requirements to the next higher authority (G-6 at a corps or the J-6 at a JTF).

5-4. The division network planners design the network, and the spectrum manager uses this design to determine the spectrum requirements necessary for the communications network. In the emerging force structure there are two spectrum managers per division. Normally, one spectrum manager will be responsible for the network to include satellite requirements while the other spectrum manager will handle combat net radio (CNR) and other systems requirements to include fires, EW, radar, and other systems. The brigade spectrum manager performs all of these functions and is located at the S-6 in order to have visibility of all spectrum related matters at the brigade.

SPECTRUM MANAGEMENT FUNCTIONS AND TASKS

5-5. The spectrum manager at the tactical level of command is the commander's principle advisor on all spectrum related matters and is primarily concerned with the following functions:

- Determining the user requirements:
  - Staff coordination.
  - Joint restricted frequency list (JRFL) .
  - Communications Security (COMSEC) .
- Processing requirements (standard frequency action format [SFAF]):
  - Processing CONUS frequency requirements.
  - Processing outside the continental United States (OCONUS) frequency requirements.
- Frequency deconfliction .
- Frequency interference resolution.
- Evaluating and optimizing spectrum use.

5-6. The tasks necessary to accomplish these functions are generally the same across the echelons. The difference is the size and scope of the tasks:

- Build and distribute CNR loadsets.
- Request, obtain, and distribute frequencies for all emitters.
- Perform network analysis to engineer line-of-sight (LOS) radio links and assign frequencies.
- Advise network planners in matters concerning spectrum management.
- Maintain and update databases.
- EW planning.
- Perform spectrum analysis and deconfliction.
- Determine and process satellite frequency requirements.
- Interference resolution.
- Advise the commander in spectrum prioritization and implementation.

DETERMINING SPECTRUM REQUIREMENTS

5-7. One of the most difficult challenges for a spectrum manager is determining the spectrum requirements. The unit table of organization and equipment will identify most of the emitters. The spectrum manager should also check with the Assistant Chief of Staff, Logistics (G-4) or the logistics staff officer (S-4) to ensure that commercial-off-the-shelf (COTS) and government-off-the-shelf procured through other acquisitions are accounted for. The spectrum manager should also periodically confer with subordinate units to maintain awareness of emitters that they are utilizing. This can be done through a call out message to all subordinate units. The units will be required to provide a list of their frequency dependent equipment, call sign requirements, nets, or any special requirements such as radar, telemetry, weapons, or un-manned vehicular systems.

5-8. Commanders should be made aware of any equipment that does not have spectrum supportability and the implications or consequences of employing such equipment. Spectrum managers must also be particularly aware of equipment that will potentially interfere with safety of life systems such as rescue, transportation, or air operations.

Staff Coordination

5-9. Spectrum managers deal with many systems that are not solely communications systems. They must be involved with other staffs to provide guidance and advice to the commander regarding the prioritization of spectrum use. Systems such as UASs and common user "jammers" all use RF spectrum for operation. It is their widespread use and unique operating characteristics that require special planning and coordination to ensure that frequency fratricide is mitigated. The spectrum manager must stay abreast of unit movement and the commander's intent. This will help the spectrum manager provide alternate courses of action regarding spectrum use to support the mission. The spectrum manager should also take part in any EW planning in order to be aware of spectrum conflicts initiated by friendly systems for force protection, enemy exploitation, or enemy denial. The advent of common user "jammers" has made this awareness and planning critical for the spectrum manager.

JRFL

5-10. The spectrum manager must work closely with the Assistant Chief of Staff, Intelligence (G-2) and Assistant Chief of Staff, Operations and Plans (G-3) to coordinate EW planning and execution as well as publication of the JRFL. To make this product useful, the spectrum manager should work to keep it current and as brief as possible. See Appendix B for a description of the JRFL.

COMSEC Coordination

5-11. The spectrum manager must work closely with COMSEC personnel to ensure that the proper keying material is matched to the appropriate resource. Spectrum managers are concerned only with the necessary COMSEC for CNR loadsets and normally do not handle or manage COMSEC for other emitters.

PROCESSING REQUIREMENTS

5-12. Processing frequency requests consists of requesting, obtaining, and distributing the frequency resources to the proper user and equipment. This process is hierarchal. The request process flows from lower to higher while the resources flow from higher to lower. This process has some inherent problems. First, the spectrum is assigned on a first come first served basis. Then the database update procedure is manual, which can lead to errors. Since spectrum cannot be assigned instantaneously it is imperative for the spectrum manager to submit requests as early as possible in order to satisfy unit requirements. The request is formatted according to the SFAF. See Appendix C for and example of the SFAF format. Another potential problem is the lack of SECRET Internet Protocol Router Network (SIPRNET) connectivity at various units. In order to complete data exchanges and frequency requests, Spectrum XXI must have a SIPRNET connection to the regional server.

5-13. Resources are matched to requirements through allocation, allotment, or assignment. Each of these designations has distinctly different meanings.

- Allocation is the designation of frequency bands for use in performing specific functions or services such as fixed, mobile, broadcast, and amateur. Services will be designated as either primary, permitted, or secondary. Primary and permitted services have equal rights, except in preparing frequency plans. Secondary services are permitted on a non-interference basis only. This is done at the national or international level.
- Allotment is the designation of specific bands or frequencies within a prescribed allocation. Once the resources have been allotted, the spectrum manager will distribute frequencies to all emitters in the AOR to include those for common user communications networks. The spectrum manager will work with the appropriate network manager or systems operator to assist in the frequency engineering of the network or system (e.g. LOS radio shots and build and publish the division signal operating instructions). An example of an allotment is the pool of frequencies used for mobile subscriber equipment (MSE) operations.
- Assignment is the designation of a specific frequency or frequencies for use by a radio station under specified conditions. These conditions normally include such things as geographic location, transmitter power, and antenna criteria. Due to the scarcity of spectrum in certain

situations, it may be necessary for the S-6 and G-6 to make recommendations to the commander concerning the prioritization of spectrum assignments.

Processing CONUS Frequency Requests

5-14. Within CONUS if a unit is co-located on an installation with a higher headquarters then the request will be sent to the higher headquarters. If the higher headquarters can not satisfy the requirement it is sent to AFMO-CONUS. If there is only one tactical unit on an installation, then the request will be sent to AFMO-CONUS. The exceptions to this are areas falling within the jurisdiction of the AFC of WSMR, the State of Arizona, and the Military District of Washington.

5-15. For CONUS tactical training, a radio frequency authorization (RFA) provides the frequency allotment to specific posts, camps, and stations. Some of these frequencies may be borrowed from other government and non-government agencies, and are to be used on a non-interference basis. If tactical operations cause harmful interference, the tactical user will be required to vacate the frequency(ies) and, if necessary, coordinate with AFMO-CONUS for additional resources.

5-16. RFA frequencies are geographic specific and under no circumstances should these be used outside their authorized areas unless cleared by AFMO-CONUS. This includes using these frequencies at other training sites, such as the national training centers.

5-17. For both ground and aerial convoys in CONUS there are dedicated frequency assignments. For a current list of the approved convoy frequencies contact AFMO CONUS.

