FM 6-02.70

ARMY ELECTROMAGNETIC SPECTRUM OPERATIONS

May 2010

HEADQUARTERS, DEPARTMENT OF THE ARMY

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Field Manual
No. 6-02.70

Headquarters
Department of the Army
Washington, DC, 20 May 2010

ARMY ELECTROMAGNETIC SPECTRUM OPERATIONS

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***This publication supersedes FMI 6-02.70, 5 September 2006**

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Preface

This manual provides an overview of electromagnetic spectrum operations 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 electromagnetic spectrum operations 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 electromagnetic spectrum manager, but it is also useful for signal leaders and supervisors to gain an understanding of electromagnetic spectrum operations.

The most significant changes in this manual from the previous edition are in Chapters 1, 5, and 6. Chapter 1 has been revised to include the introduction of electromagnetic spectrum operations, the tenets that constitute electromagnetic spectrum operations, and an overview of how electromagnetic spectrum operations support full spectrum operations. Chapter 5 has been revised to include corps and below operations in addition to a better explanation of coordination with electronic warfare operations. Chapter 6 has been updated and revised substantially particularly in regard to equipment updates. Numerous minor updates and revisions have been included throughout the manual to reflect changes in organizations, technologies, and processes.

This publication applies 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 of this publication is the United States Army Training and Doctrine Command (TRADOC). The preparing agency is the United States Army Signal Center, approved by Combined Arms Doctrine Directorate. Send comments and recommendations on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Forms) directly to: Commander, United States Army Signal Center of Excellence and Fort Gordon, ATTN: ATZH-IDC-CB (Doctrine Branch), Fort Gordon, Georgia 30905-5075, or via e-mail to signal.doctrine@conus.army.mil or signal.doctrine@us.army.mil.

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

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Chapter 1

Electromagnetic Spectrum Operations Introduction

Electromagnetic spectrum operations (EMSO) provide the resource necessary for the implementation of the wireless portion of net-centric warfare. Understanding the operational process in planning, managing, and employing this resource is critical to the conduct of all warfighting functions. This chapter provides an introduction to EMSO, its importance during military operations, and the electromagnetic spectrum operations management process.

WHAT IS ELECTROMAGNETIC SPECTRUM OPERATIONS?

1-1. EMSO is the overarching concept that incorporates spectrum management, frequency assignments, policy implementation, and host nation coordination that enables the commander's effective use of the electromagnetic spectrum for full spectrum operations (refer to FM 3-0 for further information on full spectrum operations). EMSO enable and support the six warfighting functions of: command and control, intelligence, fires, movement and maneuver, protection, and sustainment (refer to Figure 1-1).

1-2. EMSO consists of planning, operating and coordinating the use of the electromagnetic spectrum through operational, engineering, administrative and policy implementation procedures. The objective of EMSO is to enable electronic systems that rely on wireless connectivity to perform their functions in the intended environment without causing or suffering unacceptable frequency fratricide.

1-3. EMSO is one of the three signal regiment's core competencies. The two additional signal regiment core competencies are network operations (which includes network management/enterprise systems management; information assurance/computer network defense; and information dissemination management/content staging) and visual information.

1-4. EMSO is a responsibility of the assistant chief of staff, signal (G-6)/signal staff officer (S-6); and is normally performed by trained electromagnetic spectrum managers, hereafter referred to as spectrum managers, from the brigade through Army component level. EMSO is largely a hierarchal process that is bottom driven for requirements, but top fed for spectrum resources. Coordination between electronic warfare (EW), operations (OPS), network operations (NETOPS), and other known users is imperative in order to maximize use of the electromagnetic spectrum, hereafter simply referred to as spectrum.

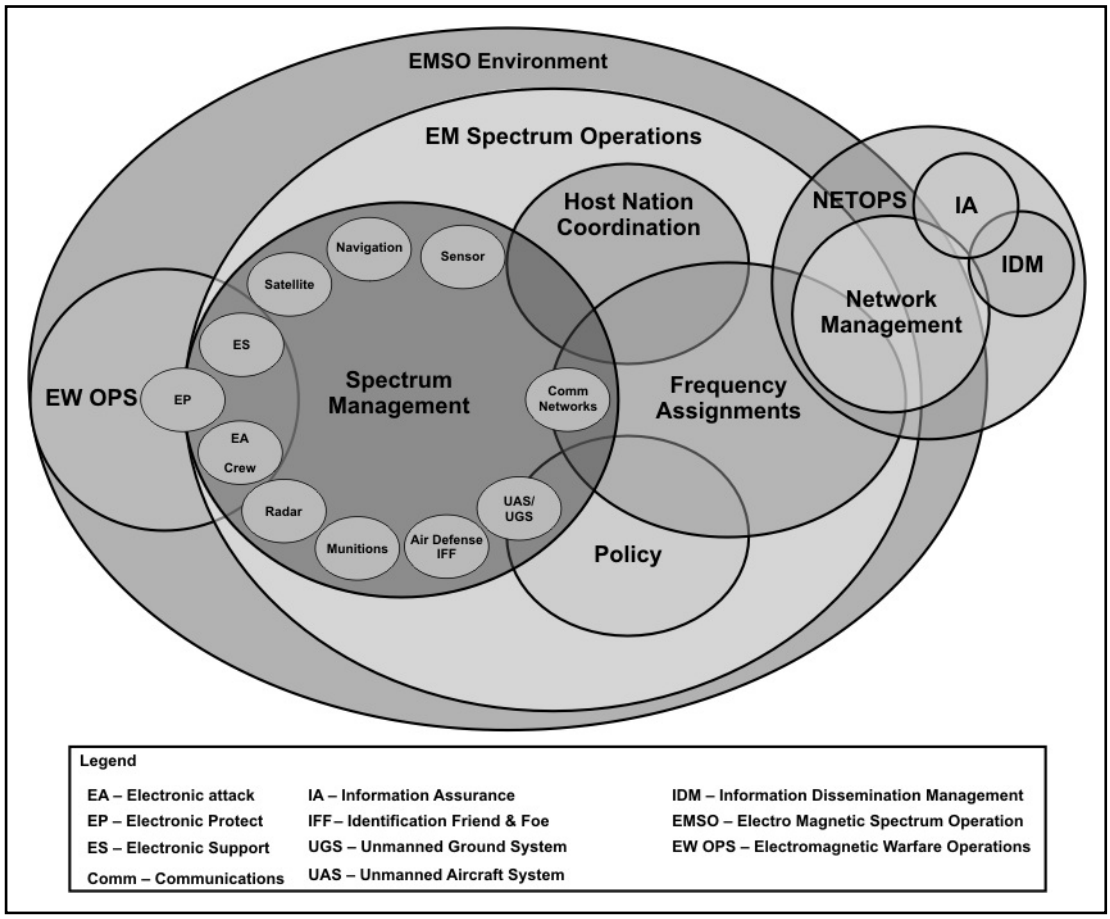

Figure 1-1. Electromagnetic spectrum operations

SPECTRUM MANAGEMENT

1-5. Spectrum management consists of evaluating and mitigating electromagnetic environmental effects (E^3), managing frequency records and databases, deconflicting frequencies, frequency interference resolution, allotting frequencies, and EW coordination to ensure electromagnetic dependent systems operate as intended.

1-6. The objective of Army spectrum management is to ensure access to the frequency spectrum in order to support users conducting the Army's operational mission. Spectrum management enables the allotment of the vital, but limited, natural resources that directly support operational forces throughout the world. The Army is dependent upon the use of the radio spectrum to communicate from the strategic to the tactical levels of war to carry out its assigned responsibilities for national security. Spectrum management enables electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference.

1-7. Spectrum dependent systems throughout the strategic and tactical arenas compete for the limited resources of spectrum and bandwidth. Spectrum management provides the means for managing the frequencies that provide spectrum support to users. This is accomplished by—

- Identifying the user's spectrum service requirements (what, when, and where).
- Identifying which communications networks and spectrum dependent systems require frequency allocations to meet the user's needs.
- Ensuring the availability of, and access to, the spectrum to meet the user's requirements.
- Protecting spectrum resources from misuse by stringently adhering to national, international, Department of Defense (DOD), and Army policies.

1-8. The Army accomplishes spectrum management by—

- Allocating frequency bands for specific functions or radio services, such as broadcast, fixed, mobile, and amateur.
- Allotting specific bands or frequencies within a prescribed (nationally or internationally) allocated band.
- Assigning radio frequencies to the user.
- Enforcing, identifying, and eliminating unauthorized use of the frequency spectrum with potentially punitive measures.
- Approving and gaining authorization for electronic attack operations.
- Identifying, resolving, or reporting interference.
- Working with other government and civil agencies to share resources when resources available are inadequate for operations or training.
- Performing frequency deconfliction to ensure systems can operate within their intended environment, either in peacetime or during war.
- Assisting with spectrum supportability assessments for new emitters.

1-9. Army spectrum management is under the control of the Army Spectrum Management Office (ASMO). The Army spectrum manager (ASM) directs Army-wide spectrum management activities. This includes the development and implementation of spectrum management policy, coordination of Army spectrum access requirements with the United States (US) government organizations, and the allocation of radio frequency (RF) assignments in support of Army operations. The ASM is the spectrum supportability certification authority for RF dependent systems and provides guidance to material developers with the identification of spectrum for both the continental United States (CONUS) and outside the continental United States (OCONUS) use. The ASM serves as the principle advisor to the Army Chief Information Officer (CIO)/G-6 in regard to RF spectrum management and regulatory matters and represents Army requirements in both National and International regulatory and policy forums.

FREQUENCY ASSIGNMENT

1-10. The frequency assignment function of EMSO entails the requesting and issuance of authorization to use frequencies for specific equipment. Examples of frequency assignment are providing the frequencies for assignment to a combat net radio (CNR) network, providing frequencies for unmanned aerial systems (UAS), or providing the frequencies for assignment to a line of sight (LOS) network.

HOST NATION COORDINATION

1-11. Each nation has sovereignty over its spectrum and the use of the spectrum must be negotiated on a case-by-case basis. Approval to transmit within a country is based on the sovereignty of that country and their regulatory processes that evaluate the US DOD request for use of spectrum perceived potential for electromagnetic interference (EMI) to local receivers. Use of military or commercial spectrum systems in host nations requires coordination and negotiation that result in formal approvals and certifications.

POLICY

1-12. International use of the spectrum is coordinated globally through the International Telecommunications Union (ITU) through a World Radio communication Conference which is held every two to three years. In the US, at the national level, the responsibility of spectrum management is divided between the National Telecommunications and Information Administration for government frequencies and the Federal Communications Commission (FCC) for nongovernment frequencies. The United States Military Communications-Electronics Board (USMCEB), commonly referred to as the Military Communications Electronics Board (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 (JCS).

1-13. The MCEB guides the DOD in preparing and coordinating technical directives and agreements and in allocating spectrum allotments from the National Telecommunications and Information Administration. The main enforcement mechanism for DOD systems is the JF-12 Spectrum Certification process (the frequency allocation to equipment process utilizing the DD Form 1494, Application for Equipment Frequency Allocation). An application for Spectrum Certification (DD Form 1494) must be completed for all systems and equipment that emit or receive Hertzian waves. Spectrum certification (JF-12) is discussed in detail in Chapter 4 of Army Regulation (AR) 5-12. Failure to adhere to these policies and regulations can cause problems that lead to mission failure, equipment damage, and loss of life.

ENABLING THE FORCE

1-14. EMSO is often addressed as an afterthought in the acquisition and operational processes. Part of the mission of those that perform this function is to educate others on the value of spectrum operations. 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 it cannot be touched or seen. The use of spectrum must be addressed early and throughout acquisition, planning, and operational processes in order to ensure the execution of continuous, simultaneous combinations of offensive, defensive, and stability, and civil support tasks.

1-15. EMSO enables and supports network operations, not only for communications systems (strategic, operational, and tactical) and EW, but EMSO is also critical to a myriad of other systems such as; air defense, navigation, munitions, manned and unmanned vehicles of all types (ground and air, unmanned ground systems [UGS]/UAS), radar, sensor, and potentially a whole host of other future systems. These electronic systems that rely on wireless connectivity are part of critical technology insertions that provide the foundation for the net-centric operational environment.

