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Research Report

JAIR AGUIRRE, JUSTIN W. LEE, NICHOLAS A. O'DONOUGHUE

# Examining U.S. Air Force Spectrum Management in the Continental United States

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# About This Report

The Department of the Air Force's (DAF's) ability to test, train, and operate in the continental United States (CONUS) is challenged not only by the increasing congestion of the electromagnetic spectrum (EMS) because of reliance on wireless communications and increased demand from the private sector to obtain spectrum but also by limitations of the systems and processes that govern spectrum management tasks in the DAF and in the federal spectrum management agencies with which the DAF must interact.

This volume is part of a three-volume report that characterizes Air Force Electromagnetic Battle Management (EMBM). The three volumes are

- Jair Aguirre, Nicholas Johnson, Padmaja Vedula, Nicholas A. O'Donoughue, Natalia Henriquez Sanchez, *Characterizing U.S. Air Force Electromagnetic Battle Management (EMBM): A Gap Analysis and Capability-Based Assessment*, RAND Corporation, Not available to the general public
- Jair Aguirre, Justin Lee, Nicholas A. O'Donoughue, *Examining U.S. Air Force Spectrum Management in the Continental United States (CONUS)*, RAND Corporation, RR-A2320-2 (this volume)
- Nicholas A. O'Donoughue, Jacob DeWeese, Christopher Lynch, Colby P. Steiner, Jair Aguirre, *Quantifying U.S. Air Force Electromagnetic Battle Management (EMBM): A Mission-level Modeling Approach*, RAND Corporation, Not available to the general public.

The research here identifies and describes specific DAF challenges in managing the EMS in the CONUS, focusing on certification and frequency assignment for EMS-dependent equipment. The research was sponsored by the Director of Planning, Deputy Chief of Staff for Plans and Programs (HAF/A8X) and the Director of Electromagnetic Spectrum Superiority Directorate (HAF/A2/6L).

This research was conducted within the Force Modernization and Employment Program of RAND Project AIR FORCE as part of a fiscal year 2023 project "Characterizing Air Force Electromagnetic Battle Management."

This report should be of interest to a wide variety of DAF, U.S. Department of Defense, and national-level audiences, such as the Federal Communications Commission, with interests in EMS superiority, spectrum management, and EMS operations, and EMBM.

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This report documents work shared with the DAF in September 2023. The draft report, dated September 2023, was reviewed by formal peer reviewers and DAF subject-matter experts.

## Acknowledgments

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# Summary


## Issue

The Department of the Air Force's (DAF's) ability to test, train, and operate in the continental United States (CONUS) is challenged not only by the increasing congestion of the electromagnetic spectrum (EMS) but also by DAF and federal administrative requirements because EMS-dependent DAF equipment must be certified and allocated to an increasingly limited spectrum, which requires long processing times. These challenges result in delays in deploying and training with spectrum-dependent equipment, ultimately challenging the DAF's technological edge in the EMS.

In our research, we sought to answer the following key questions:

- What are the common U.S. Air Force (USAF) CONUS spectrum management processes and what technology is used for them?
- What are the root causes of delays in CONUS spectrum certification and frequency assignment?
- How can timelines be shortened for CONUS spectrum certification and frequency assignment processing?

## Approach

We reviewed guidance documents for USAF, U.S. Department of Defense (DoD), and federal EMS management. In addition, we reviewed spectrum management training documentation and pipelines. We also conducted semistructured interviews and discussions with spectrum managers and EMS operations subject-matter experts at several operational commands, test ranges, and at USAF headquarters to collect input on procedures. Finally, we set out to analyze data from spectrum management systems to identify the sources of delays and their potential root causes.

## Key Findings

- Each DAF guideline provides up to nine months to process spectrum certification and assignment submissions within the DAF; these submissions are generally completed within guidelines despite much manual coordination between DAF organizations.
- Although many of the certification submissions are approved at the DAF level within guidelines, they can still require up to three months of approval time at the federal level.
- The National Telecommunications and Information Administration processes more than 90,000 frequency assignment applications per year, and the DAF has no day-to-day insight as to the reasons for a delay or the pending length of a delay for a given submission.

- It is difficult to quantify and qualify delays in the DAF with precision because corrections and updates to certification and frequency allocation submissions often require manual work and because data on delays and their reasons is not automatically collected over time.
- There is no standard workflow across the DAF for processing spectrum certification and assignment submissions at the unit level. Overcoming delays requires coordination with submitters via email and telephone.
- Enterprise databases for spectrum management are managed by Defense Information Services Agency (DISA) for all service components and within the DAF, but federal agencies employ different spectrum management databases.
- DISA spectrum management technology does not produce automated reporting of certification and assignment delays, and DAF technology and workflows are not standardized.
- Overcoming delays in requests for frequencies for electromagnetic attack test and training is largely a manual process and can require coordination with commercial providers and such federal agencies as the Federal Aviation Administration and Federal Communications Commission.
- Spectrum management within the DAF is carried out by a mix of military and civilian personnel; the number of enlisted personnel and their training under a new cyber career field designator do not reflect the importance of the EMS to operations and potential future conflicts.
- Interactions between spectrum managers and certification and assignment applicants are often focused on correcting submission errors, which suggests that they share an unfamiliarity with standard forms and administrative processes, especially at the levels below major command.

## Recommendations

We present the following DAF-focused recommendations that can be advocated for and implemented by the Air Force Spectrum Management Office with support from the Air Force Electromagnetic Spectrum Superiority Directorate:

- Establish a DAF-accessible record of delays, flag those outside reasonable guidelines, and describe their impact.
- Advocate for updates to DoD-enterprise spectrum management tools, such as Spectrum XXI, to identify DAF-wide and DoD problem areas.
- Develop and acquire technology that aids users and helps automate the certification and frequency allocation submission process.
- Establish DAF-wide standards for spectrum management technology and workflows for processing spectrum certifications and assignment applications.
- Develop new training materials for early career, enlisted spectrum managers that focus on developing core capabilities, such as spectrum expertise, process administration, and engagement with industry and operations.

- Develop DAF spectrum management community-knowledge management systems so that airmen have access to the most-recent and relevant information available to support the unique mission that spectrum managers have within their new cyber specialty designator.

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Chapter 1

# Introduction

The Department of the Air Force's (DAF's) ability to test, train, and operate in the continental United States (CONUS) is challenged not only by the increasing congestion of the electromagnetic spectrum (EMS) because of reliance on wireless communication technology and increased demand from the private sector to obtain spectrum but also by limitations of the systems and processes that govern spectrum management tasks in the DAF and in the federal spectrum management agencies with which the DAF must interact. These processes, which have been in place for decades, were described in a 1991 RAND publication as "slow and arduous,"[1] and they delay the DAF's ability to obtain authority to transmit in the EMS in CONUS.[2]

To underscore how long these issues have existed and how impactful they can be, a 1998 audit report of the U.S. Department of Defense (DoD) Inspector General, which focused on spectrum management problems overseas, indicated that DoD systems were not properly certified (and thus not usable in host nations) and had cost a total of $39.5 billion.[3] Although this report was focused on equipment that had been purchased for operations outside CONUS, spectrum-dependent systems must be certified and assigned spectrum to operate within CONUS. Aside from regulatory concerns, operating equipment that is not certified and authorized can cause electromagnetic interference and threaten safety.

These challenges can affect overall mission readiness by preventing training events, preventing the use of already-acquired EMS-dependent equipment, and denying personnel familiarity with real-world electromagnetic spectrum operations (EMSO). They can also affect the DAF's ability to keep up with advancing adversarial threats and to maintain a technological edge by preventing the rapid adoption of quickly evolving EMS technology and hindering the development of modern EMSO tactics, techniques, and procedures.

Figure 1.1 shows the frequency allocations for specific uses. This chart, which is almost completely illegible in its entirety unless it is enlarged to a size larger than a common 8 × 11-inch sheet of paper, demonstrates the congestion and complexity of the U.S. EMS. Spectrum use continues to grow, and proper spectrum management remains key to sharing the spectrum among federal government, DoD, and telecommunications providers as technology evolves and spectrum is auctioned and reorganized.

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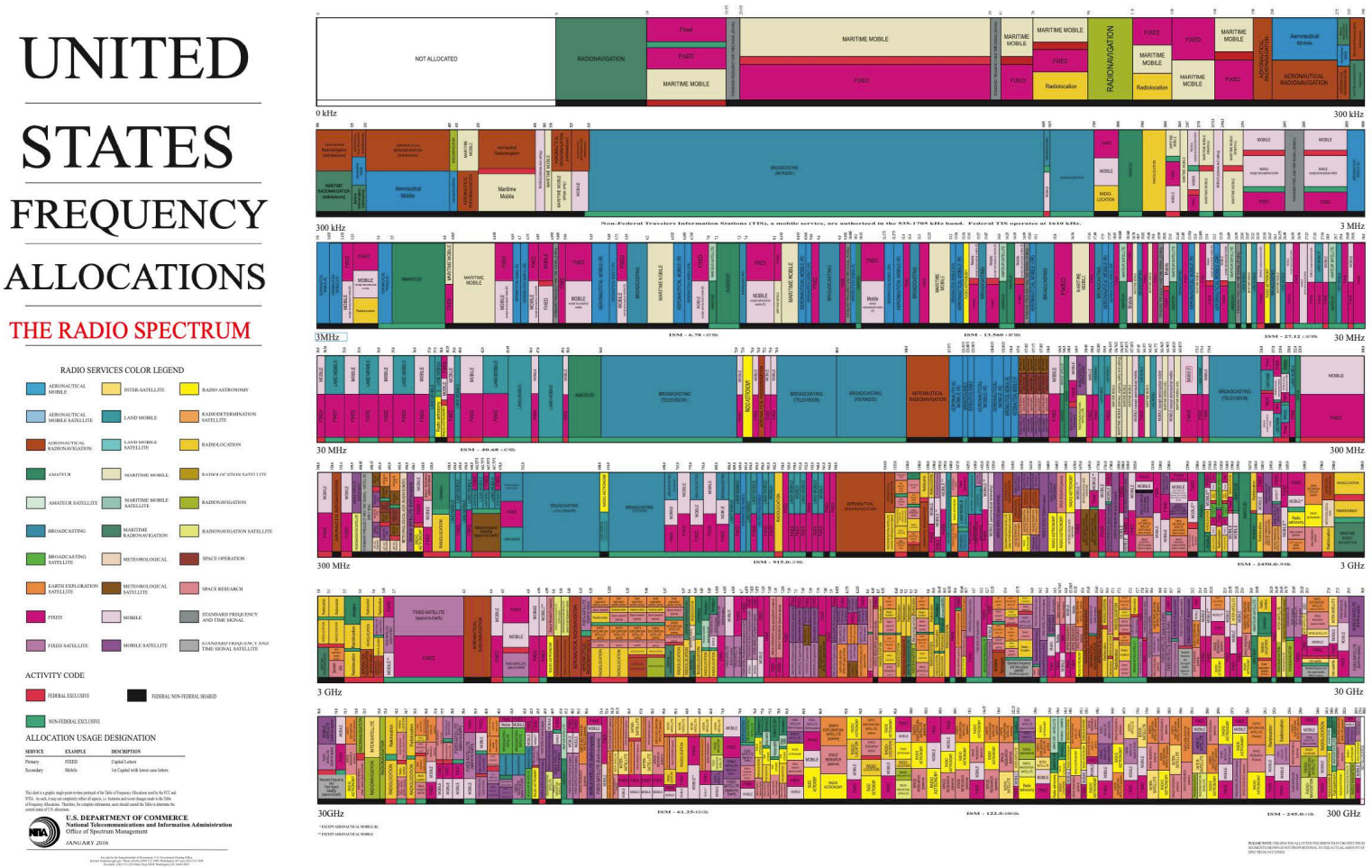
[1] Gregory E. Parnell, Cullen M. Crain, and Alvin L. Hiebert, Spectrum *Management and Electromagnetic Compatibility Issues in the Department of Defense*, RAND Corporation, N-3352-C3I, 1991.

