ATP 6-02.70

TECHNIQUES FOR SPECTRUM MANAGEMENT OPERATIONS

SEPTEMBER 2025

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This publication supersedes ATP 6-02.70, dated 16 October 2019.

HEADQUARTERS, DEPARTMENT OF THE ARMY

This publication is available at the Army Publishing Directorate site (https://armypubs.army.mil) and the Central Army Registry Site (https://atiam.train.army.mil/catalog/dashboard).

Army Techniques Publication
No. 6-02.70

Headquarters
Department of the Army
Washington, DC, 16 September 2025

TECHNIQUES FOR SPECTRUM MANAGEMENT OPERATIONS

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Preface

ATP 6-02.70 builds on the Army doctrine for spectrum management operations established in FM 6-02. This publication provides doctrinal guidance to Army spectrum users and describes how spectrum managers support commanders through the warfighting functions, the military decision-making process, and the common operational picture. This publication provides technical descriptions of the spectrum management tools, including capabilities and compatibilities and discusses ways to use the various spectrum management tools.

The principal audience for ATP 6-02.70 is Soldiers, Department of the Army civilians, and contractors whose duties involve spectrum management operations. Commanders and staff of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army may also use this publication.

Commanders, staffs, and subordinates ensure their decisions and actions comply with applicable U.S., international, and, in some cases, host-nation laws and regulations. Commanders at all levels ensure their Soldiers operate in accordance with the law of war and the rules of engagement (See FM 6-27/MCTP 11-10C). They also adhere to the Army Ethic as described in ADP 6-22.

ATP 6-02.70 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. This publication is not the proponent for any Army terms. For other definitions shown in the text, the term is italicized, and the number of the proponent publication follows the definition.

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

The proponent for ATP 6-02.70 is the United States Army Cyber Center of Excellence. The preparing agency is the Doctrine Division, United States Army Cyber Center of Excellence. Send comments and recommendations on a DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) to Commander, United States Army Cyber Center of Excellence and Fort Gordon, ATTN: ATZH-OPD (ATP 6-02.70), 419 B Street, Fort Gordon, Georgia 30905-5735, or by e-mail to usarmy.gordon.cyber-coe.mbx.gord-fg-doctrine@army.mil.

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Introduction

Spectrum management operations enable and support the Army warfighting functions and are essential to commanders' ability to exercise command and control throughout their assigned areas. Spectrum management enables electromagnetic spectrum access to support spectrum-dependent devices throughout a unit's assigned area through frequency deconfliction, and resolution of electromagnetic interference.

Spectrum managers in the cyberspace electromagnetic activities section deconflict frequency use for electromagnetic warfare, providing awareness of potential spectrum conflict between spectrum-dependent devices and reducing the risk of frequency fratricide. The cyberspace electromagnetic activities sections integrate spectrum management and electromagnetic warfare through the cyberspace electromagnetic activities working group and integrate electromagnetic spectrum operations through the joint electromagnetic spectrum operations cell.

Spectrum managers encounter numerous challenges managing the use of the electromagnetic spectrum. These challenges come from competing spectrum-dependent devices that are either friendly, threat, or neutral. Spectrum managers use various spectrum management tools to conduct spectrum management operations. These tools allow the spectrum manager create products and input during the military decision-making process and cyberspace electromagnetic activities working group.

This publication contains three chapters and five appendixes.

- **Chapter 1** provides an overview of spectrum management operations, states the objectives, and describes spectrum management operations core functions.
- **Chapter 2** discusses spectrum managers' support and input to the military decision-making process and briefly describes the common operational picture.
- **Chapter 3** links Army spectrum management operations to the warfighting functions, describes how spectrum management operations support and enable commanders' efforts as they exercise command and control.
- **Appendix A** provides basic electromagnetic physics and the underlying principles of the electromagnetic spectrum.
- **Appendix B** provides spectrum management tools, including their compatibilities and capabilities to meet spectrum management operations critical tasks. These systems are in many cases linked and accessible through Nonclassified Internet Protocol Router Network and SECRET Internet Protocol Router Network.
- **Appendix C** introduces the spectrum management life cycle. This process serves as a guide to follow in establishing a functional and efficient spectrum management program life cycle.
- **Appendix D** provides the reader with an overview of the military time zone designators for civilian and military use.
- **Appendix E** describes spectrum information and products necessary at the corps and joint task force levels.

SUMMARY OF CHANGES

This is an incremental revision of ATP 6-02.70. Changes in this revision include—

- **Updated spectrum management tools**— Deleted spectrum management tools that are no longer used by Army spectrum managers.
- **Added echelons above corps spectrum manager roles**— This ATP 6-02.70 revision discusses spectrum management at echelons above corps. The echelons in this revision include—
  - Theater army.
  - Theater signal brigade.
  - Installation spectrum management.
- Removed the spectrum management task list.

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Chapter 1
Overview

This chapter provides an overview of operational environments and spectrum management operations. It describes various challenges spectrum managers may encounter while operating in a congested and contested environment. It also provides an overview of the spectrum management operations process. This chapter describes the core functions related to spectrum management operations.

SECTION I – OPERATIONAL ENVIRONMENT AND THREAT

1-1. This section describes the operational environment and the effects of operating in a congested and contested environment. It also details environmental considerations that should be considered while managing the electromagnetic spectrum. This section discusses enemies, adversaries, and peer threats.

OPERATIONAL ENVIRONMENT

1-2. An *operational environment* is the aggregate of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the commander's decisions (JP 3-0). The operational environment encompasses the air, land, maritime, space, and cyberspace domains. For the Army, the *cyberspace domain* is the interdependent networks of information technology infrastructures and resident data, including the Internet, telecommunication networks, computer systems, embedded processors and controllers, and relevant portions of the electromagnetic spectrum (FM 3-0). The electromagnetic spectrum is crucial in all domains, enabling communication and weapon systems capabilities when properly managed.

CONGESTED AND CONTESTED ENVIRONMENT

1-3. Gaining and maintaining control of the electromagnetic spectrum is critical for the commander. All forces and supporting agencies depend on the electromagnetic spectrum to execute operations in the air, land, maritime, space, and cyberspace domains. Within the electromagnetic spectrum, joint forces compete with civil agencies, commercial entities, allied forces, and threats for the use of a common electromagnetic spectrum resource. This demand for electromagnetic spectrum results in a congested and contested environment that affects operations across all domains and functions.

Congested

1-4. The electromagnetic spectrum congestion results from multiple spectrum-dependent devices attempting to simultaneously use the same portions of the spectrum. Congestion can lead to the operational failure of systems during critical missions due to electromagnetic interference. The Army shares spectrum-related resources with other Services, civilian counterparts, friendly forces, and threats. Due to many spectrum-dependent devices using the electromagnetic spectrum, portions of the spectrum may be unavailable.

1-5. In the past, the bulk of spectrum management comprised networked communications emitters and combat net radio networks. Today, the tactical environment includes many spectrum-dependent devices operating throughout the electromagnetic spectrum across the battlefield. The key to sound spectrum management is understanding all systems in the assigned area for deconfliction.

1-6. The G-6 or S-6 spectrum manager coordinates with all electromagnetic spectrum users within a given assigned area to identify all requirements for spectrum access. The spectrum manager uses this information to conduct frequency deconfliction. The G-6 or S-6 spectrum manager also maintains a database of all known emitters and receivers in the assigned area. The use of this database is to identify and prioritize competing systems for frequency assignments. Figure 1-1 on page 2 illustrates some competing systems that cause challenges throughout the electromagnetic spectrum.

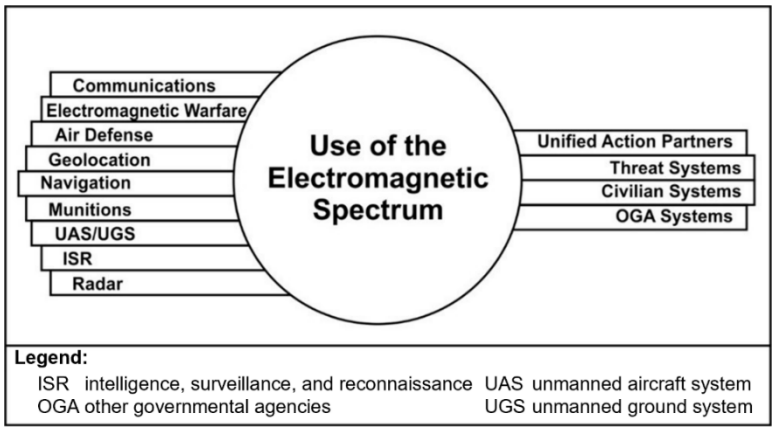


Figure 1-1. Competition in the electromagnetic spectrum

1-7. The spectrum manager maintains a paper and electronic library of spectrum-related manuals, including national, international, and governmental regulations and policies. The library consists of the manuals listed in the reference section of this publication. A spectrum manager needs to become familiar with the unit's assigned area. The contact information of national and international agencies and unified action partners regulating spectrum use is necessary to deconflict potential electromagnetic interference in a congested environment.

1-8. Undocumented spectrum-dependent devices used in the assigned area create the potential for severe mutual interference among other spectrum users or can squander resources and inhibit warfighting capabilities. The sponsoring military department submits a spectrum-dependent device's DD Form 1494 (*Application for Equipment Frequency Allocation*). A Joint Frequency 12 number, documented on the spectrum-dependent device's DD Form 1494 indicates approval to coordinate for spectrum resources. The Joint Spectrum Data Repository stores approved DD Form 1494s. See chapter 2 for more information about DD Form 1494.

1-9. Spectrum managers should understand the types and number of spectrum-dependent devices in their units. This information leads to a firm understanding of spectrum-dependent devices used during a mission to provide accurate information when requesting spectrum resources. Spectrum managers identify all spectrum-dependent devices used by the organization including modified table of organization and equipment, unit-purchased equipment, and theater-provided systems. By understanding spectrum-dependent devices in the organization, the spectrum manager can plan for future missions. With planning, the spectrum manager can identify unauthorized frequencies that, if used, may result in electromagnetic interference resulting in potential for suspension or degradation of the unit's use of the spectrum. Understanding the organization's spectrum-dependent devices and planning allows the spectrum manager to develop well-thought-out courses of action to mitigate foreseen electromagnetic interference before the mission.

1-10. The spectrum manager should visit all subordinate units in the organization to identify any spectrum-dependent devices that may not be in the database. During visits, the spectrum manager may consider meeting with unit commanders to discuss spectrum management options. Such meetings provide the commander with valuable information used during the military decision-making process and provide points of contact for spectrum concerns.

1-11. It is essential that the spectrum manager becomes familiar with the unit's spectrum management tools and develops databases for them. Part of developing databases includes building force templates that include spectrum-dependent devices and spectrum requirements to aid in mission planning. Some spectrum management tools (see appendix B) require obtaining map files, such as digital terrain elevation data for the unit's assigned area.

1-12. Home station operations present unique challenges and opportunities for spectrum managers. Spectrum-dependent devices returning from theaters outside the continental United States sometimes need spectrum support within the United States and its territories and possessions. Collaborating with civilian

counterparts supporting home station training also presents challenges because of their limited exposure to tactical spectrum operations.

Contested

1-13. Threats increasingly contest the friendly use of the electromagnetic spectrum. Enemies and adversaries may deliberately attempt to deny the friendly use of spectrum-dependent devices in all domains. Due to heavy joint reliance on advanced communications systems, such an attack may be a central element of a threat's antiaccess and area denial strategy. This may require a higher degree of protection for friendly command and control systems.

1-14. Threats have demonstrated an increased technological capability that challenges U.S. access to the electromagnetic spectrum. U.S. military communications and information networks are priority targets for threats to disrupt communications. Threats understand the extent of U.S. forces' reliance on the electromagnetic spectrum. Commanders should expect that in future conflicts, threats will contest the electromagnetic spectrum to deny operational access and diminish the effectiveness of U.S. and allied forces.

1-15. Integrating signal support with cyberspace, electromagnetic warfare, and intelligence operations is critical for achieving and maintaining freedom of action in the electromagnetic spectrum. These capabilities also enable the ability to weaken or prevent the threat's ability to carry out successful operations. Threat actions can lead to reduced capabilities of U.S. forces and joint and multinational information systems. Synchronizing capabilities across multiple domains and warfighting functions can maximize their inherently complementary effects throughout the electromagnetic spectrum.

OPERATIONAL ENVIRONMENT CONSIDERATIONS

1-16. Reliable access to the electromagnetic spectrum is critical in cyberspace operations, electromagnetic warfare, and signal support. Factors within the operational environment can impact the ability to access the electromagnetic spectrum. Understanding how these factors can impact access to the electronic spectrum and how to mitigate the effects are required to conduct spectrum management operations effectively. Factors within the operational environment that can impact access to the electromagnetic spectrum include—

- Terrain.
- Weather—atmospheric and space.
- Light and illumination.
- Civil considerations.

Terrain

1-17. The terrain within the electromagnetic operational environment can significantly impact the propagation of electromagnetic signals. Different types of terrain, such as mountains, forests, or urban areas, can affect signal strength and quality. Understanding how terrain features like hills, buildings, or dense vegetation can obstruct, reflect, or attenuate signals is essential for effective communications and electromagnetic warfare operations.

Weather

1-18. Weather conditions within the operational environment can greatly influence the use of the electromagnetic spectrum. Factors such as rain, fog, snowstorms, or even extreme heat can affect the performance of electromagnetic systems. Rainfall can attenuate radio waves, while atmospheric interference caused by temperature inversions can distort signals.

1-19. Space weather can also have a significant impact on the electromagnetic operational environment. The sun is the primary source of space weather, and solar flares, coronal mass ejections, and other solar phenomena can release huge amounts of electromagnetic radiation and charged particles into space. When these particles interact with the Earth's magnetic field, they can cause disruptions to radio communications, power grids, and other electronic systems. Awareness of these weather-related challenges helps in planning and executing effective spectrum management.

Light and Illumination

1-20. The illumination and lighting conditions in the environment play a critical role in various technologies that rely on optics and visual information, including surveillance, reconnaissance, and targeting systems. analyzing the available light and potential illumination sources in the area to ensure optimal performance and accuracy of these systems. By assessing the lighting conditions, operators can make informed decisions and adjustments to ensure that the system can effectively capture and analyze the visual information needed to achieve their objectives.

Civil Considerations

1-21. Civil considerations refer to elements of the operational environment that are outside military control but can impact operations. These factors may include civilian infrastructure such as roads and buildings, public communication systems, and potential electromagnetic interference from civilian sources. Local regulations and restrictions must be considered to ensure that operations comply with the law and without infringing on civilian rights.

THREATS

1-22. A *threat* is any combination of actors, entities, or forces that have the capability and intent to harm U.S. forces, U.S. national interests, or the homeland (ADP 3-0). Threats can be categorized as enemies, adversaries, or insider threats. An *enemy* is a party identified as hostile against which the use of force is authorized (ADP 3-0). An *adversary* is a party acknowledged as potentially hostile to a friendly party and against which the use of force may be envisaged (JP 3-0). The distinction between an enemy and an adversary may depend on context and the category in the competition continuum.

1-23. Threat actors can disrupt, destroy, or intercept the flow of information while operating from the other side of the world. Threats may include individuals or groups of individuals, organized, or not organized. Army forces are organized, trained, and equipped primarily for large-scale combat operations against peer threats. A peer threat is an adversary or enemy with capabilities and capacity to oppose U.S. forces across multiple domains worldwide or in a specific region where they enjoy a position of relative advantage (FM 3-0). Threats may use the spectrum to locate, disrupt, or interfere with communications, navigation, and other critical systems, making it essential for spectrum managers to understand and monitor the electromagnetic spectrum.

1-24. Spectrum managers must understand what capabilities peer threats can employ to degrade or destroy their networks. Those capabilities include—

- Maneuver.
- Manned and unmanned aircraft systems.
- Intelligence, surveillance, and reconnaissance.
- Artillery.
- Long-range precision fires.
- Electromagnetic attack.
- Malicious cyberspace activity.
- Space based capabilities.

Note. Refer to FM 6-02 for more information about threats as they pertain to electromagnetic spectrum use and signal support.

SECTION II – THE ELECTROMAGNETIC SPECTRUM

1-25. The electromagnetic spectrum consists of the entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light. It is a maneuver space essential for facilitating control within the operational environment and impacts all portions of the operational environment and military operations. The electromagnetic spectrum is a vital warfighting resource that requires the same planning and management as other critical resources such as fuel, water, and ammunition. The Army is dependent upon the use of the electromagnetic spectrum at all echelons.

ELECTROMAGNETIC ENVIRONMENT

1-26. The *electromagnetic environment* is the resulting product of power and time distribution in various frequency ranges of the radiated or conducted electromagnetic emission levels encountered by military forces, systems, or platforms while performing an assigned mission within its intended operational environment (JP 3-85). The electromagnetic environment consists of all spectrum emissions within an assigned area. In contrast, the electromagnetic operational environment encompasses both the electromagnetic environment and spectrum-dependent devices that emit and receive spectrum emissions within an assigned area.

ELECTROMAGNETIC OPERATIONAL ENVIRONMENT

1-27. The *electromagnetic operational environment* is a composite of the actual and potential electromagnetic energy radiation, conditions, circumstances, and influences that affect the employment of capabilities and the decisions of the commander (JP 3-85). The electromagnetic operational environment is the portion of the electromagnetic environment where the spectrum manager conducts spectrum management operations and is the authoritative source of spectrum-use information. The electromagnetic operational environment includes the background electromagnetic environment and all friendly threat (to the extent available), and neutral spectrum-dependent devices within an assigned area. The electromagnetic order of battle is the assessment of those spectrum-dependent devices encountered throughout the electromagnetic operational environment, prepared by the G-2 or S-2. The spectrum manager provides input to the electromagnetic order of battle.

1-28. In addition to spectrum use information, the electromagnetic operational environment includes environmental parameters (ground and atmospheric) and terrain elevation data. During Army operations, the spectrum management chief manages the electromagnetic operational environment. The combatant command or joint task forces joint electromagnetic spectrum operations cell (JEMSOC) manages the electromagnetic operational environment for joint operations (refer to JP 3-12 for conducting cyberspace operations in a collaborative climate). Figure 1-2 depicts the electromagnetic operational environment.

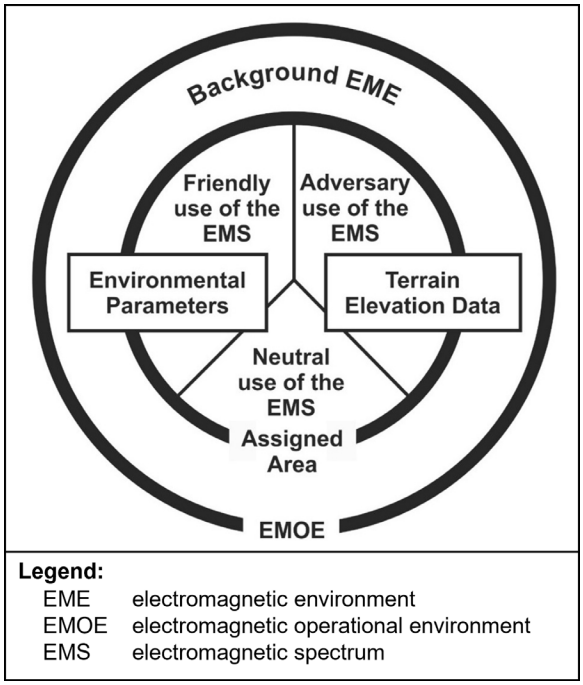


Figure 1-2. The electromagnetic operational environment

SPECTRUM-DEPENDENT DEVICES

1-29. Spectrum-dependent devices encompass various equipment, including transmitters and receivers, weapon platforms, electromagnetic warfare systems, sensors, beacons, and navigational aids. These systems

include radios and associated radio systems, radar technologies, radio-controlled robotic systems, and remotely piloted aircraft. These devices either rely on the electromagnetic spectrum or influence its use.

ELECTROMAGNETIC ENVIRONMENTAL EFFECTS

1-30. Natural electromagnetic interference is electromagnetic interference from natural sources including geographic electromagnetic phenomena originating from the earth, atmospheric noise (thunderstorms), and galactic noise (stars). The Space Weather Prediction Center transmits daily automatic digital network messages summarizing solar and geophysical activity.

SECTION III – SPECTRUM MANAGEMENT OPERATIONS

1-31. This section describes spectrum management operations and the associated activities. It also describes the electromagnetic spectrum and defines the operational environment where spectrum managers conduct spectrum management operations. This section discusses spectrum-dependent devices operating throughout the electromagnetic operational environment and describes their continuing competition for resources in the spectrum.

OVERVIEW

1-32. *Spectrum management operations* consist of the interrelated functions of spectrum management, frequency assignment, host-nation coordination, and policy that enable the planning, management, and execution of operations within the electromagnetic operational environment during all phases of military operations (FM 6-02). Spectrum managers manage electromagnetic spectrum resources and resolve electromagnetic interference by conducting electromagnetic interference analysis and resolution activities.

1-33. Spectrum management operations enable access to the electromagnetic spectrum. Spectrum managers support operational forces by coordinating resources from allotment plans and assigned frequencies. An effective spectrum management operations program enables electronic systems to perform their functions in the intended environment without causing electromagnetic interference. With the appropriate expertise and tools, Spectrum managers provide commanders with situational awareness of spectrum use in their assigned areas to support decision-making.

1-34. Spectrum management operations are bottom-driven for requirements while top-fed for resources. Brigade combat teams represent the tactical edge, and the staff at each echelon must capture all criteria to ensure commanders receive the proper spectrum resources. Maximizing the use of the electromagnetic spectrum requires the spectrum manager to coordinate with the cyberspace electromagnetic activities (CEMA) section, Department of Defense information network operations personnel, intelligence staff, and other known users. Figure 1-3 on page 7 depicts the various spectrum management responsibilities related to the electromagnetic operational environment.

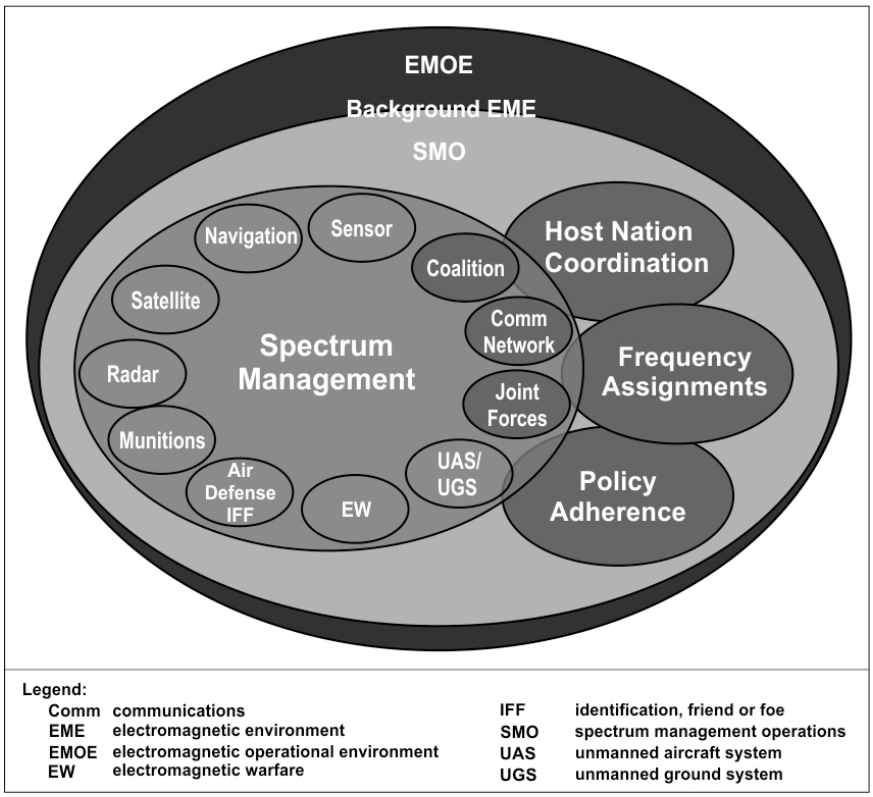


Figure 1-3. Spectrum management operations within the electromagnetic operational environment

CORE FUNCTIONS

1-35. Spectrum management operations core functions establish the tasks and requirements of the spectrum manager. These functions are—

- Spectrum management.
- Frequency assignment.
- Host-nation coordination.
- Policy.