1-16. 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 operational environment including airborne platforms such as surrogate satellites, UASs, space platforms and subterranean systems.

ELECTROMAGNETIC SPECTRUM OPERATIONS MANAGEMENT PROCESS

1-17. The EMSO management process is comprised of three interacting and continuous functions: planning, coordinating, and operating. During full spectrum operations these functions occur concurrently. (Refer to Figure 1-2 illustrating the Army EMSO management process.)

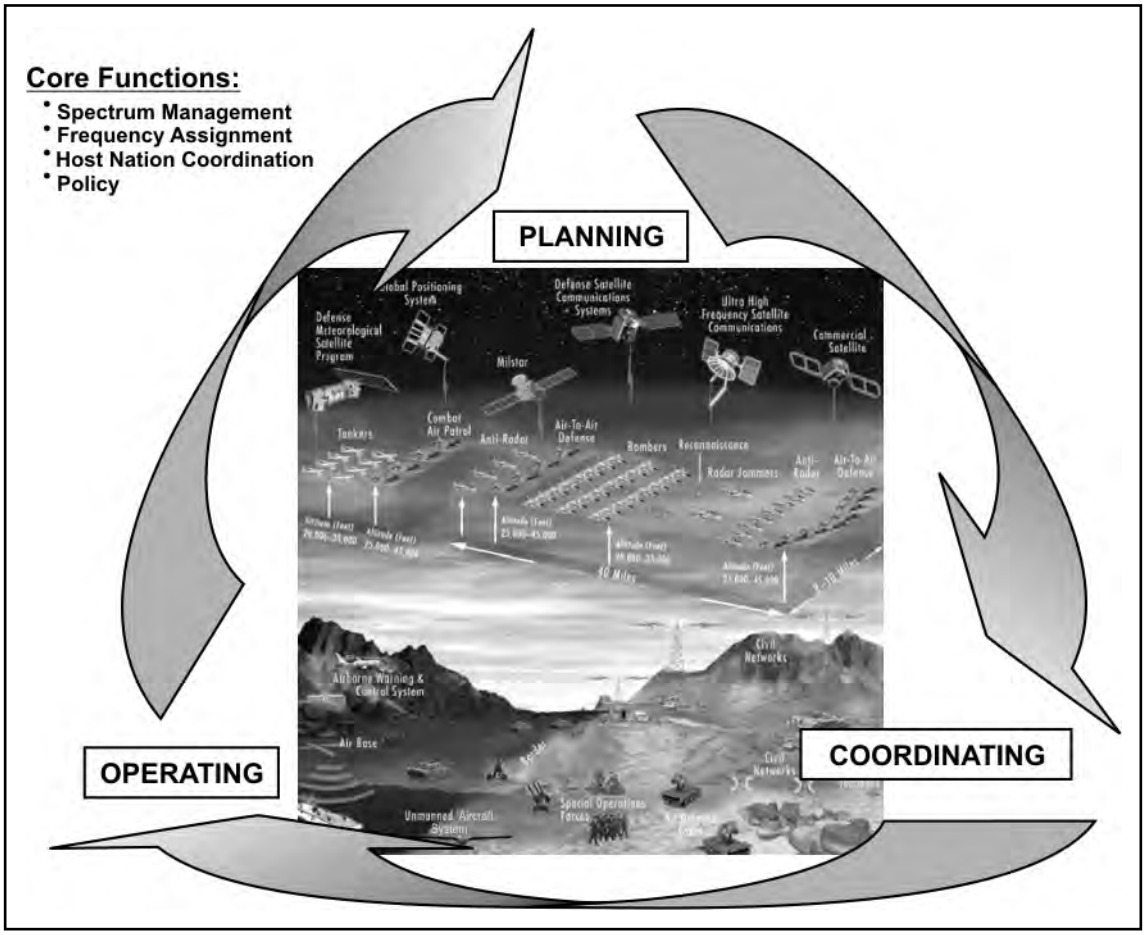

Figure 1-2. Army EMSO management process

PLANNING

1-18. EMSO planning includes the identification of spectrum requirements for training, pre-deployment, deployment, and reconstitution of Army forces, CONUS and OCONUS. EMSO planning is an on-going process that must be deliberate as well as dynamic to support future force operations. It requires the collection, storage, and protection of critical spectrum data, and assured access to spectrum planners on a global scale. Additionally, planning for the establishment of lines of communications for coordination of spectrum use with national and international government and non-government agencies is critical to the spectrum planning process.

COORDINATING

1-19. Coordinating spectrum use is the process of collaborating with US national, host-nation, government and non-government agencies, and joint, interagency, intergovernmental, multinational (JIIM) forces in specific operational areas. This function will ensure initial spectrum availability and supportability for operations. Lines of communication for coordinating spectrum allocation at the national and international level are primarily a matter of policy and must be established in the planning process. Coordination at the operational Army level for the future force will require prior coordination as well as a dynamic, real-time collaboration tool.

OPERATING

1-20. The operating function enables and sustains the functions of planning and coordinating. It includes the process to plan, conduct, coordinate, and sustain spectrum operations. EMSO ensure the efficient use of allocated spectrum and associated frequencies in a given area of operations. The operating function enables dynamic, near real-time frequency assignment, re-assignment, interference resolution, and deconfliction across all users in an area of operations. The architecture provides for interoperability with US national and local government and non-government agencies as well as JIIM forces.

SUMMARY

1-21. EMSO functions (as depicted in Figure 1-2) are executed in a continuous cycle from training to the onset of deployment notification, through deployment, reception, staging, onward movement and integration, decisive operations, recovery and re-deployment to home station. The functions of EMSO are interrelated and supportive of a commander's ability to understand, plan, and dedicate specific capabilities across the full spectrum of operations at home or abroad, on-the-move or at-the-halt. Modular force spectrum dependent capabilities require that these functions are performed in near real-time. In order to fulfill this requirement the processes that support EMSO must be deliberate, dynamic, and supportable on a global scale.

Chapter 2

International, National, and Host Nation Spectrum Management

This chapter provides an overview of international, national, and host nation organizations and agencies that are primarily responsible for policy concerning spectrum use. Electromagnetic spectrum management at this level is strategic in nature. Since both operational and tactical spectrum management policy and decisions are based on international, national, and host nation 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. These nations have agreed to an International Telecommunications Convention. This serves as the basic instrument of the 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 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 the 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.

2-4. The ITU-R 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.

2-5. Changes to the *Radio Regulations* can only be made by a World Radio communication Conference (WRC). 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.

2-6. 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.

2-7. Army tactical operations, aside from Homeland Defense (HLD) and Defense Support of Civil Authorities (DSCA) missions, are assumed to take place on the territory of other nations. Most nations derive their national tables of allocation from the ITU. An overriding ITU principle is that nations retain sovereign rights over their use of the radio spectrum. Nations may modify the *Radio Regulations* for national use within their own territory. Nevertheless, ITU members must conform to the *Radio Regulations* with respect to emissions extending beyond their territory and into space.

2-8. Article 48 of the ITU Constitution states that ITU members retain freedom with regard to military radio installations within their territory. It further directs that military installations must, so far as possible, observe statutory provisions relative to giving assistance in case of distress, observe measures to avoid harmful radio interference, and comply with the provisions of the ITU Administrative Regulations as they pertain to the installation's emissions. Article 48 allows for an extension of military use of the spectrum in exceptional circumstances and in derogation of the *Radio Regulations*. Military commanders must be aware of their responsibilities with respect to these regulations.

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

NATIONAL SPECTRUM MANAGEMENT

2-9. The Communications Act of 1934, as amended, governs radio spectrum use in the United States and its possessions (US&P). The act established duality in spectrum management in the US between the President for federal government stations and the FCC under the direction of Congress. The FCC regulates the spectrum use of nonfederal operated radio stations, common carriers, and private organizations or individuals. By Executive Order 12046 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. Refer to Figure 2-1 for a diagram of the organizations architecture.

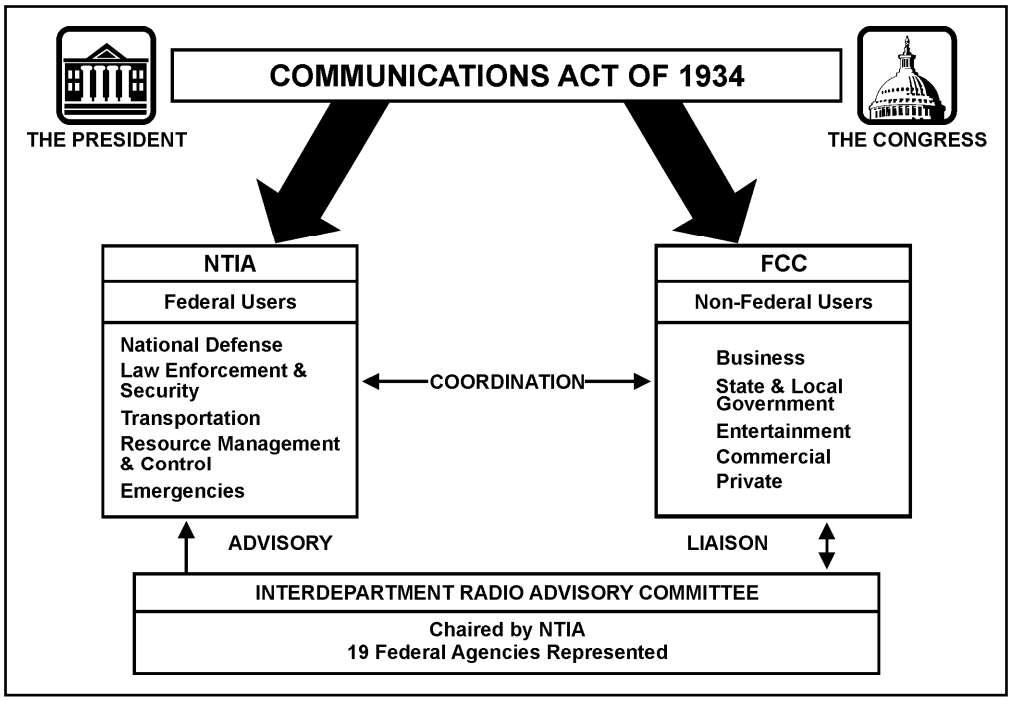

Figure 2-1. National spectrum management

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

2-10. 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.

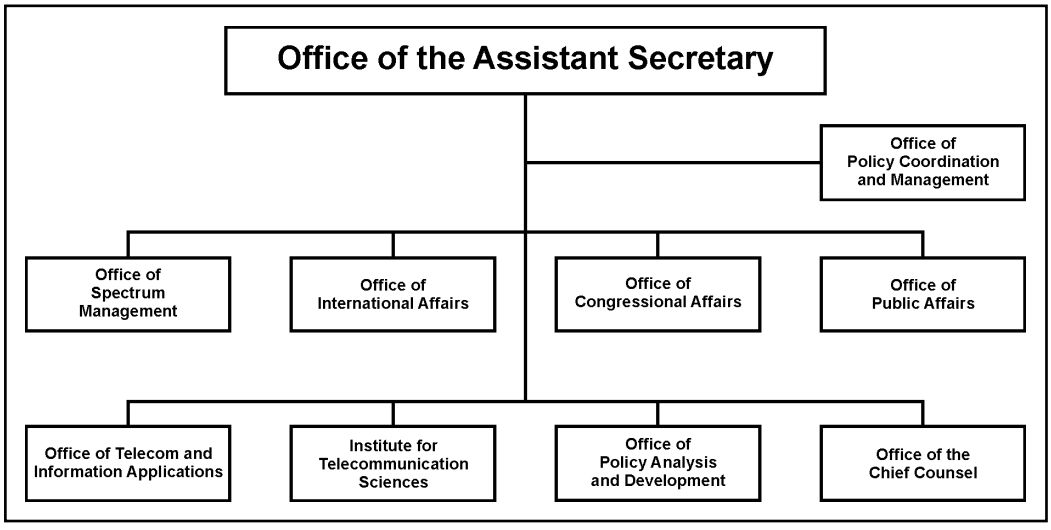

Figure 2-2. National telecommunications and information administration The Office of Spectrum Management

2-11. The Office of Spectrum Management (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. Refer to Appendix A for additional information on the spectrum certification process.