[2] The processes for obtaining authority to transmit overseas are established by host nations.

[3] Office of the Inspector General, U.S. Department of Defense, *Coordination of Electromagnetic Frequency Spectrum and International Telecommunications Agreements*, Report No. 99-009, October 9, 1998.

**Figure 1.1. Frequency Allocation in the United States, as of January 2016**




SOURCE: Reproduced from National Telecommunications and Information Administration (NTIA), "United States Frequency Allocations: The Radio Spectrum Chart," U.S. Department of Commerce, January 2016.

## Objective

The objective of this research was to identify specific challenges and potential improvements to the administrative processes within the DAF and stakeholder organizations that govern spectrum certification and frequency assignment. Wherever possible, we focused on identifying potential root causes of delays in system certification and frequency assignment with data from the systems that are used in day-to-day spectrum management operations. We considered the evolving EMS, DAF personnel and training, and the existing DAF resources to manage spectrum and, by extension, to deliver EMS capabilities.

## Approach

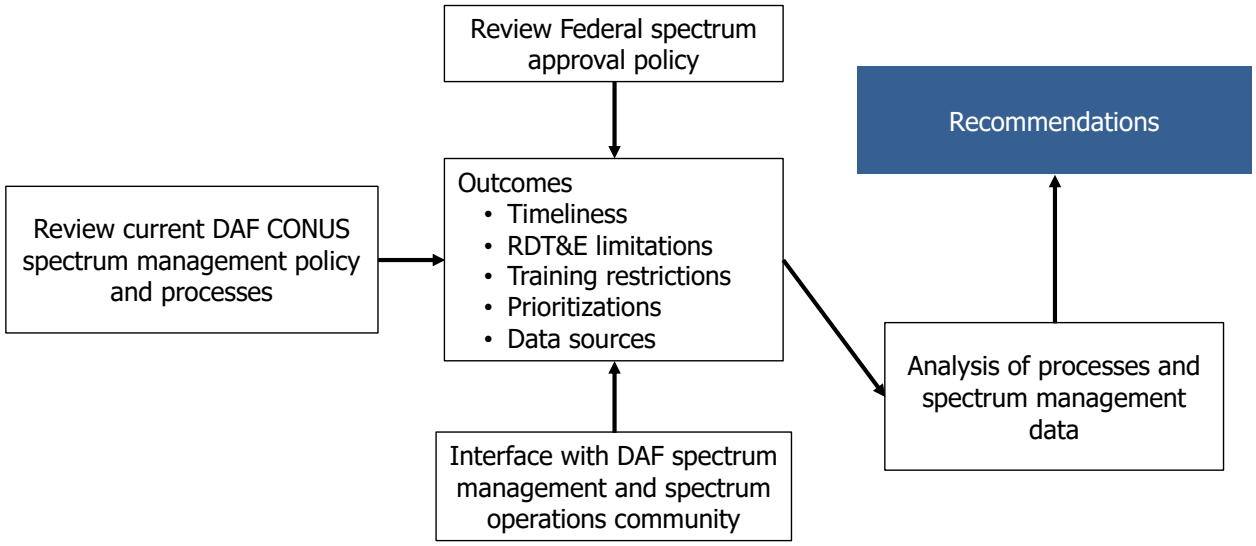
First, we reviewed guidance documents for DAF, U.S. Department of Defense (DoD), and federal EMS management. These documents focused on the roles and responsibilities for spectrum managers as well as the procedures for completing spectrum certification, allocating frequencies, and for requesting spectrum access to conduct EMSO, such as electromagnetic attack (EA), in CONUS. We also reviewed formal spectrum management training documents and pipelines.

Second, we conducted semistructured interviews and discussions with spectrum managers and EMSO subject-matter experts (SMEs) at the Air Combat Command, Pacific Air Forces, U.S. Air Forces in Europe, the Nevada Test and Training Range (NTTR), and at various other DAF organizations to collect SME-level input on day-to-day procedures.

Third, we used Python to analyze data from Stepstone, a certification process management system, to quantify delays and identify potential root causes of delays in spectrum-dependent system certification. These data contained more than 3,000 certification request records from 2007 to 2023 and contains such fields as certification request start dates, status, and number of days since certification request start. We were unable to obtain data from Spectrum XXI to analyze the root causes of delays.

Although we did not set out to conduct a complete doctrine, organization, training, materiel, leadership, personnel, and facilities analysis, many of the challenges in spectrum management can be well organized in such a framework. Our recommendations fall primarily under training and materiel. Figure 1.2 illustrates our approach.

Figure 1.2. Research Approach




NOTE: RDT&E = research, development, test, and evaluation.

## Scope

Our examination of spectrum management processes was limited to those within CONUS and further limited to related processes, systems, and operations within the DAF. Each host nation in which the DAF operates has its own processes for managing spectrum; a review of spectrum management processes globally is beyond the scope of this report.

Certification and frequency assignment for DAF systems must still be completed within CONUS and according to DAF and federal procedures—regardless of the intended area of operation.[4] Therefore, spectrum access within CONUS affects all DAF systems.

Examining federal spectrum management challenges and processes closely and developing recommendations for federal agencies was also out of scope, but we acknowledge the findings from other studies on federal spectrum management in this report.

### Defining DAF Spectrum Management

Spectrum management in the DAF is not only a career field, but also an expertise domain and an operational function that is becoming increasingly difficult in a congested and complex electromagnetic environment. For example, spectrum management is a function of Electromagnetic Battle Management (EMBM), which needs to dynamically assign spectral resources to the various sensors, effectors, and communications systems in a contested and congested EMS. It also represents an input to the Air Operations Center planning and assessment process and includes the career spectrum management personnel that provide the inputs to those processes.

[4] DoD Instruction (DoDI) 4650.01, *Policy and Procedures for Management and User of the Electromagnetic Spectrum*, change 1, October 17, 2017.

In peacetime CONUS operations, spectrum management can cover a wide variety of tasks, apart from being a career field and domain, depending on where the spectrum management occurs. At the U.S. Air Force (USAF) and U.S. Space Force levels, spectrum management includes participation in delegations that advocate for U.S. interests at international organizations, such as the International Telecommunications Union (ITU). However, day-to-day DAF-level spectrum management tasks are focused on developing guidance, supporting lower-level commands, and providing a single interface between the DAF and federal agencies, such as the National Telecommunications and Information Administration (NTIA).

At the USAF command level and below, spectrum managers ensure compliance with NTIA procedures, provide guidance to acquisitions efforts, and assist in coordination of exercises. More specifically, the spectrum managers process and obtain frequency assignments, spectrum certifications, and ITU registrations for spectrum-dependent equipment. Spectrum managers in peacetime and conflict may also operate equipment that surveys or monitors the spectrum to identify emitters that may interfere with operations or objectives.[5]

Strictly for the purposes in this report, we refer to *spectrum management* as those tasks related to DAF spectrum-dependent equipment certification and frequency allocation. Wherever necessary, we add additional detail.

## Outline of This Report

Chapter 2 is focused on equipment certification processes and describes the steps involved in submitting and completing a certification package. Chapter 3 deals with frequency assignment processes and describes the steps in completing frequency assignment for DAF systems. Chapter 4 deals with requests for spectrum in EA operations in CONUS and is a special case of spectrum management processes and challenges. Chapter 5 focuses on training and technology for DAF spectrum management. Chapter 6 concludes the report and presents recommendations to improve DAF spectrum management.

[5] Department of the Air Force Instruction 17-220, *Cyber Operations: Spectrum Management*, June 8, 2021.

Chapter 2

# DAF Spectrum Certification Processes

Under DoDI 4650.01, *Policy and Procedures for Management and Use of the Electromagnetic Spectrum* (2017), spectrum certification is a DoD requirement for radio frequency (RF) emitting equipment that certifies that a system operates within specified frequency bands and does not violate technical standards or regulations. An RF emitting system cannot be acquired without certification.

Each service component (e.g., the Army, Navy, and USAF) has its own service-owned spectrum certification workflow, but the certification process is similar across all services in that the process begins with the completion of a DD Form 1494, whose first page is shown in Figure 2.1 by manufacturers for equipment at four stages of development: conceptual (Stage 1), experimental (Stage 2), developmental (Stage 3), operational (Stage 4).[6]

[6] Submission at the conceptual stage is for planning purposes only; experimental stage submissions is for testing radiating equipment; developmental stage submissions are for major design completion; operational stage is final and requires additional technical characteristics data.

Figure 2.1. First Page of DD Form 1494

**UNCLASSIFIED**

| APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION | CLASSIFICATION | DATE | *Form Approved OMB No. 0704-0188* |
|---|---|---|---|
| | | | PAGE 1 OF PAGES |

The public reporting burden for this collection of information is estimated to average 24 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.
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**DOD GENERAL INFORMATION**

| TO | FROM |
|---|---|
| | |

**1. APPLICATION TITLE**

**2. SYSTEM NOMENCLATURE**
Same

**3. STAGE OF ALLOCATION** *(X one)*
[X] a. STAGE 1 - CONCEPTUAL [ ] b. STAGE 2 - EXPERIMENTAL [ ] c. STAGE 3 - DEVELOPMENTAL [ ] d. STAGE 4 - OPERATIONAL

**4. FREQUENCY REQUIREMENTS**
a. FREQUENCY(IES)
b. EMISSION DESIGNATOR(S)

**5. TARGET STARTING DATE FOR SUBSEQUENT STAGES**

| a. STAGE 2 | b. STAGE 3 | c. STAGE 4 |
|---|---|---|
| | | |

**6. EXTENT OF USE**

**7. GEOGRAPHICAL AREA FOR**
a. STAGE 2
b. STAGE 3
c. STAGE 4

**8. NUMBER OF UNITS**

| a. STAGE 2 | b. STAGE 3 | c. STAGE 4 |
|---|---|---|
| | | |

**9. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT**

**10. OTHER J/F 12 APPLICATION NUMBER(S) TO BE**
[ ] a. SUPERSEDED J/F 12/
[ ] b RELATED J/F 12/

**11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?**
[ ] a. YES [ ] b. NO [ ] c. NAvail

**12. NAMES AND TELEPHONE NUMBERS**

| a. PROGRAM MANAGER | (1) COMMERCIAL | (2) AUTOVON |
|---|---|---|
| b. PROJECT ENGINEER | (1) COMMERCIAL | (2) AUTOVON |

**13. REMARKS**

| DOWNGRADING INSTRUCTIONS | CLASSIFICATION | |
|---|---|---|
| | | |

**DD FORM 1494, AUG 96 (EG)** PREVIOUS EDITION MAY BE USED. Reset Designed using Perform Pro, WHS/DIOR, Aug 96

SOURCE: Reproduced from DoD, "Application for Equipment Frequency," DD Form 1494, August 1996.