SPECTRUM MANAGEMENT

1-36. Spectrum management is the operational, engineering, and administrative procedures to plan, coordinate, and manage the use of the electromagnetic spectrum in cyberspace, signal, and electromagnetic warfare operations. Spectrum management includes effective electromagnetic interference management of threat, neutral, friendly, natural, or manmade sources. Electromagnetic interference is resolved on a case-by-case basis by the spectrum manager, and users report all suspicious activity, regardless of the severity. Spectrum management functions include—

- Evaluating and mitigating electromagnetic environmental effects.
- Managing frequency records and databases.
- Deconflicting frequencies.
- Frequency interference mitigation.
- Allocating frequencies.
- Spectrum supportability assessments.
- Electromagnetic warfare coordination.

Evaluating and Mitigating Electromagnetic Environmental Effects

1-37. . Devices operating within the electromagnetic spectrum are inherently susceptible to electromagnetic environmental effects. It is essential for spectrum managers to identify and evaluate the potential critical impacts of these effects in order to effectively manage and mitigate the hazards associated with electromagnetic radiation during operations. Mitigation strategies may include coordination, deconfliction, emission control, and antenna placement. Refer to DODI 3222.03 for more information on the DOD electromagnetic environmental effects program.

Managing Frequency Records and Databases

1-38. Spectrum-use databases play a crucial role in managing the spectrum, as they help maintain the continuous and efficient use of the electromagnetic spectrum in various operational environments. These databases contain essential information about spectrum use for all devices that rely on it, including those used by friendly, civilian, threat (if available), and neutral entities. They encompass both communication and non-communication emitters. To ensure the accuracy and usefulness of this data for operational units, it is vital to coordinate with the organizations responsible for maintaining spectrum management databases. Some commonly used databases in the electromagnetic spectrum domain are—

- The Joint Equipment, Tactical, and Space Database.
- The Equipment Location-Certification Information Database.
- The Government Master File Database.
- The Frequency Resource Record System Database.
- The Host Nation Spectrum Worldwide Database Online

Note. See appendix B for more information about electromagnetic spectrum-use databases.

Deconflicting Frequencies

1-39. *Frequency deconfliction* is a systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions (JP 3-85). Frequency deconfliction is one element of electromagnetic spectrum management and applies practices to minimize or prevent spectrum-dependent devices from causing electromagnetic interference. It is easy to confuse electromagnetic interference mitigation with frequency deconfliction. The main difference is that frequency deconfliction occurs during a mission's planning phase, while electromagnetic interference mitigation occurs during mission execution.

Frequency Interference Mitigation

1-40. Mitigation and resolution of electromagnetic interference is the process of reducing or eliminating disruptive electromagnetic fields that can interfere with electronic devices. Electromagnetic interference from manmade sources may include power lines, generators, alarm systems, electric railroads, and fluorescent lighting. Spectrum managers advise users to isolate spectrum-dependent devices from manmade interference sources.

Interference Resolution

1-41. Spectrum managers perform interference resolution at the echelon receiving the interference. Interference is the radiation, emission, or indication of electromagnetic energy, intentionally or unintentionally, causing degradation, disruption, or complete obstruction of the designated function of the electronic equipment affected. The spectrum manager should use available near-real-time monitoring and analysis capabilities to aid in interference resolution. The reporting end user assists the spectrum manager in tracking, evaluating, and resolving interference. See appendix B for further information about frequency interference resolution and reporting.

Frequency Fratricide

1-42. Frequency fratricide is the unintentional interruption of friendly frequencies by a friendly emitter. The cyberspace electromagnetic activities (CEMA) spectrum manager deconflicts the spectrum, identifies conflicts, and advises the cyber electromagnetic warfare officer about measures to prevent or mitigate possible frequency fratricide. The CEMA spectrum manager works to mitigate frequency fratricide and potential electromagnetic interference during the planning phase of cyber and electromagnetic warfare operations. Frequency fratricide can cause many problems for operations, and prevention is critical to mission success. Spectrum managers provide the CEMA working group with frequency options and advice that follow internal and external policies to minimize frequency fratricide.

Allocating Frequencies

1-43. Frequency allocation refers to assigning frequency bands for specific functions or services such as fixed, mobile, and broadcast communications. Allotments, on the other hand, designate specific frequencies within an allocation. In the DOD, allotments are made to specific Services. A core function of spectrum managers is to effectively use the frequencies allotted to them. This involves using tools like Spectrum XXI and advanced modeling and simulation software to determine optimal frequency assignments within those allotments, ensuring efficient use of the electromagnetic spectrum while minimizing interference between units and complying with national and international regulations.

Spectrum Supportability Assessment

1-44. The spectrum supportability risk assessment evaluates whether the spectrum required for operating spectrum-dependent devices will be available throughout its expected lifespan. This assessment covers the entire process from the analysis phase to the actual operation in the electromagnetic environment. Army spectrum policy decisions and spectrum supportability risk assessments are based on reliable analyses and measurable, repeatable tests. A spectrum supportability risk assessment should include a detailed description of the system and its intended operational use.

Electromagnetic Warfare Coordination

1-45. Spectrum managers are in the G-6 or S-6 staff and the G-3 or S-3 CEMA section. The G-6 or S-6 spectrum manager coordinates spectrum resources that support the friendly use of the electromagnetic spectrum. The G-6 or S-6 spectrum manager coordinates with the CEMA spectrum manager to ensure spectrum-dependent devices operate without causing electromagnetic interference. The CEMA spectrum manager deconflicts spectrum resources for electromagnetic warfare operations and provides the electromagnetic warfare input to the common operational picture. The CEMA spectrum manager's duties and responsibilities include—

- Leading, developing, and synchronizing the electromagnetic warfare and electromagnetic protection plan by assessing electromagnetic attack effects on friendly force emitters.
- Mitigating the harmful impact of an electromagnetic attack on friendly forces through coordination with higher and subordinate adjacent units. This coordination includes all electromagnetic attack tests and training events.
- Synchronizing with the G-2 or S-2 on the electromagnetic attack effects to support intelligence gain and mitigate intelligence loss.
- Synchronizing cyberspace operations to protect radio frequency (RF)-enabled transport layers.
- Coordinating support for protecting RF-enabled military information support operations and psychological operations.
- Collaborating with staff, subordinates, and senior organizations to identify unit emitters for inclusion in the joint restricted frequency list (JRFL).

FREQUENCY ASSIGNMENT

1-46. Frequency assignment refers to assigning specific frequencies to various spectrum-dependent devices to avoid interference and ensure efficient spectrum use. Requesting and issuing authorizations to use frequencies for specific equipment, such as combat net radios and Army common user systems, is a task of frequency assignment. Examples of frequency assignment are assigning the frequencies required for—

- Tactical radio networks.
- Unmanned aircraft systems.
- Line of sight networks.
- Tactical Network Transport—including satellite communications frequencies.

HOST-NATION COORDINATION

1-47. Using military or commercial spectrum systems in host nations requires coordination and negotiation, resulting in formal approvals and certifications. Coordination for using the spectrum in host nations is necessary if forces stage, train, or operate within these countries including their territorial airspace, sovereign waters, and frequencies for satellites. Prior coordination and dynamic, immediate collaboration tools result in seamless spectrum use. Failure to request frequency use promptly results in the inability to operate communications equipment in the host nation. Each nation has sovereignty over its spectrum within its geographic area and negotiates the use of spectrum on a case-by-case basis. A representative of the sovereign country evaluates each DOD request for spectrum use based on the perceived potential for electromagnetic interference to local receivers.

1-48. Military spectrum management offices use the Host Nation Spectrum Worldwide Database Online (HNSWDO) to track host nation spectrum supportability requests. The sponsoring Service spectrum management agency adds the host-nation access request to HNSWDO. The sponsoring Service spectrum management agency additionally forwards the host nation's access request to the respective combatant command's joint frequency management office for situational awareness. For visibility, the joint frequency management office annotates comments regarding the host nation's access request in HNSWDO. Tactical spectrum managers coordinate frequency assignments through established spectrum coordination channels.

POLICY

1-49. Policies are crucial in shaping spectrum management, frequency assignment, and host nation coordination processes. They are authoritative instruments that guide the entire range of activities from national strategy to tactical-level decision-making. Countries coordinate global international spectrum use through the International Telecommunications Union and the World Radio Communication Conference.

1-50. At the national level under Title 47, United States Code, the division of spectrum management responsibility rests with the National Telecommunications and Information Administration for federal frequencies and the Federal Communications Commission for non-federal frequencies. The Military Command, Control, Communications, and Computers Executive Board is the central coordinating body for spectrum matters among the DOD components. Overseas, the U.S. mission, working with DOD strategic partners, negotiates treaties and agreements when stationed or training U.S. forces operating within a host nation.

1-51. These agreements establish communication between the host nation and senior military commands to negotiate spectrum use in support of training and operations. Examples of policy instruments include—

- International Telecommunications Union.
- World Radio Communication Conference agreements.
- Status of forces agreements.
- Host-nation agreements.

SPECTRUM MANAGEMENT ACTIVITIES

1-52. Effective spectrum management can make the difference between success and failure in achieving mission objectives. Spectrum managers plan, coordinate, and manage spectrum resources throughout the planning, preparation, execution, and assessment phases of all military operations. Planning and coordinating spectrum use ensures the maximum spectrum available for spectrum-dependent devices, while preventing frequency fratricide.

PLANNING

1-53. Spectrum management operations planning includes identifying spectrum requirements for training, pre-deployment, deployment, and reconstitution of Army forces in and outside the continental United States. Spectrum management operations planning is an ongoing process that must be deliberate and dynamic to

support Army operations. It requires the assessment, storage, and protection of critical spectrum data and assured access to this data by spectrum planners on a global scale. Additionally, planning for establishing communications and coordinating spectrum use with unified action partners including national and international governmental and non-governmental agencies is critical to spectrum planning. See FM 3-16 for multinational operations planning considerations.

1-54. CEMA sections at the echelons of theater army through brigade combat team have a spectrum manager to provide expertise in planning and coordinating to support Army operations. The primary role of the spectrum manager is to assist with deconflicting frequencies through the planning and targeting processes.

COORDINATING

1-55. Spectrum managers coordinate spectrum use with friendly or neutral countries adjacent to the threat, particularly if U.S. forces stage, train, or operate within these countries. Coordination includes airspace, sovereign waters, terrestrial frequencies, and satellite frequencies. Coordination at the operational Army level requires prior coordination and dynamic, instantaneous collaboration tools. Coordinating tasks include—

- Staff coordination.
- Unified action partner coordination.
- Communications security (COMSEC) coordination.
- Satellite communications coordination.
- Joint coordination.

Staff Coordination

1-56. Spectrum managers coordinate with various staff sections to ensure effective spectrum management operations. Commanders must engage spectrum managers early in the planning process when forecasting spectrum-dependent devices. Spectrum managers work with many systems that are more than just communications systems. They must interact with other staff members to provide guidance, assistance, and advice to the commander regarding the use and prioritization of the spectrum. Systems such as remotely operated aerial systems, common user jammers, radars, navigational aids, and sensors all use the spectrum for operation. Their extensive use and unique operating characteristics necessitate special planning and coordination to mitigate frequency fratricide.

Unified Action Partner Coordination

1-57. Coordinating spectrum use involves collaborating with unified action partners. This function ensures initial spectrum availability and supportability for operations. Lines of communication for coordinating spectrum allocation at the national and international levels are primarily a matter of policy established in the planning process.

Communications Security Coordination

1-58. Spectrum managers work closely with communications security personnel to ensure the proper keying material for the appropriate frequency resource of single channel ground and air radio system (SINCGARS) loadsets. Spectrum managers only manage and process COMSEC for SINCGARS by way of loadsets. They do not manage COMSEC for other emitters.

Satellite Communications Coordination

1-59. Spectrum managers coordinate with satellite managers to maintain awareness of channels (frequencies) used by satellite communications systems. The satellite manager generates and processes satellite access authorization. Spectrum managers receive and verify the information provided in the satellite access request for all satellite communications. Once approved, the spectrum manager enters the frequencies into the Spectrum XXI database as a space record for frequency deconfliction with all other emitters in the assigned area.

Joint Coordination

1-60. Joint electromagnetic spectrum coordination establishes the essential framework for effectively prioritizing, integrating, and harmonizing operations within the electromagnetic spectrum. This coordination encompasses several components, including the submission procedures for joint spectrum interference resolution reporting, routing procedures, electromagnetic spectrum operational environment monitoring, and JRFL development. A key element in this process is the establishment of the JEMSOC, which serves as a dedicated entity tasked with supporting joint planning, coordination, and control of electromagnetic spectrum activities.

Joint Restricted Frequency List

1-61. The JRFL is an electromagnetic spectrum coordination measure that operational, intelligence, and support elements use to identify the level of protection desired for various networks and frequencies. The *joint restricted frequency list* is a time and geographically oriented listing of TABOO, protected, and GUARDED frequencies. It is limited to the minimum frequencies necessary for friendly forces to achieve objectives (JP 3-85). Units may not jam frequencies listed on the JRFL. The JEMSOC, with collaborative input from the J-2, J-3, and J-6, develop the JRFL. Upon approval by the J-3, the JEMSOC publishes the JRFL and distributes it to subordinate unit spectrum managers.

1-62. The purpose of the JRFL is to protect high-priority nets, bands, and frequencies from friendly electromagnetic attacks when possible; however, the concern of the spectrum manager is to ensure that all friendly systems can operate unimpaired. They accomplish this by adding the offending jammer to a database and using spectrum management techniques such as changing frequencies, changing assignments, or moving to an unaffected area to mitigate the interference. The spectrum manager has tools that can identify potential frequency fratricide. See appendix B for more information about the JRFL.

1-63. Adherence to the JRFL does not deconflict all frequency issues. The JRFL does not provide communications planners with frequencies electromagnetic attack systems transmit or the technical information needed to deconflict electromagnetic attacks from friendly operations, including lower echelon maneuver forces. Spectrum management tools identify potential interference and frequency conflicts during mission planning reducing frequency fratricide. Refer to CJCSM 3320.01D for more information about JRFL development.

Coordination With the Joint Electromagnetic Spectrum Operations Cell

1-64. Throughout peacetime, JEMSOC activities are undertaken to ensure unrestricted access to the electromagnetic spectrum, which may involve resolving conflicts regarding spectrum use among joint users and coordinating with host nations. As the situation escalates toward crisis and armed conflict, the focus of JEMSOC shifts from coordinating spectrum access to establishing spectrum superiority. This transition entails executing coordinated military actions to exploit, attack, protect, and effectively manage the electromagnetic operational environment. Generally, combatant commanders and their subordinate joint force commanders establish a dedicated and enduring JEMSOC to facilitate joint planning, coordination, and spectrum control for the forces under their command.

MANAGING

1-65. The managing function of spectrum management operations enables and sustains planning and coordinating functions. It includes planning, conducting, coordinating, and supporting spectrum management operations. The managing function enables dynamic frequency assignment, re-assignment, interference mitigation, and frequency deconfliction across all users in an assigned area. This construct enables interoperability with U.S. national, state, local, and tribal government agencies, non-government agencies, and other unified action partners.

Chapter 2
Staff Organization and Planning

Spectrum management operations are dynamic and require continuous coordination among all echelons and warfighting functions to mitigate harmful interference. This chapter describes spectrum management operations roles and responsibilities for staff organizations at echelons above corps, corps, and below. It provides an overview of division, brigade, and battalion spectrum management operations.

SECTION I – SPECTRUM MANAGEMENT PERSONNEL AT ECHELONS ABOVE CORPS

2-1. This section provides an overview of spectrum managers at the theater army and theater signal brigade. It discusses the theater signal brigade's roles, responsibilities, and considerations for commanders and staff when conducting the operations process to deploy communications support packages for theater communications support. This section also outlines the duties of installation spectrum managers.

THEATER ARMY

2-2. The theater army is the Army Service component command to a combatant command. The theater army's mission is the most diverse and complex of any Army echelon. The theater army exercises administrative control over all Army forces in theater. It provides enabling capabilities appropriate to theater conditions, such as theater intelligence, theater sustainment, theater signal, theater fires, theater information activities, civil affairs, engineer, and theater medical commands.

2-3. Theater army spectrum managers are the Army Service-level office for all spectrum-related matters. Theater army spectrum managers coordinate spectrum policy and represent the Army in spectrum negotiations with civil, military, national, and international regulatory organizations, and host-nation spectrum authorities. The theater army spectrum manager directs all spectrum management activities, develops, and implements spectrum management policy, and allocates frequency assignments to support the Army.

2-4. The theater army spectrum manager—

- Develops, writes, and publishes theater spectrum management operations guidance.
- Determines peacetime and wartime communications equipment and spectrum requirements to obtain sufficient capabilities as appropriate.
- Ensures all U.S. devices that emit or receive electromagnetic radiation within the theater comply with national and host-nation spectrum laws, policies, and regulations.
- Establishes a program of continuing review of frequency assignments and deletes or amends such assignments as appropriate within the allotted suspense date.
- Manages spectrum databases maintained at the brigade and assists users in obtaining spectrum supportability through appropriate federal and host-nation agencies.
- Obtains spectrum resources from the spectrum management authority of the host nation during operations independent of the corps.

THEATER SIGNAL BRIGADE

2-5. A theater signal brigade and its subordinate units provide communications support to meet theater and joint requirements for theater operations. A theater signal brigade provides communications support packages according to the supported unit's mission variables, communications systems, and network specifications identified during the request for forces process (refer to FM 6-02). A theater signal brigade is structured so the commander can task-organize to design staff, sustainment, and communications support packages to meet a unique task or mission.

2-6. Theater signal brigade spectrum managers focus on spectrum operations that adhere to the various international, national, DOD, and Service regulations and policies. This includes coordinating and using RF resources within and outside the continental United States and registering and processing spectrum-dependent systems through the Army spectrum certification program.

2-7. The theater signal brigade spectrum manager—

- Assists units with spectrum requirements during the critical requirement validation board.
- Conducts organizational inspections in accordance with the organizational inspection program.
- Implements best business practices to provide customers with effective and efficient command, control, communications, and information management services.
- Prepares to meet contingency operation requirements.

EXPEDITIONARY SIGNAL BATTALIONS

2-8. An expeditionary signal battalion or expeditionary signal battalion-enhanced has two spectrum management personnel. The spectrum manager and the spectrum management noncommissioned officer (NCO) are members of the S-6 section. The spectrum manager is responsible for supervising the spectrum management NCO and, in collaboration, is responsible for conducting spectrum management operations for the expeditionary signal battalion and subordinate units.

2-9. The expeditionary signal battalion's spectrum management personnel—

- Request, allocate, and deconflict frequencies for spectrum-dependent devices.
- Establish the battalion's guidance for managing, requesting, coordinating, and assigning spectrum use, JRFL, signal operating instructions, electromagnetic interference, and related spectrum management operations functions in alignment with higher command policies and guidelines.
- Request frequencies for spectrum-dependent devices needed to establish Department of Defense information network-Army connectivity for support units.
- Prepare frequency requests using appropriate spectrum management tools and forward the requests to higher headquarters for processing. Once higher headquarters authorizes the request for frequency, the spectrum management personnel at the expeditionary signal battalion nominate frequencies from the database established by higher headquarters, make assignments in the database, and notify the requestors of the tasks.
- Request signal operating instructions and loadsets from higher headquarters and distribute them to subordinate units. The spectrum management personnel receive communications network input from the S-3. Upon interpreting the information, they create frequency requirements and plans, logically organize the data provided, and distribute signal operating instructions and loadsets to end users.
- Contribute to the higher headquarters' electromagnetic operational environment by providing data regarding all spectrum-dependent devices employed by the battalion. The completed electromagnetic operational environment is received from higher headquarters to develop the expeditionary signal battalion's common operational picture. The common operational picture includes frequency charts, diagrams, reports, and databases of frequency interference incidents, providing the commander and staff with electromagnetic operational environment situational awareness.
- Resolve electromagnetic interference reported by the expeditionary signal companies and forward resolved and unresolved electromagnetic interference incidents to higher headquarters.
- Upload electromagnetic interference reports to the Joint Spectrum Interference Resolution Online Portal.
- Maintain SECRET Internet Protocol Router Network (SIPRNET) access and accounts for assigned spectrum management tools and applications.

INSTALLATION SPECTRUM MANAGERS

2-10. The installation spectrum manager is the intermediary between the electromagnetic spectrum and the end user. The installation spectrum manager operates as a component of the network enterprise center, acting as a primary point of contact for all spectrum needs and use within the installation. This includes overseeing the activities of tenants and units engaged in training on the installation. Additionally, the installation

spectrum manager formulates installation-level policies for electromagnetic spectrum use, ensuring that a proper frequency authorization or license is obtained before granting access to the electromagnetic spectrum for a spectrum-dependent device.

2-11. Installation spectrum managers—

- Educate the installation and tenant activities on spectrum management policy and procedures.
- Ensure spectrum authorizations are valid.
- Ensure that garrison spectrum emitters operate within geographical and technical parameters.
- Keep records on the types and locations of equipment and use of the spectrum on the installation.
- Process and forward requests for frequency assignment for approval.

SECTION II – SPECTRUM MANAGEMENT PERSONNEL AT ECHELONS CORPS AND BELOW

2-12. This section discusses spectrum management personnel at echelons corps and below. This section also discusses some key roles and responsibilities of spectrum management personnel at each echelon.

CORPS

2-13. Spectrum management personnel at the corps focus on establishing policies and procedures to ensure the necessary spectrum resources are available for operations. Spectrum management personnel at the corps ensure subordinate units use the allotted spectrum resources efficiently while conducting spectrum management operations. Spectrum management personnel develop standard operating procedures based on joint and Army regulations, instructions, policies, and doctrine. At the corps, there are five spectrum management personnel:

- Spectrum management chief.
- Two spectrum managers.
- CEMA spectrum manager.
- One spectrum management NCO.