THE INTERDEPARTMENT RADIO ADVISORY COMMITTEE

2-12. The Interdepartment Radio Advisory Committee (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.

2-13. The six current subcommittees are—

- **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. The 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**—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**—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**—responsible for functions that relate to preparing for ITU radio conferences, including the development of recommended US proposals and positions.
- **Space System Subcommittee**—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 refer to the NTIA Web site at http://www.ntia.doc.gov/

THE OFFICE OF POLICY ANALYSIS AND DEVELOPMENT

2-14. The Office of Policy Analysis and Development (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

2-15. The Office of International Affairs (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 forums to promote policies that open ICT markets and encourage competition.

THE INSTITUTE FOR TELECOMMUNICATION SCIENCES

2-16. The Institute for Telecommunication Sciences (ITS) is the research and engineering laboratory of the NTIA. The 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

2-17. The Office of Telecommunications and Information Applications (OTIA) administers the Technology Opportunities Program, which provides matching grants to non-profit organizations and state and local governments across the US to demonstrate innovative applications of advanced telecommunications and information technology. The 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

2-18. 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.

2-19. 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.

2-20. 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

2-21. A host nation is a sovereign nation, including the US, in which the DOD plans or is likely to conduct military operations with the permission of that nation. Unlike the US 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.

2-22. There is no standard format or process for negotiating spectrum usage with individual nations and the spectrum manager should become familiar with respective formats and processes for each nation they deal with. The spectrum manager should also be familiar with the host nation radio service allocations and channeling plans.

2-23. 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 is a portal based tool located on the SECRET Internet Protocol Router Network (SIPRNET). HNSWD automates the distribution of host nation coordination requests and combatant command submission of host nation supportability comments (data).

2-24. 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 Soldier 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 (JSC) at www.jsc.mil.

Chapter 3

Department of Defense Spectrum Management

This chapter describes the functions and relationship of DOD spectrum management organizations. For more information concerning DOD spectrum management refer to DOD Directive 4650.1.

OVERVIEW

3-1. Spectrum management within the 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, outlines the relationships of these organizations.

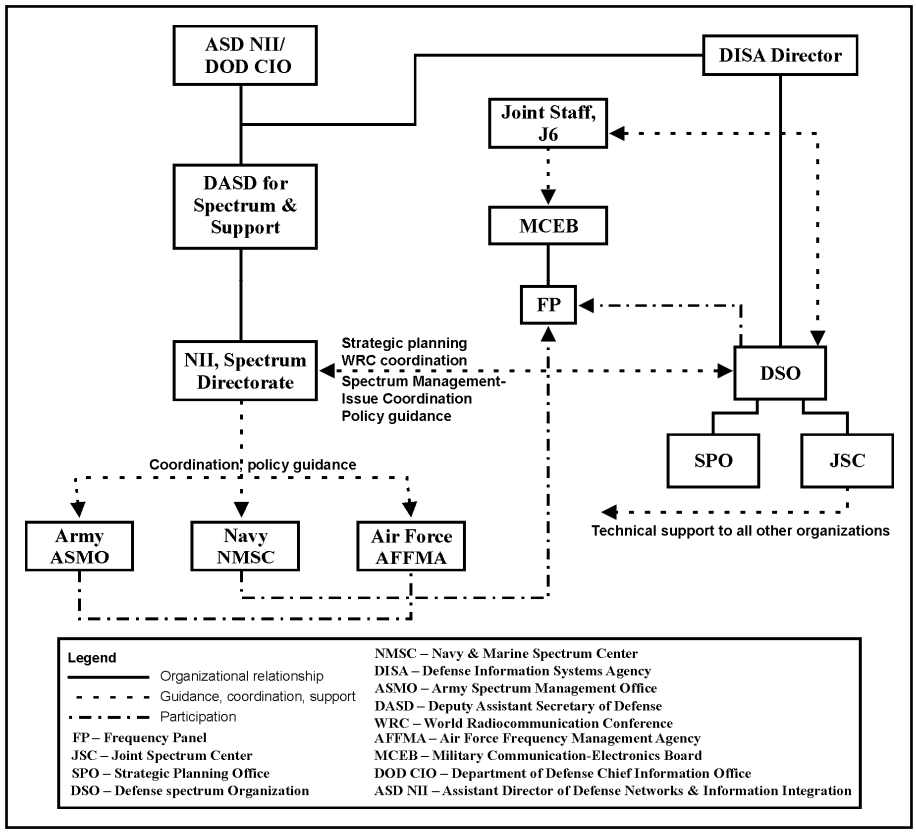

Figure 3-1. DOD spectrum management

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

3-2. The Assistant Secretary of Defense (ASD) for NII is the CIO for the DOD. The secretary serves as the principal staff assistant and advisor to the Secretary and Deputy Secretary of Defense (DSD) on spectrum related matters. Within the OASD, the Deputy Assistant Secretary of Defense (DASD) 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 is comprised of two elements; the JSC and the Strategic Planning Office (SPO).

3-4. The JSC is a field office within the DSO. The DSO provides services such as spectrum planning guidance, electromagnetic environmental effects (E^3) modeling and simulation, operational support, and spectrum management software development. These services are provided to the combatant command, 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.

3-5. The SPO develops comprehensive and integrated spectrum planning strategies for the DOD, to support National spectrum planning efforts as well as DOD requirements and acquisition processes. The SPO provides a proactive role to ensure the DOD is prepared to respond to international spectrum management issues and enhance the DOD global spectrum access. The SPO develops the DOD strategies, for presentation to spectrum bodies within international organizations (e.g., the ITU, regional bodies, and North Atlantic Treaty Organization [NATO]). To promote the insertion of effective and efficient spectrum access technologies, key strategic alliances with government, industry, and academia are formed with the SPO to maximize DOD spectrum utilization in order to meet mission requirements.

UNITED STATES MILITARY COMMUNICATIONS-ELECTRONICS BOARD

3-6. The 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 JCS. 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.

3-7. The MCEB is composed of the director of the 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.

3-8. 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.

SERVICE LEVEL OFFICES

3-9. The ASMO is the Army Service level office for all spectrum related matters. The ASMO coordinates RF spectrum policy and guidance. It also represents the Army in spectrum negotiations with civil, military, national and international regulatory organizations. The 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 Army CIO/G-6 in regard to RF spectrum management and radio regulatory matters. The other services are represented by their respective service level offices which are the Air Force Frequency Management Agency (AFFMA) and the Naval Electromagnetic Spectrum Center.

3-10. The Army Frequency Management Office (AFMO)-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. The CONUS is broken down by region and each region is assigned an area frequency coordinator (AFC).

3-11. The AFFMA defends and articulates Air Force spectrum access to regulatory agencies at the joint, national, and international levels. Its mission is to plan, provide, and preserve access to the RF spectrum for the Air Force and selected DOD activities in support of national policy objectives, systems development, and global operations through analysis and negotiation with international and national, civil and military organizations.

3-12. The Navy and Marine Spectrum Center (NMSC) is the Department of the Navy activity responsible to ensure compliance with International, National, and DOD electromagnetic spectrum management policies and regulations. NMSC represents the electromagnetic spectrum policy interests of the Department of the Navy, and is the Navy's primary organization responsible for implementation of electromagnetic spectrum policy.

AREA FREQUENCY COORDINATOR

3-13. AFCs are responsible for coordination of spectrum use within a geographic area of responsibility (AOR). 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.

3-14. 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 ASM/Director of US Army Communications-Electronics Services Office.

3-15. 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). Chapter 8 of the NTIA Manual contains criteria and procedures applicable to spectrum sharing among stations in the space and terrestrial radio communications services, notably the WSMR.

3-16. A complete list of AFCs 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.)

FREQUENCY SPECTRUM PROPONENCY OFFICE

3-17. The Frequency Spectrum Proponency Office (FSPO), located at Fort Gordon, Georgia, is TRADOC's proponent and principle source of expertise for the coordination of combat development projects in the field of RF spectrum use and management. The FSPO supports TRADOC in all matters concerning frequency spectrum doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) for all RF dependent systems to include non-communications equipment such as sensors, weapons systems, radars, and UASs. The FSPO also ensures requirements documents adequately address spectrum access and spectrum certification in order to ensure spectrum access for current and objective force systems.

Chapter 4
Joint Spectrum Operations

This chapter provides an overview of the planning, coordination, and control of the spectrum in a joint environment. Refer to Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3320.01B and Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3320.01B 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.

4-2. 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.

4-3. Military operations rely heavily on equipment using the limited resources of the electromagnetic spectrum. In joint 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 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 E^3.

4-4. 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 E^3 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 multinational forces.

4-5. The Joint Frequency Management Office (JFMO) controls all US military usage of the frequency spectrum within the combatant command AOR as designated by the JCS in accordance with established policy. To carry out this responsibility, JFMO is designated as the office responsible for overall spectrum management throughout the combatant command to include those areas, identified in Allied Communications Publication (ACP) 190 US SUPP-1, which fall within the US&P and US SUPP-2() throughout foreign areas.

4-6. Typically the JFMO will—

- Assign frequencies throughout in accordance with existing national and international instructions and agreements, as authorized by higher authority.
- Affect the necessary coordination with host governments in accordance with existing policies in areas not under the specific jurisdiction of a subordinate combatant command representative to satisfy US military spectrum requirements.
- Coordinate as necessary all frequency requirements with the JCS/USMCEB/Frequency Panel for both inter-area and intra-area.

- Be responsible for the coordination and development of supplementary instructions for specific spectrum management functions within their AOR and 200 nautical mile radius thereof.
- Functions as a member and supports the IO cell, Joint Force Commanders EW Staff (JCEWS) and the EW Coordination Cell (EWCC).
- Act as the focal point for resolution of EMI within their AOR.
- Assist in the resolution of EMI problems that cannot be resolved at a lower level and refer unresolved interference issues to appropriate agencies for assistance.
- Provide the JTF spectrum planning guidance to 'stability operations or civil support operations' in the electromagnetic battlefield.
- Assists the service components with spectrum supportability assessments and determinations for new emitters.

ELECTROMAGNETIC SPECTRUM PLANNING, COORDINATION, AND CONTROL

4-7. 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

4-8. 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.

4-9. 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 EMI and radiation hazards may become a severe limitation to rapid deployment and employment of forces.

JOINT SPECTRUM COORDINATION

4-10. 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 communications systems directorate of a joint staff (J-6). To minimize unacceptable EMI among all emitters and receivers, and to address E^3 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 (refer to Figure 4-1).