The certification process is often considered to be a license to build a system with specific conditions but should not be confused with a license to radiate. For CONUS emitters, the complete form is five pages that contain the following information:[7]

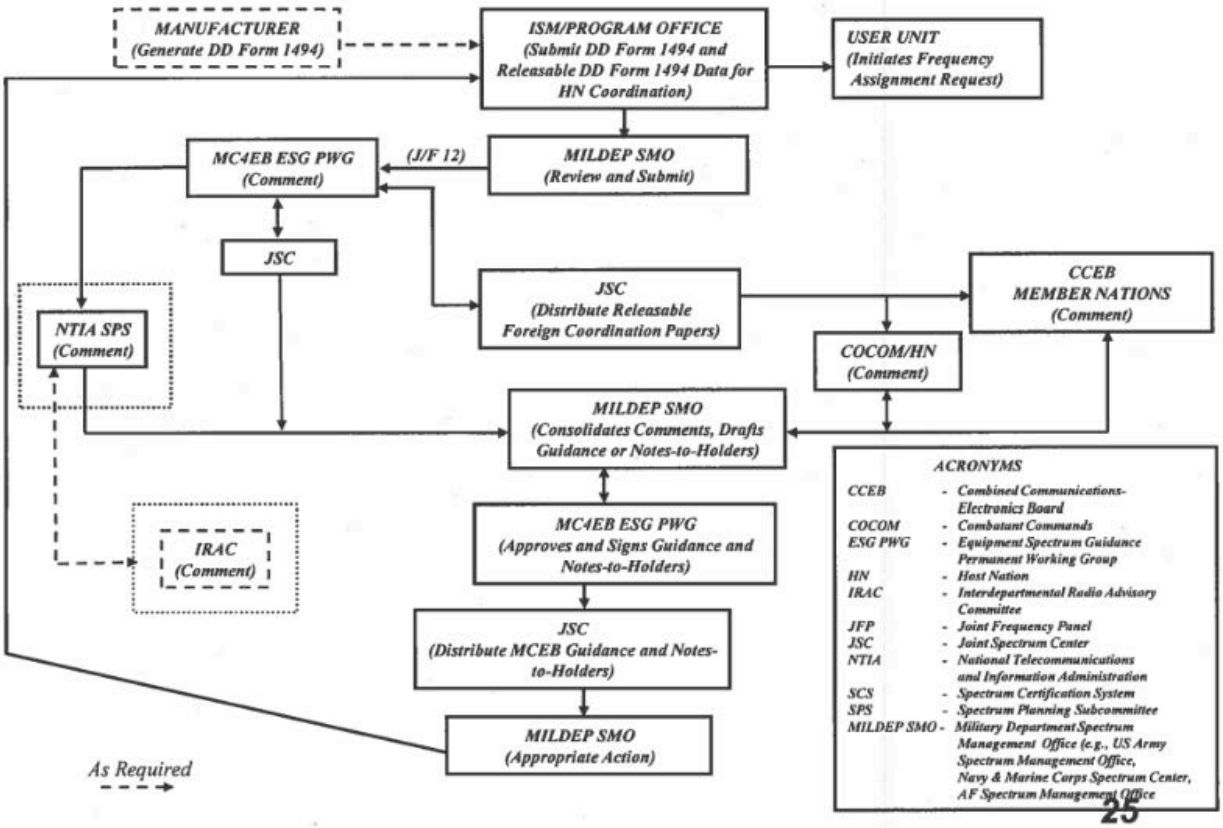
- DoD general information
- transmitter equipment characteristics
- receiver equipment characteristics
- antenna equipment characteristics.

Once the form is completed, it is submitted to a local spectrum management office (SMO) (e.g., at the installation level), where it is reviewed and then sent to the Air Force Spectrum Management Office (AFSMO). Once it is reviewed and approved, it is sent to the Military Communications, Command, Control, and Computers Executive Board (MC4EB)/Equipment Spectrum Guidance Permanent Working Group. The MC4EB reviews and comments and sends it to the NTIA/Spectrum Planning Subcommittee (SPS) for comment while working in parallel with the Joint Spectrum Center, now known as Defense Information Services Agency (DISA) Program Executive Office (PEO) Spectrum, for comment and to record the submission package. The NTIA also works with the Interdepartment Radio Advisory Committee (IRAC) to obtain spectrum advice. Once approved, the equipment is certified.[8]

[7] For emitters outside CONUS, the form also requires a Foreign Coordination General Information Page.

[8] A separate but related process, Spectrum Supportability Assessment is also required prior to frequency assignment and determines the risk of a system's intended use.

Figure 2.2. DoD Certification Process Overview




SOURCE: Reproduced from USAF, "Equipment Certification," briefing, Air Combat Command, 2022.
NOTE: JSC = Joint Spectrum Center. JSC is now known as DISA PEO Spectrum.

Figure 2.3 shows an example of an NTIA certification approval with commentary, and the appendix contains the full certification with MC4EB guidance.

**Figure 2.3. Example of National Telecommunications and Information Administration Spectrum Support Certification**

| Form NTIA-44 (3/91) | Classification | System |
|---|---|---|
| CONTINUATION PAGE | **UNCLASSIFIED** | **AN/PRC-117G(V)(C), Harris RF-300M-MP Portable Manpack Radio Set** |

**Section 3: SPS RECOMMENDATIONS**

5. Air Force be aware that operation of this system will be subject to the provisions of Section 5.1.2 of the NTIA Manual regarding its lack of compliance with the following standards:
   a. unwanted emission standards of Subsection 5.2.2.2 of the NTIA Manual for the use of the emissions 2K40G1D, 4K80G1D and 25K0F1D in the band 291-318 MHz;
   b. unwanted emission standards of Subsection 5.3.5.2 (narrowband standard) of the NTIA Manual for the use of the emission 8K00F1D in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;
   c. spurious level standards of the Subsection 5.3.5.2 of the NTIA Manual for the use of the emissions 8K010F1D and 11K0F3E in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;
   d. receiver adjacent channel selectivity standards of the Subsection 5.3.5.2 of the NTIA Manual for the use of the digital receiver (emission 8K00F1D) in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz.
6. Air Force, if frequency availability dictates, use of the bands 162.0125-174 MHz and 406.1-420 MHz give preference in selecting frequencies to those channels designated "DOD" or "AGA" in accordance with Section 8.3.18 of the NTIA Manual.
7. Air Force ensure that this system cannot be configured to transmit in bands other than those in Section 1 above.
8. Air Force ensure that personnel are protected from radiation levels that exceed generally accepted exposure levels.

| Name/Title of Recommending Official | Signature | Date |
|---|---|---|
| Stephen J. Butcher, SPS Chairman | Stephen J. Butcher | NOV 0 3 2008 |

**Section 4: NTIA CERTIFICATION**

The Office of Spectrum Management certifies Stage 4 spectrum support for this system.
This office concurs with the SPS recommendations in Section 3.

| Name/Title of Certifying Official | Signature | Date |
|---|---|---|
| Edward M. Davison Deputy Associate Administrator | Ed M. Davison | NOV 0 3 2008 |

| Distribution | Classification | Page Number |
|---|---|---|
| IRAC, SPS, FAS, EPS | **UNCLASSIFIED** | 3 of 3 pages |

SOURCE: Reproduced from NTIA, "Certification of Spectrum Support," Form NTIA-44, Federal Communications Commission, November 3, 2008, p. 3.

Although guidelines call for lead times of 90 business days between AFMSO and MC4EB and an additional 15 to 30 business days after interaction with the JSC (now known as DISA PEO Spectrum), the total time between AFSMO's first review of the DD Form 1494 submission and certification with NTIA approval is often between nine and 12 months because the NTIA review can take three months to complete. The total time from DD Form 1494 completion to approved certification can take longer than nine to 12 months because coordination between user and major command (MAJCOM) can be required before submission to AFSMO.[9]

## Addressing Delays in Certification

The system certification process is lengthy and requires multiple layers of review because operating uncertified equipment has implications for the public and private sectors as well as for the DAF and DoD. The EMS is congested and operating EMS-dependent systems that do not conform to technical standards and regulations can cause electromagnetic interference and safety issues aside from legal issues. Requiring proper certification helps prevent the funding of systems that cannot be operated. However, obtaining proper certification requires sequential interactions within the DAF and with federal agencies, each with different timeline guidance for review of the DD Form 1494 submissions. This makes the process arduous and long.

Identifying specific root causes of these delays and the length of the delays with precision across all submissions over time is difficult because the systems that store certification data and help track the certification process, such as Stepstone and End-to-End Spectrum Supportability System (E2ESS),[10] are not designed to identify the problems. We reviewed raw data exports from Stepstone and concluded that there was not enough detailed information in the data to support proper root cause analysis. According to USAF spectrum managers,[11] when there are errors in DD 1494 submissions and when there is additional coordination among stakeholders required to certify a system, this is often done manually via telephone and email, and many of those coordination details are not captured in Stepstone.

The DD 1494 form that can be completed electronically is deceptively simple. Many delays in the certification process can be traced back to additional interactions among the organizations processing a submission because of errors in completion of the form and unclear and insufficient engineering information within it. This suggests unfamiliarity with the form among the users and spectrum managers at the below-MAJCOM level, and confusion about the information that is required for a speedy certification. As an example of how complex completing this form can be, a guide to completing the form that was published to prevent documented processing delays is more than 100 pages long.[12]

[9] Systems that are submitted for certification outside bands that are allotted for an existing use can take even longer.

[10] Stepstone is a DISA system that helps users complete DD Form 1494 and stores system parametric data. E2ESS is designed for spectrum supportability processes that ensure that there is spectrum available for a certified system. These systems can be accessed via web browser with a valid DoD common access card.

[11] USAF spectrum managers, discussions with the authors, September 2022–August 2023.

[12] U.S. Army, *DD 1494 Preparation Guide*, undated.

Many spectrum certification stakeholders have indeed indicated that insufficient training or a lack of expertise with the certification process, the high complexity of the data required of certification submissions, and the technology used in submission may prevent coordination and certification submission issues. Spectrum certification processes requires a solid understanding of radio frequency principles, comfort with complex engineering specifications for a wide variety of spectrum-dependent equipment, and proficiency on systems that capture and store relevant data. Acquiring such competencies in the training pipeline for USAF spectrum managers is challenging.[13] Much of the expertise in navigating the certification process and processing certification requests at the installation, MAJCOM, and USAF level is gained by working these issues with seasoned experts.