SPECTRUM MANAGEMENT CHIEF

2-14. The corps spectrum management chief—

- Oversees the development of spectrum-related policies for the corps that describe corps and below spectrum management activities for achieving theater and joint training and operational objectives.
- Integrates the corps electromagnetic operational environment into joint and multinational operational environments.
- Ensures subordinate spectrum managers maintain a SIPRNET account and account for assigned spectrum management tools and applications.
- Coordinates with the CEMA spectrum manager to ensure friendly force spectrum-dependent devices can access the electromagnetic spectrum and are addressed in the CEMA appendix.
- Acts as the liaison between the corps and other Army, joint, multinational, and host-nation forces regarding all spectrum-related activities, including all electromagnetic attack test and training coordination requests directly with the Army Frequency Management Office or the appropriate DOD area frequency coordinator for test and training events.
- Assumes the roles and responsibilities of the JEMSOC when the corps is designated as a joint task force headquarters.
- Serves on national strategic panels, committees, and working groups while advising international, domestic, military, and civil organizations on spectrum management operations.
- Develops the corps spectrum common operational picture with assistance from subordinate spectrum management personnel The spectrum common operational picture includes frequency charts, diagrams, reports, and databases of frequency interference incidents, providing the commander and staff with electromagnetic operational environment situational awareness.
- Develops signal operating instructions and loadsets for the corps.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.

CORPS SPECTRUM MANAGERS

2-15. The corps spectrum managers—

- Serve as lead coordinators in the development and promulgation of the JRFL.
- Obtain spectrum resources from host-nation spectrum authorities.
- Prepare and forward frequency requests for coordinating frequency allotment, assignment, and use and forward assigned frequencies to subordinate divisions upon approval.
- Use appropriate spectrum management tools to prepare frequency requests to the applicable U.S. military, U.S. civilian, or host-nation agency for frequency allocation to meet corps requirements.
- Participate in the CEMA working group to assist the CEMA spectrum manager with ensuring electromagnetic warfare planning meets requirements.
- Serve as the principal spectrum manager in all activities supporting the spectrum management life cycle (see appendix C).
- Perform situational awareness analysis using a spectrum analyzer or monitoring receiver and spectrum link reliability modeling using appropriate spectrum modeling tools in coordination with the spectrum management chief and CEMA spectrum manager.
- Develop and disseminate the corps' spectrum management operations standard operating procedure with oversight from the spectrum management chief.
- Create and send data call messages to staff elements, subordinate units, and supporting agencies that specify how to request spectrum support within the corps assigned area.
- Determine whether the unit's spectrum-dependent devices are supportable.
- Provide frequency engineering support to the G-6 for communications network design and services.
- Assist the spectrum management chief with developing the communications annexes and appendixes for corps operation plans and orders.
- Upload identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintain SIPRNET access and accounts for assigned spectrum management tools and applications.

CYBERSPACE ELECTROMAGNETIC ACTIVITIES SPECTRUM MANAGER

2-16. The corps CEMA spectrum manager—

- Deconflicts EW use of the electromagnetic spectrum with the joint restricted frequency list.
- Synchronizes corps CEMA with joint electromagnetic spectrum operations through the joint task force joint electromagnetic spectrum operations cell.
- Forwards reported electromagnetic interference incidents identified by electromagnetic warfare assets to the G-6 spectrum manager for resolution.
- Maintains frequency charts, diagrams, and reports of electromagnetic interference incidents identified during electromagnetic warfare missions.
- Assists the G-6 spectrum manager by providing input for the JRFL.
- Serves as the subordinate spectrum manager in support of all activities supporting the spectrum management life cycle.
- Acts as the primary spectrum manager in the CEMA working group.
- Advises the cyber electromagnetic warfare officer on potential spectrum conflicts and issues.
- Assists the spectrum management chief with developing the communications annexes and appendixes for corps operation plans and orders.
- Distributes signal operating instructions and loadsets created by the spectrum manager or spectrum management NCO to authorized personnel in the CEMA section and electromagnetic warfare elements.
- Handles issues with the signal operating instructions and loadsets within the CEMA section. The CEMA spectrum manager then collaborates with either the spectrum management chief or spectrum manager for resolution.
- Requests and manages frequency authorizations for the corps CEMA section to support operational and training activities.

SPECTRUM MANAGEMENT NONCOMMISSIONED OFFICER

2-17. The corps spectrum management NCO—

- Assists the spectrum management chief in developing a common operational picture that displays the electromagnetic operational environment throughout the corps' assigned area.
- Oversee the distribution of frequencies to subordinate units.
- Assists in validating spectrum link reliability of assigned frequencies using appropriate modeling tools.
- Maintains an accurate listing of spectrum-dependent devices in the corps assigned area.
- Develop signal operating instructions and loadsets.
- Distributes signal operating instructions and loadsets to subordinate units.
- Conducts RF engineering and analysis and evaluates regulatory policy to determine supportability of spectrum-dependent devices used in the corps' assigned area.
- Assists the Department of Defense information network operations section with generating and submitting satellite access requests to the proper controlling authority.
- Informs users of the authorized frequencies once the controlling authority grants satellite access authorization.
- Performs regular frequency database reviews and submits requests for updates when necessary.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.

Note. All established guidance adheres to policies and guidelines established by the corps spectrum management chief per the commander's guidance.

Corps Signal Brigade

2-18. A corps signal brigade has three spectrum management personnel in its S-3 section. The spectrum management chief and spectrum management NCO are assigned to the signal engineering branch, and the electromagnetic spectrum manager is assigned to the command, control, and communication branch.

Spectrum Management Chief

2-19. The corps signal brigade spectrum management chief—

- Serves as the senior spectrum management operations advisor to the commander.
- Ensures spectrum management personnel at attached expeditionary signal battalions perform critical spectrum management tasks proficiently.
- Provides advice and assistance to attached expeditionary signal battalions on spectrum management operations for mission accomplishment and career progression.
- Prepares spectrum-specific briefings for the commander and staff during planning and throughout operations.
- Writes spectrum-related portions of the brigade's operation plans and orders.
- Assesses and recommends changes to Army and joint spectrum management policies.
- Ensures subordinate spectrum managers maintain a SIPRNET account and maintain assigned spectrum management tools and applications.
- Assists in resolving electromagnetic interference incidents and reports unresolved interference to higher headquarters of the supported organization when deployed.
- Reviews electromagnetic interference databases to identify trends and repeated incidents.

Electromagnetic Spectrum Manager

2-20. The corps signal brigade spectrum manager—

- Requests, allocates, and deconflicts frequencies for the brigade's spectrum-dependent devices.

- Defines the electromagnetic operational environment in garrison, uses the supported unit's electromagnetic operational environment during deployments, and produces a spectrum management plan for the Department of Defense information network operations section.
- Validates spectrum link reliability of assigned frequencies using a spectrum analyzer or monitoring receiver.
- Establishes the corps signal brigade's guidance for managing, requesting, coordinating, and assigning spectrum use signal operating instructions, electromagnetic interference, and related spectrum management operations functions in alignment with higher headquarters' policies and guidelines.
- Obtains the JRFL from higher headquarters in garrison or the supported unit's spectrum management personnel when deployed.
- Disseminates the JRFL to subordinate or attached units.
- Maintains an accurate listing of the brigade's spectrum-dependent devices.
- Uploads electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Maintains the brigade's frequency charts, diagrams, reports, and databases of electromagnetic interference incidents.

SPECTRUM MANAGEMENT NONCOMMISSIONED OFFICER

2-21. The corps signal brigade spectrum management NCO—

- Assists the engineering branch by requesting and disseminating frequencies for spectrum-dependent devices employed by the headquarters and attached expeditionary signal battalions.
- Identifies electromagnetic interference, takes appropriate steps to resolve interference incidents, and reports resolved and unresolved electromagnetic interference incidents to the higher headquarters spectrum manager.
- Oversees distribution of frequencies to attached expeditionary signal battalions.
- Requests signal operating instructions and loadsets from higher headquarters and distributes them to attached units.
- Prepares frequency requests using appropriate spectrum management tools and forwards requests to higher headquarters for processing.
- Nominates frequencies from the database established by higher headquarters, makes assignments in the database, and notifies the requestors of frequency assignments.
- Receives communications network input from higher headquarters to create frequency requirements and plans and logically organize the data provided.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Uploads electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.

DIVISION

2-22. The division headquarters has three spectrum management personnel:

- Spectrum management chief (tactical command post G-6 network management element).
- Electromagnetic spectrum manager (main command post G-6 plans element).
- CEMA spectrum manager (G-3 current operations CEMA section).

2-23. Network planners work closely with the spectrum manager while designing the communications network. The spectrum manager assists the network planners by determining spectrum requirements and requesting the necessary frequencies to support the communications network.

SPECTRUM MANAGEMENT CHIEF

2-24. The division spectrum management chief is responsible for network frequency assignments, including satellite access authorization and deconfliction. The division spectrum management chief—

- Develops command spectrum management policy and procedures for approval by the division commander. Subordinate spectrum management personnel use these policies and procedures as the basis for policies and procedures at lower echelons.
- Writes spectrum-related portions of division operation plans and orders.
- Assesses and recommends changes to Army and joint spectrum management policies.
- Manages the division's spectrum databases.
- Assists in resolving electromagnetic interference incidents and reports unresolved electromagnetic interference to the corps spectrum management chief.
- Reviews electromagnetic interference databases to identify trends and repeated incidents in the electromagnetic operational environment.
- Serves on national strategic panels, committees, and work groups while advising international, domestic, military, and civil organizations.
- Develops signal operating instructions and loadsets for the division headquarters.
- Assists in developing communications-electronics operating instructions and loadsets in a joint environment.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Ensures subordinate spectrum managers maintain a SIPRNET account and account for assigned spectrum management tools and applications.
- Acts as the liaison between the division and other Army, joint, multinational, and host-nation forces regarding all spectrum-related activities, including electromagnetic attack test and training coordination requests directly with the Army Frequency Management Office or the appropriate DOD area frequency coordinator.

ELECTROMAGNETIC SPECTRUM MANAGER

2-25. The division electromagnetic spectrum manager—

- Prepares and forwards the frequency requests for coordinating frequency allotment, assignment, and use to higher headquarters or appropriate military, government, or host-nation agency.
- Coordinates with the spectrum management chief and the CEMA spectrum manager and performs situational awareness analysis using spectrum modeling tools.
- Participates in the CEMA working group and assists the CEMA spectrum manager with meeting electromagnetic warfare planning requirements.
- Serves as the principal spectrum manager in all activities supporting the spectrum management life cycle.
- Prepares frequency requests for the division using appropriate spectrum management tools.
- Forwards frequency requests to higher headquarters or the appropriate civilian or military agency for authorization.
- Issues approved frequency assignments to subordinate units.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.

CYBERSPACE ELECTROMAGNETIC ACTIVITIES SPECTRUM MANAGER

2-26. The division CEMA spectrum manager—

- Maintains awareness of the electromagnetic operational environment with the joint restricted frequency list and the electromagnetic order of battle from the G-2.
- Synchronizes division CEMA with joint electromagnetic spectrum operations through the joint task force joint electromagnetic spectrum operations cell.
- Forwards electromagnetic interference incidents reported from the CEMA section to the electromagnetic spectrum manager for resolution.
- Maintains frequency charts, diagrams, and reports of electromagnetic interference incidents identified by the CEMA section.

- Assists the electromagnetic spectrum manager by providing input for the JRFL and serves as the subordinate spectrum manager to support all activities supporting the spectrum management life cycle.
- Distributes signal operating instructions or communications-electronics operating instructions and loadsets created by the spectrum management chief to authorized personnel in the CEMA section.
- Collaborates with the spectrum management chief or electromagnetic spectrum manager to resolve issues with signal operating instructions.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Requests and manages frequency authorizations for the division's CEMA section to support both operational and training activities.

BRIGADE COMBAT TEAM

2-27. Brigade combat teams have two spectrum management personnel: one electromagnetic spectrum manager in the S-6 and one CEMA spectrum management NCO in S-3 current operations section.

ELECTROMAGNETIC SPECTRUM MANAGER

2-28. The brigade combat team electromagnetic spectrum manager—

- Prepares and forwards the frequency requests for coordinating frequency allotment, assignment, and use to higher headquarters.
- Coordinates electromagnetic attack training coordination requests directly with the Army Frequency Management office or the appropriate DOD area frequency coordinator.
- Issues approved frequency assignments to subordinate battalions.
- Coordinates with the CEMA spectrum management NCO to perform situational awareness analysis using spectrum-modeling tools.
- Serves as the principal spectrum manager in all activities supporting the spectrum management life cycle.
- Develops signal operating instructions and loadsets for the brigade.
- Uploads identified electromagnetic interference incidents to the Joint Spectrum Interference Resolution Online Portal.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.

CYBERSPACE ELECTROMAGNETIC ACTIVITIES SPECTRUM MANAGEMENT NONCOMMISSIONED OFFICER

2-29. The brigade combat team CEMA spectrum management NCO—

- Assists the CEMA section in planning, coordinating, assessing, and implementing electromagnetic attack, electromagnetic protection, and electromagnetic support requirements.
- Maintains awareness of the electromagnetic operational environment with the joint restricted frequency list and the electromagnetic order of battle from the S-2.
- Synchronizes brigade CEMA operations with joint electromagnetic spectrum operations at the joint task force level through the ARFOR.
- Forwards electromagnetic interference incidents reported from the CEMA section to the electromagnetic spectrum manager for resolution.
- Maintains frequency charts, diagrams, and reports of electromagnetic interference incidents identified by the CEMA section.
- Assists the electromagnetic spectrum manager by providing input for the JRFL.
- Serves as the subordinate spectrum manager to support all activities supporting the spectrum management life cycle.
- Distributes signal operating instructions and loadsets to authorized personnel in the CEMA section.
- Collaborates with the brigade electromagnetic spectrum manager or spectrum management personnel at higher headquarters to resolve issues with signal operating instructions and loadsets within the CEMA section.

- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Requests and manages frequency authorizations for the brigade CEMA section to support both operational and training activities.

MANEUVER BATTALION

2-30. The maneuver battalion has one electromagnetic spectrum NCO in the S-6. The battalion electromagnetic spectrum NCO—

- Requests frequencies for spectrum-dependent devices throughout the battalion's assigned area.
- Oversees the distribution of frequencies to the battalion and subordinate companies.
- Validates spectrum link reliability of assigned frequencies using a spectrum analyzer or monitoring receiver.
- Establishes the battalion guidance for managing, requesting, coordinating, and assigning spectrum use, JRFL, signal operating instructions, electromagnetic interference resolution, and related spectrum management operations functions in alignment with higher headquarters' policies and guidelines.
- Maintains an accurate listing of all spectrum-dependent devices in the battalion.
- Requests signal operating instructions and loadsets from higher headquarters and distributes them to the battalion and subordinate companies.
- Receives communications network input from higher headquarters and, upon interpreting the information, creates frequency requirements and plans and logically organizes the data provided.
- Conducts RF engineering and analysis and evaluates regulatory policy to determine supportability of spectrum-dependent devices used in the battalion's assigned area.
- Nominates frequencies from the database established by higher headquarters, makes assignments in the database, and notifies the requestors of the assignments.
- Generates satellite access requests and submits them to the proper controlling authority. Once the controlling authority grants satellite access authorization, the battalion electromagnetic spectrum NCO informs and provides users with the authorized frequencies.
- Performs regular frequency database reviews and submits requests for updates when necessary.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Uploads electromagnetic interference incidents identified in the assigned area to the Joint Spectrum Interference Resolution Online Portal.

MULTIFUNCTIONAL SUPPORT BRIGADE

2-31. Multifunctional support brigades—maneuver enhancement, combat aviation, and sustainment—have two electromagnetic spectrum NCOs—one in the S-6 section and one in the CEMA section.

S-6 SECTION ELECTROMAGNETIC SPECTRUM NONCOMMISSIONED OFFICER

2-32. The S-6 electromagnetic spectrum NCO—

- Requests frequencies for spectrum-dependent devices throughout the brigade through higher headquarters.
- Nominates frequencies from the database established by higher headquarters, makes assignments in the database, and notifies the requestors of the assignments.
- Obtains the JRFL from higher headquarters and disseminates to subordinate units.
- Resolves electromagnetic interference incidents reported within the brigade.
- Forwards resolved and unresolved electromagnetic interference reports to the higher headquarters spectrum manager.
- Uploads electromagnetic interference incidents identified in the assigned area to the Joint Spectrum Interference Resolution Online Portal.
- Validates spectrum link reliability of assigned frequencies using a spectrum analyzer or monitoring receiver.
- Establishes the brigade's guidance for managing, requesting, coordinating, and assigning spectrum use, signal operating instructions, electromagnetic interference reporting, and related spectrum management operations functions.

- Ensures the brigade's spectrum guidance aligns with higher headquarters' policies and guidance.
- Maintains an accurate listing of the brigade's spectrum-dependent devices.
- Conducts RF engineering and analysis and evaluates regulatory policy to determine the supportability of the brigade's spectrum-dependent devices.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.

CYBERSPACE ELECTROMAGNETIC ACTIVITIES SECTION ELECTROMAGNETIC SPECTRUM NONCOMMISSIONED OFFICER

2-33. The CEMA section electromagnetic spectrum NCO—

- Assists the CEMA section in planning, coordinating, assessing, and implementing electromagnetic attack, electromagnetic protection, and electromagnetic support requirements.
- Defines the electromagnetic operational environment for the CEMA section.
- Forwards electromagnetic interference incidents reported from the CEMA section to the S-6 electromagnetic spectrum NCO for resolution.
- Maintains frequency charts, diagrams, and reports of electromagnetic interference incidents identified by the CEMA section.
- Assists the S-6 electromagnetic spectrum NCO by providing input for the JRFL and serving as the subordinate spectrum manager to support all activities supporting the spectrum management life cycle.
- Distributes signal operating instructions and loadsets to authorized personnel in the CEMA section.
- Collaborate with the S-6 electromagnetic spectrum NCO or spectrum management personnel at higher headquarters to resolve issues with signal operating instructions and loadsets within the CEMA section.
- Maintains SIPRNET access and accounts for assigned spectrum management tools and applications.
- Requests and manages frequency authorizations for the brigade CEMA section to support both operational and training activities.

SECTION III – SPECTRUM MANAGEMENT IN TRAINING

2-34. This section provides an overview of spectrum management in training. It discusses national policies, range and power considerations, and the process of requesting spectrum resources for training in the United States and abroad. This section specifies the responsibilities of the spectrum manager at the installation and tactical level.

NATIONAL AND INTERNATIONAL POLICY AND LAW

2-35. Spectrum management operations often involve complex issues that require careful consideration DOD directives and instructions, national and international laws, and rules of engagement.

2-36. National and international laws form the foundation of spectrum management, as each country has regulations regarding frequency allocation and usage rights. The assistance of staff legal advisors helps commanders navigate these issues throughout the operations process. Refer to the following policy documents for more information:

- The Communications Act of 1934.
- Title 47 of the United States Code.
- National Telecommunications and Information Administration Manual of Regulations for Federal Radiofrequency Spectrum Management.
- DODI 4650.01.
- International Telecommunications Union Policies.

RANGE AND POWER CONSIDERATIONS

2-37. Using spectrum-dependent devices in a training environment ensures that warfighters are a competent and ready force; however, managing the electromagnetic spectrum at an Army installation presents a unique set of challenges. With the increased use of the electromagnetic spectrum and complex radio systems, there is an increased vulnerability to electromagnetic interference. Furthermore, adjacent frequency bands and

harmonically related systems are likely co-located or in proximity may cause co-site interference. To avoid unnecessary interference, spectrum managers should consider—

- Range.
- Using minimum required power.

RANGE

2-38. To achieve optimal performance between multiple spectrum-dependent devices, it is essential to consider the distance over which the transmission will be sent when in proximity. The technical specifications sheet found with each device lists the minimum and maximum distance for optimal communication between transceivers. Modeling and simulation tools like Systems Planning, Engineering, and Evaluation Device (SPEED) and Electromagnetic Warfare Planning and Management Tool (EWPMT) assist the spectrum manager with transceiver placement while minimizing electromagnetic interference.

USING MINIMUM REQUIRED POWER

2-39. Some transmitters include adjustable transmit power settings. Using the minimum necessary transmit power prevents signals from traveling beyond the intended receiving station, limiting electromagnetic interference. A technique to establish minimum transmission power is to begin with a low transmit power setting and gradually increase the output power until the intended recipient can validate the successful reception of the transmitted signal.

FREQUENCY REQUESTS

2-40. Users of spectrum-dependent devices must obtain approved frequency assignments from the appropriate spectrum management authority before operating the equipment. A frequency assignment is an authorization of a specific frequency, group of frequencies, or frequency band to be used to a particular location under specified conditions such as bandwidth, power, azimuth, duty cycle, and modulation (AR 5-12). The local network enterprise center spectrum manager, area frequency coordinator, or other designated authority must formally provide a frequency authorization or license to obtain authority to transmit.

FREQUENCY ASSIGNMENT TYPES AND ACTIONS WITHIN THE CONTINENTAL UNITED STATES AND OUTSIDE THE CONTINENTAL UNITED STATES

2-41. The national approval for Army systems to access the electromagnetic spectrum is confirmed by the National Telecommunications and Information Administration's inclusion of a frequency assignment record in the Government Master File database (AR 5-12). Unless otherwise instructed by the Office of the Assistant Secretary of Defense, applicants must submit spectrum requests using the standard frequency action format. Types of frequency assignments include—

- Regular (permanent) frequency assignments are valid for an unspecified period and contain a review date of 5–10 years from the initial approval date.
- Temporary frequency assignments are valid for a specified period with an expiration date of five years or less.
- Trial frequency assignments are made to select a suitable operating frequency for regular assignments with an expiration date of two years or less.

INTERNATIONAL AND HOST-NATION FREQUENCY APPROVAL AND REGISTRATION

2-42. Army organizations and installations outside the continental United States that need special frequency support beyond their standard tactical and training requirements must contact the supporting theater army spectrum manager to coordinate with, and obtain approval from, the host nation to transmit radio waves. Written notification is required for host-nation approval, which will be recorded in the national frequency assignment database. The DOD uses the DD Form 1494 to provide host-nation spectrum authorities with technical details regarding U.S. military systems seeking permission to transmit within their territory. The DD Form 1494 serves three functions:

- Provides a uniform method to capture the essential spectrum-dependent devices and operational parameters of military systems in a format easily provided to U.S. and host-nation spectrum authorities.

- Standardizes the technical data format required for DOD and U.S. national databases to generate frequency assignments.
- Enables initial analyses and checks for compliance with military, U.S. national, and host-nation spectrum standards.

SECTION IV – SPECTRUM MANAGEMENT INPUT IN THE OPERATIONS PROCESS

2-43. This section discusses the inputs, processes, and outputs provided by spectrum management personnel throughout operations process. Spectrum managers contribute to the common operational picture and participate in the military decision-making process, resulting in outputs commanders need to select a course of action.

THE COMMON OPERATIONAL PICTURE

2-44. The common operational picture is a single, identical display of relevant information shared by more than one command that facilitates collaborative planning and assists all echelons to achieve situational awareness (JP 3-0). The spectrum manager assists with information collection by providing detailed situational awareness of the electromagnetic spectrum for the common operational picture.

2-45. Spectrum management operations planning tools, combined with intelligence and electromagnetic warfare information, allow the spectrum manager to collect spectrum-related details tailored to the assigned area. These tools provide a visual depiction of force structure and geographic locations in a three-dimensional picture that personnel can understand quickly and easily. Spectrum management operations support to the common operational picture includes live spectrum analysis and modeling and simulations before movement of forces to a new location.