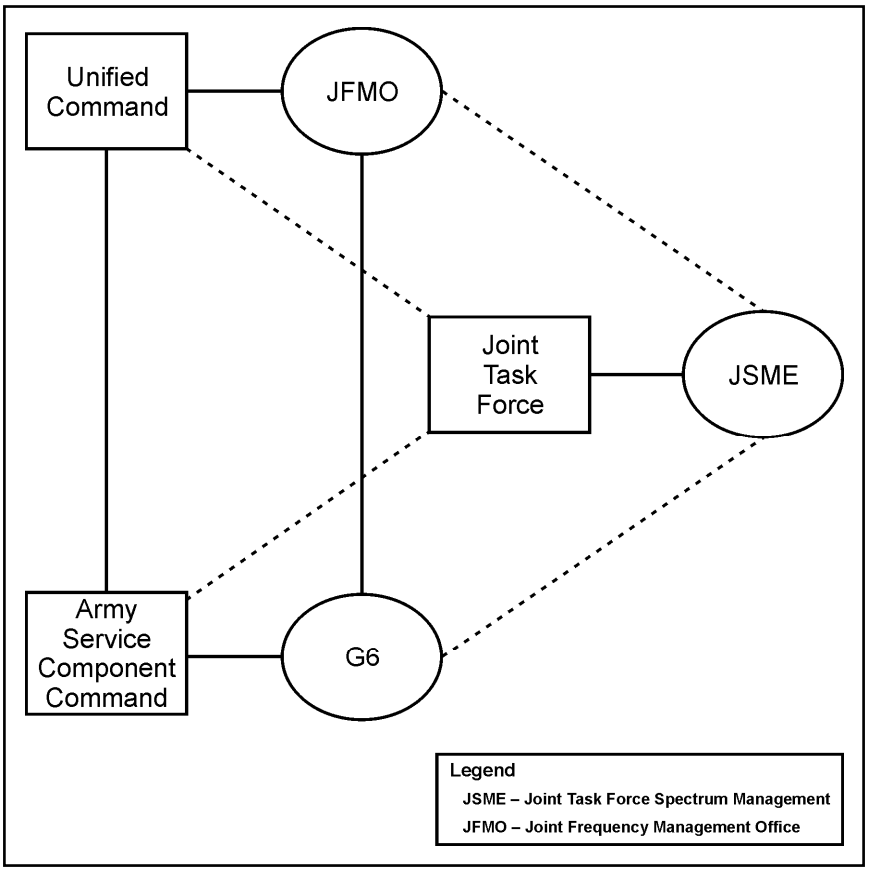

Figure 4-1. Army coordination in a joint environment

JOINT SPECTRUM CONCEPT OF CONTROL

4-11. The supported joint force commander (JFC), or commander joint task force (CJTF), holds the authority for assigning frequencies to users through the JFMO or joint spectrum management element (JSME). The JFMO or JSME may delegate frequency assignment authority to subordinate commands, decentralizing the management of EMSO. 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. The JSME will manage all spectrum assets once approved.

4-12. JSME is composed of a JTF spectrum manager and committing forces service component spectrum managers. The JSME may be assigned from the supported component's J-6 staff, from a Service component's staff, or from an external command. The JSME must be staffed with trained spectrum managers, preferably with experience in joint operations and knowledge of the spectrum requirements of the JTF component forces.

4-13. Military frequency planning for operations and exercises within the OCONUS AOR will normally be coordinated and controlled through the JSME of a multinational/joint task force. Coordination with foreign military or host government agencies is normally conducted by JFMO or other JFMOs located in the AOR.

4-14. Planning for use of the spectrum resource and the assignment of spectrum management responsibilities to meet an operational requirement must be fully integrated into the operational planning and execution process and must start as early as possible. Each military command should establish planning procedures to address all spectrum-dependent equipment used in support of the operation plan.

4-15. 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.

4-16. 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 current operational EW related considerations. 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.

4-17. Spectrum XXI software program is the primary frequency management automation tool used for generating and processing of standard frequency action format (SFAF) transactions within DOD.

4-18. The main communications document used by Joint Services is the Joint Communications-electronics Operating Instructions (JCEOI). It will be developed and generated using the current version of the Joint Automated Communication-electronics Operating Instructions (CEOI) System software, as directed by CJCS. Although signal operating instruction (SOI) formats vary from one Service component to another, the JCEOI is the standard format for JTF operations. A CEOI and SOI are the same as a JCEOI but used in other applications (such as Army only and NATO). The JCEOI/CEOI is a series of orders issued by the commander for technical control and coordination of the signal operations within the command. The product includes complete listings of all participants and their communications requirements.

4-19. Coordination procedures include—

- All routine frequency requests will be submitted as prescribed in MCEB Pub 7 at least 90 days prior to commencement of the requirement within US&P and outside US&P.
- JFMO is responsible for coordination with the appropriate host nation. The time period required for host nation coordination varies by country and is influenced by individual items in each proposal.
- JFMO is responsible for frequency coordination and assignments (temporary or permanent) for all US Military forces within their AOR.

4-20. Combatant Command Support Teams. The JSC J-3 provides combatant command support teams that perform a variety of spectrum management and planning functions for combatant command or JTF commanders. This support is available for both contingencies and joint training exercises, and can be provided from the JSC or on-site. The JSC combatant command support teams provide automated frequency management support and training, electromagnetic environmental database support, electromagnetic compatibility analysis support, and Joint Spectrum Interference Resolution (JSIR) support. In addition, they assist in the development and/or generation of JCEOI and joint restricted frequency lists (JRFL), as well as providing support to the EWCC and the IO cell.

Chapter 5

Tactical Electromagnetic Spectrum Operations

EMSO at corps and below are dynamic and require continuous coordination among all echelons and warfighting functions both laterally and horizontally in order to mitigate harmful interference. This chapter describes the roles, functions, and tasks of EMSO at corps and below with an emphasis on tactical operations.

SPECTRUM OPERATIONS FOR CORPS AND BELOW

5-1. The goal of tactical spectrum operations 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 operations at the tactical level can be a very complicated and a time consuming process given the limited functionality of the tools available.

5-2. In the past, the bulk of spectrum management was concerned with networked communications emitters and CNR networks. Today, the tactical environment includes 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 enable the warfighting functions.

5-3. Spectrum operations is bottom driven for requirements while top fed for resources. The brigade combat teams represent the “pointy end of the spear” and it is critical that all requirements are captured by the G-6, or S-6, at each echelon to ensure commanders receive the proper resources.

5-4. 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 AOR and to ensure all requirements for spectrum access are identified. A database of all known RF emitters in the AOR must be maintained by the G-6/S-6 to ensure that competing systems can be identified and, when necessary, prioritized for frequency assignments.

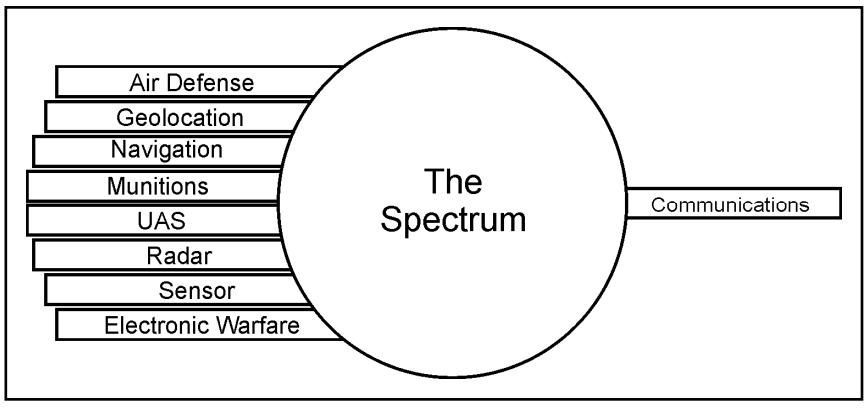

Figure 5-1. Spectrum users

CORPS SPECTRUM OPERATIONS

5-5. In the corps there are three spectrum managers. They are members of the G-6 in the corps signal company. The spectrum management chief is the principle advisor to the commander for RF spectrum related matters and is the Army spectrum authority in a corps AOR. The other two spectrum managers assist the spectrum management chief in performing corps spectrum management duties. Normally one will assist the network planners and the other will manage the SOI and other functions that fall outside of the network. The corps spectrum management chief may also be designated as the JTF spectrum manager if the Army is selected to be the lead service in a joint operation. (Refer to Chapter 4 of this manual for JTF operations.)

5-6. At the corps, spectrum operations place more emphasis on host nation coordination and establishing policy and procedure to assure the necessary spectrum is available for operations and that it is used as efficiently as possible. This is done through developing standing operating procedures (SOPs) based on joint and service regulations, instructions, policies, and doctrine.

5-7. The corps spectrum manager's responsibilities include–

- Assist in the development and publishing of communications annexes and appendices.
- Develop, produce, and disseminate spectrum operations SOPs.
- Create and send a data call message.
- Determine if equipment has spectrum supportability.
- Coordinate host nation spectrum use.
- Develop, create, and distribute the SOI.
- Coordinate and participate with other staff sections and cells such as: the assistant chief of staff, intelligence (G-2); assistant chief of staff, operations (G-3); EW and IO.
- Coordinate with joint, international, and multinational forces to support unified actions.
- Perform prescribed reviews for frequency use and requirements.
- Provide frequency engineering support for communications network design and operations.
- Interference identity, analysis, resolution and reporting.
- Assist in JRFL production and promulgation.

DIVISION AND BRIGADE SPECTRUM OPERATIONS

5-8. The role of the division and brigade spectrum manager are similar 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 combatant command or JTF).

5-9. In the current force structure there are two spectrum managers per division at the G-6. Normally, one spectrum manager will be responsible for the network frequency assignments to include satellite authorization deconfliction. The network planners design the network which determines the spectrum requirement, and the spectrum manager uses this design to request the spectrum requirements necessary for the communications network. The other spectrum manager will be responsible for CNR and other systems requirements to include fires, EW, radar, and other systems.

5-10. The brigade spectrum manager performs all of these functions and should be located at the S-6 in order to have visibility of all spectrum related matters at the brigade. The brigade is the lowest echelon to have a spectrum manager. Echelons lower than brigade will coordinate their spectrum requirements and concerns through the brigade spectrum manager.

5-11. The division and brigade spectrum managers responsibilities include the following–

- Advise the commander in spectrum prioritization and implementation.
- Build and distribute Single-Channel Ground and Airborne Radio System (SINCGARS) loadsets.
- Request, obtain, and distribute frequencies for all emitters.
- Perform RF network analysis to engineer LOS radio links and assign frequencies.
- Advise network planners in matters concerning spectrum management.

- Maintain and update databases.
- Advise and coordinate with EW personnel for frequency planning and use.
- Perform spectrum analysis and deconfliction.
- Coordinate satellite authorization deconfliction.
- Interference identity, analysis, resolution and reporting.
- Perform spectral analysis using a spectrum analyzer.
- Perform propagation analysis for high frequency (HF) and tropospheric (TROPO) systems.
- Assist in JRFL production and promulgation.
- Assist in spectrum supportability determinations.

SPECTRUM MANAGEMENT FUNCTIONS AND TASKS

5-12. The spectrum manager at the tactical level of command is the commander's principle advisor on all spectrum related matters. Depending on the echelon and where the spectrum manager works the functions and tasks may overlap several of the EMSO domains of spectrum management, frequency assignment, host nation coordination, and policy.

5-13. The tasks necessary to accomplish these functions are generally the same across the echelons. The difference is the size and scope of the tasks. For example, developing a corps SOI is a much larger task than developing a SOI for a brigade even though the same process and tool is used to create the SOI.

5-14. 25E is the military occupational specialty (MOS) responsible for conducting EMSO along with officers holding the 5D skill identifier (SI). Refer to Appendix B for more information on the MOS and training.

DETERMINING SPECTRUM REQUIREMENTS

5-15. 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.

DATA CALL MESSAGE

5-16. Although typically done at the corps level a call out message is another way to determine spectrum requirements. A call out message requires units to provide a list of their frequency dependent equipment, call sign requirements, and nets, to include any special requirements such as radar, telemetry, weapons, or un-manned vehicular systems. Ideally the call out message should provide enough information in order to generate a SFAF which is used for the request process. This message is sent to all subordinate spectrum management elements who are required to identify all spectrum requirements for their units; and those attached or under the operational control of them. All call out messages, and their responses, should be logged and tracked to ensure suspense's are met from subordinate units.

PROCESSING REQUIREMENTS

5-17. 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. Another problem is that the database update procedure is manual, which can lead to errors.

5-18. 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. Currently the request is formatted according to the SFAF. With the publication of MCEB, Pub 8, the format will change to the standard spectrum resource format (SSRF). The SSRF allows the preferred request procedure is to use Spectrum

XXI to generate and submit SFAFs. Spectrum XXI requires SIPRNET connectivity to the regional server in order to complete data exchanges and frequency requests.

5-19. If Spectrum XXI is not available, the spectrum manager should use the Defense Message Service to request frequency support from the appropriate authority. E-mail should only be used as a last resort due to security and accountability concerns with this type of media. When using communications means other than Spectrum XXI the spectrum manager should pay attention to the classification of requests and handle them accordingly.

5-20. 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 (NIB) 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 the appropriate 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 to build a hopset for SINCGARS.
- **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

5-21. 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 cannot satisfy the requirement it is processed through the installation Network Enterprise Center (NEC) to AFMO-CONUS. If there is only one tactical unit on an installation, then the request will be processed through the installation NEC and 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. (Refer to Figure 5-2 for further information on spectrum coordination channels.)