Processing OCONUS Frequency Requests

5-18. Units will generally send requests through higher headquarters to a regional combatant command when an OCONUS request is processed. In some instances the spectrum manager may have to directly coordinate with host nation spectrum representatives for support. See Chapter 2 for host nation spectrum support information.

Frequency Deconfliction

5-19. Frequency deconfliction is a systematic management procedure. It is used to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. Current spectrum management tools, such as Spectrum XXI, perform frequency deconfliction in the macro sense. Limitations of today's spectrum management tools make it impossible for the spectrum manager to keep a real-time database of frequency use. This is due to the highly dynamic nature of tactical operations and the inability of the tools to do real-time updates automatically. In fast paced operations the spectrum manager will mainly be concerned with interference resolution or deconfliction by exception.

Frequency Interference Resolution

5-20. Interference is 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 D for a detailed description of interference resolution. Interference resolution is performed by the spectrum manager at the echelon receiving the interference. 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 non-signal devices (such as welders or vehicle engines).The skill level of systems operators and maintenance personnel can mean the difference between a minor inconvenience and complete system disablement.

5-21. When 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. An alternate frequency may be assigned if the interference persists. If the operator suspects man-made interference, he makes an internal equipment check to exclude equipment malfunctions. Improper alignment, degraded components, antenna disorientation, or poor maintenance is usually the cause of interference. 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. The spectrum manager will conduct an analysis of the database, a site survey (if possible), and coordinate with other units in the vicinity to identify the cause of the interference. If the spectrum manager is unable to isolate the cause of the interference they will submit a report to the next spectrum management level for resolution. See Appendix D for further information concerning interference resolution.

EVALUATING AND OPTIMIZING SPECTRUM USE

5-22. The spectrum manager must continuously update and maintain the database in order to have a clear picture of spectrum usage. In order for resources to be utilized in an efficient manner, the spectrum manager must conduct frequency analysis and deconfliction on a regular basis.

5-23. It is critical that all levels of command understand the inherent risk of violating the rules of proper spectrum management. Generally, a radio signal is all that connects a soldier, platoon, or company to safety; by providing situational awareness or communications. Emitters that are turned on in a geographic area of operations without the proper clearance and certification have the same affect as “bootlegging” a frequency. In the past, “bootlegging” a frequency usually only affected the communications network. Today, this practice can have first, second, or third order effects that are undesirable on other systems. Some of the effects of these actions have included the damaging of multi-million dollar UASs, lack of communications between elements during critical situations, and interference with safety of life frequencies; such as medical evacuation and search and rescue. See Appendix E for international distress and emergency frequencies.

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Chapter 6
Installation Frequency Coordination

This chapter discusses the installation commander's role, and the user's responsibilities concerning frequency coordination on the installation. This chapter also describes the commercial and tactical systems that the installation frequency coordinator may encounter. The chapter concludes with approaches to interoperability in order to facilitate the interaction between military and civil users.

RESPONSIBILITIES

6-1. Installation commanders will coordinate, plan, program, and fund adequate coordination and supervision of the spectrum. Installation commanders (both CONUS and OCONUS) are responsible for all devices that emit electromagnetic emissions from their installation, whether COTS or government issued. The installation commander will assign frequency coordination responsibilities to the Directorate of Information Management (DOIM) or a similar office. In frequency coordination, the installation commander must—

- Ensure that the frequency coordinator is properly trained. Frequency coordination constitutes dealing with international and national laws on a regular basis in addition to safety of life issues. Assigning this responsibility as an additional duty or temporary assignment could have severe repercussions.
- Ensure that the frequency-dependent equipment has an approved DD Form 1494 (*Application for Equipment Frequency Allocation*). See Appendix A for a description of the DD 1494 process.
- Ensure that the equipment or system has an authorized frequency assignment in CONUS and host nation approval in OCONUS locations (see AR 5-12, Chapter 5).
- Ensure that users understand the operating parameters (power level, antenna type, height, gain, authorized operational use, and area of operation) of their assigned frequencies.
- Establish a program of continual review of frequency assignments, and delete or amend such assignments as appropriate.
- Ensure that radio stations obtain identification, international call signs, and other non-tactical call signs per AR 5-12, Chapter 6.
- Coordinate with other installation directorates and tenant activities to ensure that the frequency-dependent equipment (e.g., fire alarms, paging systems, handheld radios, barcode readers) being developed or procured is fully supportable on the installation (see AR 5-12, Chapters 4 and 5).
- Assist in resolving incidents of harmful radio interference caused by or to Army users (see AR 5-12, Appendix C).
- Ensure that the necessary classification markings, classification authority, and downgrading instruction for classified frequency certification and frequency assignment records are done IAW AR 380-5.

USER RESPONSIBILITIES

6-2. The installation frequency coordinator is responsible for educating users as to their responsibilities. Users will—

- Obtain a frequency assignment before using devices that intentionally emit RF energy or require interference protection of receive-only frequencies.

- Coordinate frequency actions with the installation frequency coordinator.
- Request the minimum number of frequencies necessary to accomplish the mission.
- Request minimum transmitter power and antenna gain or height necessary to ensure adequate coverage.
- Maintain a frequency authorization document for each frequency used.
- Ensure that electromagnetic radiating equipment operations comply with the authorized parameters (e.g., power, location, and frequency).
- Ensure that current Army RF spectrum management instructions are available and followed.
- When operating electromagnetic radiating equipment, perform positive radio control duties such as:
  - Using radiation-suppression devices (dummy loads) as much as possible when tuning, testing, or experimenting.
  - Ensuring that proper radio procedures are used when transmitting. Refer to the appropriate Allied Communications Publication for appropriate procedures.
  - Ensuring that transmissions on all RF emitters are for official government business.
  - Providing, in writing to the installation frequency coordinator, the name and phone number of a point of contact for frequency matters.
  - Advising the installation frequency coordinator of any changes in location, operations, or technical parameters (e.g., power, operating bandwidth, change of antenna type, or height) for operation of electromagnetic radiating equipment.
  - Advising the installation frequency coordinator immediately when frequencies are no longer required.
- Act promptly to resolve and report incidents of interference as stated in AR 5-12, Chapter 3 and Appendix C.

6-3. The installation frequency coordinator should be familiar with garrison (non-tactical), commercial, and tactical systems. The land mobile radio (LMR) system will comprise the bulk of the garrison systems while other commercial systems may be utilized for specialized functions. If tactical communications equipment is located on the installation, the installation frequency coordinator needs to know the spectrum requirements and capabilities of the equipment. Knowing the capabilities and spectrum requirements of this equipment will reduce interference incidents and enhance interoperability during times of emergency, whether for force protection or homeland defense operations.

COMMERCIAL SYSTEMS

6-4. Commercial systems comprise the largest segment of emitters that the installation frequency coordinator will encounter. As the Army participates more in stability and reconstruction operations, tactical spectrum managers find themselves dealing with more commercial equipment and vendors as they help develop telecommunications infrastructure. Also, due to rapid acquisition initiatives, more commercial equipment is making its way to the tactical arena necessitating the need to understand these systems and the process for assigning spectrum to them.