LIVE SPECTRUM ANALYSIS

2-46. Spectrum planning tools include spectrum analyzers, monitoring receivers, direction-finding antennas, and analysis software. Spectrum planning tools can be used to show or model persistent unplanned signals that interfere with assigned frequencies during the detection of electromagnetic interference. Spectrum planning tools provide a three-dimensional picture of the electromagnetic environment to the commander and include a graphical depiction of the spectrum footprint, along with recommendations for frequency reassignment to maintain communications in the assigned area. The spectrum manager uses spectrum planning tools to analyze electromagnetic emissions within the assigned area. The spectrum analysis information is used to mitigate electromagnetic interference. Using information provided by spectrum planning tools aligned with mission priorities, the commander may deem it necessary to request new frequencies for mission accomplishment.

MOVEMENT OF FORCES TO A NEW LOCATION

2-47. When the commander orders the movement of forces to a new area, the spectrum manager analyzes the proposed movement route with the spectrum planning tools. The spectrum manager collaborates with adjacent units to minimize electromagnetic interference with friendly forces' communications systems, sensors, and receivers throughout the movement. The spectrum planning tools simulate and evaluate the supportability of proposed routes to determine whether communications systems can remain operational during movement. The spectrum planning tools determine whether a specific movement route with active electromagnetic warfare systems can cause unintentional interference with friendly communications (frequency fratricide) along that route. Spectrum planning tools produce a report with actionable information such as sources, victims, levels, and duration of interference. This information provides the commander with supplementary information to make informed decisions.

MILITARY DECISION-MAKING PROCESS

2-48. The *military decision-making process* is an iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order (ADP 5-0). Commanders at echelons battalion and above use the military decision-making process to organize and conduct their planning

activities. The process helps leaders apply critical and creative thinking to analyze a mission; develop, analyze, and compare alternative courses of action; select the best course of action; and produce an operation plan or order.

2-49. The military decision-making process is essential to operations and minimizes the risk of overlooking a critical aspect of the operation. The military decision-making process is time-consuming; however, if implemented correctly, it alleviates many unexpected issues, resulting in preplanned contingencies for possible changes during an operation. For detailed information about the spectrum manager's role in the military decision-making process, refer to FM 6-02 and ATP 6-02.12.

2-50. Spectrum managers provide critical inputs for Annex H (Signal) to an operation plan or order. Spectrum management operations necessary outputs for the military decision-making process are the completed signal operating instructions, reports, frequency proposals, or data call messages. Table 2-1 on page 26 depicts the critical spectrum management operations inputs and outputs for each step of the military decision-making process.

Table 2-1. Key spectrum management operations inputs and outputs during the military decision-making process

Key spectrum management operations inputs	*Steps*	*Key spectrum management operations outputs*
• Updated EMS database • Unit electromagnetic order of battle • Library of EMS documents • HN allocation tables • Gather spectrum management tools	Step 1: Receipt of mission	• Defined electromagnetic operational environment • Data call message • Identify EMS constraints • JRFL guidance
• Identified EMS capabilities about combat power • List of unit spectrum-dependent devices • Frequency requests • JRFL requests	Step 2: Mission analysis	• Prioritized EMS use • Completed JRFL • Frequency reuse plans • Initial EMS risk assessment
• Commander's intent • Frequency allotments • Initial frequency assignments • DD-1494 for unit's spectrum-dependent devices	Step 3: Course of action development	• M&S of EMS to develop multiple COAs • EMI and EW deconfliction • Initial spectrum plan • EMS COP
• Initial spectrum plan • Mitigating factors to decrease EMS risk	Step 4: Course of action analysis and war gaming	• M&S shows EMS advantages and disadvantages for each COA • Continued analysis of EMS risk assessment • Recommend modifications
• Optional unit movement routes for planning COTM • Refined EMS COAs	Step 5: Course of action comparison	• M&S depicts EMS use to compare COAs • Recommended EMS COAs
• Recommended EMS COA • Coordinated frequency conflicts • Frequency proposals	Step 6: Course of action approval	• Commander selected EMS COA and any modifications • Frequency assignments
• Frequency assignments and allotments from higher echelon spectrum manager • HN frequency clearance • CREW loadsets	Step 7: Orders production, dissemination, and transition	• The spectrum plans • SOI • Annex H of OPORD • Distribute frequency assignments to requestors • CNR loadsets

Legend:

CNR	combat net radio	EMS	electromagnetic spectrum
COA	course of action	EW	electromagnetic warfare
COP	common operational picture	HN	host-nation
COTM	communications on the move	JRFL	joint restricted frequency list
CREW	counter-radio controlled improvised explosive device electromagnetic warfare	M&S	modeling and simulation
		OPORD	operation order
EA	electromagnetic attack	SOI	signal operating instructions
EMI	electromagnetic interference		

STEP 1 – RECEIPT OF MISSION

2-51. During receipt of mission, the spectrum manager—

- Conducts data calls to collect a list of spectrum-dependent devices and their spectrum requirements.

- Uses spectrum management tools to analyze spectrum supportability and models the operational area with digital topography and electromagnetic environmental effects information.
- Determines frequencies used in an assigned area using governmental and host-nation spectrum allocation tables.
- Compiles restraints or constraints for spectrum use that may prevent the planning and use of TABOO, protected, and guarded frequencies around operations.
- Develops understanding of the electromagnetic operational environment for awareness of the spectrum use in the assigned area.

STEP 2 – MISSION ANALYSIS

2-52. During mission analysis, the spectrum manager—

- Analyzes the electromagnetic operational environment, highlighting unified action partners' spectrum users and aids the commander in determining spectrum priorities.
- Conducts an initial spectrum risk assessment identifying the spectrum impact on unified action partners in the operational area. This process also identifies frequency use conflicts such as electromagnetic interference and frequency fratricide.
- Generates a frequency reuse plan for spectrum optimization and increased spectrum capabilities.
- Identifies constraints within the electromagnetic spectrum where specific frequencies are TABOO, protected, guarded. Constraints include those frequencies not allocated for use by the host nation.
- Determines spectrum capabilities of combat power, such as electromagnetic warfare and counter-radio controlled improvised explosive device electromagnetic warfare systems with guidance from the cyber electromagnetic warfare officer.

STEP 3 – COURSE OF ACTION DEVELOPMENT

2-53. During the course of action development, the spectrum manager—

- Uses spectrum management tools to model the unit's boundaries and formations to develop course of action recommendations.
- Performs electromagnetic interference and electromagnetic warfare frequency deconfliction using spectrum management tools for course of action development and spectrum supportability analysis.
- Generates frequency allotment and allocation tables for subordinate units.
- Identifies spectrum impact on civilian spectrum users in the assigned area.
- Evaluates primary, alternate, contingency, and emergency means of communication for each course of action based on unit capabilities, software simulation, and spectrum supportability.

STEP 4 – COURSE OF ACTION ANALYSIS (WARGAMING)

2-54. During the course of action analysis, the spectrum manager—

- Identifies the spectrum advantages and disadvantages throughout the assigned area for each course of action.
- Identifies mitigating factors for the spectrum risk assessment to reduce or eliminate risks.
- Recommends modifications to the course of action based on newly identified spectrum requirements and supportability during the wargame.

STEP 5 – COURSE OF ACTION COMPARISON

2-55. During course of action comparison, the spectrum manager—

- Use spectrum management tools to evaluate multiple courses of action.
- Analyzes routes used for the movement of forces and advises the commander on routes with the least likelihood of spectrum interference or loss of spectrum coverage.

STEP 6 – COURSE OF ACTION APPROVAL

2-56. During course of action approval, the spectrum manager—

- Consolidates the unit's submission of frequency proposals and provides frequency assignments.
- Modifies the spectrum management portion of the selected course of action according to the commander's guidance.

- Coordinates frequency conflicts through higher echelons for mitigation assistance.

STEP 7 – ORDERS PRODUCTION, DISSEMINATION, AND TRANSITION

2-57. During orders production, dissemination, and transition, he spectrum manager—

- Produces the signal operating instructions and disseminates them to subordinate units.
- Provides input to Annex H (Signal), such as location, movement of critical signal nodes, and critical electromagnetic spectrum considerations throughout the operation.

Chapter 3

Support to the Warfighting Functions

Spectrum management operations enable and support the Army's warfighting functions described in ADP 3-0. This chapter links Army spectrum management operations to warfighting functions and explains how spectrum management operations support and enable the commander's efforts as they exercise command and control.

COMMAND AND CONTROL

3-1. Spectrum management operations enable command and control by mitigating electromagnetic interference from frequency fratricide and threat electromagnetic attack. Spectrum management plays a vital part in understanding the electromagnetic operational environment, while contributing to situational awareness and development of the common operational picture to support decision making.

3-2. Spectrum management operations support command and control by—

- Planning and preparing spectrum use to support a mission.
- Assessing the electromagnetic operational environment in response to the commander's intent.
- Preparing and maintaining the electromagnetic operational environment database.
- Understanding the impact of a mission on unified action partners.
- Collecting spectrum information and visualizing this information in quick and easy to understand formats for completion of the common operational picture.
- Controlling the spectrum through force tracking and visualization, frequency deconfliction, reprogramming, and registration of spectrum-dependent devices.
- Using spectrum planning and management tools to support spectrum use and plan interoperable communications with Army forces and unified action partners.

MOVEMENT AND MANEUVER

3-3. Spectrum management operations enable movement and maneuver by maintaining freedom of action within the electromagnetic spectrum. Spectrum management operations support movement and maneuver through—

- Spectrum resource planning, analysis, and simulation to determine spectrum supportability over a projected movement route.
- Frequency deconfliction planning during the movement of forces.

INTELLIGENCE

3-4. Spectrum management supports intelligence throughout the electromagnetic operational environment. Understanding the electromagnetic operational environment results in successful frequency deconfliction, greater fidelity in threat recognition, and provision in support of the intelligence warfighting function. Spectrum management operations support intelligence by—

- Providing a detailed picture of the electromagnetic operational environment for situational awareness.
- Using centralized databases to enable collection management through subordinate and adjacent units.
- Deconflicting frequencies that create electromagnetic interference with intelligence systems in the assigned area.

FIRES

3-5. Spectrum management provides critical support to the fires warfighting function through spectrum awareness and direct support to electromagnetic warfare. Spectrum management operations help mitigate electromagnetic interference among fires systems. Spectrum management operations support fires through—

- Coordination throughout the electromagnetic operational environment to prevent electromagnetic interference to and from firing devices, sensors, and data links.
- Coordination with the CEMA section to allow effective use of spectrum resources for fires operations.
- Integration and synchronization of spectrum-dependent devices by assigning and allocating frequencies within a joint environment.

SUSTAINMENT

3-6. Spectrum management operations ensure all spectrum-dependent devices used for sustainment have necessary frequencies and minimal electromagnetic interference. Spectrum management contributes to the long-term sustainability of the contested electromagnetic spectrum by coordinating spectrum use with all units in the assigned area. Spectrum management operations support sustainment by—

- Providing the necessary frequencies for logistics spectrum-dependent devices.
- Obtaining frequency clearance to support sustainment operations for the duration of the mission.

PROTECTION

3-7. The *protection warfighting function* is the related tasks, systems, and methods that prevent or mitigate detection, threat effects, and hazards to preserve combat power and enable freedom of action (FM 3-0). Spectrum management operations support protection through—

- Frequency deconfliction, interference mitigation, and support for electromagnetic protection.
- Network and frequency fratricide avoidance, detection, and mitigation.
- Development of the JRFL.
- Coordination with the CEMA section to protect against frequency fratricide during electromagnetic warfare operations, such as counter-radio controlled improvised explosive device electromagnetic warfare use.

3-8. The spectrum manager also protects the force by recognizing the potential of electromagnetic environmental effects. *Electromagnetic environmental effects* are the impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms (JP 3-85). The three types of electromagnetic environmental effects are—

- Electromagnetic interference.
- Electromagnetic pulse.
- Electromagnetic radiation hazards.

ELECTROMAGNETIC INTERFERENCE

3-9. *Electromagnetic interference* is any electromagnetic disturbance, induced intentionally or unintentionally, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electromagnetic spectrum-dependent systems and electrical equipment (JP 3-85). Electromagnetic interference can be injected intentionally, as in jamming, or unintentionally, because of signal interference or mixing of modulated signals resulting in unwanted frequencies. The spectrum manager ensures all spectrum-dependent devices operate as intended without electromagnetic interference. The spectrum manager is the commander's resident expert who provides courses of action based on software modeling and simulation to mitigate electromagnetic interference.

ELECTROMAGNETIC PULSE

3-10. An *electromagnetic pulse* is an intense burst of electromagnetic radiation caused by a nuclear explosion, energy weapon, or natural phenomenon that may couple with electrical or electronic systems to produce damaging current and voltage surges (JP 3-85). It is important to consider and incorporate measures to shield and protect friendly equipment, personnel, and facilities against the effects of an electromagnetic pulse. This requires thorough planning and preparation to mitigate the potential consequences of such an event on critical infrastructure.

ELECTROMAGNETIC RADIATION HAZARDS

3-11. *Electromagnetic radiation hazards* are transmitter or antenna installations that generate or increase electromagnetic radiation in the vicinity of ordnance, personnel, or fueling operations in excess of established safe levels (JP 3-85). Electromagnetic emissions from communication and noncommunication transmitters can cause hazardous levels of radiation. Electromagnetic radiation hazards include—

- Hazards of electromagnetic radiation to personnel.
- Hazards of electromagnetic radiation to ordnance.
- Hazards of electromagnetic radiation to fuels.
- Natural phenomena effects such as space weather, lightning, and precipitation static.

Hazards of Electromagnetic Radiation to Personnel

3-12. Hazards of electromagnetic radiation to personnel are the hazard that exists due to the exposure of personnel to an electromagnetic field with sufficient intensity to heat the human body. Radar, communication, and electromagnetic warfare systems that use high-power transmitters and high-gain antennas represent a hazard to personnel working on or near these systems. Leaders should ensure areas are marked off to avoid injury to personnel.

Hazards of Electromagnetic Radiation to Ordnance

3-13. *Hazards of electromagnetic radiation to ordnance* are the danger of accidental actuation of electro-explosive devices or otherwise electrically activating ordnance because of radio frequency electromagnetic fields (JP 3-02). This unintended actuation could cause premature firing of susceptible or unsafe ordnance. Leaders should consider this hazard and integrate risk management into all training and military operations. Refer to the spectrum supportability risk assessment stoplight chart in AR 5-12 for more information on how to identify and mitigate hazards of electromagnetic radiation to ordnance.

Hazards of Electromagnetic Radiation to Fuels

3-14. *Hazards of electromagnetic radiation to fuels* is the hazard created when volatile combustibles, such as fuel, are exposed to electromagnetic fields of sufficient energy to cause ignition (JP 3-85). The hazard is likely to occur during refueling operations. Leaders must adhere to proper electrical grounding and static discharge procedures. Refer to TC 6-02.6 for more information about grounding techniques.

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Appendix A

Spectrum Physics

This appendix describes the physics of the radio frequency spectrum. A basic understanding of the underlying principles of radio frequency energy is necessary for the execution of spectrum management operations.

RADIO FREQUENCY

A-1. RF communications, based on the laws of physics, describes the behavior of electromagnetic energy waves. RF communications work by creating electromagnetic waves at a source and being able to receive those electromagnetic waves at a particular destination. These electromagnetic waves travel at the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency, the shorter the wavelength.

A-2. Frequency measurements are expressed in hertz (Hz) or cycles per second. Typically, radio frequency measurements are in kilohertz (kHz) or thousands of cycles per second, megahertz (MHz) or millions of cycles per second, or gigahertz (GHz) or billions of cycles per second. The wavelength for a device utilizing a frequency in the MHz range is longer than a frequency in a GHz range. In general, signals with longer wavelengths travel a greater distance and penetrate objects through and around better than signals with shorter wavelengths.

A-3. Waveforms are patterns of electrical energy over time. A sine wave is the fundamental building block of electricity and other energy types. A sine wave mathematically defines a natural action describing a harmonic alternating event.

A-4. The wavelength is the distance from one crest or trough on a wave to the same point on the preceding crest or trough. Amplitude is the displacement of a crest or trough from the centerline or rest position. The displacement is the crest (high point) and trough (low point) of a wave. Figure A-1 provides a graphic depiction of a simple sinusoidal waveform.

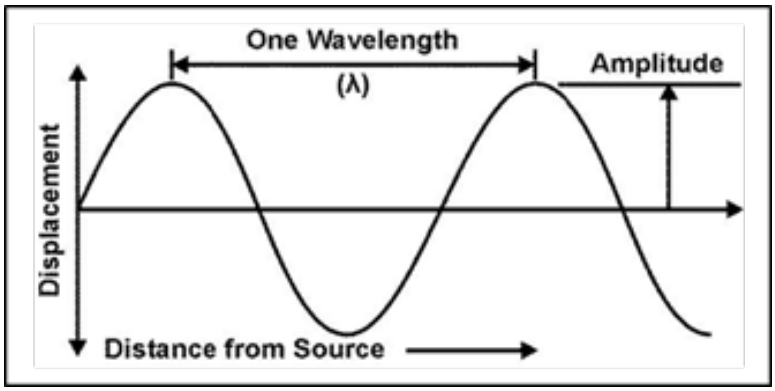


Figure A-1. Waveform characteristics

HARMONICS AND INTERMODULATION PRODUCTS

A-5. Frequencies are associated with different standing wave patterns that produce wave patterns known as harmonics. The pattern for the first harmonic reveals a half wavelength where each point on the line represents nodes, and the arching middle represents antinodes. The second harmonic displays a complete wavelength; this pattern describes as starting at the rest position, rising upward to peak displacement, returning down to a rest position, then descending to a peak downward displacement, and finally returning to the rest position.

A-6. One complete wave in a standing wave pattern consists of two loops. Thus, one loop is equivalent to one-half of a wavelength. The third harmonic pattern consists of three antinodes. There are three loops within the length of the wave. Since each loop is equivalent to one-half wavelength, the length of the wave is equal to three-halves of a wavelength. The table has a pattern when inspecting standing wave patterns and the length-wavelength relationships for the first three harmonics. The number of antinodes in the pattern is equal to the harmonic number of that pattern. The first harmonic has one antinode; the second harmonic has two antinodes, and the third harmonic has three antinodes. The mathematical relationship emerges from the pattern and the understanding that each loop in the pattern is equivalent to one-half of a wavelength. Figure A-2 depicts the general equation that describes this length–wavelength relationship for any harmonic.

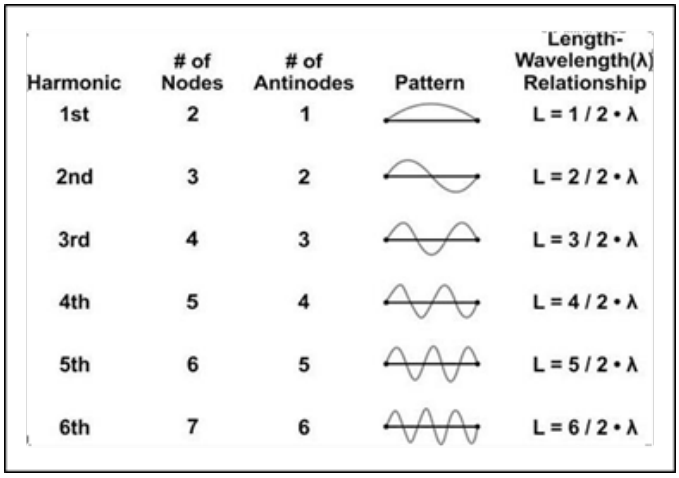


Figure A-2. Wavelength relationship

A-7. Harmonics develop into currents and voltages with frequencies that are multiples of the fundamental frequency. Harmonic signals that fall within the passband of a receiver with a signal level of sufficient amplitude can degrade the performance of the receiver. Receivers live under constant bombardment of signals that enter through the antenna port. Some of these signals quickly attenuate due to front-end filtering, also called pre-selection.

A-8. Intermodulation occurs when multiple signals reach a non-linear element, such as a detector, mixer, or amplifier, and are mixed. Whenever two signals mix, the introduction of two additional signals result as the sum and difference of the original frequencies. This process is often intentional as in the case of mixing a frequency with the intermediate frequency in a system to produce the desired operating signal. Harmonics of the original two frequencies are still present, but most occur well outside the passband of the RF and intermediate frequency filters and cause no problems. The harmonics that tend to create the most problems are the odd-order products. For example, if a 50 MHz mixing frequency combines with a 98 MHz intermediate frequency to produce the desired transmission signal of 148 MHz, this is very close to the third order harmonic of 50 MHz (150 MHz) and may cause interference at the desired frequency. Channelized communications systems tend to suffer more from these issues due to uniform channel spacing.

TRANSMISSION, PROPAGATION, AND RECEPTION

A-9. A radio transmits a signal by driving a current on an antenna where the current amplitude is the changing quantity of the signal. This current change, in turn, induces an electromagnetic field about itself, with a field strength that corresponds to the current amplitude. This electromagnetic field propagates away from the antenna as a radio wave at the speed of light. As the signal propagates, it weakens. At a remote receiver, the electromagnetic wave passes across the receiving antenna and induces a current. Figure A-3 on page 35 illustrates transmission and propagation of radio waves.

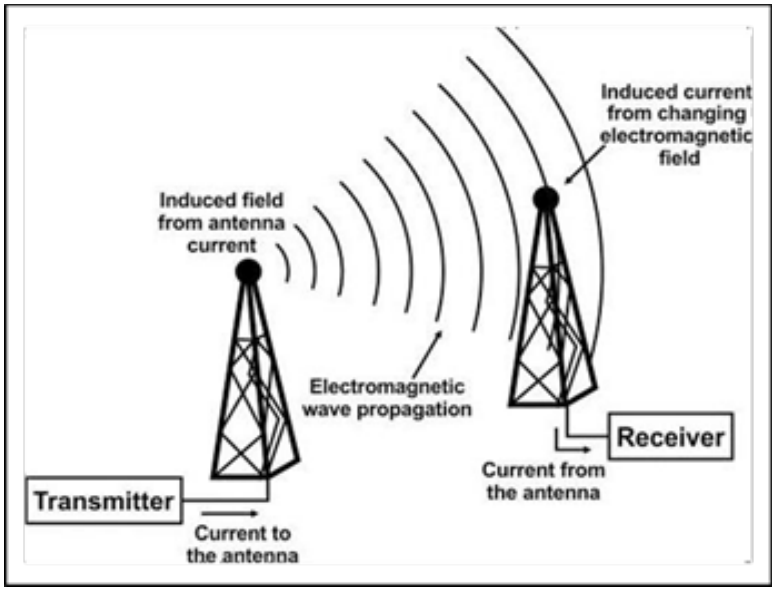


Figure A-3. Transmission and propagation of radio waves

A-10. Electromagnetic radiation in the area passes across the receiving antenna. The receiving antenna must be able to isolate the desired signal from all others to detect and receive the correct signal. If the receiver is in the range of two transmitters using the same frequency it is attempting to receive, the receiver may not correctly capture the desired signal for demodulation, rendering the received signal unintelligible. The goal is not to deter transmitters from using the same frequencies, but to ensure that receivers can receive and distinguish the desired signals. There may be more than one transmitter using the same carrier frequency if the receivers can distinguish the desired signal over the others.

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Appendix B

Spectrum Management Tools, Compatibility, and Capabilities

Spectrum managers use various hardware and software tools for spectrum planning and management. This appendix provides a technical description of several of the more popular tools used for spectrum management operations, including hardware and infrastructure requirements, software used, and capabilities. This appendix additionally provides an overview of the capabilities and compatibility of various spectrum management tools.