Aside from errors in the DD Form 1494, USAF spectrum managers cited additional potential factors in certification delays, including a lack of lead time for review of the DD Form 1494 submission at each step in the process and a lack of involvement with the stakeholders that lead to slow response times between all.[14] When there is an issue with certification at the NTIA, for example, AFSMO must review the issue and then coordinate with the submitting MAJCOM, and the MAJCOM coordinates with the submitter. The submitter cannot bypass the MAJCOM or AFSMO and coordinate with the NTIA themselves.

Other factors that lead to delays include the candidate system's complexity and the data required on forms, and additional engineering and coordination with federal agencies required for specific systems. For example, Link-16 certifications and modifications are governed by its own DoD guidance[15] and memorandums between DoD and Department of Transportation.[16] Figure 2.4 presents the process for certifying new Link-16 related systems and average timelines for certification. This process requires additional coordination with SPS Working Groups 1 and 8 (WG-1, WG-8), which report to the NTIA and require Systems Review Board assessment.

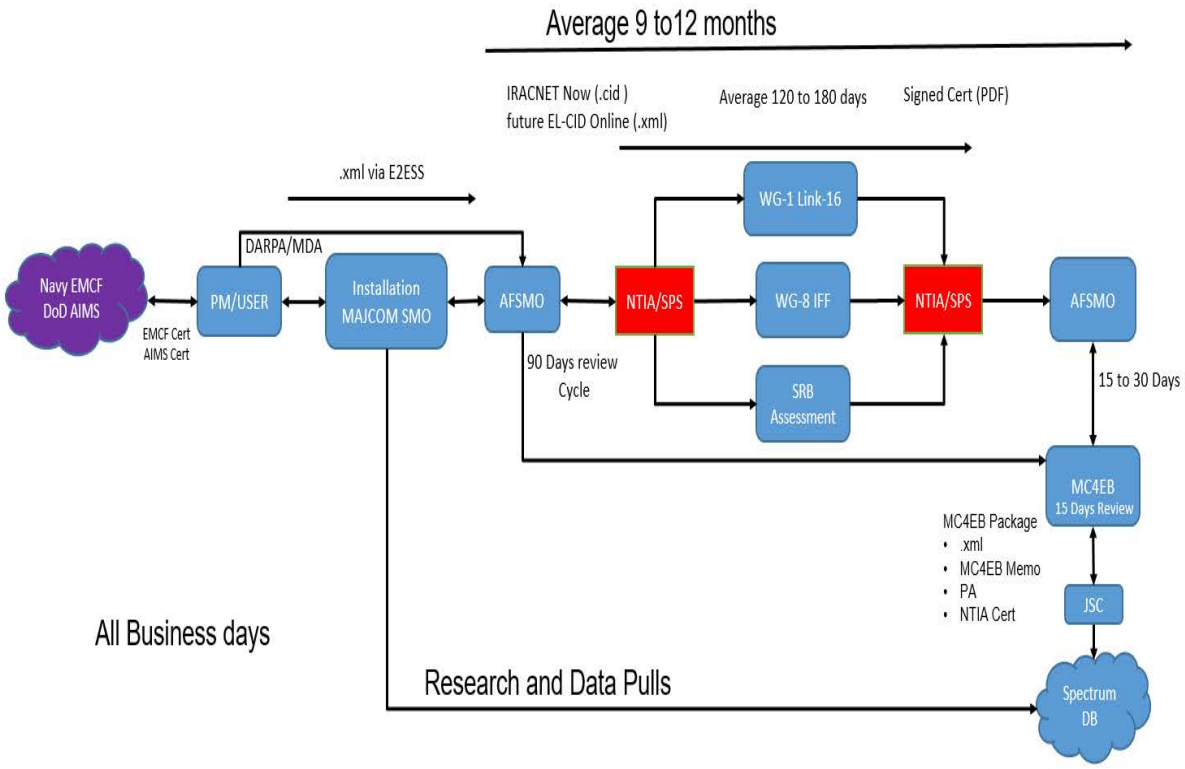
[13] Spectrum management training is discussed in Chapter 5.

[14] USAF spectrum managers, discussions with the authors, September 2022–August 2023.

[15] Assistant Secretary of Defense for Networks and Information Integration, *Link 16 Electromagnetic Compatibility (EMC) Features Certification Process and Requirements*, DoD 4650.1-R1, U.S. Department of Defense, April 26, 2005.

[16] Memorandum of Agreement Between Department of Defense and Department of Transportation Regarding the 960–1215 MHz Frequency Band, December 31, 2002.

**Figure 2.4. Example of Link-16 Certification Process**




SOURCE: Reproduced from USAF, Spectrum Certifications briefing to Air Force Link Network Management Working Group, Air Force Spectrum Management Office, November 1, 2022.
NOTE: Cert. = certification; DoD AIMS = DoD Air Traffic Control Radar Beacon System, Identification Friend or Foe, Mark XII/XIIA Systems Program Office; EMCF = Electromagnetic Compatibility Features; IRACNET = Interdepartment Radio Advisory Committee Network; PM = Project Manager; DARPA = Defense Advanced Research Projects Agency; MDA = Milestone Decision Authority; Spectrum DB = spectrum databases.

Given the trend in software defined radio adoption, navigating the spectrum certification process properly and coordinating changes and updates to systems are especially critical as software updates can result in major modifications to technical characteristics of a system, thereby nullifying a certification and taking a system out of regulatory and operational compliance.

Enterprise information technology (IT) also challenges the spectrum certification process. The database systems within which the USAF stores and processes certifications are not owned or maintained by the USAF. These systems belong to DISA and fall under the Defense Spectrum Organization's suite of spectrum capabilities called Global Electromagnetic Spectrum Information System (GEMSIS). These systems require formal processes for integrating new capabilities that would address issues in tracking certifications, alerting for problematic submissions, and storing additional relevant information. For example, according to USAF spectrum managers we spoke to over several technical exchanges,[17] existing data from these systems can be problematic because of

[17] AFSMO spectrum managers, discussions with the authors, January 2023–August 2023.

permissions issues, classification issues, and lack of detail in these data. Furthermore, certification process expertise is required to properly interpret these data.

Spectrum managers at each installation, MAJCOM, and other organizations can implement site-specific workflows and technology to assist in day-to-day spectrum management operations to address specific USAF spectrum management requirements. However, when USAF spectrum managers rotate to new assignments, they must learn the local workflows and adopt the technology used.

The challenge of operating multiple systems, workflows, and coordinating different processes while trying to keep up with technology developments is not unique to the USAF. A U.S. Government Accountability Office (GAO) reported in 2022 that the NTIA had highlighted out-of-date IT systems as "hindering" spectrum management,[18] and the NTIA emphasized in a separate report the importance of interoperability of these systems.[19] For example, the NTIA does not use the GEMSIS suite of tools to review and certify spectrum systems. While the USAF primarily uses Stepstone and E2ESS to track certification submissions, the NTIA uses Equipment Location-Certification Information Database.

Although the USAF spectrum management community has strived to adhere to lead time guidance in spectrum certification, it cannot control the tempo for review, approval, and coordination at the federal level. New technology solutions at the AFSMO level and below may assist in speeding up processing (e.g., automating rote processes), but if these solutions do not interact or interoperate well with federal systems, it may also lead to delayed certification timelines.

Additionally, because certification process expertise often comes from time on the job without a robust knowledge management system to help spectrum managers navigate certification processes and data at every organizational level and across commands, the valuable expertise that is used to accomplish certification approvals can be lost when personnel rotate and retire.

[18] GAO, *Spectrum Management: Information Technologies for Managing Federal Use*, GAO-22-105221, February 17, 2022b.

[19] Charles A. Cooper, *Plan to Modernize and Automate the Infrastructure of NTIA Related to Managing Federal Spectrum Use*, National Telecommunications and Information Administration, September 2021.

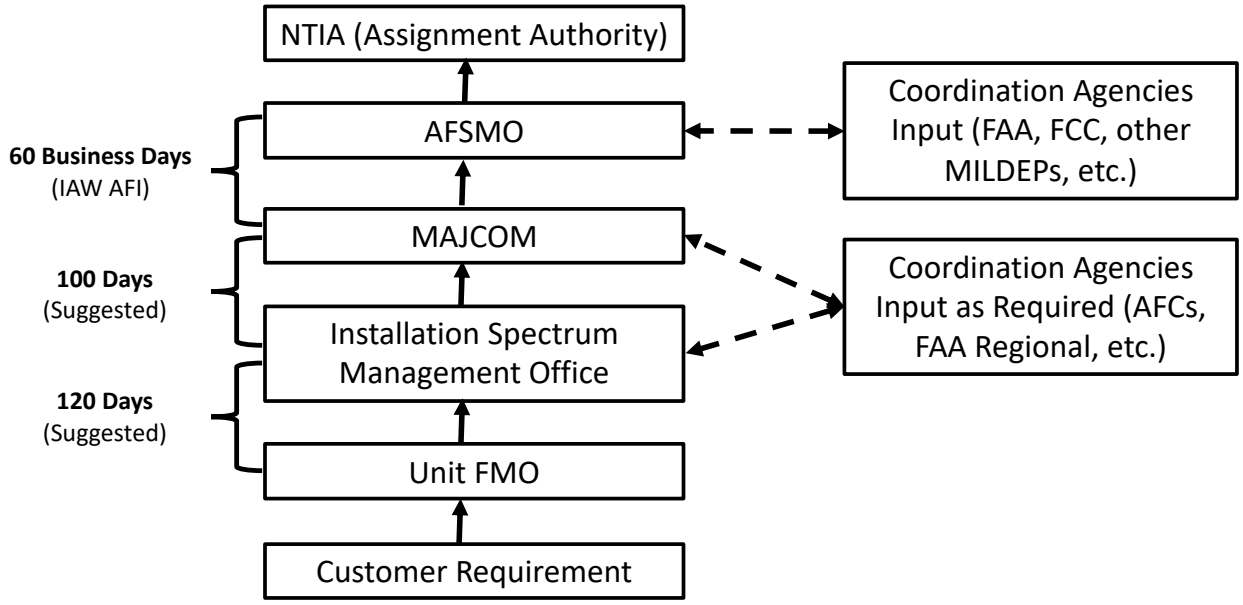
Chapter 3

# DAF Frequency Assignment Processes

Once spectrum-dependent equipment is certified (as described in Chapter 2), the submitting office then applies for frequency assignment through the AFMSO. When a system is assigned a frequency (or set of frequencies), it is authorized to transmit in that spectrum (and only at specific locations and times for some systems, such as jammers). The process begins when an office submits a Standard Frequency Action Format (SFAF) for ingestion into Spectrum XXI. *Spectrum XXI* is a desktop-based frequency assignment management and visualization tool for submitting frequency assignment requests and that also validates data and ensures regulatory compliance. AFSMO reviews and approves these submissions (or rejects them back to the submitting office) and works with the submitter and federal agencies, such as the Federal Aviation Administration (FAA) and Federal Communications Commission (FCC), before submitting to NTIA. There, the submission package is reviewed or rejected and sent back to AFSMO.

Much like the spectrum certification process, interaction with NTIA and federal stakeholders is done strictly through AFSMO. Submitting offices cannot resolve issues directly with the federal stakeholders and can cause delays because of a lack of coordination.