LMR SYSTEM

6-5. The LMR system is normally the primary system used for daily installation communications. These systems are normally used for administrative installation activities in public safety organizations. LMR systems range from single-channel analog to digital trunked systems. The most basic LMR systems are single-channel analog systems. Each radio is set to a particular frequency that must be monitored by everyone utilizing the same channel. These systems have a dedicated channel for each group or agency using the system. In smaller agencies, if the system experiences heavy usage, users may not be able to place calls. The majority of these systems are very high frequency (VHF) systems that offer very little flexibility in their operations. These systems fail to provide a common air interface and cannot

accommodate users outside the system. These systems are inefficient users of spectrum, and many agencies have outgrown them.

6-6. The majority of public safety organizations are currently using single-channel analog systems. Many of these organizations are in the process of switching, or have switched to, digital trunked systems. Trunked systems utilize a relatively small number of paths, or channels, for a large number of users. This is similar to commercial telephones. Rather than having a dedicated wire line for every user, the phone company has a computer (switch) that manages many calls over a relatively small number of telephone lines. This is based on the assumption that not every user will require a line at the same time.

6-7. Trunked systems are generally made up of a control console, repeaters, and radios. Instead of using switches and phone lines, these systems use consoles and channels or frequencies to complete calls. The process is the dynamic allocation of a channel that is totally transparent to the user. When the user of a trunked system activates the push-to-talk, the system automatically searches for an unused channel on which to complete the call.

6-8. Digital trunked systems offer better performance and provide a more flexible platform. This system will accommodate a greater number of users and offer an open ended architecture. This allows for various modes of communications such as data, telephone interconnect, and security functions. Additionally, there will be faster system access, more user privacy, and the ability to expand by providing a common air interface. For CONUS LMR regulations see the NTIA *Redbook,* Chapter 10.

GUIDANCE FOR INSTALLATION SUPPORT RADIOS

6-9. Fixed, mobile, and portable radio systems are used in administrative nets. These nets include installation utilities, transportation, emergency services, medical services, fixed range control, radio/wire integration, and other installation support networks. Installation radio support includes frequency and call sign assignments, contingency radio stations, and the Military Affiliate Radio System.

6-10. Installation radios are authorized only if mission essential requirements cannot be satisfied by telephone or other existing telecommunications facilities. Each radio facility is engineered to ensure:

- Equipment compatibility.
- Adequate radio coverage.
- Minimum power and antenna height consistent with required performance.
- Noninterference with other radio nets and weapon systems.

6-11. Engineering for installation support radio systems is the responsibility of the supporting DOIM. Engineering service beyond the capability of the DOIM may be available from a contractor. If not, a request for engineering assistance can be made through channels to the supporting United States Army Network Engineering Telecommunications Agency. COTS radios are used for installation radio support. The variety of makes and models of radios should be limited to reduce support cost and increase operational efficiency.

6-12. The following criteria are considered in programming installation radio support:

- Determining actual and anticipated requirements.
- Consolidating requirements to take advantage of bulk procurement and competitive bidding.
- Providing interoperability with existing and programmed networks.
- Utilizing independent resources for technological advice instead of relying solely on the vendor.
- Purchasing scalable systems with an open-ended architecture to facilitate growth while maintaining costs.
- Determining what, if any, emergency response the vendor will provide in the way of personnel, equipment, or technical support.
- Using multi-frequency, tunable, or switch selectable radios to standardize the radio population.
- Pricing total package cost to include site surveys, maintenance contract, technical support, warranty, and training.
- Standardized technical and performance criteria.

- Improving reliability and maintainability through programmed provisioning.
- Meeting narrowband requirements.

Narrowband Mandate

6-13. The narrowband mandates include NTIA, Deputy Secretary of Defense (DSD) 1 August 2001 Memo, and DA Memo 26 February 2002. The objective of these mandates is to ensure that DOD LMR systems will be acquired with appropriate consideration of:

- Timely and cost effective migration to mandated narrowbanding requirements.
- Achieving interoperability to meet the mission.
- Meeting security requirements.
- Minimizing procurement and support costs.

6-14. Table 6-1 lists frequency bands of existing equipment that must operate in a 12.5-kHz bandwidth channel or less by the dates listed. Any new equipment must be compliant.

Table 6-1. Narrowband Mandates

Frequency Bandwidth Rate	*Effective Date*	*Mandate*
380 - 399.9 MHz	Currently in effect for all new systems	DSD Memo
162 - 174 MHz	1 Jan 2005	NTIA 4.3.7A
138 - 150.8 MHz	1 Jan 2008	NTIA 5.3.5.2
406.1 - 420 MHz	1 Jan 2008	NTIA 4.3.9

6-15. NTIA and DOD narrowbanding mandates apply to all spectrum-dependent non-tactical equipment to include alarms, target scoring, hydrology, and paging that operate in these bands.

CELLULAR TELEPHONE

6-16. Cellular telephones are generally used in emergency responses because they offer compatible communications regardless of agency. The drawback is that commercial systems can be overwhelmed once the system reaches the saturation level of use, and calls cannot be processed. Additionally, if a disaster or event destroys or damages critical facilities such as central offices, towers, cables, or fiber; then system capacity is diminished, and service will either be limited or unavailable. Cellular telephones in the United States operate in two bands and in several different modes. Table 6-2 provides cellular telephone use of the spectrum. The commercial sector is pushing for the reallocation of portions of the federal spectrum for third generation wireless (3G) use. The portion they desire is the 1755-1850-MHz band that is used by the military for satellite control and ground tactical radio networks.

Table 6-2. Cellular Telephone

Mode	*Air Interface*	*Description*	*Frequency Band*
Analog 1G	Advanced Mobile Phone Service	The original standard for cellular in the United States.	XMT 824.04-848.97 MHz RCV 869.04-893.97 MHz (800 MHz Band)
Digital 2G	Time Division Multiple Access (TDMA)	Splits the allocated bandwidth into discrete channels to move digitized information.	800 MHz and 1900 (1850-1990) MHz Bands
	Code Division Multiple Access (CDMA)	A spread spectrum technology that uses digital coding to separate the digitized information being transmitted.	800 and 1900 MHz Bands
	Global System for Mobile Communications (GSM)	Uses a variation of TDMA. Widely used in other parts of the world but in different frequency bands.	1900 MHz Band
Digital 2.5G and 3G	Variations of CDMA-GPRS, EDGE, CDMA 2000 1X, CDMA 2000, UMTS, WCDMA	Instead of circuit switching, these systems will utilize packet switching for higher throughput and management.	Band to be determined

PERSONAL DIGITAL ASSISTANT (PDA) AND PERSONAL ELECTRONIC DEVICE (PED)

6-17. PDAs and PEDs can utilize cellular phone and wireless local area network (WLAN) technologies in order to send both voice and data. PDA is a term for any small, mobile hand-held device that provides computing and information storage and retrieval capabilities for personal or business use. It is often used for keeping schedule calendars and address book information available. A true PDA has no communications capability other than, possibly, an infrared port to a host computer. A PED is a wireless handheld device that has the function of a PDA, combined with the wireless extension of the Internet. It provides e-mail and Web browsing capabilities. It utilizes several different wireless data networks operating in 800, 900, and 1900 MHz frequency bands. Table 6-3 lists the leading wireless data network protocols in the United States and their frequency bands. More highly evolved devices are now entering the market that incorporate the functions of a PDA, PED, and cellular phone; utilizing the GSM standard in a personal communications system (PCS). These devices are capable of voice, paging, caller ID, and e-mail bundled together. These services may not be available in all parts of the country.