OVERVIEW

B-1. Spectrum management tools are used to plan, manage, and distribute frequencies for communications networks and spectrum-dependent devices. Spectrum management tools should be interoperable with other tools the spectrum manager uses. For example, electromagnetic warfare personnel should use the same spectrum management tool as the spectrum manager, allowing the spectrum manager to mitigate harmful interference to friendly systems possibly caused by electromagnetic warfare systems.

B-2. Gathering and managing spectrum data requires considerable time to ensure accuracy. Tools that support the automation of spectrum management functions can drastically reduce this time constraint. Spectrum management tools that promote the flow of information between spectrum stakeholders reduce the planning cycle, resulting in quicker decision-making. Spectrum managers can perform the core spectrum management operations functions efficiently when tools comply with the network environment.

GLOBAL ELECTROMAGNETIC SPECTRUM INFORMATION SYSTEM

B-3. Global Electromagnetic Spectrum Information System (GEMSIS) is a joint program of record that provides access to several spectrum management tools. Spectrum managers access GEMSIS on the Internet using Nonclassified Internet Protocol Router Network or SIPRNET access. GEMSIS enables the accuracy of the common operational picture, accelerates spectrum access, and increases interoperability. GEMSIS increment 2 incorporates other spectrum management tools, such as Spectrum XXI and Stepstone.

B-4. GEMSIS provides worldwide visibility of host-nation supportability of spectrum-dependent devices. The system automates the distribution of host-nation coordination requests and combatant command submission of host-nation supportability comments. GEMSIS enables spectrum managers to determine the historical supportability of other systems in the same frequency band. GEMSIS provides the following spectrum services and tools—

- Integrated Spectrum Desktop.
- Joint Spectrum Data Repository.
- Spectrum XXI.
- End-to-End Supportability System.
- HNSWDO.
- Stepstone.
- EWPMT.

INTEGRATED SPECTRUM DESKTOP

B-5. Integrated Spectrum Desktop provides a common desktop for accessing web-based spectrum management capabilities. Integrated Spectrum Desktop facilitates the integration and interoperability of the GEMSIS spectrum tools. Integrated Spectrum Desktop includes web links to various sites and abilities used to support the spectrum community.

B-6. Integrated Spectrum Desktop integrates web-based capabilities within GEMSIS and provides a single website to access those capabilities. Access to all spectrum tools through Integrated Spectrum Desktop requires a single login, and users access spectrum tools by clicking authorized widgets.

JOINT SPECTRUM DATA REPOSITORY

B-7. The Defense Spectrum Organization gathers, standardizes, and distributes spectrum-related data. The Defense Spectrum Organization provides direct online data access to the joint spectrum data repository and provides customized reports. The joint spectrum data repository contains DOD, national, and international spectrum-related information up to the secret level. Spectrum managers access the joint spectrum data repository at the Joint Spectrum Center Data Access Web Server (JDAWS) tool. The JDAWS provides user access to the database components of the joint spectrum data repository.

B-8. The Joint Spectrum Data Repository allows access to over 100 area studies. The area studies are the Defense Spectrum Organization-produced country-specific telecommunication profiles hosted on Intelink. Area studies found within the JDAWS provide hyperlink access to the Intelink site.

B-9. The Joint Spectrum Data Repository contains various resources in a variety of formats. The following are the primary resources available through the Joint Spectrum Data Repository:

- **Joint Equipment, Tactical, and Space Database**—a Defense Spectrum Organization created and maintained resource that includes—
  - Parametric data for DOD, commercial and multinational equipment.
  - Platform data, including equipment complements.
  - U.S. military unit names, locations, and hierarchy.
  - U.S. military unit equipment and platform complements.
  - Satellite parametric and orbital data.
- **HNSWDO**—a web-based application for processing DOD host-nation coordination requests and responses.
- **Spectrum Certification System Database**—the central archive repository for all DOD spectrum certification system data, including information from the Joint Frequency 12 application for equipment frequency allocation. Joint Frequency 12 is the unique tracking number assigned by the Army Spectrum Management Office.
- **Background Environmental Information Database**—represents the electromagnetic environment. The Defense Spectrum Organization gathers additional non-U.S. federal and international frequency assignments stored in the background environmental information database. The background environmental information includes International Telecommunication Union, Federal Communications Commission, Canadian, and Radio Astronomy assignments.
- **Government Master File Database**—a data source containing records of the frequency assigned to all government agencies in the United States and its territories and possessions. National Telecommunications and Information Administration provides the data.
- **Frequency Resource Record System Database**—contains information about DOD frequency assignments controlled by combatant commanders and Military Departments worldwide.
- **Electromagnetic Order of Battle Database**—the joint spectrum data repository contains nearly 25,000 Defense Intelligence Agency electromagnetic orders of battle for foreign equipment locations.

SPECTRUM XXI

B-10. Spectrum XXI is a client and server, Windows-based software system that provides spectrum managers with a single information system that addresses spectrum management automation requirements. Spectrum XXI supports operational planning and management of the electromagnetic spectrum, emphasizing assigning compatible frequencies and performing spectrum-engineering tasks. Spectrum XXI client version is a software package that requires a unit-provided computer.

B-11. Spectrum XXI's joint spectrum center central repository provides a central database of spectrum certifications for compliant systems, topography and electromagnetic environmental effects data, and all DOD spectrum proposals and assignments. The repository also transfers data between the DOD and National Telecommunications and Information Administration for permanent frequency assignments in the United

States and its territories and possessions. Spectrum XXI users may access the government master file through the central repository.

Spectrum XXI Users

B-12. Spectrum XXI users can connect to one of the three regional servers through local area network access, SIPRNET access, or secure telephone for dial-up access. The Spectrum XXI database uses the Oracle database management system based on structured query language that requires licenses and training for the regional servers. The client version that Army spectrum managers use does not require an Oracle license or training. The client can function in stand-alone mode using the local database with limited functionality when network connectivity is unavailable. Spectrum XXI contains a table of International Telecommunications Union regional allocations to aid international spectrum planning compliance. The Spectrum XXI database also includes geographical boundaries and utilities. The system can plot spectrum-dependent devices based on frequency records.

B-13. Spectrum XXI allows users to create and maintain permanent, temporary, or proposed assignments, including background on frequency assignments. Spectrum XXI analyzes frequency assignments for operating conditions, interference, intermodulation, allocation and allotment tables, and compliance with technical and administrative standards. A simulated spectrum analyzer displays current and projected spectrum use at user-defined sites. The system also creates and manages input to the JRFL. Spectrum XXI can analyze the impact of electromagnetic warfare on spectrum users.

Spectrum XXI Modules

B-14. Spectrum XXI includes numerous spectrum management capabilities using various software component modules. Such modules include—

- Interference analysis module.
- Interference report module.
- Electromagnetic warfare deconfliction module.
- Joint restricted frequency list module.
- Coordinate conversion module.
- Co-site analysis module.
- Coverage plots module.
- Geomagnetic conversion module.
- High frequency skywave analysis module.
- Point-to-point link analysis module.
- Satellite look angles for multiple earth stations and multiple satellites module.
- Spectrum occupancy model.
- Topographic manager module.
- Frequency assignment module.
- Allotment plan generator module.
- Compliance module.
- Spectrum certification system.
- Data exchange module.

Interference Analysis Module

B-15. The interference analysis module analyzes existing frequency assignments for potential interference. Perform this analysis when the holder of a frequency assignment reports interference from an unknown station. An interference analysis can determine whether a transmitter on a single frequency could cause interference to an existing environmental receiver represented by a frequency record in the database. The interference analysis module analyzes whether a receiver may receive interference from an existing environmental transmitted by a frequency record in the database.

Interference Report Module

B-16. The interference report module generates reports describing interference problems and provides information to resolve the problem. Interference reports can also document a history of issues and thus identify possible causes for subsequent interference. If interference problems exist, the first step as a spectrum manager is to verify that the person reporting the interference is authorized to use that frequency. Spectrum managers attempt to resolve interference problems at the lowest level possible. If this is not possible, the spectrum manager creates a report for distribution to higher authorities. The spectrum manager reports the interference information to the combatant command or the theater army, who then may call upon the joint spectrum interference resolution team to investigate.

Electromagnetic Warfare Deconfliction Module

B-17. The electromagnetic warfare deconfliction module assesses the impact of a planned electromagnetic attack and jamming on existing receivers during contingency operations and exercises. The joint staff J-3 must know the operational situation to make intelligent decisions using this module. The electromagnetic warfare deconfliction module, used with the JRFL module, documents a list of frequencies protected from jamming. In addition, the module analyzes the impact an electromagnetic jammer has on environmental receivers using a range of azimuths. Analysis results comprise three types of conflicts—

- Frequency assignment conflicts.
- JRFL conflicts.
- Signal operating instructions conflicts.

Joint Restricted Frequency List Module

B-18. The JRFL module is a management tool used by various operational and support elements to identify the level of protection they desire, applied to a specific spectrum, to preclude these assets from being jammed by friendly forces conducting electromagnetic attacks. The JRFL identification and building process begins at the unit level, works upward through the chain of command, and then consolidates within the joint task force staff or combatant command. The module allows users to select a frequency assignment from Spectrum XXI or signal operating instructions nets. Spectrum managers select these frequency assignments by importing the generated signal operating instructions in the JRFL module.

Coordinate Conversion Module

B-19. The coordinate conversion module provides a graphical representation of the conversion between latitude, longitude, and Military Grid Reference System coordinates.

Co-Site Analysis Module

B-20. The co-site analysis module performs co-site analysis on a list of frequencies and emissions.

Coverage Plots Module

B-21. The coverage plots module creates terrain elevation, line-of-sight, and signal strength plots. This function provides the commander analytics to help determine the best placement of sensors.

Geomagnetic Conversion Module

B-22. The geomagnetic conversion module converts magnetic azimuths to true azimuths.

High Frequency Skywave Analysis Module

B-23. The high frequency skywave analysis module calculates the high frequency skywave propagation prediction values for the maximum usable frequency, the frequency of optimum transmission, and the lowest usable frequency between a transmitting and receiving location based on the time of day.

Point-to-Point Link Analysis Module

B-24. The point-to-point link analysis module displays the terrain profile and aids in the determination of the viability of radio links between proposed transmitting and receiving locations.

Satellite Look Angles for Multiple Earth Stations and Multiple Satellites Modules

B-25. The satellite look angles for multiple earth stations modules, and the multiple satellite modules calculate the azimuth and elevation angles from earth stations to geostationary satellites.

Spectrum Occupancy Module

B-26. The spectrum occupancy module displays a graphical representation of the calculated received signal power at a specified location indicated in the frequency records of the assignment database. This is like the view seen on a spectrum analyzer.

Topographic Manager Module

B-27. The topographic manager module is an automated capability that reformats the level 1 and level 2 digital terrain elevation data obtained directly from the National Geospatial-Intelligence Agency on compact disk read-only memory media. The topographic manager can register and manage reformatted topographical data files.

Frequency Assignment Module

B-28. The frequency assignment module automates the processing of requests to use frequency resources. The process includes the preparation of frequency assignment proposals, validation of those proposals, determination of possible interference with the background environment, distribution, and status tracking of frequency proposals. The frequency assignment module also provides processes for frequency assignment database updates and retrievals.

Allotment Plan Generator Module

B-29. The allotment plan generator module creates a list of frequencies commonly referred to as allotment plans, channelization plans, spectrum use plans, or radio frequency authorizations. These plans are a frequency resource for nominating proposals using the frequency assignment module. Sometimes, allotment plans disseminate authorized temporary frequencies for training or tactical exercises.

Compliance Module

B-30. The compliance module checks the format and content of frequency records saved to a file and is not in the proposal editor. Three compliance checks are performed:

- Allocation table checks.
- Canadian and Mexican coordination checks.
- Field validation checks.

B-31. Users have the option to complete all checks. The record source determines which validation checks are performed based on the records provided. International users should use the validation option only.

Spectrum Certification System

B-32. The spectrum certification system is an automated system used to prepare a DD Form 1494 at frequency management offices supporting the acquisition process.

Data Exchange Module

B-33. The data exchange module electronically exchanges data between servers and client computers. The data exchange module manages server accounts, job accounts, and domains used for data exchange. A stand-alone client cannot use the functions of data exchange. When first installed, Spectrum XXI is a stand-alone client until the initial connection to a server. When connected, it becomes a data exchange client.

END-TO-END SUPPORTABILITY SYSTEM

B-34. The end-to-end supportability system provides a data collection tool and database for spectrum supportability business processes. The end-to-end supportability system provides worldwide visibility of host-nation spectrum-dependent device supportability. The end-to-end supportability system integrates Stepstone and HNSWDO capabilities to meet GEMSIS end-to-end supportability requirements.

HOST-NATION SPECTRUM WORLDWIDE DATABASE ONLINE

B-35. HNSWDO is a web-based application providing worldwide visibility of host-nation spectrum supportability. HNSWDO automates the distribution of host-nation coordination requests, allowing combatant command submission for host-nation supportability and reducing time requirements for managing host-nation spectrum authorization. The database enables informed decision-making concerning frequency use. HNSWDO mitigates the risk of acquiring potentially unsupportable systems. HNSWDO provides the user with near-instantaneous updates and dramatic reductions in process lag (from year to months). HNSWDO requires an approved account and Nonclassified Internet Protocol Router Network access using a unit-provided computer. The Defense Spectrum Organization processes account requests.

Note. Host-nation allocation tables and spectrum-dependent device certification do not constitute the authority to assign frequencies within a host nation. All formal frequency requests are sent to the host nation for frequency authorization. Refer to FM 6-02 and JP 3-85 for more information about host-nation coordination.

STEPSTONE

B-36. Stepstone is an online platform that facilitates the capture of parametric information for spectrum-dependent devices. It supports the processes of spectrum certification and spectrum supportability. Stepstone provides a mechanism to complete DD Form 1494. Stepstone can also conduct compliance checks to ensure data quality, collaboration and workflow capabilities, and certification process metrics for spectrum-dependent devices.

ELECTROMAGNETIC WARFARE PLANNING AND MANAGEMENT TOOL

B-37. EWPMT is a web-based system that allows the cyber electromagnetic warfare officer and spectrum manager to plan, coordinate, and synchronize spectrum management operations and electromagnetic warfare throughout operations. EWPMT integrates electromagnetic warfare battlefield information and management of electromagnetic warfare systems into command-and-control information systems and enables electromagnetic capabilities management. EWPMT provides a tailorable, user-defined display of the electromagnetic operational environment at echelons battalion through theater army.

B-38. EWPMT is a suite of software tools to control and manage a unit's designated portion of the electromagnetic spectrum. EWPMT provides a common operational picture of the electromagnetic operational environment that integrates command and control, intelligence, and fires data elements. Using EWPMT, a cyber electromagnetic warfare officer can plan, coordinate, and manage electromagnetic warfare activities and employ assets to conduct electromagnetic attacks. The spectrum manager can conduct near real-time spectrum deconfliction with electromagnetic warfare elements.

B-39. EWPMT allows spectrum managers to send, receive, store, display, and develop situational awareness information regarding friendly, threat, neutral, and unknown spectrum users within an assigned area. EWPMT synchronizes current and emergent spectrum management and electromagnetic warfare capabilities to provide commanders with situational understanding of the electromagnetic operational environment and illustrate the electromagnetic emissions of organic equipment, including electromagnetic warfare systems. For emerging technologies, EWPMT utilizes an information technology box strategy that allows software upgrades to meet the requirements of rapidly evolving technology.

OTHER AVAILABLE SPECTRUM MANAGEMENT TOOLS AND SERVICES

B-40. In addition to GEMSIS, other spectrum management tools and services are available to a spectrum manager. Some tools and services may have capabilities like GEMSIS but are more user-friendly, or they may have additional capabilities necessary for interoperability with emerging and evolving technologies.

SYSTEMS PLANNING, ENGINEERING, AND EVALUATION DEVICE

B-41. The Systems Planning, Engineering, and Evaluation Device (SPEED) is a Marine Corps-developed government off-the-shelf software application distributed with the Automated Communications Engineering Software or Joint Automated Communications-Electronics Operating Instruction System image on a unit-provided AN/GYK-33 computer. SPEED provides modules to meet user-specific requirements. SPEED allows the spectrum manager to complete and edit the standard frequency action format forms using an equipment database that includes tactical platforms, equipment, and antennas. The SPEED asset manager module can import, export, and build vehicle manifests, personnel rosters, and equipment deployment lists. SPEED is accessible to all federal agencies but is primarily used by Marine Corps spectrum managers. Army spectrum managers may interface with SPEED in joint operations.

B-42. SPEED provides two- and three-dimensional views of the operational area to support situational understanding. The Advanced Prophet and Terrain Integrated Rough Earth Model and National Geospatial-Intelligence Agency provide map data to the system. SPEED offers a color-coded display of spectrum use across an operational area. SPEED can generate JRFL input in the correct format to the next higher echelon. The system allows users to manually input, store, and view information for a tactical satellite network defined in a satellite access authorization. Still, it cannot automatically format the approval into the standard frequency action format or standard spectrum resolution form.

REAL-TIME SPECTRUM OPERATIONS

B-43. Real-time spectrum operations (RTSO) is an integrated operational radar, combat system, and communications frequency planning tool primarily used by Navy and Coast Guard spectrum managers. This tool calculates optimal frequency use and distance separation, considering all strike group spectrum-dependent devices. RTSO minimizes electromagnetic interference according to national and international frequency regulations. The strike group staff or designated frequency coordinator can select frequencies and separation distances for the group's ships to ensure radars operate with minimal electromagnetic interference.

B-44. In addition to Navy and Coast Guard vessels, RTSO contains data from naval fleets of over 60 countries. RTSO supports radar and communication analysis and spectrum planning for joint operations on—

- Ships.
- Submarines.
- Aircraft.
- Military and civilian ground sites.

B-45. RTSO updates have improved the performance of communications networks in the presence of counter radio-controlled improvised explosive device electromagnetic warfare and other electromagnetic warfare capabilities. The RTSO master database is shore-based and only available using SIPRNET. RTSO is available in a stand-alone mode with a local database for users with no SIPRNET access or operating with limited bandwidth.

B-46. RTSO complies with the standard frequency action format and standard spectrum resolution form. Measurements taken by RTSO provide input and development of the DD Form 1494. RTSO provides spectrum visualization after analysis of spectrum use. RTSO can import and export Extensible Markup Language (XML) files. The system can provide input from the Navy to the JRFL during joint operations. Army spectrum managers may interface with RTSO when deconflicting spectrum use with Navy missions.

AUTOMATED COMMUNICATIONS ENGINEERING SOFTWARE AND JOINT AUTOMATED COMMUNICATIONS ENGINEERING SOFTWARE

B-47. Automated Communications Engineering Software (ACES) and Joint Automated Communications Engineering Software (JACS) are part of the Army key management system that automates the management

of COMSEC keys, electromagnetic protection data, and signal operating instructions. These multipurpose programs reside on a laptop computer. Key features of the software for spectrum managers are signal operating instructions generation, viewing, and printing; electromagnetic protection identifiers; transmission security keys; data generation; creating loadsets for SINCGARS and compatible radios; and electronic distribution of signal operating instructions.

B-48. ACES and JACS integrate secure network planning, electromagnetic protection distribution, and signal operating instructions or communications-electronics operation instructions generation and management. The workstation functions with the data transfer device, hosting tier 3 software to automate cryptographic control operation for networks with electronically keyed COMSEC equipment.

B-49. The resident software components on the ACES and JACS workstation include—

- CORE Component.
- General-Purpose Module.
- Resource Manager Module.
- Master Net List Module.
- Signal Operating Instructions Module.
- Combat Net Radio Module.
- Key List.
- Random Number Generator.

CORE Component

B-50. The CORE Component is the basis for all system wide operations within ACES such as export, import, tier 3 download, and deletion of plan data. CORE also provides system navigation functions for ACES by coordinating with, making available and invoking network planning activities in other ACES components.

General Purpose Module

B-51. The General Purpose Module provides the required capabilities for general-purpose network planning in ACES. General Purpose Module network planning allows the user to define general purpose networks, which include a variety of network configurations and equipment not supported by fully automated net validation and generation components such as signal operating instructions and combat net radio (CNR). Using the General Purpose Module, the user can create, edit, and delete general purpose planning data, including nets, platforms, equipment, key designators, and key designator assignments to equipment fill slots according to equipment profiles pre-stored in the ACES database. Once the networks are defined and the key designators are assigned, the user can generate key edition and suffix information for specific time frames. The General Purpose Module also supports export, import, and preparation of Tier 3 device download data for developed general purpose networks.

Resource Manager Module

B-52. The Resource Manager Module provides the required capabilities for frequency resource management in ACES. Information about the available frequency ranges, frequency power levels and frequency restrictions must be developed for each plan. The ACES planner uses the information from the spectrum manager and other sources to complete steps to define available frequencies and their power levels as well as station class, emission designator and location. The Resource Manager Module supports viewing and editing of frequencies in a graphical map and list format. The Resource Manager Module allows the user to define frequency resources which are used during network planning. The ACES user can create frequency resources and store them in the ACES database for use during planning of other network types requiring frequency resources. The Resource Manager Module also supports export and import of developed resource management data including import of resources in standard frequency action format.

Master Net List Module

B-53. The Master Net List module provides the required capability for net level management of certain net types. CNR nets are managed at the net level by master net list. The Master Net List Module provides a grid view of created networks and management level attributes and incorporates capabilities to edit option

selections in the grid view net attribute cells. The Master Net List Module provides several master net list views. Each view displays a subset of net attributes. Attribute views accommodate Army, Navy, Air Force, Marine Corps, Space, air tasking order, frequency proposal, communications-electronics operating instructions (CEOI) or signal operating instructions groups, COMSEC, and joint perspectives. Master net list signal operating instructions, CNR and Resource Manager Module, combined, satisfy Joint Automated CEOI System requirements. From the Master Net List Module, the user can create and delete nets; edit management level attributes; and initiate network validation, generation and creation of externalized standard frequency action format data. The Master Net List Module also supports export, import, download, and deletion of developed master net list data.

Signal Operating Instructions Module

B-54. The Signal Operating Instructions module contains call signs, call words, frequency assignments, signs, and countersigns necessary in making signal operating instructions. The Signal Operating Instructions Module includes pyrotechnic and smoke signals, dictionaries, groups, a quick reference, and title pages. The generation of pyrotechnics and smoke signal components may be separate or randomly selected. The Signal Operating Instructions Module also allows the creation of master call sign packets and different extract packets while maintaining a database link to nets in the master net list.

Combat Net Radio Module

B-55. The Combat Net Radio module provides the required capabilities for CNR network planning in ACES. Full planning for CNRs involves—

- Definitions of frequency resources via the resource manager module.
- Definition of CNR.
- Assignment of frequency resources.
- Validation of the created networks.
- Creation of transmission encryption key share groups.
- Generation of net plan assignments.
- Editing of key tags for pre-positioned keys.
- Generation of key tag information for specific periods.
- Planning of signal operating instructions information for the CNR.

B-56. Using the Combat Net Radio Module, the user can create, edit, and delete CNRs. After defining networks and assigning key designators, the user can validate CNR structures, create plan key assignments, generate key edition and suffix information for specified time frames. The Combat Net Radio Module also supports exporting, importing, and preparing tier 3 device download data for developed CNR nets.

Key List

B-57. The Key List Module provides required capabilities for operator creation and editing of plan key tag data.