**Figure 3.1. USAF Frequency Assignment Process**




SOURCE: Reproduced from U.S. Air Force Spectrum Certification briefing, Headquarters, Air Combat Command, undated.
NOTE: AFC = Area Frequency Coordinator; AFI = Air Force Instruction; FMO = Frequency Management Office; IAW = in accordance with; MILDEP = Military Department.

Timelines for completed frequency assignments stretch to over nine months, depending on the requesting office, because units purchasing equipment must coordinate through their installation spectrum manager and the spectrum manager then must coordinate with the MAJCOM before coordinating with AFSMO. There is a 60-business day lead time required for coordination between the MAJCOM and AFSMO, and 220 days are suggested as a total lead time between unit customers and the MAJCOM.

## Addressing Delays in Frequency Assignment

Just as with the spectrum certification process, it is difficult to quantify and qualify delays because much of the coordination is done manually. Throughout our discussions with USAF spectrum managers,[20] many of the issues focused on the Spectrum XXI software. This system has been in use for two decades and is missing features that many USAF spectrum managers described as necessary to help speed up the frequency assignment process. For example, as of this writing, Spectrum XXI does not have a feature to alert spectrum managers of disapproved SFAF submissions; managers must monitor their submissions manually, checking into the system regularly to check the status of requests and to respond to request issues and required further coordination.

Furthermore, exporting data from the system to analyze delays over time is not straightforward—we were unable to obtain data to analyze the root causes of delays in frequency assignment. Previous

[20] USAF spectrum managers, discussions with the authors, June 2022–August 2023.

attempts to track delays via spreadsheets at the USAF level were abandoned because of how cumbersome the process can be. Although Spectrum XXI can store dozens of data points for a given emitter, NTIA focuses on an emitter's location, power, and frequencies of intended use. Table 3.1 below shows the six primary data points the NTIA uses in the frequency assignment process.

**Table 3.1. Example of Primary Emitter Data Required in Frequency Assignment Process**

| Data | Description | Example Submission |
|---|---|---|
| Signal characteristics | Includes frequency or bands of frequencies requested, such as adjustments for frequencies tolerances, and the power levels at which such frequencies will be transmitted | Land mobile 406.1 through 420 megahertz (MHz) at 50 watts of power |
| Time of use | The percentage of time the frequency is anticipated to be in use | 10–50 percent of the time |
| Antenna location | Location of antenna in latitude and longitude: 38.8951 and –77.0364 | Location of antenna in latitude and longitude: 38.8951 and –77.0364 |
| User | Which agency or agency subcomponent will use the frequency | U.S. Navy |
| Interference potential | Narrative information relating to international coordination concerns, if applicable | FAA identifies possible harmful interference in its spectrum assignment application |
| Type of use | Information related to the type of emitter's broadcasting frequencies | Global Positioning System (GPS) |

SOURCE: Adapted from GAO, *Report to the Congressional Committees, Spectrum Management, NTIA Should Improve Spectrum Reallocation Planning and Assess Its Workforce*, GAO-22-104537, January 2022a.

Just as the spectrum certification process consists of interactions between USAF organizations and interactions with federal agencies, so too is the frequency assignment process. And like the certification process, the USAF cannot control the tempo for review and approval at the federal level and does not own or manage the enterprise technology used to process assignment requests.

Although the NTIA primarily focuses on the data in Table 3.1, a GAO report from 2022 echoed USAF spectrum management's concerns about Spectrum XXI because the data collected are not precise.[21] For example, for most frequency bands, rather than submit days and times of emission, a percentage of time used is submitted, and although precise emitter locations can be provided by the submitting office, the emitter's coverage area (based on power and other characteristics) is not submitted. For bands where the data are submitted, this occurs outside Spectrum XXI via ad hoc processes.

Attempts at deconflicting the spectrum, coordinating with the FCC and FAA, and using systems that are missing required features complicates processing for the 90,000 frequency assignment submissions that the NTIA sees annually. Delays and additional coordination at the federal level ultimately affect the USAF process, which is already long and arduous.

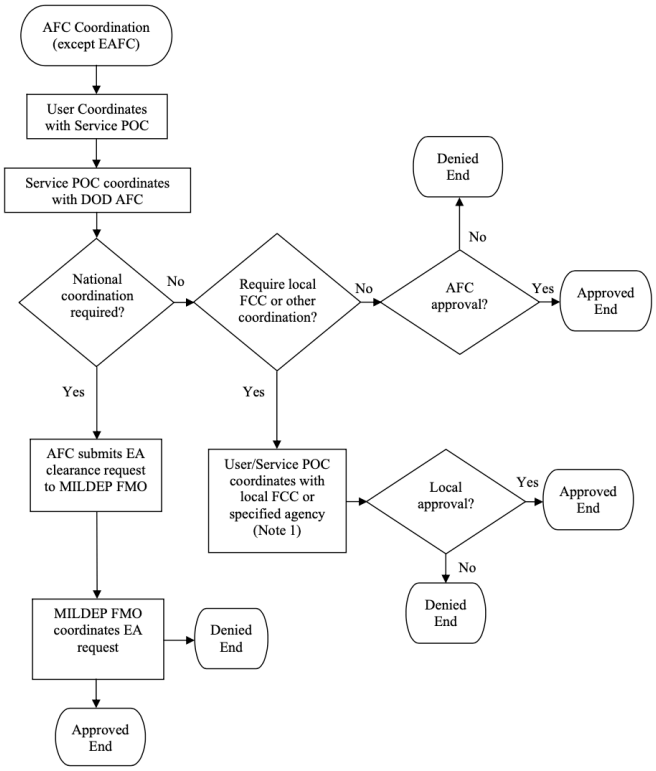
[21] GAO, 2022a.

Chapter 4

# Air Force Electromagnetic Attack Spectrum Requests

Challenges in USAF spectrum management also exist outside the preliminary spectrum certification and frequency assignment processes described in the previous chapters, but they are directly related to these processes. For example, conducting airborne EA training and testing in CONUS is one area that has been challenging for decades because jamming communications, and command and control links, and other systems can affect nonmilitary spectrum-dependent systems and can cause safety issues, such as the loss of navigation capability or the loss of contact with air traffic control systems. These challenges are further complicated by the increasing congestion in the EMS because industry continues to obtain spectrum that may conflict with the frequency bands that the USAF uses to train and test EA capabilities. USAF spectrum managers are critical in helping ensure coordinated and deconflicted EA training and test events. The process for requesting and coordinating spectrum for EA in CONUS is shown in Figure 4.1.

**Figure 4.1. Area Frequency Coordinator Process for Electromagnetic Attack in CONUS**




SOURCE: Chairman of the Joint Chiefs of Staff Manual 3212.02C, *Performing Electronic Attack in the U.S. & Canada for Tests, Training, and Exercises*, March 20, 2011.
NOTE: EAFC = Eastern Area Frequency Coordinator; MILDEP FMO = Military Department Frequency Management Offices; POC = point of contact.

To transmit in such CONUS areas as the NTTR, EA customers submit EA requests via their MAJCOM spectrum managers, and coordination occurs between DoD AFCs and the submitting spectrum managers as well as with the spectrum managers at that range. If operating in federal bands or coordination with FAA or FCC is otherwise required, it is handled by AFSMO. Table 4.1 contains an example of frequency bands and their required coordination for EA operations.

**Table 4.1. Example of Frequency Bands and Required Coordination**

| Frequency Band (MHz) | Required Coordination |
|---|---|
| 150–156 | Local |
| 156–158 | Federal |
| 158–161 | Local |
| 161–174 | Federal |
| 174–175 | Local (FCC) |
| 175–200 | Local (FCC) |
| 200–216 | Local (FCC) |
| 216–222 | Federal |
| 222–225 | Local |

SOURCE: Adapted from Chairman of Joint Chiefs of Staff Manual 3212.02C, 2011.
NOTE: Local = coordination required with any DoD AFC or Fleet Area Coordination and Surveillance Facilities that are within line of sight (substitute service point of contact if no facilities apply); Local (FCC) = coordination required with local FCC regional representative; Federal = coordination required with national (FCC, FAA, Department of State, and other agencies) and Service SMO.

The main task in coordinating the use of the spectrum for EA training is determining whether the attacking systems will interfere with other systems not participating in the training operations that are already certified and authorized to transmit in the target spectrum. Although this determination is aided by such DoD tools as Spectrum XXI, such federal agencies as the FAA use additional tools (for example, WebAFM and HTZ Warfare) to supplement their analysis.[22] The lead time for requests that require federal coordination is 60 days, and the FAA and FCC are to respond to requests within 30 days of receiving a request. Typically, requests can be approved for operations that occur regularly for a period of one year. For systems that are ground-based or that do not move regularly, approval for these systems is straightforward as long as they do not interfere with other spectrum-dependent systems.[23]

## Challenges to Cross-Range Electromagnetic Attack Clearances

Increasingly, large exercises designed to develop and test real-world EMSO capabilities are conducted across multiple training ranges, such as the R-2508 Complex at Edwards Air Force Base,

[22] GAO, 2022b.

[23] Simulated threat systems are not necessarily EA systems, and they require certification and frequency assignment through normal channels. If operating on and sharing spectrum with primary civilian systems, these systems must do so through memorandums with the primary system operators.

California, the Nevada Test and Training Range at Nellis Air Force Base, and the Utah Test and Training Range at Hill Air Force Base. Coordinating such events requires interaction with multiple airspace authorities and can require lead times that are longer than those required of a single range. The challenge is exacerbated if jamming platforms on one range attempt to engage emitters on another range because this also affects any spectrum users between the two ranges, which are outside of DoD control.

Furthermore, USAF operators train to attack a threat system's entire operating band according to their EA system's capabilities. In CONUS, some simulated military threat systems must share spectrum with civilian systems that are primary users. This means that if airborne EA request submissions include spectrum that is shared with civilian systems and cause interference, these requests will be either completely or partially denied and can compromise effective training.

## Limited Feedback with Electromagnetic Attack Clearance Denials

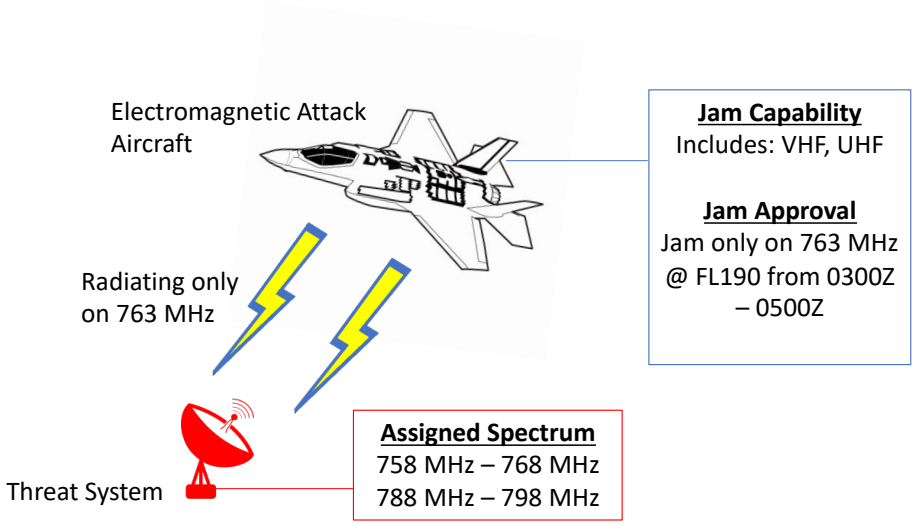
In cases in which only a subset of requested frequencies for EA are approved, there are often limited explanations as to why others were denied. This lack of feedback makes it difficult for spectrum managers to properly justify their requests and to work toward an acceptable solution that meets training objectives and satisfies spectrum control authorities because there is no specific issue to resolve. This lack of information is uniquely challenging for EA requests because authorization is sometimes approved for ground-based emitters but not the airborne systems that target them.