Table 6-3. Wireless Data Networks

Protocol	*Description*	*Frequency Band*
Mobitex	A packet switched, narrowband PCS network.	XMT 896-902 MHz RCV 935-941 MHz (900 MHz PCS)
DataTAC ®	A packet switched, narrowband PCS network.	XMT 806-825 MHz RCV 851-870 MHz (900 MHz PCS)
iDEN	Integrated Digital Enhanced Network—a broadband PCS network that rides over the GSM network.	1850-1990 MHz (1900 MHz)
GPRS	General Packet Radio Service—a broadband PCS network that rides over the GSM network.	1850-1990 MHz (1900 MHz)

PAGERS

6-18. First developed in the late 1940s, pagers are still the most prevalent wireless communications devices. With the development of advanced services and features, pagers are emerging as compact mobile terminals for both non-voice and voice services. This is possible due to the implementation of new protocols that allow higher data rates. Pagers offer several advantages over cellular phones including low cost, better area coverage, and fewer frequencies required for operations. Although pagers are allowed to operate in both low and high band VHF, these bands are primarily for in-house paging. Some systems still operate in the 450 MHz band, but most modern systems use the PCS bands for nationwide paging services. Table 6-4 lists the pager protocols and their frequency band.

Table 6-4. Pagers

Protocol	*Description*	*Frequency Band*
Post Office Code Standardization Advisory Group	A standard paging protocol developed in the United Kingdom.	928-932 MHz (900 MHz PCS Band)
FLEX/ReFLEX™	A narrowband PCS protocol developed by Motorola that allows for two-way (ReFlex™) text messaging and higher throughput.	928-932 MHz (900 MHz PCS Band)

ALARMS

6-19. The military uses the 138-144 MHz band for wireless central alarm notification. Commercial central alarms generally operate in either the 450-470 MHz bands or the 900 MHz PCS bands.

WLAN

6-20. The desire to have ubiquitous data connectivity has propelled the development of WLAN solutions. The mode, standards, and equipment vary greatly, and some systems operate in unlicensed frequency bands. WLAN systems often operate in unlicensed bands and use different protocols and interfaces. Before any systems are procured, a thorough analysis is done to insure that frequency conflicts will be minimal. Areas of concern would be hospitals and any nearby radar systems. The advantages of these systems are that they can be set up quickly compared to installing cable or fiber and can provide nearly the same throughput and capabilities of wired systems. Table 6-5 provides a description of WLANs, their frequency bands, and competing commercial and military uses.

Table 6-5. WLAN

Name	*Description*	*Frequency Band*	*Competing Commercial Uses*	*Competing Military Uses*
802.11b(g)	Also known as WI-FI, this WLAN protocol provides up to 11 Mbps (802.11g 54 Mbps) throughput up to 100m. Operates in the unlicensed industrial, scientific, and medical (ISM) Band.	2.4-2.4835 GHz (2.4 GHz Band)	Home RF, Bluetooth®, microwave ovens, fusion lighting.	Logistics, Medical, Fire Support, Soldier Radio
802.11a	Primarily used on college campuses. It is actually comprised of three bands. Operates in the Unlicensed National Information Infrastructure and ISM bands.	5.15-5.25 GHz 5.25-5.35 GHz 5.725-5.825 GHz (5 GHz band)	Radar systems, future upper band microwave ovens, door openers.	Various search, navigation, and fire control radars. The heaviest use is in the 5.725-5.875 GHz (ISM) band.
Local Multipoint Distribution System	Also known as millimeter/microwave technology. Sometimes used in conjunction with free space optics (FSO) for hybrid systems. Very susceptible to rain fade.	"A" license: 27.5-28.35, 29.1-29.25, and 31.075-31.225 GHz. "B" license: 31-31.075 and 31.225-31.3 GHz	Various fixed and mobile satellite services. Radio astronomy and control of timed traffic signals.	Both fixed and mobile satellites, standard frequency, and time satellite (30-31.3 GHz).
FSO	Uses lasers to send packetized data. FSO is very susceptible to fade in fog.	194 or 375 THz	Various lasers.	Various lasers and communications experimentation.

TACTICAL SYSTEMS OVERVIEW

6-21. During times of crisis, military systems may be employed to provide communications in the event that commercial systems are either unavailable or damaged. Some military systems can be integrated into commercial networks. Coordination with tenant tactical units will identify the communications capabilities of the unit. Non-communications systems such as radars, beacons, and sister services co-located on the installation may have equipment utilizing these or other bands. Table 6-6 provides a partial list of the more common tactical systems and the bands in which they operate.

Table 6-6. Tactical Systems

Frequency Band	*System/Nomenclature*	*Description*
2-30 MHz (high frequency [HF])	AN/PRC-150, AN/PRC-104, AN/GRC-213, AN/GRC-193.	Used primarily for intermediate and long haul communications.
30-88 MHz (VHF)	Single-channel ground and airborne radio system (SINCGARS), mobile subscriber	SINCGARS—the primary CNR. MSRT—wireless extension of the MSE phone system.

Table 6-6. Tactical Systems

Frequency Band	*System/Nomenclature*	*Description*
	radiotelephone terminal (MSRT).	
30-512 MHz	AN/PRC-117 AN/PRC-148	Multimode, multifunction radios that provide HF, VHF, and single-channel tactical satellite (SC-TACSAT) ultra high frequency (UHF).
138-144 MHz	AN/PRC-127, AN/PRC-148 (multiband inter/intra team radio [MBITR]).	Primarily used for squad radios.
225-400 MHz	MSE Band I, Near Term Digital Radio (NTDR), AN/PSC-5 (Spitfire) SC TACSAT, AN/PSC-7.	MSE uses this band for LOS transmission. NTDR provides tactical operations center (tactical operations center [TOC]-to-TOC) connectivity at brigade and below. Also various SC TACSAT and air-ground-air systems.
420-450 MHz	AN/TSQ-158 (Enhanced Position Location Reporting System [EPLRS]).	Will be used as the primary data network for brigade and below.
1350-1850 MHz	MSE Band III, Digital Group Multiplexing (DGM) (Tri-Service Tactical Communications [TRI-TAC]) Program.	MSE uses this for LOS transmission. Also used by other equipment for LOS transmission.
2201.25-2388.75 MHz	MSE Band III High-Capacity Line of Sight (HCLOS).	Extended range HCLOS.
4400-5000 MHz	AN/TRC-170 (Tropo).	The primary purpose of Tropo is to provide connectivity between two major TRI-TAC nodes.

APPROACHES TO INTEROPERABILITY

6-22. The three types of interoperability are: day-to-day, which is used for routine public safety operations; mutual aid, which involves joint and immediate response such as forest fires, bombings, and plane crashes; and task force, which involves local, state, and federal agencies operating together over sustained periods of disaster recovery, security for major events, and coordination for ongoing criminal investigations. Current approaches to interoperability include:

- Agencies exchanging radios.
- Dispatcher interfaces via landline (telephone).
- Installation of multiband repeaters.
- Couriers.