Random Number Generator

B-58. The Random Number Generator produces random numbers, which are essential for creating SINCGARS transmission security keys and hopsets. This module offers a robust interface that allows it to be easily accessed by other components within ACES. By leveraging the capabilities of the Random Nata Generator, various ACES components can seamlessly obtain the random numbers required for their functions, ensuring reliable and efficient operations in complex military communication scenarios. The Random Number Generator is available to any other ACES component needing random numbers through its interface.

Note. Spectrum managers at all echelons need SIPRNET to access GEMSIS, Joint Integrated Satellite Communications Tool, HNSWDO, Spectrum XXI, and other spectrum management tools.

JOINT SPECTRUM INTERFERENCE RESOLUTION ONLINE

B-59. The Joint Spectrum Interference Resolution Online Portal is the preferred tool for reporting electromagnetic interference. The Joint Spectrum Interference Resolution Online Portal is a web-based, centralized application containing data and correspondence for historical electromagnetic interference, intrusion, and jamming incidents dating back to 1970. The Joint Spectrum Interference Resolution Online Portal is the repository for the results of analyses, collected data, and supporting documentation for electromagnetic interference resolution to support trend and future interference resolution analysis.

B-60. The Joint Spectrum Interference Resolution Online Portal tool is accessed through SIPRNET. The spectrum manager may access the tool through a SIPRNET connected computer without loading software onto the computer. The Joint Spectrum Interference Resolution Online Portal allows the user to upload files that may be instrumental in mitigating electromagnetic interference, such as spectrum analyzer traces, recorded audio, or comma-separated values (CSV) files. Spectrum managers use the manual joint spectrum interference resolution report format when SIPRNET access is unavailable.

B-61. When reporting online, the Joint Spectrum Interference Resolution Online Portal prompts the user for required information using a fill in the blank form. Check boxes and dropdown menus supply choices where possible. The Joint Spectrum Interference Resolution Online Portal provides free text input space for input directly into the report. Spectrum managers can copy and include text from e-mail and other documents in the Joint Spectrum Interference Resolution Online Portal report or add them as attachments. Spectrum managers update reports as more information becomes available.

SECTION II – SPECTRUM MANAGEMENT TOOL COMPATIBILITY AND CAPABILITIES

B-62. This section discusses compatibility considerations for spectrum management tools. Spectrum managers must know the interoperability between spectrum management tools to determine which best suits the mission. This section also discusses the capabilities of various spectrum management tools currently used by spectrum managers. Spectrum managers' awareness of spectrum management tool capabilities assists in determining which tool provides the necessary capabilities to enable completion of critical spectrum management tasks.

COMPATIBILITY

B-63. The spectrum manager should understand spectrum management tool compatibilities to ensure interoperability between spectrum management tools and services. Table B-1 on page 47 shows the compatibilities among spectrum management tools, describing known compatibility fixes.

Table B-1. Compatibility between spectrum management tools

TOOL	*Spectrum XXI*	*EWPMT*	*S2AS*	*RTSO*	*SPEED*	*ACES/JACS*	*HNSWDO*
Spectrum XXI		X	X	X	X	X	
EWPMT	X		X		X	X	X
S2AS	X	X					
RTSO	X						X
SPEED	X	X					X
ACES/ JACS	X	X					X
HNSWDO		X		X	X	X	

Legend:

X =	formatting compatible
blank =	not currently compatible
ACES	Automated Communications Engineering Software
EWPMT	Electromagnetic Warfare Planning and Management Tool
HNSWDO	Host-Nation Spectrum Worldwide Database Online
JACS	Joint Automated Communications-Electronics Operating Instructions System
RTSO	Real-Time Spectrum Operations
S2AS	Spectrum Situational Awareness System
SPEED	Systems Planning, Engineering, and Evaluation Device

B-64. Format compatibility is a spectrum management tool that can import and export spectrum-related files from another spectrum management tool without the need to modify the original format. Format compatibility between tools complies with the concept and reduces time constraints for spectrum managers in a joint environment. Limited format compatibility means that the tool can import or export spectrum-related files between other tools but requires the spectrum manager to manipulate format inconsistencies. For instance, legacy Spectrum XXI records modify or delete records in Spectrum XXI Online but cannot create new records.

CAPABILITIES

B-65. Spectrum managers should know the capabilities provided by the various spectrum management tools. Spectrum management tool capabilities are the attributes of a system or tool used to perform spectrum management operations. The following list is not comprehensive; many spectrum management tools change with technology improvements. Table B-2 beginning on page 48 compares spectrum management tools and shows the capability of each tool. A description of each capability follows the table.

Table B-2. Spectrum management tool capabilities

Capability	*Spectrum management tools*						
	Spectrum XXI	***EWPMT***	***HNSWDO***	***S2AS***	***RTSO***	***SPEED***	***ACES/ JACS***
Spectrum measurement and direction finding				X			
Live spectrum analysis				X			
EW/EMI analysis and frequency deconfliction (fixed location)	*	X			X	X	
EW and EMI analysis and frequency deconfliction (on the move)		X			X	X	
2D and 3D simulation and modeling of the electromagnetic operational environment	*	X		X	*	X	
Plan spectrum reuse and minimize requirements		*				*	X

Legend:

X =	formatting compatible
* =	limited format compatibility
ACES	Automated Communications Engineering Software
EMI	electromagnetic interference
EW	electromagnetic warfare
EWPMT	Electromagnetic Warfare Planning and Management Tool
HNSWDO	Host Nation Spectrum Worldwide Database Online
JACS	Joint Automated Communications-Electronics Operating Instructions System
RTSO	Real-Time Spectrum Operations
S2AS	Spectrum Situational Awareness System
SPEED	Systems Planning, Engineering, and Evaluation Device

Table B-2. Spectrum management tool capabilities (continued)

Capability	*Spectrum management tools*						
	Spectrum XXI	***EWPMT***	***HNSWDO***	***S2AS***	***RTSO***	***SPEED***	***ACES/ JACS***
Import satellite access authorization and convert to SFAF or SSRF		X				X	
Drag and drop force structure templates		X			X	X	
Assign frequencies	X	*			*	*	*
Access JETS database		X					
Access HN comments			X				
XML format		X		X	X	X	
HTML format		X		X			
CSV format		X		X		X	
Generate SOI					X		X

Legend:

X =	formatting compatible
* =	limited format compatibility
ACES	Automated Communications Engineering Software
CSV	comma-separated values
EWPMT	Electromagnetic Warfare Planning and Management Tool
HN	host-nation
HNSWDO	Host Nation Spectrum Worldwide Database Online
HTML	Hypertext Markup Language
JACS	Joint Automated Communications-Electronics Operating Instructions System
JETS	Joint Equipment, Tactical, and Space
RTSO	Real-Time Spectrum Operations
S2AS	Spectrum Situational Awareness System
SFAF	standard frequency action format
SOI	signal operating instructions
SPEED	Systems Planning, Engineering, and Evaluation Device
SSRF	standard spectrum resource format
XML	Extensible Markup Language

Table B-2. Spectrum management tool capabilities (continued)

Capabilities	*Spectrum management tools*						
	Spectrum XXI	**EWPMT**	**HNSWDO**	**S2AS**	**RTSO**	**SPEED**	**ACES/ JACS**
Provide input to SOI		X					
Generate JSIR report	X	X					
Provide JRFL input to a higher echelon	X	X			X	X	
SFAF	X	X		X	X	X	X
SSRF		*			X	X	
Provide input to COP						X	
COA Development		X			X	*	
Stand-alone operations	X	X	X	X	X	X	X

Legend:

X =	formatting compatible
* =	limited format compatibility
ACES	Automated Communications Engineering Software
COA	course of action
COP	common operational picture
EWPMT	Electromagnetic Warfare Planning and Management Tool
HNSWDO	Host Nation Spectrum Worldwide Database Online
JACS	Joint Automated Communications-Electronics Operating Instructions System
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
S2AS	Spectrum Situational Awareness System
SFAF	standard frequency action format
SOI	signal operating instructions
SPEED	Systems Planning, Engineering, and Evaluation Device
SSRF	standard spectrum resource format

Spectrum Measurement and Direction Finding

B-66. This capability takes live measurements of the spectrum and provides direction finding of unknown, unplanned, electromagnetic warfare, or electromagnetic interference signals.

Live Spectrum Analysis

B-67. This capability receives spectrum measurements and provides analysis of the measured signals over time for frequency records, trend analysis, and electromagnetic warfare interference detection.

Electromagnetic Warfare and Electromagnetic Interference Analysis and Frequency Deconfliction (Fixed Location)

B-68. This capability analyzes electromagnetic warfare and interference effects (actual or planned) on spectrum use. It provides recommendations and courses of action for the deconfliction of electromagnetic warfare and electromagnetic interference for stationary spectrum-dependent devices. This tool also includes the analysis of second or third-order harmonics, intermodulation, and electromagnetic environmental effects in the areas impacted by spectrum use.

Electromagnetic Warfare and Electromagnetic Interference Analysis and Frequency Deconfliction (On-the-Move)

B-69. This capability is the same as fixed site, except that the tool analyzes and deconflicts spectrum-dependent devices while communicating on-the-move.

Two or Three-Dimensional Modeling and Simulation of the Electromagnetic Operational Environment

B-70. This capability provides a two- and three-dimensional model of the electromagnetic operational environment, including topography, electromagnetic environmental effects, and color-coded spectrum footprints.

Plan Spectrum Reuses and Minimize Requirements

B-71. This capability reduces the impact of a mission on the spectrum by reusing frequencies in different locations and planning for the minimum requirements for spectrum users and providing more flexible and available spectrum resources for all users.

Import Satellite Access Authorization and Convert to Standard Frequency Action Format or Standard Spectrum Resolution Form

B-72. This capability imports an authorization and automatically converts it to the standard frequency action format or standard spectrum resolution form approved format. This capability provides a complete spectrum database and aids in mitigating electromagnetic interference caused by or affecting space-based spectrum-dependent devices.

Force Structure Templates

B-73. This capability can create or access force structures and place them quickly and easily on the three-dimensional map of the battlefield using drag and drop, with associated spectrum-dependent devices and the general spectrum requirements for those devices.

Assign Frequencies

B-74. The capability can assign frequencies to users who submitted a frequency proposal in standard frequency action format or standard spectrum resolution form. A check mark means that the tool is capable and authorized to assign frequencies. An asterisk indicates the tool may allocate and plan for projected frequencies approved by another tool before using the projected spectrum.

Access the Joint Equipment, Tactical and Space Database

B-75. This capability may query the Joint Equipment, Tactical, and Space database for information and receive updates (refreshes) from the database.

Access Three-Dimensional Digital Terrain Databases

B-76. This capability imports detailed three-dimensional digital terrain data from various sources, such as the terrain-integrated rough earth model or Google Maps, for planning, managing, and visualizing the electromagnetic operational environment. If marked with an asterisk, the tool has limited capabilities, such as two-dimensional maps only.

Access Host-Nation Comments

B-77. This capability has access to host-nation allocation tables that aid in planning spectrum use in various host-nation locations. If marked with an asterisk, the tool has limited access, such as relying on importing data from another tool.

Extensible Markup Language

B-78. XML is a file format rapidly becoming the standard for compatibility between software packages. The tool may import or export various files (records, reports, and data) in XML format if selected.

HYPERTEXT MARKUP LANGUAGE

B-79. Hypertext Markup Language (HTML) is the primary language for creating web pages and other information displayed in a web browser. HTML elements form the building blocks of all websites. HTML allows embedding images and objects within web pages to create interactive forms. It provides a means to create structured documents by denoting structural semantics for text, such as headings, paragraphs, lists, links, quotes, and other items.

COMMA-SEPARATED VALUES FORMAT

B-80. CSV is a common, relatively simple file format widely supported by consumer, business, and scientific applications. Among its most common uses is moving tabular data between programs that natively operate on incompatible (often proprietary or undocumented) formats. Moving tabular data in this fashion works because so many programs support some variation of CSV, at least as an alternative import or export format. The tool can import or export various files in CSV format if checked.

GENERATE SIGNAL OPERATING INSTRUCTIONS

B-81. Many of the spectrum management tools are capable of generating signal operating instructions. The tool may generate and disseminate signal operating instructions in the correct format to subordinate units if selected.

PROVIDE INPUT TO SIGNAL OPERATING INSTRUCTIONS

B-82. This capability provides input to the signal operating instructions with compatible formats but cannot generate the signal operating instructions.

GENERATE JOINT SPECTRUM INTERFERENCE RESOLUTION REPORT

B-83. Use the joint spectrum interference resolution report format to report electromagnetic interference occurrence to the next higher echelon when operating as part of a joint task force. This capability can generate the joint spectrum interference resolution report in the correct format and export the report to the next higher echelon.

PROVIDE JOINT RESTRICTED FREQUENCY LIST INPUT TO HIGHER ECHELON

B-84. This capability allows the operator to process JRFL input from subordinate forces, provide the data to higher echelons in the correct format, and distribute the JRFL to concerned units upon approval from the higher echelon.

STANDARD FREQUENCY ACTION FORMAT

B-85. This capability can propose, assign, modify, renew, review, and delete radio frequencies in the approved standard frequency action format. If marked with an asterisk, the capability has limited compatibility. For example, it can only import and read a standard frequency action format frequency record.

STANDARD SPECTRUM RESOLUTION FORM

B-86. This capability can propose, assign, modify, renew, review, and delete radio frequencies in the standard spectrum resolution form format. If marked with an asterisk, the tool has limited compatibility. For example, the capability requires manual workarounds to generate proposals in the standard spectrum resolution format.

PROVIDE INPUT TO COMMON OPERATIONAL PICTURE

B-87. The common operational picture displays identical relevant information multiple commands share. This capability can interface and provide relevant spectrum information to the common operational picture.

COURSE OF ACTION DEVELOPMENT

B-88. This capability can analyze spectrum resources impacted by a mission and develop many courses of action to determine how to support the mission best and mitigate spectrum conflicts.

OPERATE IN A STAND-ALONE ENVIRONMENT

B-89. This capability can operate while disconnected from outside agencies or central databases.

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Appendix C

Spectrum Management Life Cycle

The Army spectrum management life cycle guides establishing a functional and efficient spectrum management program. The life cycle encompasses the complete process of providing spectrum management support to the commander and applies to all spectrum managers regardless of duty location. The Army spectrum management life cycle mirrors the joint task force life cycle.

ACTIVITIES OF THE SPECTRUM MANAGEMENT LIFE CYCLE

C-1. The spectrum management life cycle consists of 12 activities that enhance spectrum management operations. It is optional to conduct life cycle activities as presented. Some spectrum management life cycle activities happen simultaneously, while others happen only in succession. Listed below are the 12 activities of the spectrum management life cycle—

- Activity 1—Define command-specific policy and guidance.
- Activity 2—Gather requirements.
- Activity 3—Develop an electromagnetic spectrum requirements summary.
- Activity 4—Define the electromagnetic operational environment.
- Activity 5—Obtain spectrum resources.
- Activity 6—Develop a spectrum management plan.
- Activity 7—Nominate and assign frequencies.
- Activity 8—Generate joint communication-electronics operating instructions.
- Activity 9—Develop JRFL.
- Activity 10—Perform electromagnetic warfare deconfliction.
- Activity 11—Resolve interference.
- Activity 12—Report interference.

ACTIVITY 1—DEFINE COMMAND-SPECIFIC POLICY AND GUIDANCE

C-2. Unit standard operating procedures establish specific guidance for managing, requesting, coordinating, and assigning spectrum use, communications electronics operating instructions, and other operations. Policy and guidance information should be available in the commander's spectrum guidance, spectrum management manual, command regulations, instructions, or existing plans.

C-3. Spectrum managers require many resources. The unit's standard operating procedure would establish the essential spectrum management resources needed to confirm a spectrum management element supporting operations anywhere within the assigned area. Such resources should include digitized terrain data, background electromagnetic environment records, country area studies, copies of agreements for spectrum use or sharing with involved or adjacent host nations, and historical spectrum use records involving the operational area. This step generates two deliverable products: the spectrum concept and the spectrum requirements data call message.

SPECTRUM MANAGEMENT CONCEPT

C-4. The spectrum management concept is the vision of the best way to perform spectrum management operations supporting the mission. It includes assumptions, considerations, and restrictions that, when analyzed together, illustrate the best approach to managing the electromagnetic operational environment.

DATA CALL MESSAGE

C-5. The electromagnetic spectrum requires data call message guides staff elements, components, and supporting agencies on requesting spectrum support for spectrum-dependent devices under their control within the electromagnetic operational environment. This multipart message should cover—

- Spectrum management policy and guidance.
- Security classification guidance.
- Frequency and communications-electronics operating instructions master net list request procedures.
- A guide for identifying nets and frequencies to be included in the JRFL.

ACTIVITY 2 – GATHER REQUIREMENTS

C-6. Gathering requirements begin when spectrum management receives guidance and defined coordination channels. Spectrum managers must also obtain the requirements of spectrum users, primarily the staff elements. These requirements must address both communications and non-communications, such as radar and weapons systems, and are stated in terms of spectrum requirements to support the command. This step involves undocumented requirements from sources external to the spectrum management coordination chain.

C-7. Spectrum managers identify all requirements for their spectrum-dependent devices. The best practice for identifying spectrum-dependent device requirements is attending operational briefings, meetings, and planning sessions to mitigate the chance of being missed or overlooked in coordinating spectrum use. Determining all receive-only spectrum-dependent devices (those designed to receive and do not radiate or transmit a signal) is essential since these systems are vulnerable to interference from licensed emitters. Recognizing many of these receive-only spectrum-dependent devices results in collaboration with staff sections and ensuring request information about known receive-only spectrum-dependent devices currently activated or planned for activation. Once identified, the spectrum manager can document known receive-only spectrum-dependent devices by creating a standard frequency action format record within the Spectrum XXI database as the best way to protect these devices.

C-8. Satellite systems operators receive authorization to use satellites from the satellite controlling authority. Satellite access authorizations stating local frequency clearance are the responsibility of the user. The spectrum manager ensures the electromagnetic spectrum requirement data call message includes instructions to users, including procedures for submitting satellite access requests and authorizations. The spectrum manager creates standard frequency action format records for these authorizations. The spectrum manager should consider making a separate frequency assignment record for single channel satellite systems located at higher headquarters. These frequencies are protected frequencies. Having a different frequency assignment record for these protected frequencies aids in reducing and identifying electromagnetic interference. The spectrum manager also requests approval from the commander to place these protected frequencies on the unit's JRFL.

C-9. The spectrum manager must be aware of incoming units and organizations that operate in the electromagnetic operational environment. Incoming units and organizations should coordinate with the spectrum manager for spectrum use and support. Coordination between the spectrum manager and supported units will result in the reduction of electromagnetic interference.

C-10. Gathering requirements involves capturing and documenting potential joint task force spectrum use by other service components and joint task force staff, as well as undocumented external sources to the spectrum management coordination chain. Spectrum managers ensure that the electromagnetic spectrum requirements data call message requires units to submit their spectrum requests accordingly. Gathering requirements are ongoing until the mission dissolves and requires flexible planning. The product generated by the gathering requirements activity is a Spectrum XXI database that contains known spectrum requirements and spectrum-dependent devices already in use in the assigned area.

ACTIVITY 3 – DEVELOP THE ELECTROMAGNETIC SPECTRUM REQUIREMENTS SUMMARY

C-11. This summary quantifies the spectrum necessary to support the command, determines the necessity of frequency sharing and reuse plans, and helps develop allotment or channeling plans. This process requires compiling and analyzing the data generated. The spectrum manager analyzes the summary and determines the amount of spectrum needed. The spectrum requirements summary identifies the number of different radio services competing for spectrum in the same frequency band, defines the additional emissions utilizing a particular band, and supports the development of a frequency-sharing plan.

C-12. The spectrum requirements summary generated is a compilation of the requirements identified in response to the spectrum requirements data call message. This product is for the sole use of the spectrum manager and provides a tool to base future decisions on efficient spectrum use and initial requirements definition. This product may assist the spectrum manager with requesting spectrum authorization from a host nation. The product may also help the spectrum manager allocate portions of the spectrum better, with supporting emitters utilizing varying bandwidths.

ACTIVITY 4 – DEFINE THE ELECTROMAGNETIC OPERATIONAL ENVIRONMENT

C-13. Military operations require a common, single, authoritative source for spectrum use information for all friendly, threat (to the extent available), neutral, and civil emitters and receivers to achieve and manage joint spectrum use successfully. This common spectrum source uses information within the electromagnetic operational environment to be current, accurate, and accessible to authorized users. The spectrum manager is responsible for building and managing this common source of information.

C-14. The electromagnetic operational environment database contains spectrum use information about all friendly military and civilian, available threat, and neutral forces. Defining the electromagnetic operational environment creates a database of frequency assignments and identifies factors that affect signal propagation, such as environmental characteristics and terrain. This activity starts with defining your operational area and its environmental aspects, locating necessary terrain data, and then locating the data for and creating a database of the known spectrum use information. Defining an electromagnetic operational environment is an ongoing activity. The information produced by this activity provides a baseline database digitally depicting the electromagnetic operational environment and the basis for all spectrum interaction analyses.

ACTIVITY 5 – OBTAIN SPECTRUM RESOURCES

C-15. Obtain spectrum resources needed to support the command. The spectrum manager coordinates military spectrum use with the spectrum management authority of the host nation or multinational forces involved. The host nation can request spectrum resources for exercises or most military operations other than war. Operations that preclude prior coordination with a host nation, such as forced entry, require the spectrum manager to determine the spectrum resource; evaluation of the background and history of the electromagnetic environment supports the spectrum manager. Assessing the background environment is essential to establish well-defined spectrum requirements and for the electromagnetic operational environment to remain as current as possible.

C-16. It is essential to establish well-defined electromagnetic spectrum requirements and for the electromagnetic operational environment to be as up to date as possible. Spectrum requirements generated in previous activities assist in determining the number of spectrums needed to support the mission. The spectrum requirements summary can help quantify the spectrum required and identify the different radio services and emissions operating within each frequency band.

ACTIVITY 6 – DEVELOP THE SPECTRUM MANAGEMENT PLAN

C-17. Unit standard operating procedures establish specific guidance for managing, requesting, coordinating, and assigning spectrum use and procedures for JRFL and signal operating instructions processing. Additionally, the spectrum manager is the focal point for including spectrum use considerations in the Annex H development and provides administrative and technical support for military spectrum use. This process uses the spectrum management concept developed in the first activity and existing policy and guidance.

C-18. The spectrum manager devises a plan to use available spectrum resources that depend upon the products resulting from the previous activities. Spectrum managers regularly evaluate spectrum management plans for possible improvement. The spectrum management plan is typically included as an appendix to Annex H of an operation plan or order. It evolves from guidance as to the operation or exercise transitions from the planning to the execution phase.

C-19. The spectrum management plan guides all functions, including information exchange, expected coordination channels, format for deliverable products, interference and reporting resolution procedures, and suggested resolution steps. Evaluation for possible improvement of the spectrum management plan is continuous. Other sources of information are lessons learned from previous operations and exercises and other spectrum managers.

ACTIVITY 7 – NOMINATE AND ASSIGN FREQUENCIES

C-20. Nominate and assign frequencies is the actual implementation of the spectrum management plan. Authority, delegated to components, to issue frequency assignments or allotments provides the maximum latitude and flexibility in support of combat operations. This activity involves the initial assigning of frequencies. The spectrum manager may assign frequencies or delegate (decentralize) assignment authority using frequency pools (allotment plans) provided to functional and service component spectrum managers, allowing them to assign frequencies. The Decentralized assignment authority requires that all temporary frequency assignments be exchanged data with the Spectrum XXI regional server to be included in other spectrum managers' nomination and assign frequencies activity. Conducting a data exchange for all temporary frequency assignments also requires continuously updating the electromagnetic operational environment as part of Activity 4. It depends upon the available electromagnetic spectrum resources and restrictions established in Activity 6.