5-22. 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 (or frequencies) and, if necessary, coordinate with AFMO-CONUS for additional resources.

5-23. 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.

5-24. 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 ALASKA, HAWAII, AND POSESSIONS FREQUENCY REQUESTS

5-25. Frequency requests for US&P that fall outside CONUS require special considerations due to the unique nature of the commands. Typically Army units requesting spectrum support will coordinate through the Army unit or command that they will be supporting. If the supported unit or command can fulfill the

supporting unit's spectrum requirements they will courtesy copy the combatant command JFMO/JSME of the action. If they cannot fulfill the request the supported unit or command will forward the request to the JFMO/JSME for spectrum support. For units permanently garrisoned within Alaska, Hawaii and Possessions requests for permanent frequency assignments should be coordinated with the appropriate Army Service Component Command. (See Chapter 4 of AR 5-12 for detailed information.)

NATIONAL GUARD FREQUENCY REQUESTS

5-26. Unlike the United States Army Reserve, the Army National Guard (ARNG) serves under the control of the state governor unless federalized. While in Title 32 status (state), ARNG units will request spectrum support from their parent commands to the adjutant general (TAG) or state joint force headquarters (JFHQ). If federalized (Title 10 status), the ARNG may be required to submit frequency requests directly to the supported combatant command or Army forces.

5-27. ARNG units may have a blend of tactical and commercial systems. When processing ARNG requests special attention must be paid to the requests to ensure only federally funded systems are given assignments. Typically these are tactical systems such as SINCGARS and other CNR systems. Commercial systems procured with state funding may not have spectrum certification and are not spectrum supportable through DOD channels.

RESEARCH, DEVELOPMENT, TEST AND EVALUATION FREQUENCY REQUESTS

5-28. Research, Development, Test and Evaluation (RDT&E) activities typically support program executive officers, program managers, and Army test ranges and sites. Spectrum managers at installations, posts, camps, or stations should direct any request by RDT&E activities to the appropriate DOD/Army AFC for frequency support (regardless if they can accommodate the request or not). This is to ensure that RDT&E activities have followed the spectrum supportability process and have a valid DD Form 1494 for operation. (Refer to Appendix A for more information on the spectrum supportability process.)

PROCESSING OCONUS FREQUENCY REQUESTS

5-29. Units will generally send requests through higher headquarters to a geographical 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. (Refer to Chapter 2 for host nation spectrum support information.)

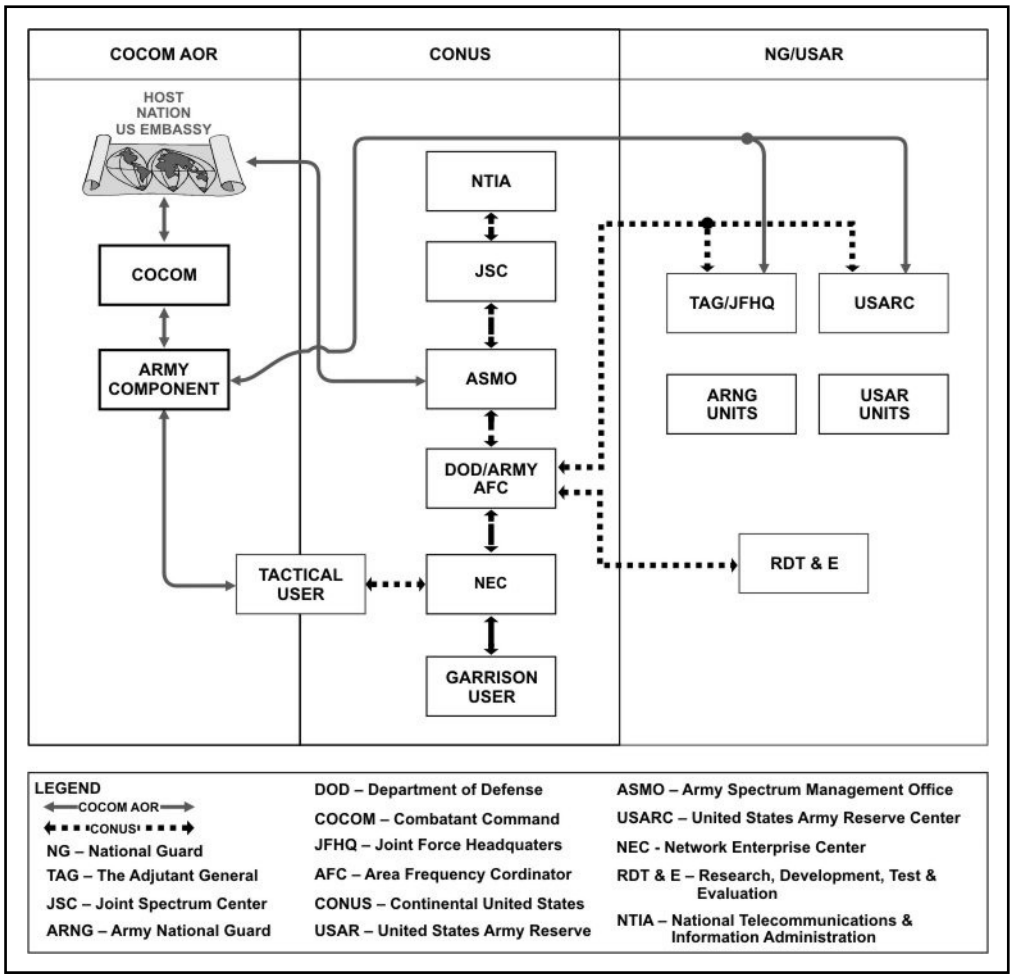

Figure 5-2. Spectrum coordination channels

STAFF COORDINATION

5-30. 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 use and prioritization of spectrum. Systems such as UASs, common user jammers, radars, navigational aids, and sensors 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.

5-31. The spectrum manager must be engaged with the appropriate staffs or liaisons for these systems to ensure that spectrum support is available. Many of these systems, particularly radars, operate on fixed frequencies and depending on proximity to other systems they may induce harmful interference unless proper coordination takes place.

5-32. The spectrum manager should be knowledgeable on the spectrum requirements of all spectrum dependent systems. Most spectrum dependent systems are operator owned and maintained. Many of these systems such as HF automatic link establishment (ALE), airborne systems, and tactical satellite systems have their own communications planning software necessary to configure the systems for operation. It is the unit or operator responsibility to configure these systems for operations. For example, the spectrum manager will provide the frequencies for a HF ALE radio but it is the unit's responsibility to configure and operate the radio. The exception is the SINCGARS radio due to a legacy requirement for communications planning for these radios.

ELECTRONIC WARFARE COORDINATION

5-33. The spectrum manager should be an integral part of all EW planning in order to be aware of spectrum conflicts initiated by friendly systems for personnel protection, enemy exploitation, or enemy denial. The advent of common user "jammers" has made this awareness and planning critical for the spectrum manager. In addition to jammers, non-lethal weapons that use electromagnetic radiation must be taken into account. Coordination for EW will normally take place in a EWCC depending on the echelon. The EWCC is under the cognizance of the operations staff officer section (S-3)/G-3 and normally consists of members from the primary staff sections, a fires officer, and a spectrum manager and is headed by the senior electronics warfare officer (EWO). (Refer to Figure 5-3 for EMSO/EW deconfliction procedures.)

5-34. Although in some respects the functions of the EWO and the spectrum manager appear similar they differ in that the spectrum manager is concerned with the proper operation of friendly RF dependent systems whereas the EWO is threat focused and works to protect the electromagnetic environment for friendly forces while denying the enemy use of the spectrum for operations. It is important that commanders realize this distinction and avoid relying on one person or cell to manage both functions.

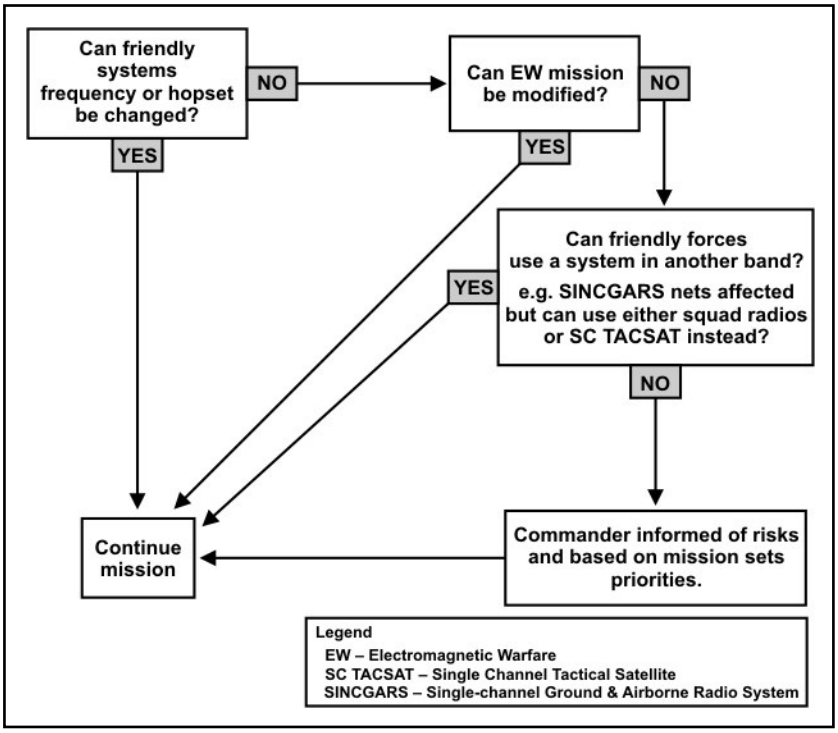

Figure 5-3. EMSO/EW deconfliction

JOINT RESTRICTED FREQUENCY LIST

5-35. A JRFL is normally a corps or theater product. The spectrum manager must work closely with the G-2 and G-3; and the EWO to coordinate publication of the JRFL. To make this product useful, the spectrum manager should work to keep it as current and as brief as possible. At lower echelons a restricted frequency list may be developed and published depending upon need and mission. Refer to Appendix C for a description of the JRFL.

COMMUNICATIONS SECURITY COORDINATION

5-36. The spectrum manager must work closely with communications security (COMSEC) personnel to ensure that the proper keying material is matched to the appropriate frequency resource for SINCGARS loadsets. Spectrum managers are concerned only with the necessary COMSEC for SINCGARS loadsets and do not handle or manage COMSEC for other emitters.

SATELLITE COORDINATION

5-37. The spectrum manager coordinates with satellite managers to maintain awareness of channels (frequencies) being used by satellite communications (SATCOM) systems. The satellite manager will generate and process satellite access requests for all very high frequency (VHF)/ultra high frequency (UHF)/super high frequency (SHF)/extremely high frequency satellite systems and once the request is approved the spectrum manager will enter the frequencies into the database in order to do frequency deconfliction with all other emitters in the area of operations.

FREQUENCY DECONFLICTION

5-38. 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

5-39. 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. (Refer to Appendix D for a detailed description of interference resolution.) The reporting end user is responsible for assisting the spectrum manger in tracking, evaluating, and resolving interference. Interference resolution is performed by the spectrum manager at the echelon receiving the interference. The spectrum manager is the final authority of interference.

5-40. 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.

5-41. 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.

5-42. 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. (Refer to Appendix D for further information concerning interference resolution.)

EVALUATING AND OPTIMIZING SPECTRUM USE

5-43. In order for resources to be utilized in an efficient manner, the spectrum manager must conduct frequency analysis on a regular basis in order to determine if frequencies are still being utilized. Using the information from this analysis the spectrum manager must continuously update and maintain databases in order to optimize and have a clear picture of spectrum usage.

5-44. Radios or systems that use frequency hopping techniques should be utilized in this mode instead of single channel configurations. In addition to improving low probability of jamming and interception utilizing the frequency hopping mode allows more efficient use of the spectrum in the bands in which it operates.

POLICY ADHERENCE

5-45. 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 effect as "bootlegging" a frequency. In the past, "bootlegging" a frequency usually only affected the communications network.