6-23. These measures are stop-gap measures and do not provide the quality of communications often needed in mutual aid or task force situations. From the government user's standpoint, more proactive measures can be taken to facilitate interoperability. A government radio station may utilize any frequency authorized to a non-government radio station under Part 90 of the rules of the FCC. This rule states that utilization is necessary for intercommunication with non-government stations or coordination with non-government activities, provided a mutually approved arrangement has been concluded between the government agency concerned, the FCC, and the non-government licensee involved. See the NTIA *Redbook* paragraph 7.12 for further information concerning FCC Part 90 rules.

6-24. There are two steps required to conclude a mutually approved arrangement. First, the government agency must obtain, from the non-government licensee, a written certification (memorandum of agreement [MOA] or similar document) that the government operation is necessary. Second, after receipt of the certification, the government agency must coordinate the proposed usage with the FCC (see NTIA *Redbook* 8.3.3). All operations by government stations are under these provisions:

- Shall be conducted in essentially the same geographical area as the non-government licensee.
- Shall be restricted to the purpose for which the particular frequency is authorized to non-government stations.
- Shall be in accordance with the FCC rules and regulations.
- Shall be subject to immediate termination if harmful interference is caused to the service rendered by non-government stations.
- Shall not bar, in any way, the expansion of non-government services for which the frequencies are allocated.

6-25. The design of the systems, to include dispatch consoles with the ability to bridge disparate radio bands, greatly enhances the interoperability by not requiring agencies to have compatible equipment. Many newer digital trunking systems that are being installed have this capability. Cost can also be a factor in determining the robustness in which systems are implemented.

FUNDING AND STANDARDIZATION

6-26. Two major factors that contribute to interoperability problems are funding and standardization. All agencies, regardless of size, experience budgeting problems when funding communications systems. Many agencies do not have the resources to procure the latest technologically advanced equipment, thereby placing them at a disadvantage in maintaining the ability to effectively communicate with adjacent agencies or organizations. In smaller agencies, such as volunteer fire departments, the funding may have to be generated from donations. In larger agencies, the overall cost of replacing and implementing a new system can be overwhelming. Competing needs such as other equipment and personnel funding may override implementing a more efficient and robust communications system. Greater gains may be realized by using creativity and exploiting all federal, state, and local programs for communications initiatives.

6-27. Standardization also presents an interoperability problem in that many agencies do not have dedicated communications personnel who understand, or are aware of, the various standards and operating protocols. As communications systems become increasingly more complex, the technological understanding at the user level must keep pace. While voice is currently the primary communications method, data and imagery are rapidly becoming integrated into today's communications networks. By retaining or hiring trained communications professionals, public safety agencies can realize both savings due to sound decision making and communications systems that will perform optimally.

PUBLIC SAFETY BANDS

6-28. Although Table 6-7 indicates some overlap of frequency bands, for the most part these public safety bands are fragmented. This leads to interoperability problems among local, state, and federal public safety users. Disparate frequency bands often isolate agencies and jurisdictions from one another. Both the NTIA and the FCC have taken steps to improve interoperability. The NTIA has authorized the use of 20 frequencies between 162-174 MHz and 20 frequencies in the 406.1-420 MHz band. This will allow interoperability for joint local, state, and federal law enforcement and public safety operations during disasters and emergencies. The FCC has designated five frequencies in the 150-162 MHz band and four channel pairs in the 450-512 MHz band for mutual aid purposes.

6-29. In order to utilize the existing bands more efficiently, the NTIA and DOD have initiated a narrowbanding policy for non-tactical LMRs. This action, by requiring 12.5 KHz of channel bandwidth or less (vs. 25 kHz), effectively doubles the amount of available channels. Most equipment manufacturers are now producing equipment to meet these requirements. Another problem has surfaced regarding the 800-MHz band. Since commercial bands are adjacent to the public safety bands, there have been cases of interference to public safety radios by cellular phone systems. In most instances when a problem has been

identified, the commercial company has re-engineered its systems to mitigate this interference. This same potential for interference also exists in the 700-MHz band, as commercial bands will also be adjacent to the public safety bands. Therefore, it is important to analyze the potential for harmful interference before implementing an LMR system.

6-30. Public safety organizations have urged the FCC for additional spectrum, and the FCC has responded by allocating 50 MHz in the 4.9-GHz band (WLAN) and 24 MHz in the 700-MHz band. The move to the 700-MHz band may take some time to implement due to the fact that this portion of the spectrum is currently being used by television broadcasters. Broadcasters are supposed to vacate the spectrum and begin digital television broadcasting no later than 2006.

Table 6-7. Public Safety Bands

Local and State Bands (MHz)	*Federal Bands (MHz)*
25-50	30-50
72-76	138-150.8
150-174	162-174
220-222	220-222
450-512	406.1-420
764-776 and 794-806	
806-824 and 851-869	

Appendix A

Spectrum Certification Process

DD Form 1494 is used to obtain spectrum support guidance from the USMCEB. This guidance outlines the general considerations, provisions, and restrictions that apply to a particular system concerning the use of the electromagnetic spectrum. It is directive upon the submitting Army command or center, and the conditions of frequency assignment to the operational user.

DD 1494

A-1. Unless specifically exempted, a DD Form 1494 must be submitted for all radio frequency spectrum radiating systems; this must include the system receivers. To assess susceptibility to interference from existing or planned transmitters, a DD Form 1494 may be submitted for receive-only systems. A system is defined as a set of equipment comprised of a transmitter, a transmit antenna, a receiver, and receive antenna. Where this equipment is installed (e.g., aircraft, tank, shelter) is indicated in the installation block in the form. An Army command or major acquisition center (such as the electronic proving grounds) submits the application to the ASMO for national level processing. The data required is technical and must be provided by a source familiar with the equipment component design. If the data is deemed proprietary or competition sensitive, the form must be marked and handled accordingly. For equipment being used outside US&P, the release of technical information to foreign governments is necessary to coordinate RF spectrum support for Army systems.

A-2. The DD Form 1494 is composed of six pages of information, a line diagram, and an orbital information sheet for space systems. The MCEB's automated spectrum certification system contains the capability to generate a DD Form 1494. The form is available via the DOD forms web site at http://web1.whs.osd.mil. The following is a brief description of each stage.

- STAGE 1- Conceptual. The initial planning effort is completed, including proposed frequency bands and other available characteristics.
- STAGE 2- Experimental. The preliminary design is completed and radiation using test equipment or preliminary models is required.
- STAGE 3- Developmental. The major design is completed and radiation is required during testing.
- STAGE 4- Operational. Identify final operating constraints or restrictions required to assure compatibility when development is essentially completed.

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Appendix B

Joint Restricted Frequency List

The J-6, under the oversight of the electronic warfare officer and typically through the JFMO or JSME, will publish, distribute and maintain a JRFL based on inputs from the J-2, J-3, and J-6. The J-3 must approve the coordinated JRFL prior to its release. For conflicting or competing spectrum use within IO that affects spectrum-dependent systems across more than one functional area, the IO cell examines requirements and attempts to resolve coordination issues with JFMO or JSME. If resolution is impossible at this level, the matter is elevated to the JFMO or JSME. The JRFL defines those frequencies that are protected from specific uses as defined below. The JRFL is not a static product and will change as the operation or mission changes.