C-21. The frequency assignment database, which conforms to and is created based on the table of frequency allocations, radio regulations, and channel plans, is the most critical resource for the spectrum manager. They are available at all echelons and form the basis for nominating interference-free assignments. They also provide impact analysis of electromagnetic warfare operations and assist in identifying and resolving interference issues.

ACTIVITY 8 – GENERATE SIGNAL OPERATING INSTRUCTIONS

C-22. The signal operating instructions are a two-part document. Part 1 is a directory of radio nets or units and their associated frequencies, call signs, call words, and network identification listed by time. Part 2 contains supplemental procedures for electronic, visual, and verbal interactions, such as sign or countersigns, obscurants or pyrotechnics, and suffixes or expanders. The signal operating instructions development and distribution are G-6 or S-6 responsibilities delegated to the spectrum manager.

C-23. The signal operating instructions provide communications details and information including—

- Daily changing and non-changing frequency assignments.
- SINCGARS cue, manual, and net identification assignments.
- Call sign assignments.
- Call words assignments.
- Daily changing code words.
- Running passwords.

C-24. Information found in the signal operating instructions includes document-handling instructions, controlling authority data, effective dates, and reproduction instructions. Due to the sensitive information in the signal operating instructions, classification should be at the same level. Overarching regulatory guidance for signal operating instructions management, including call signs and call words, is contained within CJCSI 3320.03E. Additional guidance may apply based on command relationships with other unified action partners.

C-25. During joint operations, the combatant commander is the authority for joint communications-electronics operating instructions. The delegation of electromagnetic spectrum coordinating authority allows the functional or Service components to submit component spectrum requirements to the JEMSOC to ensure unity of effort across the joint force in the consolidation of the joint communications-electronics operating instructions. There is a distinction between the air and ground component operating instructions. The relevant air component issues a special instructions document that is the air operations equivalent of the Army's signal operating instructions.

C-26. In garrison, the Army Command, Army Service component command, or direct reporting unit commander is responsible for signal operating instructions production and distribution in support of training requirements. FORSCOM may delegate authority to a corps or division or remain centralized to meet installation training objectives. Regardless of echelon, the commander is responsible for the signal operating instructions. Distribution and Development

C-27. The COMSEC facility provides distribution of the final ACES- or JACS-produced signal operating instructions. Doing so ensures all units receive the latest signal operating instructions by disseminating COMSEC. Communication cards are derivative products of the signal operating instructions driven by the mission variables of mission, enemy, terrain and weather, troops and support available, time available, civil considerations, and informational considerations. These products inherit the classification level of the source signal operating instructions.

CALL SIGNS, CALL WORDS, SUFFIXES, AND EXPANDERS

C-28. Call signs and call words are used to establish and maintain communication. They identify the radio stations of command authorities, activities, facilities, units, elements, or individual positions. Call signs do not identify people. Tactical call sign systems meet specific military requirements under an exemption from the International Telecommunications Union radio regulations.

- **Call signs** are a combination of alphanumeric or phonetically pronounceable characters that identify a communication facility, command, authority, activity, or unit used primarily for establishing and maintaining communications.
- **Call words** identify units when communicating within a secure communications net. The generation of call words differs based on Service component guidance or are directed based on command authority.

C-29. **Suffixes and expanders** further assist in identifying a radio station's position or function. Care in managing call words ensures that each station sounds phonetically different over voice transport (for example, MAD DOG 6). Call word use is for secure networks only. Table C-1 on page 60 shows examples and explanations of call signs.

Table C-1 Call signs, call words, suffixes, and expanders

Item Name	*Example*	*Explanation*
Call Sign	X6Y24E B9K60H	Call sign refers to the letter-number-letter combination that typically designates a unit element in the SOI. CJCSI 3320.03E specifies that changes to call signs, call words, and frequencies occur daily, weekly, monthly, or quarterly based on threat, security of radio communications, and commander's guidance. EXAMPLES: X6Y= 1/A/1-25 INF (1st PLT, A CO., 1-25 INF BN)
Call Word	Bulldog24E Fury60H	Pronounceable words that identify a communications facility, command, authority, activity, or unit serve the same functionality as the call sign. The Army does not have set call words per unit. Call word deconfliction is typically handled by the highest-level spectrum manager. EXAMPLES: Bulldog = 1/A/1-25 INF (1st Platoon, A CO., 1-25 INF BN)
Suffix	X6Y24E B9K60H Bulldog24E Fury60H	Suffix refers to the two digits assigned to a particular position, mission, or function within a unit or element. EXAMPLES: 24 = AVN Officer/NCO 60 = G-6 or S-6
Expander	X6Y24E B9K60H Bulldog24E Fury60H	A single letter code (A through Z) is used with a suffix and call sign to identify a sub-element of the position, mission, or function. EXAMPLES: E = NCOIC H = officer in charge

Legend:

AVN	aviation
BN	battalion
CJSCI	Chairman of the Joint Chiefs of Staff instruction
CO	company
G-6	assistant chief of staff, signal
INF	infantry
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
PLT	platoon
S-6	battalion or brigade signal staff officer
SOI	signal operating instructions

SECURITY CLASSIFICATION

C-30. The content of the signal operating instructions, master net list, and communications card extracts determine the classification levels. The level of COMSEC key tag information entered into the system for the ACES terminal and corresponding generated loadsets determines the classification. Like a classified presentation, the overall classification of a specific product would be the highest level of classification it contains. Refer to AR 380-5 for security classification marking requirements.

ACTIVITY 9 – DEVELOP JOINT RESTRICTED FREQUENCY LIST

C-31. Developing the JRFL requires the spectrum manager to prepare and combine J-2, J-3, J-6, and component inputs to build a JRFL for approval by the J-3 and, when needed, periodically update, and distribute the JRFL.

C-32. The JRFL protects communications nets, including friendly communications for command and control, threat communications for exploitation purposes, and safety of life frequencies used by the command and local civil noncombatants. The development, distribution, and maintenance of the JRFL is a task of the

J-6 or J-6 and generally accomplished by the spectrum manager. The creation of the JRFL is based on guidelines established by the commander, with the recommendation of the J-3.

C-33. Leaders should become familiar with the types of protection status codes for the JRFL. Knowing these status codes allows the cyber electromagnetic warfare officer to plan jamming operations on unrestricted frequencies for training and during operations. Three types of protection status code apply to frequency assets identified for inclusion in a JRFL: TABOO frequencies, protected frequencies, and guarded frequencies.

TABOO FREQUENCIES

C-34. *TABOO frequencies* are friendly frequencies of such importance that they must never be deliberately jammed or interfered with by friendly forces, including international distress, safety, and controller frequencies. (JP 3-85).

PROTECTED FREQUENCIES

C-35. *Protected frequencies* are friendly, generally time-oriented, frequencies used for a particular operation, identified, and protected to prevent them from being inadvertently jammed by friendly forces while active electromagnetic warfare operations are directed against hostile forces (JP 3-85). These frequencies are of such critical importance that jamming should be restricted unless necessary or until coordination with the user unit. These frequencies are generally time-oriented, may change with the tactical situation, and are updated periodically. Protected frequencies are friendly frequencies used for a particular operation. An example of a Protected frequency would be the command net of a maneuver force engaged in the fight.

GUARDED FREQUENCIES

C-36. *Guarded frequencies* are a list of time-oriented, enemy frequencies that are currently being exploited for combat information and intelligence or jammed after the commander has weighed the potential operational gain against the loss of the technical information gained (JP 3-85). Guarded frequencies are time-oriented because the list changes as the enemy assumes different combat postures.

ACTIVITY 10 – PERFORM ELECTROMAGNETIC WARFARE DECONFLICTION

C-37. The CEMA spectrum manager is a member of the CEMA section and performs spectrum management duties, including electromagnetic warfare deconfliction analysis. The cyber electromagnetic warfare officer identifies planned electromagnetic attack missions and requests the CEMA spectrum manager analyze the impact of these missions on operations. The analysis determines the effects of the electromagnetic attack mission on communication nets, systems, threat communications, and possible safety of life situations.

C-38. This product provides the CEMA section with an analysis of the potential impact of friendly electromagnetic warfare operations on friendly forces. The CEMA section then decides whether the benefits of the jamming mission outweigh the dangers of the possible frequency fratricide. This product is time-sensitive and produced on an as-needed basis. This process requires information from the JRFL, signal operating instructions, and electromagnetic operational environment.

ACTIVITY 11 – RESOLVE INTERFERENCE

C-39. Resolving electromagnetic interference is a daily activity once forces have deployed and are part of the planning process. This activity encompasses reporting and attempting to resolve electromagnetic interference. Various factors can create interference, such as unauthorized users, faulty nomination criteria, lack of timely data exchanges, or equipment problems.

C-40. Victim units should make every effort to resolve electromagnetic interference locally. Multiple interference problems may indicate the unintentional impact of friendly or neutral electromagnetic warfare operations, errors in the spectrum management plan, or threat electromagnetic warfare operations. The spectrum manager should define and analyze the electromagnetic operational environment to help determine the cause of an electromagnetic interference problem.

ACTIVITY 12 – REPORT INTERFERENCE

C-41. Spectrum congestion and the nature of military operations make some level of electromagnetic interference likely. Interference reporting and tracking provide the spectrum manager with a valuable historical reference for resolving future electromagnetic interference problems. After performing interference analysis, always create an interference report to document the results.

C-42. Spectrum managers must keep these reports in a database used as a history of interference problems. The purpose of the interference report database is to provide the spectrum manager with a repository for previous interference incidents and steps taken to resolve them. This database offers a wealth of information about unit discipline, training deficiencies and a starting place for the spectrum manager to begin resolving interference issues. Spectrum managers share this database with all. To the extent that unexplained interference persists or recurs coincidence with either threat, friendly, or neutral operations, notification to the CEMA section occurs.

C-43. The involvement of the spectrum manager begins at the onset of interference. Spectrum managers resolve and report interference within the unit's assigned area and set alerts in the Joint Spectrum Interference Resolution Online Portal for interference affecting the unit's operations. They receive notifications of interference reports submitted for action and situational understanding of the interference by secure e-mail. Spectrum managers assist and mitigate spectrum interference at the lowest level possible and should be knowledgeable of all forms of jamming, deception, and interference. Users experiencing electromagnetic interference may change frequencies only when the spectrum manager coordinates authorized replacement frequencies. Guidance for the joint spectrum interference resolution program can be found in CJCSI 3320.02F. Additional procedural guidance in support of the joint spectrum interference resolution program may apply based on command relationships such as military departments, Army commands, and combatant commands.

JOINT SPECTRUM INTERFERENCE RESOLUTION

C-44. Victims of interference report electromagnetic interference using the Joint Spectrum Interference Resolution Online Portal. The Joint Spectrum Interference Resolution Online Portal is a web-based, centralized application containing data and correspondence for reported electromagnetic interference, intrusion, and jamming incidents. It is the repository for the results of analyses, collected data, and supporting documentation for electromagnetic interference resolution to support trends and future interference resolution analysis. The Joint Spectrum Interference Resolution Online Portal and CJCSI 3320.02F provide an operator checklist for local investigations.

C-45. Electromagnetic interference mitigation begins with operator-level troubleshooting and reporting. Affected users must attempt to resolve electromagnetic interference incidents at the lowest possible level. Troubleshooting may identify the source of the interference as truly electromagnetic interference or, in most cases, an equipment or operator failure. Reporting facilitates situational understanding and supports the development of solutions. The spectrum manager reports and investigates all prohibitive electromagnetic interference through the joint spectrum interference resolution program. Not all electromagnetic interference incidents are restrictive; however, prohibitive electromagnetic interference has an operational impact. Equipment operators should identify the difference between prohibitive electromagnetic interference, equipment failure, and intentional interference (jamming). The Joint Spectrum Interference Resolution Online Portal report is submitted through intelligence channels by the appropriate authority if the interfering signal is determined to be from a hostile source. Table C-2 on page 63 describes the inputs required for reporting electromagnetic interference using the joint spectrum interference resolution format.

Table C-2. Data input for joint spectrum interference resolution online reporting

Item Number	*Data Input*
1	Time electromagnetic interference started (Zulu time).
2	The affected system name, nomenclature, manufacturer (with the model number), or other system description. If available, include the equipment characteristics of the victim receiver, such as bandwidth, antenna type, and antenna size.
3	The affected frequency (format must be numerical).
4	The channel is selected on the affected system.
5	The characteristics of the interference (noise, pulsed, continuous, intermittent, frequency, or bandwidth).
6	The geographical location of the affected system.
7	The name of the country that the affected system is in.
8	The description of the interference (including what it sounds like, reduced range, false targets, reduced intelligibility, data errors, actions taken thus far, and any other descriptive comments).
9	Victim unit point of contact (including name, phone number, e-mail, unit, combatant command, Service, or agency).

TYPES OF JAMMING SIGNALS

C-46. Jamming is an effective way for the threat to disrupt command and control. A threat can jam by broadcasting a signal tuned to friendly frequencies with enough power to override friendly signals at the receivers. There are two modes of jamming:

- Spot jamming—power concentrated toward one channel or frequency.
- Barrage jamming—power spread over several frequencies or channels simultaneously.

C-47. Jamming can be difficult and sometimes impossible to detect. Users of spectrum-dependent devices have the potential of being jammed and should be trained to recognize jamming. The two types of jamming most encountered are obvious and subtle jamming. Obvious jamming is usually very simple to detect. When experiencing a jamming incident, it is more important to recognize and overcome the incident than to identify it formally. The spectrum manager or victim reports the jamming signal during the joint spectrum interference resolution process. Table C-3 on page 64 lists commonly encountered jamming signals.

Table C-3. Common jamming signals

Signal	*Description*
Random Noise	Synthetic radio noise. It is indiscriminate in amplitude and frequency. It is similar to normal background noise and can degrade all types of signals. Operators often mistake random noise jamming for receiver or atmospheric noise and fail to take appropriate electronic protection actions.
Stepped Tones	Tones transmitted in increasing and decreasing pitch. They resemble the sound of bagpipes. Stepped tones are effective against single-channel amplitude modulation or frequency modulation voice circuits.
Spark	Bursts are of short duration and high intensity; they are repeated at a rapid rate. This signal is effective in disrupting all types of radio communications. Spark jamming is easy to produce and one of the most effective jamming signals.
Gulls	Quickly rising and slowly falling variable radio frequency. The effect produced is similar to the cry of a seagull. Gulls produce a nuisance effect and are very effective against voice radio communications.
Random Pulse	Pulses of varying amplitude, duration, and rate. Pulses disrupt teletypewriter, radar, and various data transmission systems.
Wobbler	A single frequency, modulated by a low and slowly varying tone. The result is a howling sound that causes a nuisance effect on voice radio communications.
Recorded Sounds	Any audible sound, especially of a variable nature. Recorded sounds can distract radio operators and disrupt communications. Music, screams, applause, whistles, machinery noise, and laughter are examples.
Preamble Jamming	A tone resembling the synchronization preamble of the speech security equipment, broadcasting over the operating frequency of secure radio sets. Results in all radios being locked in the receive mode. Preamble jamming is especially effective when employed against radio networks that use speech security devices.

RECOGNIZING JAMMING

C-48. Equipment operators must be able to recognize jamming. Threat jammers may employ obvious or subtle jamming techniques. In addition, interference caused by sources having nothing to do with threat jamming may be the source. Jammers affect receivers and do not affect transmitters.

C-49. The following may cause prohibitive electromagnetic interference:

- Other radios (friendly and threat)—may be intentional or unintentional.
- Other electronic, electric, or electromechanical equipment.
- Atmospheric conditions.
- Malfunction of the radio.
- Improper operation of the radio.
- Combination of any of the above.

Internal or External Interference

C-50. The two sources of interference are internal and external. If the interference or suspected jamming remains after grounding or disconnecting the antenna, the disturbance is most likely internal and caused by a malfunction of the radio. The operator should contact maintenance personnel to assist in troubleshooting. Further examinations could reveal external interference from threat jamming or unintentional interference.

Jamming or Unintentional Interference

C-51. The battlefield is so crowded with radios and other electronic equipment that some unintentional interference is virtually unavoidable. Static electricity produced by atmospheric conditions can negatively affect radio communications. Unintentional interference usually travels a short distance, and a search of the immediate area may reveal the source of this type of interference. Moving the receiving antenna a short distance may cause noticeable variations in the strength of the interfering signal. These variations usually indicate unintentional interference. Conversely, little or no variation may indicate inadvertent friendly or

threat jamming. Regardless of the source, operators should take action to reduce the effect of interference on communications.

C-52. In all cases, units report suspected threat jamming and any unidentified or unintentional interference that disrupts the ability to communicate. Reporting applies even if the radio operator can overcome the effects of the jamming or interference. Information provided to higher headquarters in the joint spectrum interference resolution report mitigates the threat's jamming efforts.

Note. Threats can use two types of jamming signals: unmodulated or modulated signals.

OVERCOMING JAMMING

C-53. Threats continually strive to perfect and use new and more confusing forms of jamming. Equipment operators must be increasingly alert to the possibility of jamming. Training and experience are essential tools operators must use to determine when a particular signal is jamming. Exposure to the effects of jamming during training events or actual situations is invaluable. The ability to recognize jamming is essential because jamming is a problem that requires action.

C-54. Operators continue to operate affected equipment if jamming does occur. Usually, threat jamming involves a period of jamming followed by a brief listening period. The threat will attempt to determine how effective jamming has been. What the victim does during this short listening period tells the jammer how effective jamming has been.

C-55. If the operation continues as before the jamming began, the threat may assume that jamming has not been effective. If the threat finds users discussing the jamming over the radio or they shut down operation entirely, the threat may assume that jamming has been effective. Because the threat jammer monitors operations, unless otherwise ordered, operators never cease operation or disclose adversely effects. Normal operation should continue even when degraded by jamming. Methods to overcome jamming include—

- Improving the signal-to-jamming ratio.
- Repositioning antennas.
- Establishing a retransmission station.
- Using an alternate route for communication.
- Changing frequencies.

Improve the Signal-to-Jamming Ratio

C-56. The signal-to-jamming ratio compares the desired signal's strength to the interference signal. The desired signal is the frequency users want to receive, while the jamming signal refers to any unwanted or unidentified interference. If the desired signal is stronger than the jamming signal, it will not significantly degrade the quality of the desired signal.

C-57. Users experiencing jamming may take various steps to improve the signal-to-jamming ratio. Adjusting the receiver to ensure frequency tuning is as precise as possible to the desired incoming signal may improve the signal-to-jamming ratio. Additional techniques to improve signal-to-jamming ratio include—

- Adjusting the radio frequency bandwidth if possible.
- Adjusting the gain or volume control.
- Fine-tuning the frequency.
- Increasing transmitter power output.

C-58. Increasing the transmitter's power output by emitting the desired signal improves the signal-to-jamming ratio. The transmitter must be set on something less than full power when jamming increases the power output at the time of jamming. Using low power as a preventive technique depends on the threat's inability to detect radio transmissions. Once the threat begins jamming radios, the risk of exposure increases.

Reposition Antennas

C-59. Users experiencing jamming should ensure antennas are in the best position to receive the desired signal. Additional techniques to improve incoming signal strength regarding antenna position include—

- Reorienting the antenna.
- Changing the antenna polarization must be performed at all stations.
- Installing a higher gain antenna.

C-60. Frequently, relocating the antenna and its associated radio set affected by the jamming or interference improves the signal-to-jamming ratio. Improving the signal-to-jamming ratio may require moving the antenna a few or several hundred meters. It is best to relocate the antenna and associated radio set to an area with a terrain feature between the user and any suspected threat jamming location.

Establish a Retransmission Station

C-61. A retransmission station can increase the range and power of a signal between two or more radio stations. Depending on the available resources and the situation, this may be a viable method to improve the signal-to-jamming ratio.

Use an Alternate Route for Communication

C-62. If radio communication is degraded between two radio stations that must communicate, there may be another radio station or route of communication that can communicate with both radio stations. Operators should use the alternate radio station or route as a relay between the two other radio stations.

Change Frequencies

C-63. If a radio net cannot overcome threat jamming using other measures, the commander or designated representative may direct the net to switch to an alternate or spare frequency coordinated through the spectrum manager. If practical, dummy stations can continue to operate on the frequency being jammed to mask the change to an alternate frequency. Preplanned frequency changes result in minimal communication loss. During a jamming incident, it is challenging to coordinate a change of frequency.

Appendix D

Military Time Zone Designators

Spectrum managers communicate with users across different time zones and provide commanders with operational times established during missions. Support for airborne operations provides the most extensive use of military time zones during flight missions. Knowledge of global military time zone differences for spectrum managers is vital. Spectrum managers can prepare briefings, conduct, and assist planning, or provide input to critical documents; accurate time zone information is essential.

MILITARY TIME

D-1. Military time uses the 24-hour clock beginning at midnight (0000) and ending at 2359. Military time format eliminates the need to use A.M. and P.M. designations, as regular time uses numbers 1 to 12 to identify the hours in a day. In military time, 12:00 P.M. is 1200, 1:00 P.M. is 1300, 2:00 P.M. is 1400, continuing until 11:00 P.M., which is 2300. The military uses this standard as it leaves less room for ambiguity than the 12-hour clock. The earth has 24 equally divided time zones, each with a letter designation and the military phonetic alphabet word.

D-2. The time zone for Greenwich, England, is the letter Z, and the military phonetic word is Zulu. Since many operations coordinate across time zones, the military uses Coordinated Universal Time (formerly Greenwich Mean Time) as the standard time. The U.S. military refers to this as Zulu time and attaches the suffix Z to ensure the related time zone is clear.

D-3. When referring to specific military time zones, users speak the letter or word attached. For example, 3:00 P.M., or 1500 Zulu time, which is written as 1500Z.

D-4. The time zones in the United States are R, S, T, U, V, W, and X. Local time uses the letter J. The written format for 9:00 A.M. local time is 0900J and is spoken as zero nine hundred Juliet time. The L time zone designator does not equate to local time. See the time zone chart, figure D-1 on page 58 for the location of the Lima time zone.

TIME ZONE OFFSETS

D-5. Some countries have a 15-, 30-, or 45-minute offset from the designated time zone designator. Although located in the D time zone, local time in Afghanistan is Coordinated Universal Time +4 hours 30 minutes. An asterisk behind the affected time zone designator denotes a local time offset is in effect. See the time zone chart for affected regions.

DATE-TIME GROUP

D-6. Military date-time groups are indicated in the 12-character format DD####RMMMYY. The first two characters [DD] are the two-digit day of the month. The next five characters are the military time, with time zone indicator. The next three characters [MMM] are the three-letter abbreviations for the month. The final two characters [YY] are the last two digits of the year. Using this format, 1:30 P.M. Coordinated Universal Time on April 15th, 2025, would be rendered as 151330ZAPR25.

MILITARY TIME ZONE CONSIDERATIONS

D-7. While conducting military operations, spectrum managers must consider all rules for determining a specific time. The following are some considerations to be aware of—

- The military observes daylight savings time when recognized by the state or country.
- The 12 time zones west of the Zulu time zone (Coordinated Universal Time), starting from the International Date Line and ending in the Pacific Ocean, are November through Yankee.
- The 12 time zones east of the Zulu time zone (Coordinated Universal Time), starting at the International Date Line and ending in the Pacific Ocean, are Alpha through Mike.