Without feedback, it is unclear why the requested frequency was denied. For example, it is possible that the clearance could be denied because the airborne emitter will interfere with the ground-emitter because they would be operating in the same frequency ranges. However, this very interference is the desired training effect. If the denial is because of potential interference with civilian systems, there is no chance to model the signal environment to test whether there would be actual interference in executing training objectives.

## Addressing Challenges in USAF Electromagnetic Attack Requests

A common workaround to these types of spectrum conflicts is that the EA requestor (typically an electromagnetic warfare officer) asks for only specific frequencies on which to transmit rather than bands of spectrum to prevent interference with civilian systems. This requires coordination with the threat system operators and spectrum managers to know which frequencies will be used before submitting EA requests. Further details—such as specific locations, transmitting power, and altitude—can help spectrum managers, area frequency coordinators, and federal stakeholders approve the EA request. Figure 4.2 shows a notional example of this workaround.

**Figure 4.2. Limited CONUS Electromagnetic Attack on a Simulated Threat System with Assigned Bands**




SOURCE: Features image by CINDYFLA (CC BY 4.0).
NOTE: FL = flight level; UHF = ultra high frequency; VHF = very high frequency; Z = Zulu time.

Although this workaround reduces realism in training in CONUS, it enables the operation of EA systems without taking on risk of interference with civilian systems.

The primary tool for USAF spectrum managers processing EA requests is Spectrum XXI. USAF spectrum managers indicate that requests for the operation of spectrum capabilities whose features and specifications are not readily accessible require manual management processes—often involving phone and email coordination.[24] This also requires personnel that are authorized and knowledgeable in handling such requests.

[24] USAF spectrum managers, discussions with the authors, June 2023–August 2023.

Chapter 5

# Air Force Spectrum Management Training and Technology

In the previous chapters, we examined spectrum management processes that are largely governed by federal requirements and that are dependent on factors outside USAF control. In this chapter, we examine areas that are within the control of the USAF: the training that the USAF provides and the technology it uses to conduct these spectrum management activities.

In the USAF, the spectrum manager force is a mix of enlisted airmen and civilian personnel. For the airmen, the spectrum management career field accepts only cross-trainees from other fields and is not one into which airmen are trained on entry into the USAF. Cross-trainees can come from any career field as long as they are approved by the career field manager. The initial technical training lasts 12 weeks and includes coursework on the federal processes described previously, such common spectrum management tools as Spectrum XXI, and some radio frequency theory. However, such a course is not sufficient for the expertise required of operational spectrum managers. USAF spectrum managers report that success in their fields can often be attributed to the mentorship experienced spectrum managers from either the enlisted or civilian force, particularly for those who come from career fields that do not involve knowledge of the EMS.

The career field within the USAF is evolving and spectrum operations airmen who were previously classified under Cyberspace Support now fall under a new specialty code that combines 11 career fields into a single field focused on cyber defense operations. There are less than 130 enlisted spectrum managers throughout the entire USAF, with billets distributed evenly across the ranks of E-4 to E-7 and with less than five total billets for E-3s and one E-8.

The level of billets translates into only one or two enlisted spectrum managers per major installation. This change can create bottlenecks at installations where spectrum managers are tasked with a saturated monitoring spectrum, processing certification and assignment requests, and providing other spectrum-dependent system acquisition support.

Airmen transitioning to new installations can often face new localized processes and technology that are unfamiliar. This is because there is no standardized method across installations for conducting day-to-day spectrum management activities. For example, SharePoint is used to manage information and customer interactions at some installations, while other installations use a spreadsheet and email approach. The challenge of adapting to a new system can be exacerbated when going from installation-level spectrum management to MAJCOMs and to the AFSMO level.

## Addressing Challenges in USAF Spectrum Management Training and Technology

Because USAF spectrum managers are the primary personnel processing spectrum certifications, frequency assignments, and EA requests in CONUS, these personnel would benefit from changes in training and technology, given the growing importance of the EMS to operations and the spectrum management career field transitioning to a cyber career classification. Table 5.1 is a summary of a strengths, weaknesses, opportunities, and threats analysis of the career field.

**Table 5.1. Strengths, Weaknesses, Opportunities, Threats Analysis of the USAF Spectrum Management Career Field**

| Strengths | Weaknesses |
|---|---|
| • Force is made up of cross-trainees; E-5 and higher<br>• Processes and tools are specialized to organization and mission<br>• Experienced spectrum operators serve in multiple roles: spectrum managers, exercise facilitators, and provide input to EMSOCs | • Some have cross-trained from non-spectrum related career fields<br>• Most expertise is developed on the job<br>• Relatively small career field; many positions are 1-deep<br>• Mismatches between expertise and requirements |
| **Opportunities** | **Threats** |
| • Refresh schoolhouse training to include more foundational and mission relevant material, including EMBM<br>• Standardize and automate common processes<br>• Increase outreach to potential cross-trainees<br>• Strengthen spectrum community of interest<br>• Increase collaboration between spectrum and cyber operators<br>• Optimize enlisted talent management | • Underinvestment vis-à-vis spectrum reality<br>• Formal training failing behind spectrum innovations and updates in EMBM systems<br>• Losing personnel to cross-training out of spectrum operations and separation |
| | *Spectrum processes may not improve without a well-trained and resourced workforce.* |

SOURCE: Features information from USAF spectrum managers, discussions with the authors, June 2022–August 2023.
NOTE: EMSOC = Electromagnetic Spectrum Operations Cell.

In particular, knowledge-management systems offer an opportunity for improvement in that they can record standardized knowledge and best practices across installations, MAJCOMs, and AFSMO. They can also serve as a central hub for spectrum manager workforce development and as "living documentation" of delays, impacts, and workarounds until an automated system that captures these

data is established.[25] The utility of such systems lies in regular interaction with its users and their ability to evolve with the domain it serves.

[25] Such systems as SharePoint are already in use at some USAF installations, but these systems are not standardized across the USAF; according to spectrum managers, they are primarily used for local customer request management. According to GAO, many federal agencies involved in spectrum management maintain their own IT tools to store data that are specific to their mission needs (see GAO, 2022b).

Chapter 6

# Conclusions and Recommendations

The processes for spectrum certification and frequency assignment within the USAF can each require up to nine months to complete. However, these processes are dependent on federal review, and the USAF cannot control the tempo of these coordination processes. Delays in certification and assignment can lead to delays in testing and fielding equipment; furthermore, training expectations are unrealistic because real-world systems cannot be used. The NTIA processes more than 90,000 submissions per year, and issues with federal spectrum management processes have been documented in recent GAO reports. USAF spectrum managers reported federal delays up to three months for spectrum certification, but this research focuses on areas in which the USAF can improve its own internal certification and assignment timelines.

There is no standard workflow across the DAF for processing spectrum certification and assignment applications: These are processed at the local unit using local workflows and additional tools, such as Microsoft Excel, until they are approved and sent up the chain through Stepstone and Spectrum XXI and ultimately arrive at AFSMO. It is generally difficult to quantify and qualify delays in these processes with precision because so many coordination tasks are executed manually with little documentation of the reasons for errors, corrections, and additional coordination required for every certification and assignment request that the USAF sees. Furthermore, the primary technologies that the USAF uses to process certification and assignment requests at the enterprise level, Stepstone and Spectrum XXI, are owned and managed by DISA, which complicates how the USAF can directly address issues with this technology, such as the inability to precisely track delays and their root causes over time.[26]

Spectrum requests for EA operations in CONUS for testing and training are related to the processes for certification and assignment in that the EA systems in question must be certified and have frequency assignments. However, airborne EA system operators must request spectrum every time they plan to transmit. The timelines for these approvals are shorter than those of certification and assignment but can be rejected if a system will operate out of its authorized spectrum band or if the operator is unfamiliar with common spectrum management workarounds to conducting EA in CONUS.

The community of USAF spectrum managers is small and is a mix of enlisted airmen and civilians in which the number of airmen is fewer than 130. These airmen are expected to process these requests, monitor spectrum, provide other acquisition support to their respective installations and organizations, and must gain expertise in complex DoD and federal policy, processes, and technology—while maintaining their expertise of the EMS and radio theory that help them do their

[26] USAF spectrum managers also use auxiliary technology, such as Microsoft Excel, to manage spectrum submission data and other relevant information.

jobs. Spectrum managers have indicated that there are often many errors in certification and assignment submissions, and this causes additional interactions among the processing organizations. This suggests shortfalls in pipeline training, overall career field knowledge management, and community awareness (even if final approval timelines are within guidance).