TABOO FREQUENCIES

B-1. These are any friendly frequencies of such importance that they must never be deliberately jammed or interfered with by friendly forces. These frequencies include international distress, stop buzzer, safety, and controller frequencies. They are generally long-standing as well as time-oriented. For example, as the combat or exercise situation changes, the restriction must be removed.

PROTECTED FREQUENCIES

B-2. These are frequencies used for a particular operation. They are identified and protected to prevent them from being inadvertently jammed by friendly forces, while active electronic warfare operations are directed against hostile forces. These frequencies are of such critical importance that jamming should be restricted unless absolutely necessary or until coordination with the using unit is made. They are generally time-oriented may change with the tactical situation, and must be updated periodically. An example of a protected frequency would be the command net of a maneuver force engaged in the fight.

GUARDED FREQUENCIES

B-3. Enemy frequencies that are currently being exploited for combat information and intelligence. A guarded frequency is time oriented in that the list changes as the enemy assumes different combat postures. These frequencies may be jammed after the commander has weighed the potential operational gain against the loss of technical information. An example of a guarded frequency is an enemy intelligence frequency that is being monitored.

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Appendix C

Standard Frequency Action Format

Refer to MCEB Pub 7 for a detailed explanation of necessary codes and descriptions of items. Not all item numbers are necessary for a complete SFAF.

ADMINISTRATIVE DATA	
005	Security Classification
006	Security Classification Modification
010	Type of Action
020	Proposal References
101	FRRS ID
102	Agency Serial Number
103	IRAC Docket Number
104	Assignment Authority
105	List Serial Number
106	Serial Replaced, Delete Date
108	Docket Numbers of Older Authorizations
EMISSION CHARACTERISTICS	
110	Frequency(ies)
111	Excluded Frequency Band
112	Frequency Separation Criteria
113	Station Class
114	Emission Designator
115	Transmitter Power
116	Power Type
TIME/DATE INFORMATION	
130	Time
131	Percent Time
140	Required Date
141	Expiration Date
142	Review Date
144	Record Indicator
145	IFRB Registration
146	DOS Trunk ID
147	Joint Agencies
151	Coordination Indicator
152	Coordination Data
ORGANIZATIONAL INFORMATION	
200	Agency
201	Unified Command
202	Unified Command Service
203	Bureau
204	Command
205	Subcommand

206	Installation Frequency Manager
207	Operating Unit
208	User/Net Code
209	AFC/DOD AFO/Other Organizations
TRANSMITTER LOCATION DATA	
300	State/Country
301	Antenna Location
302	Station Control
303	Antenna Coordinates
304	Call Sign
306	Authorized Radius
TRANSMITTER EQUIPMENT	
340	Equipment Nomenclature
341	Number of Equipments, System Name
343	Equipment Allocation Status
345	Radar Tunability
346	Pulse Duration
347	Pulse Repetition Rate
348	Intermediate Frequency
349	Side Lobe Suppression
TRANSMITTER ANTENNA DATA	
354	Antenna Name
355	Antenna Nomenclature
356	Antenna Structure Height
357	Antenna Gain
358	Antenna Elevation
359	Antenna Feed Point Height
360	Antenna Horizontal Beamwidth
361	Antenna Vertical Beamwidth
362	Antenna Orientation
363	Antenna Polarization
RECEIVER LOCATION DATA	
400	State/Country
401	Antenna Location
403	Antenna Coordinates
404	Call Sign
406	Authorized Radius
407	Path Length
408	Repeater Indicator
RECEIVER EQUIPMENT	
440	Equipment Nomenclature
443	Equipment Allocation Status
RECEIVER ANTENNA DATA	
454	Antenna Name
455	Antenna Nomenclature
456	Antenna Structure Height
457	Antenna Gain
458	Antenna Elevation
459	Antenna Feed Point Height
460	Antenna Horizontal Beamwidth

461	Antenna Vertical Beamwidth
462	Antenna Orientation
463	Antenna Polarization
SUPPLEMENTARY DETAILS	
500	IRAC Notes
501	Notes Free-Text Comments
502	Description of Requirement
503	Agency Free-Text Comments
504	FAS Agenda or US&P Comments
505	NATO Pooled Frequency Code Number
520	Supplementary Details
530	Authorized Areas
531	Authorized States
OTHER ASSIGNMENT IDENTIFIERS	
701	Frequency Action Officer
702	Control/Request Number
704	Type of Service
705	System Identifier
707	USCINOPAC Complement/Allied Radio Frequency Agency Function Number
710	Host Country Docket Number
71I	Aeronautical Service Range and Height
715	Transmitter AREA Net Number
716	Usage Code
ADDITIONAL INFORMATION	
801	Coordination Data/Remarks
803	Requester Data
804	Tuning Range/Tuning Increments
805	Date Response Required
806	Indication if Host Nominations are Acceptable
807	Frequencies to be Deleted

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Appendix D

Joint Spectrum Interference Resolution (JSIR) Program

The JSIR program was established in October 1992 by the DOD. This program addresses persistent and recurring interference problems in joint operations, those between civil and DOD systems, and those involving space systems. It was designed as a replacement for the electromagnetic interference portion of the former DOD Meaconing, Intrusion, Jamming, and Interference (MIJI) Program that was administered by the Joint Electronic Warfare Center. For more information on the JSIR Program see CJCSI 3320.02C *Joint Spectrum Interference Resolution*.

JOINT SPECTRUM INTERFERENCE RESOLUTION PROGRAM DESCRIPTION

D-1. The focus of the JSIR program is primarily on the reporting, analysis, and resolution of persistent, recurring, non-hostile interference incidents affecting US military systems. The JSIR program is structured to have interference incidents resolved at the lowest feasible level of the DOD component chain of command, using component organic resources to resolve interference incidents where possible. Those incidents that cannot be resolved locally are referred up the chain of command with resolution attempted at each level.

D-2. In order to account for hostile interference actions, the JSIR program addresses the following categories of electronic attack:

- Meaconing is a form of imitative electromagnetic deception. This type of deception introduces electromagnetic energy into enemy systems that imitates enemy emissions.
- Electromagnetic intrusion is the intentional insertion of electromagnetic energy into transmission paths in any manner. The objective is to deceive operators or cause confusion.
- Electromagnetic jamming is the deliberate radiation, re-radiation or reflection of electromagnetic energy for the purpose of preventing or reducing an enemy's effective use of the electromagnetic spectrum. This form of attack is intended to degrade or neutralize the enemy's combat capability.

D-3. If the interference incident cannot be resolved by the affected DOD component or the service engineering agency responsible for spectrum interference resolution, it is referred to the DSO JSIR office for resolution in accordance with applicable DOD component spectrum interference resolution program instructions. Interference incidents that are suspected to be caused by hostile electronic attack will be assessed at the lowest possible level in the chain of command and reported to the DSO (for more information see CJCSI 3320.02-1[S] JSIR secret supplement). If assistance is requested for electronic attack incidents, the DSO will coordinate analysis, collection and field support activities with the National Military Command Center, joint staff, affected theater commander, IO, and intelligence communities.