5-46. 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. (Refer to Appendix E for international distress and emergency frequencies.)

5-47. 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 search and rescue, medical, or air operations.

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Chapter 6

Installation Spectrum Management

This chapter addresses the installation commander's role and the user's responsibilities concerning spectrum management on the installation. This chapter also describes the commercial and tactical systems that the installation spectrum manager may encounter and it contains information applicable to both stability and civil support operations. 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 spectrum management responsibilities to the NEC or a similar office. In installation spectrum management, the installation commander must—

- Ensure that the spectrum manger is properly trained. Spectrum 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. Refer to Appendix A for a description of the DD Form 1494 process.
- Ensure that the equipment or system has an authorized frequency assignment in CONUS and host nation approval in foreign locations (refer to Chapter 5, AR 5-12).
- 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 Chapter 6, AR 5-12.
- 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 (refer to Chapters 4 and 5, AR 5-12).
- Assist in resolving incidents of harmful radio interference caused by or to Army users (refer to Appendix C, AR 5-12).
- Ensure that the necessary classification markings, classification authority, and downgrading instruction for classified frequency certification and frequency assignment records are done in accordance with AR 380-5.
- Be familiar with the *Manual of Regulations and Procedures for Federal Radio Frequency Management* (NTIA "*Redbook*").
- Use DOD approved software and processes for frequency processing.
- Be familiar with commercial systems, policy, and regulation concerning the use of commercial systems to include satellite on military installations.
- Be familiar with Federal Aviation Administration rules and procedures to include antenna marking requirements.

6-2. The NEC will—

- Serve as the information management authority for the installation. This includes, but is not limited to–
  - Providing spectrum resources for operations and training which are authorized on the installation.
  - Processing new requests for frequencies.
  - Educating the installation and tenant activities on Army spectrum management procedures, doctrine, and policy.
- Coordinate with the installation commander, the Army command Deputy Chief of Staff for Information Management, and the ASMO, to identify and forward to the installation resource manager budgeting requirements for procurement of Army-approved automated hardware and user-friendly software to perform base-level spectrum management and technical analysis functions (e.g., sustaining base information services software).
- Determine peace and wartime communications equipment, spectrum resources, and computer system requirements and obtain sufficient capabilities as appropriate to the installation (e.g., increased mobilization and/or training base requirements).
- Coordinate with other installation directorates to ensure that frequency-dependent equipment being developed or procured by or for use on the installation are fully spectrum supportable.
- Assure that spectrum authorizations used within NEC AORs are valid.
- Ensure that garrison spectrum emitters operate within geographical and technical parameters to promote electromagnetic compatibility among equipment.
- Serve as the point of contact for spectrum and non-tactical call sign requirements and usage within the installation, including tenant activities and units conducting training on the installation.
- Keep records on the types of equipment, locations of equipment, and use of the spectrum and non-tactical call signs assigned to the installation.
- Process and forward requests for spectrum and call sign assignment, which cannot be met from authorized resources, to the supporting AFC.
- Review all spectrum assignments at least every five years or sooner.
- Program, budget, and coordinate with the installation commander and appropriate directorates for financial resources for executing assigned spectrum management responsibilities per AR 1-1 and AR 5-12.
- Perform other duties as assigned by AR 25-1.

USER RESPONSIBILITIES

6-3. The installation frequency coordinator is responsible for educating users about their individual 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).
- Assist spectrum manager in tracking, evaluating, and resolving electromagnetic interference.
- 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 ACP 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 Chapter 3 and Appendix D. (For further information refer to Chapter 3 of AR 5-12.)

6-4. The installation spectrum manager 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 spectrum manager 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 personnel protection or HLD operations.

6-5. The installation spectrum manager should have the capability to interface with tactical spectrum managers using the same spectrum tools used by the tactical users. Currently this is Spectrum XXI which requires SIPRNET connectivity. Another requirement of Spectrum XXI is that users be trained in order to establish a user account.

COMMERCIAL SYSTEMS

6-6. Commercial systems comprise the largest segment of emitters that the installation frequency coordinator will encounter. As the private sector spectrum use increases, the US federal government is required to share more spectrums with the civil sector. As the Army is a major participant in US HLD and DSCA, tactical spectrum managers will find themselves dealing with more commercial equipment as they support Army tactical and strategic missions. 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. Regardless of acquisition process all emitters must have a spectrum supportability determination based on Army policy and regulation. FCC licensed commercial stations may operate on a military installations but these operations may be limited by the installation commander. (See Chapter 5 of AR 5-12 for more information.)

LMR SYSTEM

6-7. The LMR System is typically the primary system used for daily installation communications. It is also commonly used for administrative installation activities in public safety organizations and is compliant with the Association of Public Safety Communications Officials P25 standards. 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 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. (For US&P LMR regulations see Chapter 8 of the NTIA *Redbook*.)

6-8. 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.

6-9. 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.

6-10. 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 interconnects, 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 refer to the NTIA *Redbook*, Chapter 10.

GUIDANCE FOR INSTALLATION SUPPORT RADIOS

6-11. 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.

6-12. 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.

6-13. Engineering for installation support radio systems is the responsibility of the supporting NEC. Engineering service beyond the capability of the NEC may be available from a contractor. If not, a request for engineering assistance can be made through channels to the supporting US 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.

6-14. The following criteria is 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

6-15. The narrowband mandates contained in the NTIA Redbook originate from a directive sent from the DSD, 1 August 2001. 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.

6-16. Table 6-1 lists frequency bands of existing equipment that must operate in a 12.5 kilohertz (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 megahertz (MHz)	Currently in effect for all new systems	NTIA 3.9.7
162–174 MHz	1 Jan 2005	NTIA 4.3.7.2
138–150.8 MHz	1 Jan 2008	NTIA 5.3.5.2
406.1–420 MHz	1 Jan 2008	NTIA 4.3.9

6-17. 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.

6-18. Although the dates for these mandates have passed there is still some equipment that does not meet the narrowband requirements. This equipment will be allowed to operate on NIB until it is replaced. The NTIA defines NIB as “a condition of use relative to other specified uses that affords no protection from harmful interference from the other specified users, and prohibits causing harmful interference to the other specified users.”

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 personal communications system (PCS) bands.

CELLULAR TELEPHONE

6-20. 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 US operate in two bands and in several different modes that may compete with the cell bands of other countries.

6-21. Table 6-2 outlines the technical parameters of major cell phone technologies. The recent reallocation of the 1.7 gigahertz (GHz) and 2.1 GHz bands has allowed for the use of third generation (3G) wireless technology. The commercial sector has initiated implementation of fourth generation (4G) wireless technology; however, 4G is in a long developmental phase because of the broad use of the term. Current 4G developers are calling for use of the 2–8 GHz band, which may necessitate further reallocation of spectrum resources in the future.

Table 6-2. Technical parameters of major cell phone technologies

Mode	*Air Interface*	*Description*	*Frequency Band*
Analog1G	Advanced mobile phone service	The original standard for cellular in the US.	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.	XMT 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-General Packet Radio Service (GPRS), EDGE, CDMA 2000 1X, CDMA 2000, UMTS, WCDMA	Instead of circuit switching, these systems will utilize packet switching for higher throughput and management.	1710–1755 MHz band 2110–2170 MHz band
Digital 4G	Orthoganal Frequency Division Multiplex and Multi Carrier CDMA	Voice and data transmission will converge over Internet Protocol (data is no longer ‘add-on’). Will use hybrid architecture, integrating wireless local area network (WLAN) and wide-area networks.	Band to be determined (possibly 2–8 GHz)

PERSONAL DIGITAL ASSISTANT AND PERSONAL ELECTRONIC DEVICE

6-22. Personal digital assistants (PDAs) and personal electronic device (PEDs) can utilize cellular phone and 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.

6-23. 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.

6-24. Table 6-3 lists the leading wireless data network protocols in the US and their frequency bands. More highly evolved devices that incorporate the functions of a PDA, PED, and cellular phone are becoming common on the market. These devices (mostly 'smart phones') utilize either GSM or CDMA technology in a PCS. These devices are capable of voice, paging, caller identification, data transmission, and e-mail bundled together. These services may not be available in all parts of the country.

Table 6-3. Wireless data networks frequency bands and descriptions

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 (iDEN) a broadband PCS network that rides over the GSM network.	806–824 MHz and 851–869 MHz (800 MHz band) 1910-1915 MHz (1900 MHz band)
GPRS	GPRS—a broadband PCS network that rides over the GSM network.	1850–1910 MHz and 1930–1990 MHz (1900 MHz band)

GLOBAL POSITIONING SYSTEM

6-25. The Global Positioning System (GPS) was developed by the DOD in the late 1970s to provide the military with a space based, all weather, jam resistant continuous operation radio navigation system. Additionally, GPS provides precision timing for communication networks and systems. While originally developed strictly for military applications, GPS was opened for civilian use in the 1980s and is used extensively in commercial applications.

6-26. All satellites in the GPS constellation broadcast on the same two frequencies, 1575.42 MHz (L1 signal) and 1227.6 MHz (L2 signal). The receiver can distinguish the signals from different satellites. The GPS uses a CDMA spread-spectrum technique where the low-bit rate message data is encoded with a single high-rate pseudo-random sequence that is different for each satellite.

6-27. Besides the two primary frequencies, GPS utilizes three other frequencies for special purposes. Table 6-4 lists the bands and designations. Because of its critical nature GPS must be protected by providing a minimum of +/- 12 MHz of channel separation from the center frequency.

Table 6-4. Global positioning system bands and designations

Designation	*Frequency*	*Description*
L1	1575.42 MHz	Carries a publicly usable coarse-acquisition (C/A) code as well as an encrypted precision P(Y) code.
L2	1227.60 MHz	Usually carries only the P(Y) code. The encryption keys required to directly use the P(Y) code are tightly controlled by the U.S. government and are generally provided only for military use. The keys are changed on a daily basis.
L3	1381.05 MHz	Used by the Nuclear Detonation Detection System Payload to signal detection of nuclear detonations and other high-energy infrared events. Used to enforce nuclear test ban treaties.
L4	1379.913 MHz	Being studied for additional ionospheric correction.
L5	1176.45 MHz	Used as a civilian safety-of-life signal.

PAGERS

6-28. First developed in the late 1940s, pagers are 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 6-5 lists two common pager protocols and their frequency band. In addition to the bands used by the protocols listed in Table 6-5, commercial pagers may also use the following frequencies (in MHz): 35–36, 43–44, 152–159, and 454–460.

Table 6-5. Pagers frequency bands and descriptions

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)

WIRELESS LOCAL AREA NETWORK

6-29. 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 6-6 provides a description of WLANs, their frequency bands, and competing commercial and military uses.

Table 6-6. Wireless local area network standards and descriptions

Standard	***Description***	***Frequency Band***	***Competing Commercial Uses***	***Competing Military Uses***
802.11a	Primarily used on college campuses. It is actually comprised of three bands. Operates in the Unlicensed National Information Infrastructure and industrial, scientific, and medical (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. (UASs)

Table 6-6. Wireless local area network standards and descriptions (continued)

Standard	*Description*	*Frequency Band*	*Competing Commercial Uses*	*Competing Military Uses*
802.11b(g)	Also known as Wireless-Fidelity (Wi-Fi), this WLAN protocol provides up to 11 megabits per second (Mbps) (802.11g 54 Mbps) throughput up to 100m. Operates in the unlicensed ISM band.	2.4–2.4835 GHz (2.4 GHz band)	Home RF, Bluetooth®, microwave ovens, fusion lighting.	Logistics, medical, fire support, Soldier radio. Secure local area network (LAN), UASs/UGS.
802.11n	802.11n is a newer standard of Wi-Fi LAN, or wireless local area network technology, subsequent to standards 802.11a, 802.11b and 802.11g. Adds multiple-input and multiple-output, functionality.	2.4–2.4835 GHz (2.4 GHz band) 5.15–5.25 GHz, 5.25–5.35 GHz, 5.725–5.825 GHz (5 GHz band).	Home RF, Bluetooth®, microwave ovens, radar systems, future upper band microwave ovens, door openers.	Logistics, medical, fire support, Soldier radio, various search, navigation, and fire control radars, UASs, UGVs.
802.11y	IEEE 802.11y is an amendment to the IEEE 802.11 standard that will enable high powered Wi-Fi equipment to operate on a co-primary basis.	3650–3700 MHz	Back haul for municipal Wi-Fi networks, campus and enterprise networking, public safety and security networks.	Fixed satellite services earth stations, terrestrial operations.
802.22	Will be the first complete cognitive radio-based international standard with frequency bands allocated for its use.	54–862 MHz	Fixed point-to-mulitpoint wireless regional area networks	TV broadcasting, wireless microphones, SINCGARS, Enhanced Position Location Reporting System (EPLRS), radio frequency identification (RFID) tags.
Local Multipoint Distribution System	Also known as millimeter/microwave technology. Sometimes used in conjunction with free space optics 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).