## Recommendations

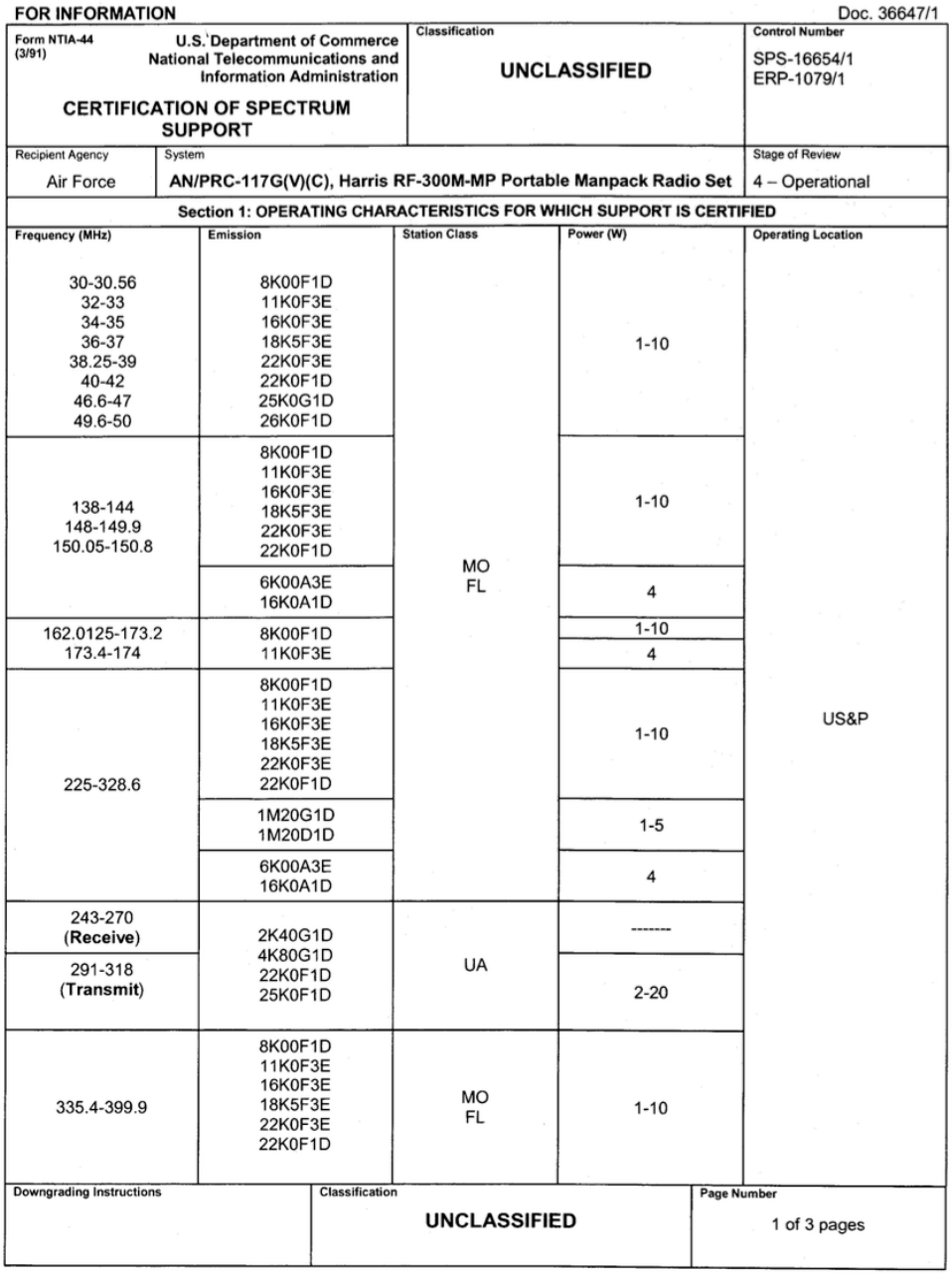
To take steps toward improved spectrum management processes (such as certification, frequency assignment, and EA requests) in CONUS, we present the following DAF-focused recommendations that stakeholder organizations, such as the AFSMO, can advocate for and implement with support from the Air Force Electromagnetic Superiority Directorate.

- Establish a DAF-accessible record of delays, flag those outside reasonable guidelines, and describe their impact. This record can begin as a spreadsheet approach for the most recent submissions and can be shared with the sister services and federal partners to help emphasize and prioritize communitywide spectrum management issues.
- Advocate for updates to DoD enterprise spectrum management tools, such as Spectrum XXI, that can leverage speed, scale, and detail in data to identify DAF-wide and DoD problem areas.
- Develop and acquire technology that aids users and helps automate the certification and frequency allocation submission process. As of this writing, tools fall short and should be replaced or updated to address training and expertise shortfalls. Attention should be given to capabilities that enable prioritization of submissions that require additional attention and coordination.
- Establish DAF-wide standards for spectrum management technology and workflows for processing spectrum certifications and assignment applications at commands and units with effective documentation that will outlast rotations and career advancements. These can include knowledge management systems and other web-based systems that can be exported and easily updated to capture evolving best practices and common workarounds to problematic administrative challenges.
- Develop new training materials for enlisted spectrum managers early in their career that focus on developing core capabilities, such as spectrum expertise, process administration, and engagement with industry and operations. Improved training, standardized workflows, and centralized knowledge management systems may reduce the administrative pressure that exists within the small but high-impact spectrum management career field.
- Develop DAF spectrum management community knowledge management systems so that airmen have access to the most recent and relevant information available to supplement their formal training and to support the unique mission that spectrum managers have within their new specialty code. Some of this work is already in motion as the spectrum management career field evolves; focus can be applied through the development and use of self-paced training modules to address potential common delays in certification and assignment.

Appendix

# Example Spectrum Certification

**Figure A.1. Example of National Telecommunications and Information Administration Certification**



FOR INFORMATION — Doc. 36647/1

| Form NTIA-44 (3/91) U.S. Department of Commerce National Telecommunications and Information Administration<br>CERTIFICATION OF SPECTRUM SUPPORT | Classification: UNCLASSIFIED | Control Number: SPS-16654/1 ERP-1079/1 |
|---|---|---|
| Recipient Agency: Air Force | System: AN/PRC-117G(V)(C), Harris RF-300M-MP Portable Manpack Radio Set | Stage of Review: 4 – Operational |

**Section 1: OPERATING CHARACTERISTICS FOR WHICH SUPPORT IS CERTIFIED**

| Frequency (MHz) | Emission | Station Class | Power (W) | Operating Location |
|---|---|---|---|---|
| 30-30.56<br>32-33<br>34-35<br>36-37<br>38.25-39<br>40-42<br>46.6-47<br>49.6-50 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F3E<br>22K0F1D<br>25K0G1D<br>26K0F1D | MO<br>FL | 1-10 | US&P |
| 138-144<br>148-149.9<br>150.05-150.8 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F3E<br>22K0F1D | | 1-10 | |
| | 6K00A3E<br>16K0A1D | | 4 | |
| 162.0125-173.2<br>173.4-174 | 8K00F1D<br>11K0F3E | | 1-10<br>4 | |
| 225-328.6 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F3E<br>22K0F1D | | 1-10 | |
| | 1M20G1D<br>1M20D1D | | 1-5 | |
| | 6K00A3E<br>16K0A1D | | 4 | |
| 243-270<br>**(Receive)** | 2K40G1D<br>4K80G1D<br>22K0F1D<br>25K0F1D | UA | ------- | |
| 291-318<br>**(Transmit)** | | | 2-20 | |
| 335.4-399.9 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F3E<br>22K0F1D | MO<br>FL | 1-10 | |

| Downgrading Instructions | Classification: UNCLASSIFIED | Page Number: 1 of 3 pages |
|---|---|---|

| Form NTIA-44 (3/91) | Classification | System |
|---|---|---|
| CONTINUATION PAGE | **UNCLASSIFIED** | **AN/PRC-117G(V)(C), Harris RF-300M-MP Portable Manpack Radio Set** |

| Frequency (MHz) | Emission | Station Class | Power (W) | Operating Location |
|---|---|---|---|---|
| 406.1-420 | 1M20G1D<br>1M20D1D | MO<br>FL | 1-5 | US&P |
| | 6K00A3E<br>16K0A1D | | 4 | |
| | 8K00F1D<br>11K0F3E | | 1-10<br>4 | |
| 1370-1390 | 1M20G1D<br>1M20D1D<br>5M00G1D<br>5M00D1D | | 1-5 | |
| 1755-1850 | 1M20G1D<br>1M20D1D<br>5M00G1D<br>5M00D1D | | 1-5 | |
| 1227.6 (receive only)<br>1575.42 (receive only) | 24M0G1D | UM | -------- | |

**Section 2: SOURCE DOCUMENTS**

| Docket Number | Description of Document | Dated |
|---|---|---|
| SPS-16581/1 | Air Force Request for Stage 4 System Review | June 27, 2008 |
| SPS-16625/1 | NTIA Preliminary Assessment | August 12, 2008 |

The Spectrum Planning Subcommittee has reviewed this system under the provisions of Chapter 10 of the NTIA Manual, and recommends that:

1. NTIA certify Stage 4 spectrum support for the AN/PRC-117G(V)(C), Harris RF-300M-MP Portable Manpack Radio Set, as specified in Section 1.
2. Air Force be aware that:
   a. in the bands 162-174 and 406.1-420 MHz, tactical communications are prohibited;
   b. not all emission designators can be used in all bands; emissions in each band must be limited as shown in Section 1;
   c. any use of the 162.0125-174 MHz and 406.1-420 MHz bands by the military services is limited to non-tactical or intrabase radio operations, in accordance with the channeling plan specified in Sections 4.3.7 and 4.3.9 of the NTIA Manual, as referenced in Footnote G5 to the National Table of Frequency Allocations;
   d. any tactical and training operations in non-Federal bands with the 30-88 MHz range within the US&P are to be conducted on an unprotected, non-interference basis in accordance with Section 7.15.3 of the NTIA Manual.
3. Air Force take all practical steps to protect the radio astronomy service from harmful interference in the band 1350-1400 MHz in accordance with Footnote US311 to the National Table of Frequency Allocation and the bands 322-328.6 and 1330-1400 MHz in accordance with Footnote US342 to the National Table of Frequency Allocation.
4. Air Force coordinate all frequency assignment actions for the bands 225-328.6 MHz and 335.4-399.9 MHz with the Military Assignment Group, in accordance with Section 1.3.2 of the NTIA Manual.

| Downgrading Instructions | Classification | Page Number |
|---|---|---|
| | **UNCLASSIFIED** | 2 of 3 pages |

| Form NTIA-44 (3/91) | Classification | System |
|---|---|---|
| CONTINUATION PAGE | **UNCLASSIFIED** | **AN/PRC-117G(V)(C), Harris RF-300M-MP Portable Manpack Radio Set** |

**Section 3: SPS RECOMMENDATIONS**

5. Air Force be aware that operation of this system will be subject to the provisions of Section 5.1.2 of the NTIA Manual regarding its lack of compliance with the following standards:
   a. unwanted emission standards of Subsection 5.2.2.2 of the NTIA Manual for the use of the emissions 2K40G1D, 4K80G1D and 25K0F1D in the band 291-318 MHz;
   b. unwanted emission standards of Subsection 5.3.5.2 (narrowband standard) of the NTIA Manual for the use of the emission 8K00F1D in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;
   c. spurious level standards of the Subsection 5.3.5.2 of the NTIA Manual for the use of the emissions 8K010F1D and 11K0F3E in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;
   d. receiver adjacent channel selectivity standards of the Subsection 5.3.5.2 of the NTIA Manual for the use of the digital receiver (emission 8K00F1D) in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz.
6. Air Force, if frequency availability dictates, use of the bands 162.0125-174 MHz and 406.1-420 MHz give preference in selecting frequencies to those channels designated "DOD" or "AGA" in accordance with Section 8.3.18 of the NTIA Manual.
7. Air Force ensure that this system cannot be configured to transmit in bands other than those in Section 1 above.
8. Air Force ensure that personnel are protected from radiation levels that exceed generally accepted exposure levels.

| Name/Title of Recommending Official | Signature | Date |
|---|---|---|
| Stephen J. Butcher,<br>SPS Chairman | Stephen J. Butcher | NOV 0 3 2008 |

**Section 4: NTIA CERTIFICATION**

The Office of Spectrum Management certifies Stage 4 spectrum support for this system.
This office concurs with the SPS recommendations in Section 3.

| Name/Title of Certifying Official | Signature | Date |
|---|---|---|
| Edward M. Davison<br>Deputy Associate Administrator | Ed M. Davison | NOV 0 3 2008 |

| Distribution | Classification | Page Number |
|---|---|---|
| IRAC, SPS, FAS, EPS | **UNCLASSIFIED** | 3 of 3 pages |

SOURCE: Reproduced from NTIA, "Certification of Spectrum Support," Form NTIA-44, Federal Communications Commission, November 3, 2008.
NOTE: Emissions are designator codes that describe the signal and its characteristics. Station identifies the class of station (e.g. fixed, mobile).