RESPONSIBILITIES

D-4. Identified below are responsibilities for specific DOD components. Additionally, all DOD components will provide internal directions and procedures to implement the other responsibilities of the directive.

DSO will:

- Manage the DOD JSIR program in accordance with guidance from the Assistant Secretary of Defense (Networks and Information Integration) and the J-6.
- Resolve persistent, recurring interference problems that cannot be resolved by the DOD components. The DSO will assist the DOD components in resolving interference incidents after the incident has been coordinated and resolution has been attempted up the chain of command to service, major or the joint task force level. The DSO will analyze and recommend corrective action for reported interference problems. First by using the DSO and JSIR databases and other analytical tools; and then by providing personnel and equipment to perform on-site direction finding and equipment testing. The organization requesting JSIR services will be provided a report of the results of the JSIR analysis and appropriate information will be incorporated into the JSIR database.
- Assist United States Strategic Command (USSTRATCOM) Global Satellite Communications (SATCOM) Support Center (GSSC) in the resolution of interference problems affecting DOD SATCOM systems, to include spacecraft, ground control sites and associated user terminals.
- Develop and maintain the JSIR database, interference resolution tools (e.g., Spectrum XXI), direction finding and spectrum monitoring equipment. The DSO will maintain an automated database of interference incidents, resolutions and lessons learned for all the past MIJI reports and for all interference reports addressed to the DSO. This database will support trend analysis, future interference analysis, and will be accessible to DOD components.
- Coordinate analysis of interference incidents involving suspected hostile electronic attack with the cognizant members of the National Military Command Center, Joint Staff, affected combatant command, IO, and intelligence communities.
- Inform the DOD component interference resolution program offices of primary responsibility of interference incidents affecting systems under their cognizance.

DOD Components will:

- Attempt to resolve persistent, recurring interference problems affecting systems under their auspices at the lowest echelon possible within their chain of command. Forward interference problems that cannot be resolved up the chain of command for resolution assistance. Interference incidents that cannot be resolved will be referred to the DSO JSIR Office for assistance.
- Attempt to resolve suspected hostile electronic attacks affecting systems under their auspices at the lowest echelon possible within their chain of command. Rapidly report incidents involving suspected or confirmed hostile electronic attack to the DSO. The report will indicate whether assistance is required.
- In accordance with the CJCSI, provide information copies of interference incident reports to the DSO JSIR Office for inclusion in the JSIR database.
- Develop procedures for implementing this instruction and provide a copy of all implementing policy documents to the DSO for reference.
- Provide an interference point of contact to the DSO for the promulgation and coordination of interference incidents and policy.

USSTRATCOM's GSSC will:

- Act as focal point for all incidents of interference and electronic attack affecting DOD SATCOM systems to include spacecraft, ground control sites and associated user terminals.
- When necessary, request assistance from the DSO in the resolution of interference or electronic attack.
- When necessary, the GSSC will coordinate the request for intelligence support with the appropriate agencies to identify/resolve interference to SATCOM systems.

Appendix E

International Distress and Emergency Frequencies

The US government and DOD have adopted the international distress and emergency frequencies shown in Table E-1. Frequency assignments are not required.

E-1. Any mobile station experiencing an emergency may use the frequencies listed in Table E-1. If a mobile station in distress is unable to make contact on emergency frequencies, it may use any available means to obtain support.

E-2. Policies for using these frequencies are:

- Send distress calls or messages only on the authority of the person responsible for the ship, aircraft, or other vehicle carrying the mobile station.
- The frequencies are used only for actual emergencies, not for simulated emergency training.
- Do not radiate when testing an emergency frequency during experimental, production, or maintenance operations.
- Do not make operational checks to ensure proper system operation (confidence checks) more than once in any 24-hour period, and keep them as short as possible.
- Activities that complete a communications contact on equipment used for emergency purposes will be considered the contact for the confidence check for that period.
- Only make confidence checks with stations authorized to operate on the particular emergency frequency. Do not transmit "in the blind" for confidence checks.
- Army activities may use the Radio Amateur Civil Emergency Service (RACES) station frequencies listed in Table E-1, to make initial contact with RACES personnel to coordinate on emergency or disaster related matters.

Table E-1. Emergency Frequencies

Service	*Frequency (Emission)*	*Communication Service*	*Function*
International Distress and Emergency	500 kHz	Aeronautical, Maritime, Survival Craft	Distress (Telegraphy)
	2182 kHz	Aeronautical, Maritime Mobile, Survival Craft	Distress
	3023 kHz	Mobile	Search and Rescue
	5680 kHz	Mobile	Search and Rescue Operations
	8364 kHz	Aeronautical, Maritime Mobile	Search and Rescue
	40.5 MHz	Mobile	Military Joint Common (US&P only)
	121.5 MHz	Aeronautical	Emergency and Safety
	123.1 MHz	Aeronautical, Mobile	Search and Rescue, Scene of Action
	156.3 MHz	Aeronautical, Maritime Mobile	Search and Rescue Operations
	156.8 MHz	Maritime Mobile	Call, Reply and Safety
	243.0 MHz	Military Aeronautical	Emergency and Survival
	406-406.1 MHz	Mobile-Satellite	Emergency Position-Indicating Radiobeacon
RACES	3997 kHz (6K00A3E)	RACES Stations	Civil Emergency
	3998.5 kHz (3K00H3E)		
	53.3 MHz (36K00F3E)		

Glossary

SECTION I - ACRONYMS AND ABBREVIATIONS

Acronym	Definition
1G,2G,2.5G,3G	versions of cellular telephone referred to as generations
AAG	Aeronautical Assignment Group
AFC	area frequency coordinator
AFFMA	Air Force Frequency Management Agency
AFMO-CONUS	Army Frequency Management Office-Continental United States
AOR	area of responsibility
ASD	Assistant Secretary of Defense
ASM	Army Spectrum Manager
ASMO	Army Spectrum Management Office
C4	command, control, communications, and computers
CDMA	Code Division Multiple Access
CJTF	commander joint task force
CIO	chief information officer
CNR	combat net radio
COCOM	combatant comand (command authority)
COMSEC	communications security
CONUS	Continental United States
COTS	commercial-off-the-shelf
DGM	digital group multiplexing
DISA	Defense Information Systems Agency
DOD	Department of Defense
DOIM	Directorate of Information Management
DSD	Deputy Secretary of Defense
DSN	Defense Switched Network
DSO	Defense Spectrum Organization
E3	electromagnetic environmental effects
EHF	extremely high frequency
ELF	extremely low frequency
EMI	electromagnetic interference
EMC	electromagnetic compatibility
EPLRS	Enhanced Position Location Reporting System
EPS	Emergency Planning Subcommittee
EW	electromagnetic warfare
FAA	Federal Aviation Administration
FAS	Frequency Assignment Subcommittee

FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FLEWUG	Federal Law Enforcement Wireless Users Group
FM	frequency modulated
FSO	free space optics
FTS2000	Federal Telecommunications System 2000
G-2	Assistant Chief of Staff, Intelligence
G-3	Assistant Chief of Staff, Operations and Plans
G-4	Assistant Chief of Staff, Logistics
G-6	Assistant Chief of Staff for Command, Control, Communications, and Computer Operations
GETS	Government Emergency Telecommunications Service
GHz	gigahertz
GSA	General Services Administration
GSM	Global System for Mobile Communication
GSSC	Global Satellite Communications Support Center
HCLOS	high capacity line of sight
HF	high frequency
HNSWD	Host Nation Spectrum Worldwide Database
HQ	headquarters
Hz	hertz
ICT	information and communications technology
IEC	interexchange carrier
IEEE	Institute of Electrical and Electronics Engineers
IFM	installation frequency manager
IFRB	International Frequency Registration Board
ING	International Notification Group
IO	information operations
IOC	installation operations center
IRAC	Interdepartment Radio Advisory Committee
ISM	industrial, scientific, and medical
ITS	Institute for Telecommunication Sciences
ITU	International Telecommunications Union
ITU-D	Telecommunication Development Sector
ITU-R	Radiocommunication Sector
ITU-T	Telecommunication Sttandardization Sector
J-2	intelligence directorate of a joint staff
J-3	operations directorate of a joint staff
J-5	plans directorate of a joint staff
J-6	command, control, communications, and computer systems dirrectorate of a joint staff

JFC	joint force commander
JFMO	joint frequency management office
JFP	Joint Frequency Panel
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JSME	joint task force spectrum management element
JTF	joint task force
kHz	kilohertz
LAN	local area network
LEC	local exchange carrier
LF	low frequency
LMR	land mobile radio
LOS	line-of-sight
MAG	Military Assignment Group
MBITR	multiband inter/intra team radio
MCEB	Military Communication-Electronics Board
MF	medium frequency
MHz	megahertz
MIJI	Meaconging, Intrusion, Jamming, and Interference Program
MOA	memorandum of agreement
MOU	memorandum of understanding
MSE	mobile subscriber equipment
MSP	mobile service provider
MSRT	mobile subscriber radio-telephone terminal
NATO	North Atlantic Treaty Organization
NCC	National Coordinating Center for Telecommunications
NCS	National Communications System
NII	networks and information integration
NTC	National Training Center
NTDR	near-term digital radio
NTIA	National Telecommunications and Information Administration
OASD	Office of the Assistant Secretary of Defense
OCONUS	outside the continental United States
OIA	Office of International Affairs
OPAD	Office of Policy Analysis and Development
OPR	office of primary responsibility
OSM	Office of Spectrum Management
OTIA	Office of Telecommunications and Information Applications
PCS	personal communications system
PDA	personal digital assistant
PED	personal electronic device

PIN	personal identification number
PSWN	Public Safety Wireless Network
PTFP	Public Telecommunications Facilities Program
RACES	Radio Amateur Civil Emergency Service
RCS	Radio Conference Subcommittee
RF	radio frequency
RFA	radio frequency authorization
S-3	battalion or brigade operations section
S-4	logistics staff officer
S-6	command, control, communications and computer (C4) operations officer
SAR	satellite access request
SATCOM	satellite communications
SC TACSAT	single-channel tactical satellite
SFAF	standard frequency action format
SHF	super high frequency
SINCGARS	single-channel ground and airborne radio system
SIPRNET	SECRET Internet Protocol Router Network
SMD	spectrum management division
SMR	specialized mobile radio
SPS	Spectrum Planning Subcommittee
SSS	Space System Subcommittee
TACSAT	tactical satellite
TDMA	time division multiple access
THz	terahertz
TOC	tactical operations center
TRI-TAC	Tri-Services Tactical Communications Program
TSC	technical subcommittee
UAS	unmanned arial system
USSTRATCOM	United States Strategic Command
UHF	ultra high frequency
US&P	United States and Possessions
USACESO	United States Army Communications-Electronics Services Office
USMCEB	United States Military Communications-Electronics Board
VHF	very high frequency
WLAN	wireless local area network
WRC	world radio communication
WSMR	White Sands Missile Range

SECTION II-TERMS

assignment	A specific frequency or frequencies for use by a radio station under specified conditions.
band (frequency)	A range of frequencies.
Bluetooth	A wireless technology developed to replace cable or infrared connections between electronic devices such as desktop computers, electronic organizers, and printers.
combatant command	A unified or specified command with a broad continuing mission under a single commander established and so designated by the President, through the Secretary of Defense and with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Combatant commands typically have geographic or functional responsibilities.
command and control	The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. Also known as C2. (JP 1-02)
common operating environment	Automation services that support the development of the common reusable software modules that enable interoperability across multiple combat support applications. This includes segmentation of common software modules from existing applications, integration of commercial products, development of a common architecture, and development of common tools for application developers. Also known as COE. (JP 1-02)
electromagnetic compatibility	The ability of systems, equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response. It involves the application of sound electromagnetic spectrum management; system, equipment, and device design configuration that ensures interference-free operation; and clear concepts and doctrines that maximize operational effectiveness. Also known as EMC. (JP 1-02)
electromagnetic environmental effects	The impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. It encompasses all electromagnetic disciplines, including electromagnetic compatibility/ electromagnetic interference; electromagnetic vulnerability; electromagnetic pulse; electronic protection, hazards of electromagnetic radiation to personnel, ordnance, and volatile materials; and natural phenomena effects of lightning and p-static. Also known as E3. (JP 1-02)

electromagnetic interference	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. Also known as EMI. (JP 1-02)
electromagnetic spectrum	The range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 alphabetically designated bands. (JP 1-02)
frequency coordination	The process of coordinating with the responsible area frequency coordinator (AFC) to obtain spectrum support for installation radios and emitters.
frequency deconfliction	A systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. Frequency deconfliction is one element of electromagnetic spectrum management. (JP 1-02)
Redbook	Unofficial name for the NTIA *Manual of Regulations* and *Procedures for Federal Radio Frequency Management*
S-3 section	battalion or brigade operations section
specified command	A command that has a broad, continuing mission, normally functional, and is established and so designated by the President through the Secretary of Defense with the advice and assistance of the Chairman of the Joint Chiefs of Staff. It normally is composed of forces from a single Military Department. Also called specified combatant command (JP 1-02).
spectrum management	Planning, coordinating, and managing joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures. The objective of spectrum management is to enable electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference.
spectrum supportability	Spectrum supportability is the process of actively integrating spectrum management considerations into all phases of the combat development and materiel development of a spectrum-dependent equipment or system. It includes integration of spectrum considerations into operational requirements documentations, e.g., Mission Needs Statement (MNS), Required Operational Capability (ROC). It involves the investigation and evaluation of spectrum available and identification of potential operational frequency problems in various host nations in which the equipment or system is intended to operate. Army spectrum managers continually study frequency supportability problems and actively assist the developers in resolving frequency supportability issues throughout the life cycle of the spectrum-dependent system or equipment.

Telecommunication	Any transmission, emission, or reception of signs, signals, writings, images, sounds, or information of any nature by wire, radio, visual, or other electromagnetic systems. (JP 1-02)
Unified Command	A command with a broad continuing mission under a single commander and composed of significant assigned components of two or more military departments, that is established and so designated by the President through the Secretary of Defense with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Also called unified combatant command (JP 1-02).

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By order of the Secretary of the Army:

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