WiMAX

6-30. Worldwide Interoperability for Microwave Access (WiMAX) is a telecommunications technology that provides wireless data in a variety of ways, from point-to-point links to full mobile cellular type access. It is based on the IEEE 802.16 standard.

Table 6-7. WiMAX frequency bands and descriptions

Frequency Band	*Spectrum Remarks*	*WiMAX Uses*
2.4–2.483 GHz	ISM and FCC Part 15, used for Wi-Fi; to be avoided by WiMAX operators on concerns of interference from Wi-Fi.	Connects Wi-Fi hotspots with other parts of the Internet. Provides a wireless alternative to cable and DSL for last mile broadband access. Provides data and telecommunications services. Providing portable connectivity.
2.5 GHz	Projected as being a popular licensed WiMAX spectrum.	
3.5 GHz	Unlicensed in much of the world outside the US.	
.65 GHz	FCC issued an announcement in 2004 promoting opening spectrum here for some unlicensed use.	
.9 GHz	Public Safety Band in the US; intended for use by first responders (police, fire, ambulance and other emergency services).	
5.72–5.85 GHz	US unlicensed.	

Radio Frequency Identification

6-31. RFID is a wireless identification technology that is seeing rapid development in many applications. RFID employs a 'tag' which, when exposed to electromagnetic radiation by a 'reader,' radiates a modulated signal containing data that the reader then receives and processes. The tags can be either passive or active. Passive tags rely on the inductive power to emit data via a backscatter radiation, and have a limited effective range (a few inches to a few meters). Active tags contain a battery which can power the modulating circuitry, the transmitter or both. Active tags tend to have significantly greater range. RFID tags are commonly used in inventory tracking, facility badge access, and passports.

6-32. There is not yet a global standard for RFID, though many governing bodies have set their own standards. As a result, RFID systems may operate anywhere between very low frequency bands to SHF bands. Many RFID tags operate on the 433 MHz frequency, used by the Army's EPLRS data link and very high power missile early warning radar. In the US, the FCC considers RFID systems to be Part 15 devices which can be operated without a license. Certain states in the US have their own laws concerning RFID use. Currently, the International Standardization Organization (ISO) standards have the broadest impact on regulating RFID. ISO RFID regulations can be found in ISO 18000.

Unmanned Systems

6-33. The military role of UASs, or UGSs, is growing at unprecedented rates. Unmanned systems perform a wide variety of functions. The majority of these functions include intelligence, surveillance and reconnaissance (ISR) functions. Less common functions of UASs include the support of weapons platforms and aerial transport. Unmanned systems can be remote controlled or fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems.

6-34. Table 6-8 lists some of the current unmanned systems both ground and air, as well as operational frequency bands and J/F 12 number. Further details of the J/F 12 process can be viewed in Appendix A and copies of J/F 12 pages are available from ASMO.

Table 6-8. Air and ground unmanned systems frequency bands

	Unmanned System	***Current Operational Frequency Bands****	***J/F-12***
UGV/UGS (Ground)	PackBot Explosive Ordnance Disposal (EOD)	2.412–2.462 GHz	9135
	Man Transportable Robotic System (MTRS)	2.4–2.483 GHz	9128/9173
	Mini Andros II	138–174/403–470 MHz	9456
	Remote Ordnance Neutralization System	138–174 MHz	7672/3
	All-Purpose Remote Transport System	902–928 MHz	7316/7725
	Surveillance and Reconnaissance Ground Equipment	403–416 MHz	7777
	Mechanical Anti-Personnel Mine Clearing System (MV-4B)	228–235 MHz	9359/9358
UAS (Air)	Predator B	Data Uplink: 5625–5850 Data Downlink: 5250–5475	7253
	Global Hawk	LOS Data Uplink: 9750–9950 LOS Data Downlink: 10150–10425	7159/8193
	Pointer	394.5–395.10 MHz/433.08 MHz	8057
	RQ-7A Shadow	4400–4940 MHz	7989
	Silver Fox	310–390 MHz/1710–1850 MHz	9117/9118
	Dragon Eye and Pioneer	394.5–395.10 MHz/1710–1850 MHz	7908/8128

*__Note__: From the Office of Secretary of Defense Memorandum Subject: UAS Spectrum Regulatory Policy Guidance states that some UASs will migrate into alternative spectrum.

TACTICAL SYSTEMS OVERVIEW

6-35. During times of crisis or to support HLD/DSCA missions 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 6-9 provides a partial list of the more common tactical systems and the bands in which they operate.

Table 6-9. Tactical systems frequency bands and descriptions

Frequency Band	***Example/System/Nomenclature***	***Description***
2–30 MHz 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	SINCGARS	The primary CNR.
30–512 MHz	AN/PRC-117 AN/PRC-148	Multimode, multifunction radios that provide HF, VHF, and SC-TACSAT UHF operate in 225–400 MHz. The spectrum 450-512 MHz is reserved for exclusive civil use.
138–144 MHz	AN/PRC-148 (multiband inter/intra team radio)	Primarily used for squad radios and installation support functions.

Table 6-9. Tactical systems frequency bands and descriptions (continued)

Frequency Band	*Example/System/Nomenclature*	*Description*
225–400 MHz	AN/PSC-5 (Spitfire) single-channel tactical satellite (SC TACSAT), AN/PSC-7 near term digital radio (NTDR) Warfighter Information Network-Tactical (WIN-T) microwave LOS systems	One of the most heavily used military bands. NTDR provides tactical operations center (TOC) (TOC-to-TOC) connectivity at brigade and below. Also various SC TACSAT and air-ground-air systems.
420–450 MHz	AN/TSQ-158 (EPLRS)	Currently used as the primary data network for brigade and below.
1350–1850 MHz	Digital Group Multiplexing (Tri-Service Tactical Communications [TRI-TAC]) Program WIN-T microwave LOS systems	Used for microwave LOS transmission. Much of this spectrum is reserved for exclusive civil use.
2201.25–2388.75 MHz	High-capacity line of sight (HCLOS) WIN-T microwave LOS systems	Extended range HCLOS.
2400–2483.5 MHz	Secure Wireless Local Area Network (SWLAN)	Harris SECNET 54 is an example of a SWLAN.
4400–4990 MHz	AN/TRC-170 (TROPO)	The primary purpose of TROPO is to provide connectivity between two major TRI-TAC nodes. The 4940–4940 MHz band is not available in the US to the military.
5450–5850 MHz	WIN-T Local Access Waveform Civil RLANS	Local Access Waveform will be used for WIN-T communications between the tactical communications nodes and a wide variety of support vehicles.
14400–15350 MHz	Common Data Link WIN-T High-band Networking Waveform	Common Data Link is designed to achieve data link interoperability and provide communications between multiple ISR collection systems.

APPROACHES TO INTEROPERABILITY

6-36. 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.

6-37. 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. (Refer to the NTIA *Redbook* paragraph 7.12 for further information concerning FCC Part 90 rules.)

6-38. 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 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 (refer to 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.

6-39. 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

6-40. 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.

6-41. 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.

6-42. 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.

UNITED STATES PUBLIC SAFETY BANDS

6-43. Although Table 6-10 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.

Table 6-10. 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	4940–4990
806–824 and 851–869	

6-44. In order to utilize the existing bands more efficiently, the NTIA and DOD have initiated a narrow banding 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.

6-45. 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.

6-46. 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. Any qualified agency may now obtain a license and use the 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 June 2010.

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, Army Service component command, direct reporting unit or center, and the conditions of frequency assignment to the operational user.

SPECTRUM SUPPORTABILITY ASSESSMENT

A-1. The purpose of the spectrum supportability assessment is to identify and assess regulatory, technical, and operational spectrum issues with the potential to affect the required operational performance of the candidate system. The SSA process consists of documenting the spectrum-dependent aspects of a system during each phase of the acquisition life cycle. The detail and scope of individual SSAs depend upon several factors including the system's entry point into the Department of Defense acquisition system (DAS), the complexity of the system, and the intended operational environment. Table A-1 shows the type of spectrum supportability assessment required in each phase of the DAS.

Table A-1. Spectrum supportability assessments required in DAS phases

DAS Phase	Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
Spectrum Supportability Assessment	Initial Regulatory SSA Component(s)	Initial Technical SSA Component(s) Initial Operational SSA Component(s)	Detailed Technical SSA Component(s) Detailed Regulatory Component SSA(s)	Updated Detailed Regulatory SSA Component(s) Updated Detailed Technical SSA Component(s)	Operational SSA(s) for specific missions, new host nation deployments, system modifications, etc.

A-2. The results of spectrum supportability assessments provide an important input to the technical data required by the DD Form 1494 and the CIO/G-6 spectrum supportability determination required for Army Systems Acquisition Review Council decisions. Table A-2 shows the DD Form 1494 Stage that is required in each phase of the DAS. As the system progresses through the DAS, the type and detail of system parametric data required to request spectrum access during each acquisition phase becomes more complex.

Table A-2. Relationship between DAS phases and DD Form 1494 stages

DAS Phase	Concept Refinement	Technology Development	System Development and Demonstration	Production and Deployment	Operations and Support
DD Form 1494 Stage	Stage 1 Conceptual	Stage 2 Experimental	Stage 3 Developmental	Stage 4 Operational	Stage 4 Notes to Holders

DD FORM 1494

A-3. 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.

A-4. An Army command, Army Service component command, direct reporting unit 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-5. 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. Certification of spectrum support for telecommunication systems at Stage 1 provides initial guidance on the feasibility of obtaining certification of spectrum supportability at subsequent stages.
- **STAGE 2—experimental**. The preliminary design has been completed. Radiation using "bread board" equipment or preliminary models may be required. Certification of spectrum supportability for RF systems at Stage 2 is a prerequisite for receiving a frequency assignment supporting experimentation required for program development.

- **STAGE 3—developmental**. The major design has been completed and radiation may be required from "brass board" models during testing. Certification of spectrum supportability for RF systems at Stage 3 is a prerequisite for US national authorization of radiation in support of developmental testing of systems. It also provides guidelines for assuring certification of spectrum supportability at Stage 4. At this point, the intended frequency band will normally have been determined and certification at Stage 3 will be required for testing of proposed operational hardware and potential equipment configurations. System parameters may be provided to host nations through combatant command spectrum offices for spectrum supportability comments.
- **STAGE 4—operational**. Identify the final operating constraints or restrictions required to ensure compatibility when development has been essentially completed. Certification of spectrum supportability for RF systems at Stage 4 is a prerequisite for a frequency assignment for operational systems The system parameters included on the Stage 4 DD Form 1494 are normally provided to host nations through combatant command spectrum offices to obtain spectrum supportability comments.

A-6. Spectrum supportability assessments will accompany DD Form 1494 submissions for systems under development and will be used by the CIO/G-6 as an input to the Milestone Decision Authority. Table A-3 shows the minimum time required for submission of spectrum supportability assessments and DD Form 1494s to CIO/G-6 and ASMO.