**Figure A.2. Example of Military Communications Electronics Board Equipment Frequency Allocation Guidance**

**MILITARY COMMUNICATIONS ELECTRONICS BOARD (MCEB)**

**EQUIPMENT FREQUENCY ALLOCATION GUIDANCE**

| Military Department | Equipment | Stage |
|---|---|---|
| Air Force, Army, Navy | **AN/PRC-117(V)(C), Harris RF-300M-MP Portable Manpack Radio Set, Multi-band, Multi-mode** | 4-Operational |

**Section 1: ENCLOSURES**

| Enclosure Number | Description | Dated |
|---|---|---|
| 1 | J/F 12/9512 | 23 June 2008 |

**Section 2: OPERATING CHARACTERISTICS FOR WHICH SUPPORT IS CERTIFIED**

| Frequency (MHz) | Emission | Power (Max Mean) | Type of Service | Operating Location |
|---|---|---|---|---|
| 30-30.56<br>32-33<br>34-35<br>36-37<br>38.25-39<br>40-42<br>46.6-47<br>49.6-50 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F1D<br>22K0F3E<br>25K0G1D<br>26K0F1D | 10 W | Mobile | US&P |
| 138-144<br>148-149.9<br>150.05-150.8 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F1D<br>22K0F3E | | | |
| | 6K00A3E<br>16K0A1D | 4 W | | |
| 162.0125-173.2<br>173.4-174 | 8K00F1D<br>11K0F3E | 10 W | | |
| 225-328.6<br>335.4-399.9 | 8K00F1D<br>11K0F3E<br>16K0F3E<br>18K5F3E<br>22K0F1D<br>22K0F3E | | | |
| | 1M20D1D<br>1M20G1D | 5 W | | |
| | 6K00A3E<br>16K0A1D | 4 W | | |

| Steering Member ESG Working Group MCEB Frequency Panel | Signature | Date | IRAC/SPS Number | Page |
|---|---|---|---|---|
| | | DEC 03 2008 | Doc. 36647/1 SPS-16654/1 | 1 of 5 |

| Downgrading Instructions | Distribution | MCEB J-12 Number |
|---|---|---|
| Classified by: NA<br>Declassify on: NA | J-12 Holders | J/F 12/9512/1 |

MILITARY COMMUNICATIONS ELECTRONICS BOARD (MCEB)

EQUIPMENT FREQUENCY ALLOCATION GUIDANCE

| MCEB GUIDANCE CONTINUATION PAGE | Equipment AN/PRC-117(V)(C), Harris RF-300M-MP Portable Manpack Radio Set, Multi-band, Multi-mode |
|---|---|

Section 2: OPERATING CHARACTERISTICS FOR WHICH SUPPORT IS CERTIFIED (continued)

| Frequency (MHz) | Emission | Power (Max Mean) | Type of Service | Operating Location |
|---|---|---|---|---|
| 243-270 | 2K40G1D<br>4K80G1D<br>22K0F1D<br>25K0F1D | NA (receive-only) | Mobile-Satellite | US&P |
| 291-318 | | 20 W | | |
| 406.1-420 | 8K00F1D<br>11K0F3E | 10 W | Mobile | |
| 1370-1390<br>1755-1850 | 1M20D1D<br>1M20G1D<br>5M00D1D<br>5M00G1D | 5 W | | |
| 1227.6<br>1575.42 | 24M0G1D | NA (receive-only) | Radionavigation-Satellite | |

Section 3: MCEB GUIDANCE

1. The enclosed application as described in Section 2 above is approved for operational use subject to the guidance below.

2. For the intended operation in the mobile, mobile-satellite, and radionavigation-satellite services, the subject equipment is in accordance with the US Table of Frequency Allocations, and with the ITU Table of Frequency Allocations in some ITU Regions.

3. Based on the information provided, the subject equipment complies with the

a. frequency tolerance requirements of NTIA Manual Section 5.2.1;

b. transmitter primary emission requirements of NTIA Manual Section 5.2.2.2, except as noted below;

c. transmitter harmonic level requirements of NTIA Manual Section 5.2.2.2;

d. transmitter spurious level requirements of NTIA Manual Section 5.2.2.2;

e. transmitter primary emission requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz), except as noted below;

f. transmitter harmonic level requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz);

g. transmitter frequency deviation requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz);

h. receiver spurious response attenuation requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz);

i. receiver adjacent channel selectivity requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz), except as noted below;

j. receiver intermodulation attenuation requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz);

k. receiver conducted spurious emissions requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz).

4. Continued compliance with the provisions of the standards cited in paragraphs 3a through 3k above is mandatory.

5. Based on the information provided, the subject equipment does not comply with the

a. transmitter primary emission requirements of NTIA Manual Section 5.2.2.2 for emissions 2K40G1D, 4K80G1D, and 25K0F1D;

b. transmitter primary emission requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz) for emission 8K00F1D;

c. transmitter spurious level requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz);

d. receiver adjacent channel selectivity requirements of NTIA Manual Section 5.3.5.2 (for operation in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz) for emission 8K00F1D.

MILITARY COMMUNICATIONS ELECTRONICS BOARD (MCEB)

EQUIPMENT FREQUENCY ALLOCATION GUIDANCE

| MCEB GUIDANCE<br>CONTINUATION PAGE | Equipment<br>**AN/PRC-117(V)(C), Harris RF-300M-MP<br>Portable Manpack Radio Set, Multi-band, Multi-mode** |
|---|---|

**Section 3: MCEB GUIDANCE (continued)**

6. In any instance of harmful interference caused by nonconformance with the provisions of the standards cited in paragraphs 5a through 5d above, the responsibility for eliminating the harmful interference normally shall rest with the agency operating in nonconformance.

7. Based on the information provided, the subject equipment does not comply with the harmonic level and spurious level requirements of MIL-STD-461F.

8. Frequency assignment requests must be submitted using Standard Frequency Action Format (SFAF) and coordinated with the cognizant area frequency coordinator in accordance with ACP 190 US SUPP-1 (C), Guide to Frequency Planning, prior to activation.

9. Coordination with NTIA/SPS has been completed and the following comments were received:

a. DOD be aware that:

1) in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz, tactical communications are prohibited;

2) not all emission designators can be used in all bands; emissions in each band must be limited as shown in Section 2;

3) any use of the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz by the military services is limited to non-tactical or intrabase radio operations, in accordance with the channeling plan specified in Sections 4.3.7 and 4.3.9 of the NTIA Manual, as referenced in Footnote G5 to the National Table of Frequency Allocations.

4) any tactical and training operations in non-Federal bands within the 30-88 MHz range within the US&P are to be conducted on an unprotected, non-interference basis in accordance with Section 7.15.3 of the NTIA Manual.

b. DOD take all practicable steps to protect the radio astronomy service from harmful interference in the band 1350-1400 MHz in accordance with Footnote US311 to the National Table of Frequency Allocations and the bands 322-328.6 MHz and 1330-1400 MHz in accordance with Footnote US342 to the National Table of Frequency Allocations.

c. DOD coordinate all frequency assignment actions for the bands 225-328.6 MHz and 335.4-399.9 MHz with the Military Assignment Group, in accordance with Section 1.3.2 of the NTIA Manual.

MILITARY COMMUNICATIONS ELECTRONICS BOARD (MCEB)

EQUIPMENT FREQUENCY ALLOCATION GUIDANCE

| MCEB GUIDANCE<br>CONTINUATION PAGE | Equipment<br>AN/PRC-117(V)(C), Harris RF-300M-MP<br>Portable Manpack Radio Set, Multi-band, Multi-mode |
|---|---|

Section 3: MCEB GUIDANCE (continued)

d. DOD be aware that operation of this system will be subject to the provisions of Section 5.1.2 of the NTIA Manual regarding its lack of compliance with the following standards:

1) unwanted emissions standards of Subsection 5.2.2.2 of the NTIA Manual for the use of the emissions 2K40G1D, 4K80G1D, and 25K0F1D in the band 291-318 MHz;

2) unwanted emissions standards of Subsection 5.3.5.2 (narrowband standard) of the NTIA Manual for the use of the emission 8K00F1D in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;

3) spurious level standards of Subsection 5.3.5.2 of the NTIA Manual for the use of the emissions 8K00F1D and 11K0F3E in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz;

4) receiver adjacent channel selectivity standards of Subsection 5.3.5.2 of the NTIA Manual for the use of the digital receiver (emission 8K00F1D) in the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz.

e. DOD, if frequency availability dictates, use of the bands 162.0125-173.2 MHz, 173.4-174 MHz, and 406.1-420 MHz give preference in selecting frequencies to those channels designated "DOD" or "AGA" in accordance with Section 8.3.18 of the NTIA Manual.

f. DOD ensure that this system cannot be configured to transmit in bands other than those in Section 2 above.

g. DOD ensure that personnel are protected from radiation levels that exceed generally accepted exposure criteria.

10. Operational use within the appropriate theater commands outside the United States has not been approved. Approval for operational use in the intended deployment area requires appropriate COCOM's statement(s) that the subject system has been deemed frequency supportable.

| | Page<br>5 of 5 | MCEB J-12 Number<br>J/F 12/9512/1 |
|---|---|---|

UNCLASSIFIED

SOURCE: NTIA, "Military Communications Electronics Board (MCEB) Equipment Frequency Allocation Guidance: AN/PRC-117(V)(C), Harris RF300M-MP Portable Manpack Radio Set, Multi-Band, Multi-Mode," December 3, 2008.

# Abbreviations

| | |
|---|---|
| AFC | Area Frequency Coordinator |
| AFSMO | Air Force Spectrum Management Office |
| CONUS | continental United States |
| DAF | Department of the Air Force |
| DISA | Defense Information Services Agency |
| DoD | U.S. Department of Defense |
| DoDI | Department of Defense Instruction |
| DSO | Defense Spectrum Organization |
| E2ESS | End-to-End Spectrum Supportability System |
| EA | electromagnetic attack |
| EMBM | Electromagnetic Battle Management |
| EMS | electromagnetic spectrum |
| EMSO | electromagnetic spectrum operations |
| FAA | Federal Aviation Administration |
| FCC | Federal Communications Commission |
| GAO | U.S. Government Accountability Office |
| IT | information technology |
| JSC | Joint Spectrum Center |
| MAJCOM | major command |
| MC4EB | Military Communications, Command, Control, and Computers Executive Board |
| MHz | megahertz |
| NTIA | National Telecommunications and Information Administration |
| NTTR | Nevada Test and Training Range |
| PAF | Project AIR FORCE |
| PEO | Program Executive Office |
| SFAF | Standard Frequency Action Format |
| SMO | Spectrum Management Office |
| SPS | Spectrum Planning Subcommittee |
| USAF | U.S. Air Force |

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DoD—*See* U.S. Department of Defense.

DoDI—*See* Department of Defense Instruction.

GAO—*See* U.S. Government Accountability Office.

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