Table A-3. Time required for SSA and DD Form 1494 submissions

Relationship Between Defense Acquisition System Events and Spectrum Processes				
DAS Phase	***DD Form 1494 Stage***	***Event***	***Acquisition Category***	***Months Prior to Event Required for SSA and DD Form 1494 Submission to CIO/G-6***
Concept Refinement	Stage One (Conceptual)	Milestone A	ACAT I/II	9
			ACAT III	6
Technology Development	Stage Two (Experimental)	Milestone B	ACAT I/II	12
			ACAT III	9
System Development and Demonstration	Stage Three (Developmental)	Milestone C	ACAT I/II	18
			ACAT III	12
Production and Deployment	Stage Four (Operational)	Initial Operational Capability	ACAT I/II	18
			ACAT III	12
Operations and Support	Stage Four Note to Holders	Full Operational Capability	ACAT I/II	12
			ACAT III	9
Operations and Support	Note to Holders	Major change in system's RF parameters or deployment areas	ACAT I/II/III	9
Note. ASMO reviews of DD Forms 1494 normally take 6 to 12 months, depending on a system's complexity, operating frequency bands, intended deployment areas and mission.				

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Appendix B
Training

EMSO present a complex environment requiring highly trained and proficient Soldiers. Resident training is the preferred method of instruction and commanders should exercise prudent judgment in sending only the best qualified Soldiers.

EMSO TRAINING

B-1. The following paragraphs discuss the EMSO training responsible for accomplishing the EMSO mission.

UNITED STATES ARMY SIGNAL CENTER OF EXCELLENCE

B-2. The Commanding General, United States Army Signal Center of Excellence and Fort Gordon, directs and supervises all training for EMSO. This includes the basic course, Electromagnetic Spectrum Manager, 4C-SI5D/260-25E30 and the Joint Spectrum Management Course, 260-ASIS9.

ENLISTED TRAINING

B-3. Advanced Individual Training for MOS 25E is open to Active Army and Reserve Component Staff Sergeant Basic Noncommissioned Officer Course graduates from MOS 25C, 25F, 25L, 25N, 25P, 25Q, 25S, or 25U who are assigned to, or are expected to be assigned to, a position requiring classification as MOS 25E30. The course is 10 weeks and 3 days long and instruction includes frequency planning, engineering, coordinating, and assigning frequencies. Additionally the course provides an introduction to–

- Communication electronics principles.
- Radio wave propagation and theory.
- Systems engineering.
- Electromagnetic compatibility.
- Automated RF engineering and assigning programs.
- Electronic warfare cell operations.

B-4. The Advanced Noncommissioned Officer Course (ANCOC) consists of common core courses taught by the Regimental Noncommissioned Officers Academy and the Joint Spectrum Management Course which consists of training to perform in a Joint operational environment to include operating as a spectrum manager in a Combined Joint Task Force using both Spectrum XXI and Joint Automated Communications Software for spectrum operations planning, engineering, and operations utilizing a Joint operational scenario. The technical portion of ANCOC is five weeks in duration.

OFFICER TRAINING

B-5. Signal officers who attend the basic course are awarded SI 5D. This is the same course as the enlisted MOS 25E course and is conducted concurrently with the MOS producing course. Officers selected to attend the Electromagnetic Spectrum Management Course are generally serving in, or are expected to serve in positions requiring SI 5D. The officer provides oversight and management to EMSO particularly in corps and above operations although they can be assigned beginning at the brigade level.

B-6. Officers selected to serve in joint positions attend the Joint Spectrum Management Course. This is the same course used for the enlisted ANCOC and is also conducted concurrently with the technical portion of ANCOC for the enlisted Soldier.

B-7. Currently there are no warrant officer spectrum management positions. Commanders, based on mission needs, may send warrant officers to either course. This is typically done for reserve component forces.

Appendix C

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 require protection and are defined below. The JRFL is not a static product and will change as the operation or mission changes.

TABOO FREQUENCIES

C-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

C-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 EW 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

C-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 D

Joint Spectrum Interference Resolution 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 EMI 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 refer to CJCSI 3320.02B.

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.

D-4. 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 refer to CJCSI 3320.02-1[S]). 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.

DSO RESPONSIBILITIES

D-5. The DSO has the following responsibilities–

- Manage the DOD JSIR program in accordance with guidance from the ASD (NII) 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 JTF 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 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 an analysis of interference incidents involving suspected hostile electronic attacks 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 RESPONSIBILITIES

D-6. DOD components have the following responsibilities–

- 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.

D-7. Additionally, all DOD components will provide internal directions and procedures to implement the other responsibilities of the directive.

UNITED STATES STRATEGIC COMMAND GLOBAL SATELLITE COMMUNICATIONS SUPPORT CENTER

D-8. USSTRATCOM's GSSC has the following responsibilities–

- 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.

D-9. When necessary, the GSSC will coordinate the request for intelligence support with the appropriate agencies to identify/resolve interference to SATCOM systems.

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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.

USE OF EMERGENCY FREQUENCIES

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

Table E-1. Emergency frequencies (continued)

Service	*Frequency (Emission)*	*Communication Service*	*Function*
	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 Radio beacon
RACES	3997 kHz (6K00A3E)	RACES Stations	Civil Emergency
	3998.5 kHz (3K00H3E)		
	53.3 MHz (36K00F3E)		

Glossary

The glossary lists acronyms and terms with Army, multi-service, or joint definitions, and other selected terms. Where Army and joint definitions are different, *(Army)* follows the term. Terms for which FM 6-02.70 is the proponent manual (the authority) are marked with an asterisk (*). The proponent manual for other terms is listed in parentheses after the definition.

SECTION I - ACRONYMS AND ABBREVIATIONS

1G, 2G, 2.5G, 3G	versions of cellular telephone referred to as generations
AAG	Aeronautical Assignment Group
ACP	allied communications publication
AFC	area frequency coordinator
AFFMA	Air Force Frequency Management Agency
AFMO-CONUS	Army Frequency Management Office-Continental United States
ALE	automatic link establishment
ANCOC	Advanced Noncommissioned Officer Course
ARNG	Army National Guard
ARNGUS	Army National Guard of the United States
AOR	area of responsibility
AR	Army regulation
ASD	Assistant Secretary of Defense
ASM	Army spectrum manager
ASMO	Army Spectrum Management Office
CDMA	code division multiple access
CEOI	communication-electronics operating instructions
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
CJTF	commander joint task force
CIO	chief information officer
CNR	combat net radio
COMSEC	communications security
CONUS	continental United States
COTS	commercial off-the-shelf
DA	Department of the Army
DAS	Department of Defense acquisition system
DASD	Deputy Assistant Secretary of Defense
DISA	Defense Information Systems Agency
DOD	Department of Defense
DOTMLPF	doctrine, organization, training, materiel, leadership and education, personnel and facilities
DSCA	Defense Support of Civil Authorities

DSD	Deputy Secretary of Defense
DSO	Defense Spectrum Organization
E^3	electromagnetic environmental effects
EMI	electromagnetic interference
EMSO	electromagnetic spectrum operations
EOD	explosive ordnance disposal
EPLRS	Enhanced Position Location Reporting System
EPS	Emergency Planning Subcommittee
EW	electromagnetic warfare
EWCC	Electronic Warfare Coordination Center or Cell
EWO	electronics warfare officer
FAS	Frequency Assignment Subcommittee
FCC	Federal Communications Commission
G-2	assistant chief of staff, intelligence
G-3	assistant chief of staff, operations
G-4	assistant chief of staff, logistics
G-6	assistant chief of staff, signal
GHz	gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GSSC	Global Satellite Communications Support Center
HCLOS	high-capacity line of sight
HF	high frequency
HLD	homeland defense
HNSWD	Host Nation Spectrum Worldwide Database
ICT	information and communications technology
IO	information operations
IRAC	Interdepartment Radio Advisory Committee
ISM	industrial, scientific, and medical
ISO	International Standardization Organization
ISR	intelligence, surveillance and reconnaissance
ITS	Institute for Telecommunication Sciences
ITU	International Telecommunications Union
ITU-D	Telecommunication Development Sector
ITU-R	Radiocommunication Sector
ITU-T	Telecommunication Standardization 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	communications systems dirrectorate of a joint staff
JCEOI	joint communication-electronics operating instructions

JCS	Joint Chiefs of Staff
JFC	joint force commander
JFHQ	joint force headquarters
JFMO	joint frequency management office
JFP	Joint Frequency Panel
JIIM	joint, interagency, intergovernmental, multinational
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JSME	joint task force spectrum management element
JSC	Joint Spectrum Center
JTF	joint task force
kHz	kilohertz
LAN	local area network
LMR	land mobile radio
LOS	line of sight
MAG	Military Assignment Group
MBITR	multiband inter/intra team radio
Mbps	megabits per second
MCEB	Military Communication-Electronics Board
MHz	megahertz
MIJI	Meaconging, Intrusion, Jamming, and Interference Program
MOS	military occupational specialty
NATO	North Atlantic Treaty Organization
NEC	Network Enterprise Center
NETOPS	network operations
NIB	non-interference basis
NII	networks and information integration
NMSC	Navy and Marine Spectrum Center
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
OPS	operations
OSM	Office of Spectrum Management
OTIA	Office of Telecommunications and Information Applications
PCS	personal communications system
PDA	personal digital assistant
PED	personal electronic device

RACES	Radio Amateur Civil Emergency Service
RF	radio frequency
RFID	radio frequency identification
RFA	radio frequency authorization
S-3	operations staff officer
S-4	logistics staff officer
S-6	signal staff officer
SATCOM	satellite communications
SC TACSAT	single-channel tactical satellite
SFAF	standard frequency action format
SHF	super high frequency
SI	skill identifier
SINCGARS	Single-Channel Ground and Airborne Radio System
SIPRNET	SECRET Internet Protocol Router Network
SMD	spectrum management division
SOI	signal operating instructions
SOP	standing operating procedures
SPO	Strategic Planning Office
SSRF	standard spectrum resource format
SWLAN	secure wireless local area network
TAG	the adjutant general
TDMA	time division multiple access
TOC	tactical operations center
TRADOC	United States Army Training and Doctrine Command
TRI-TAC	Tri-Service Tactical Communications
TROPO	tropospheric
USAR	United States Army Reserve
UAS	unmanned aircraft system
UGS	unmanned ground systems
UHF	ultra high frequency
US	United States
US&P	United States and Possessions
USMCEB	United States Military Communications-Electronics Board
USSTRATCOM	United States Strategic Command
VHF	very high frequency

Wi-Fi	Wireless-Fidelity
WIN-T	Warfighter Information Network-Tactical
WLAN	wireless local area network
WRC	World Radiocommunication Conference
WSMR	White Sands Missile Range

SECTION II – TERMS

combatant command

(joint) 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. (JP 1-02)

common operating environment

(joint) 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. (JP 1-02)

electromagnetic compatibility

(joint) 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. (JP 1-02)

electromagnetic environmental effects

(joint) 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. (JP 1-02)

electromagnetic interference

(joint) 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. (JP 1-02)

electromagnetic spectrum

(joint) The range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 alphabetically designated bands. (JP 1-02)

electromagnetic spectrum management

(joint) 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. (JP 1-02)

full spectrum operations

The Army's operational concept: Army forces combine offensive, defensive, and stability or civil support operations simultaneously as part of an interdependent joint force to seize, retain, and exploit the initiative, accepting prudent risk to create opportunities to achieve decisive results. They employ synchronized action—lethal and nonlethal—proportional to the mission and informed by a thorough understanding of all variables of the operational environment. Mission command that conveys intent and an appreciation of all aspects of the situation guides the adaptive use of Army forces. (FM 3-0)

***frequency assignment**

A specific frequency or frequencies for use by a radio station under specified conditions.

***frequency band**

A range of radio frequencies.

frequency deconfliction

(joint) 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)

specified command

(joint) 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. (JP 1-02)

telecommunication

(joint) 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

(joint) 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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Most Army doctrinal publications are available online at– https://akocomm.us.army.mil/usapa/. (Access requires an Army Knowledge Online account.)
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DOCUMENTS NEEDED

These documents must be available to the intended user of this publication.

DA Form 2028. *Recommended Changes to Publications and Blank Forms*.

DD Form 1494. *Application for Equipment Frequency Allocation*.

DA Forms are available on the APD web site (www.apd.army.mil). DD forms are available on the OSD web site (www.dtc.mil/whs/directives/infomgt/forms/formsprogram.htm).

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FM 6-02.70
20 May 2010

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