- 12:00 A.M. can be either 0000 or 2400. However, clocks that display military time always display it as 0000.

D-8. Many countries use the 24-hour clock as their primary time format. European, African, Asian, and Latin American countries commonly use the 24-hour clock. Some countries use both the 12- and 24-hour clocks. Figure D-1 shows the world map and military zone designators for each zone.

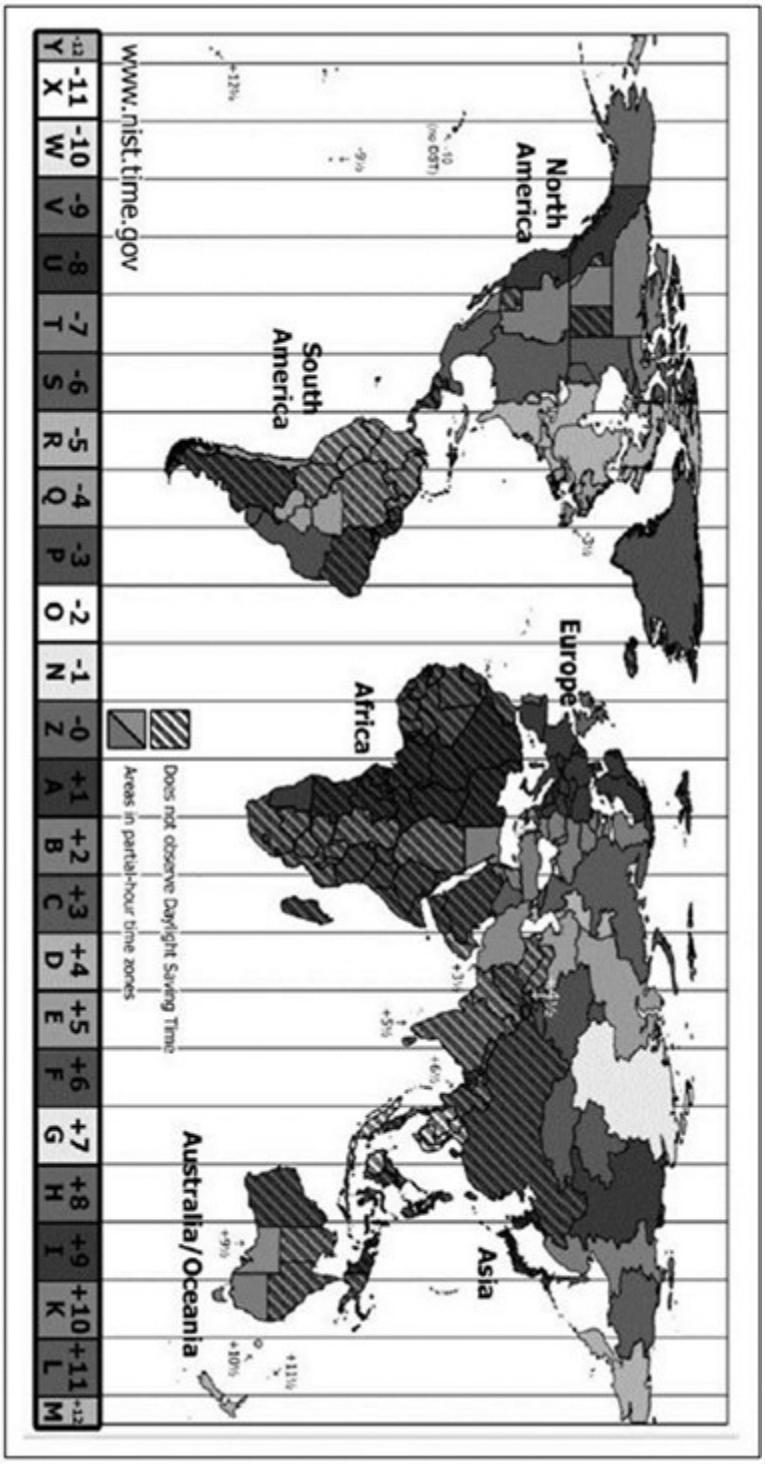


Figure D-1. World military time zone designator chart

D-9. Table D-1 depicts the time zones around the world in relation to Zulu time.

Table D-1 Time zone relationships to Zulu time.

Military Time Zone Designators																							
Y	**X**	**W**	**V**	**U**	**T**	**S**	**R**	**Q**	**P**	**O**	**N**	**Z**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**	**L**	**M**
Civilian Time Zones																								
IDLW	**NT**	**HST**	**ASDT**	**PST**	**MST**	**CST**	**EST**	**AST**	**NST**	**AT**	**WAT**	**UTC**	**CET**	**EET**	**BT**	**ZP4**	**ZP5**	**ZP6**	**WAST**	**CCT**	**JST**	**GST**	**SBT**	**IDLE**
1200	1300	1400	1500	1600	1700	1800	1900 **	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200 *

Standard Time=Universal Time + Value from Table									
Z	0	E	+5	K	+10	P	-3	U	-8
A	+1	F	+6	L	+11	Q	-4	V	-9
B	+2	G	+7	M	+12	R	-5	W	-10
C	+3	H	+8	N	-1	S	-6	X	-11
D	+4	I	+9	O	-2	T	-7	Y	-12

* =Today ** =Yesterday

Legend:

ASDT	Alaska Standard Time	GST	Guam Standard Time	PST	Pacific Standard Time
AST	Atlantic Standard Time	HST	Hawaii Standard Time	SBT	Solomon Island Time
AT	Azores Time	IDLE	International Date Line East	UTC	Coordinated Universal Time
AWST	Australian Western Standard Time	IDLW	International Date Line West	WAST	West Africa Time Zone
BT	Baghdad Time			WAT	West Africa Time
CCT	China Coast Time	JST	Japan Standard Time	ZP-4	Azerbaijan, Oman, Mauritius
CET	Central European Time	MST	Mountain Standard Time		
CST	Central Standard Time	NST	Newfoundland Standard Time	ZP-5	Maldives, Pakistan, Tajikistan
EET	Eastern European Time				
EST	Eastern Standard Time	NT	Nome Time	ZP-6	Bangladesh, Kazakhstan

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Appendix E

Joint Task Force Considerations

Modern warfare is inherently joint. Joint operations require precise coordination and establishment of procedures for effective spectrum use. This chapter describes the information and products for planning, coordination, and control of the electromagnetic spectrum at the joint task force level.

SPECTRUM MANAGERS WITHIN A JOINT TASK FORCE

E-1. Spectrum manager assignments within a joint task force include the joint frequency management office or the JEMSOC. These elements have a wide variety of inputs, internal processes, and products. The following paragraphs contain an in-depth look at the workflow between organizations in a joint task force. Figure E-1 illustrates the spectrum management workflow between organizations in a joint task force.

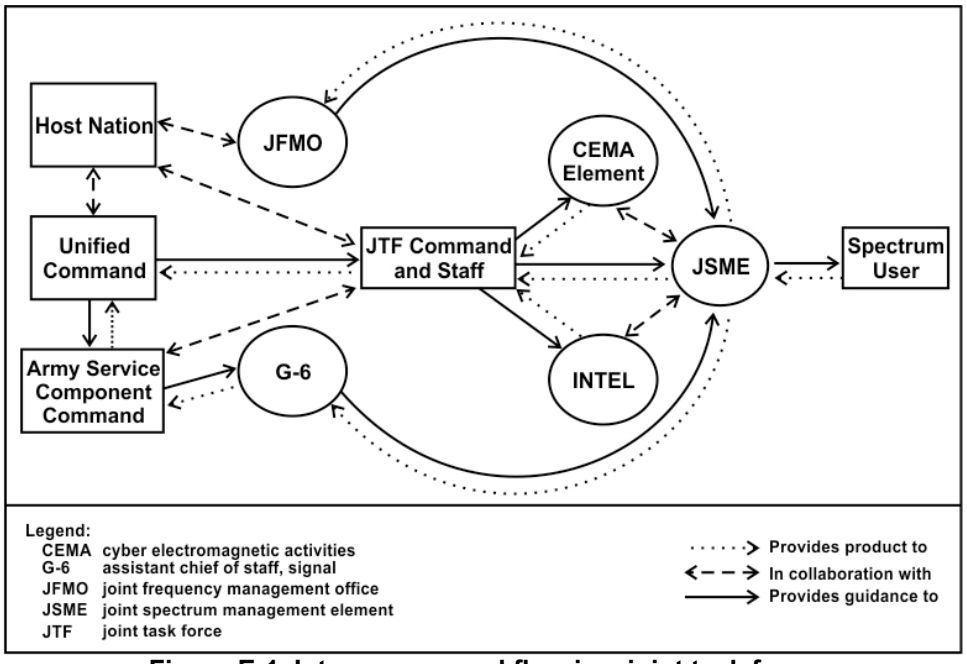


Figure E-1. Interagency workflow in a joint task force

JOINT FREQUENCY MANAGEMENT OFFICE

E-2. The joint frequency management office is a permanent organization within a combatant command. Action officers' staff the joint frequency management office to exercise the core functions of joint electromagnetic spectrum management operations—spectrum management, frequency management, joint spectrum interference resolution, and host-nation coordination. The joint frequency management office staff size varies and depends on regional requirements. Figure E-2 on page 72 shows the basic structure of the joint frequency management office.

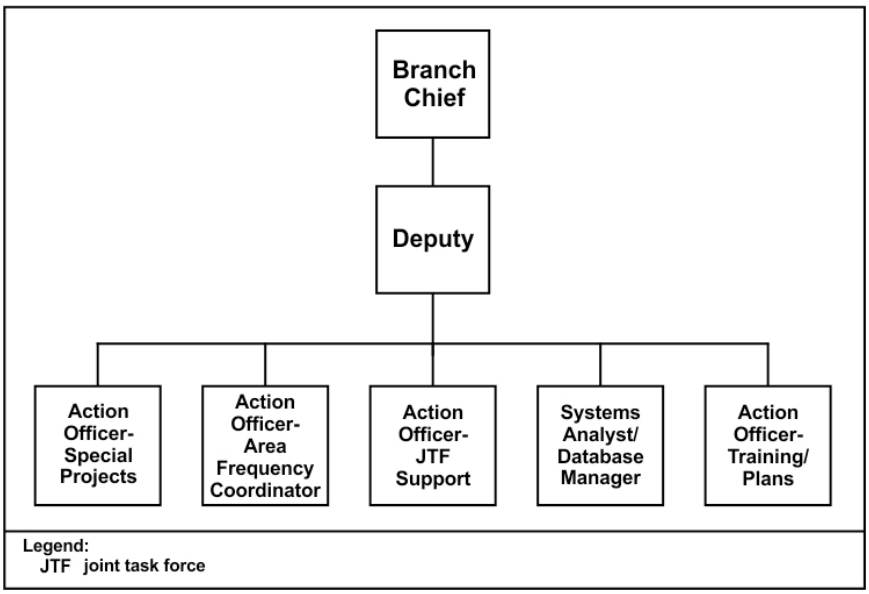


Figure E-2. Joint frequency management office structure

E-3. Table E-1 shows agency inputs to the joint frequency management office. The table provides the agency, the action conducted, and the input the agency offers.

Table E-1. Agency inputs to the joint frequency management office

Agency	***Action***	***JFMO Inputs***
Combatant command	Provides guidance and direction	CEOI
JTF staff, JEMSOC	Provides	Inputs to develop a JTF JRFL
JEMSOC	Receives	Frequency proposals
Joint staff J-9, host nation	Provide input and responsible for	Host-nation frequency authorizations
Spectrum users experiencing EMI	Submit	JSIR report

Legend:

CEOI	communications-electronics operating instructions
EMI	electromagnetic interference
J-9	civil-military operations directorate of a joint staff
JEMSOC	joint electromagnetic spectrum operations cell
JFMO	joint frequency management office
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JTF	joint task force

E-4. Table E-2 on page 73 shows a sample of the products of the joint frequency management office and includes the agency and action taken. Refer to JP 6-0 for more information about the joint frequency management office.

Table E-2. Products of the joint frequency management office

Agency	*Action*	*JFMO Products*
Spectrum users	Provides guidance and direction	Administrative and technical support for spectrum use
JTF staff, JEMSOC, spectrum users	Provides guidance and direction	CEOI
JTF staff, JEMSOC	Provides guidance and direction	The spectrum plan, including frequency use, reuse, and sharing schemes
JFMO	Provides guidance and direction	Frequency assignments and allotments Production and management of common spectrum use databases The JRFL, upon approval from J-3 Mitigation assistance for EMI

Legend:

CEOI	communications-electronics operating instructions
EMI	electromagnetic interference
J-3	operations directorate of a joint staff
JEMSOC	joint electromagnetic spectrum operations cell
JFMO	joint frequency management office
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JTF	joint task force

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS CELL

E-5. The JEMSOC is a temporary organization that activates only for the duration of a specific joint task force operation or campaign. The JEMSOC members assigned to the joint task force's joint cyber center of the come from the Service components of the joint task force. The lead Service of a joint task force may task its senior spectrum manager as the JEMSOC lead. Upon designation, the Service's spectrum management office assumes the roles and responsibilities of the JEMSOC.

E-6. Spectrum management personnel from multinational forces and other Services augment organizations designated as a JEMSOC during deliberate planning using the global force management process. Initial augmentation during crisis action planning may come from joint enablers such as the joint spectrum center or the joint electromagnetic warfare center or directly from the combatant command or J-6 joint frequency management office. Depending on the size of the force structure supported, JEMSOC end strength ranges from three to ten positions.

E-7. The JEMSOC establishes joint task force guidance for the functions and the communications-electronics operating instructions. The JEMSOC develops the JRFL by gathering requirements from the J-2, J-3, and J-6 for approval by the J-3. The JEMSOC has the authority to either issue frequency assignments or allotments or delegate this authority. However, the JEMSOC must ensure that components overlapping geographic areas do not assign multiple frequencies on the same RF band.

E-8. The JEMSOC maintains the common spectrum-use database required for planning and coordinating access to the electromagnetic operational environment. This database includes spectrum use information about military, civilian, and threat forces.

E-9. The JEMSOC ensures that assigned joint task force elements receive sufficient access to the spectrum to execute their designated missions. The JEMSOC satisfies spectrum needs and provides frequency deconfliction for all spectrum-dependent devices before assignment or allotment, including systems used by the joint task force, Service components, and multinational forces, such as the United Nations, or the North Atlantic Treaty Organization. The JEMSOC provides additional support based on strategic agreements between the DOD, the chief of mission, and the host nation. Table E-3 on page 74 shows the agency inputs

to the JEMSOC. Refer to JP 3-85 for more information about the JEMSOC and FM 3-16 for more information about multinational operations.

Table E-3. Agency inputs to the joint electromagnetic spectrum operations cell

Agency	*Action*	*JEMSOC Inputs*
Commander, JTF; JFMO	Provide guidance and direction for	CEOI
JTF staff	Responsible for	Interservice considerations include data formats, tools in use, and frequency request procedures.
J-6	Provide guidance and direction for	Nets to be included in the CEOI
Service component commanders	Receive guidance and direction from	Friendly force spectrum user requirements and call words for inclusion in the CEOI
J-2	Responsible for	Priority of intelligence gathering requirements
Spectrum users	Provide input	JRFL requirements
Spectrum users experiencing EMI	Provide input	JSIR report
JTF staff and various databases	Provide guidance and direction for	Spectrum use information about all friendly military and civilian, available threat, and neutral forces
Spectrum Users	Responsible for	Requests for frequency authorization, modification, and deletion
JFMO	Provide guidance and direction for	Frequency allocations
CEMA section	Responsible for	Instances of hostile EW
J-3	Provide guidance and direction for	Spectrum user priority
J-9; host nation	Provide	Host-nation spectrum authorization

Legend:

CEMA	cyberspace electromagnetic activities
CEOI	communications-electronics operating instructions
EMI	electromagnetic interference
EW	electromagnetic warfare
J-2	intelligence directorate of a joint staff
J-3	operations directorate of a joint staff
J-6	communications system directorate of a joint staff
J-9	civil-military operations directorate of a joint staff
JEMSOC	joint electromagnetic spectrum operations cell
JFMO	joint frequency management office
JRFL	joint restricted frequency list
JSIR	joint spectrum interference resolution
JTF	joint task force

E-10. Collaboration and coordination with varying agencies, especially host nations, occur through various processes. These processes are generally formal and established to foster mutual trust and rapport between the joint frequency management office and the host nation. The spectrum manager must keep in mind customs, cultures, tact, courtesy, and the concerns of other agencies while still attempting to obtain the

spectrum resources necessary for the mission. The spectrum manager must also maintain accurate records of all dialogue and agreements with the host nation. Figure E-3 shows the spectrum manager's products to the JEMSOC.

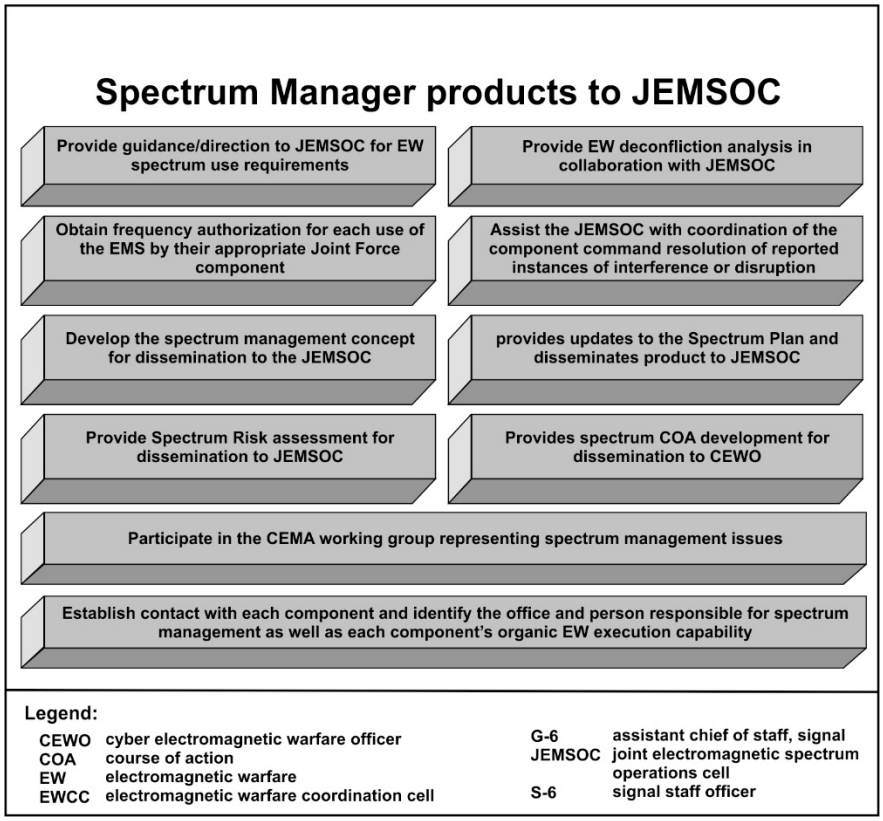


Figure E-3. Spectrum manager inputs for a joint electromagnetic spectrum operations cell

SPECTRUM MANAGEMENT SUPPORT TO DEFENSE SUPPORT OF CIVIL AUTHORITIES

E-11. Defense support of civil authorities encompasses all support provided by the components of the Army to civil authorities within the United States and its territories and possessions. Defense support of civil authorities includes support provided by the Active Army, Army Reserve, and the Army National Guard of the United States. Title 10, U.S. Code applies when National Guard forces are activated under federal control (Army National Guard of the United States). Title 32, U.S. Code applies to National Guard forces conducting defense support of civil authorities under the authority of their respective state (Army National Guard). Army forces conduct defense support from civil authorities in response to requests from federal, state, local, and tribal jurisdictions for domestic incidents, emergencies, disasters, designated law enforcement support, and other domestic activities.

E-12. Spectrum management supporting domestic operations requires liaison with federal, state, municipal, local, and tribal authorities and first responders. Spectrum management for operations within the continental United States must comply with a complex legal, regulatory, and policy framework. USNORTHCOM and USINDOPACOM are the principal planning agents for defense support of civil authorities. They provide joint planning and execution directives for peacetime assistance rendered by the DOD within their areas of responsibility. The other combatant commands provide capabilities to USNORTHCOM and USINDOPACOM for defense support of civil authorities as directed by the Secretary of Defense.

E-13. Each state's separate joint force headquarters retains responsibility for forces operating within that state or territory. The Army National Guard G-6 spectrum management branch coordinates and plans spectrum management for Army National Guard forces. It provides support to the state's spectrum managers for domestic operations. The National Guard G-6 spectrum management branch includes coordination

between the state's spectrum managers and all federal agencies and authorizes state spectrum managers to directly liaise with the Army Frequency Management Office or the Army Spectrum Management Office. Spectrum managers from joint task force headquarters form a JEMSOC supporting operational task forces under state active duty or dual status (Title 32 and Title 10) domestic operations.

E-14. After acquiring frequency assignments, activated forces may operate civil and military systems within an assigned area to enhance interoperability with other federal agencies and civil authorities. National Guard forces may request frequency assignments through either National Guard or Title 10 military channels, depending on their duty status for a given operation. Like numerous states, local agencies, and federal agencies, National Guard forces and the Coast Guard may operate civil and military systems within a domestic area.

E-15. After receiving orders to conduct movement for a domestic operation, each operational element initially contacts their state spectrum manager or JEMSOC for a communication-electronics operating instructions extract detailing the frequencies and procedures to use for communications. The regional spectrum manager or the JEMSOC submits a standard frequency action format request for frequencies on behalf of end users. A state spectrum manager provides spectrum management functions for a given state to the greatest extent possible. Spectrum managers coordinate regional operations and spectrum deconfliction for operations adjacent to another spectrum manager's assigned area. Local spectrum managers form the JEMSOC and work directly for the incident commander or the state joint force headquarters before the appointment of an incident commander.

E-16. Lessons learned from past domestic operations have demonstrated that unity of effort and coordinated spectrum management are critical to the operation's success. Congress and the DOD, through the implementation of a dual-status commander (commander of both Title 32 National Guard forces and Title 10 National Guard of the United States and Active Component forces for a domestic operation), have addressed unity of effort. Unity of command is not applicable between federal military forces and the state National Guard. Still, unity of effort is possible if the President and the governor formally agree to appoint a dual-status commander. Established federal authorities allow a designated dual-status commander to serve in a hybrid federal and state status. A dual-status commander is usually a National Guard officer who exercises simultaneous but separate authority over federal and state military forces. Spectrum management for a domestic operation requires consolidation under one JEMSOC or a coordinated Title 10 and Title 32 JEMSOC led by the same commander to minimize confusion and provide seamless support to tactical communications.

E-17. The JEMSOC initially assigned to an incident continues to work for the incident commander as the operation transitions to a different duty status or legal authority to ensure continuity of spectrum management. Typically, a state governor or adjutant general creates a standing joint task force, including a JEMSOC, or establishes a joint task force with a JEMSOC in response to an incident. If a state does not have qualified spectrum managers, the Adjutant General and governor may request spectrum managers deploy from other states, forming a JEMSOC under formalized emergency management assistance compact. The JEMSOC may require a spectrum flyaway team from the National Guard Bureau J-6 and USNORTHCOM to supplement the element. Figure E-4 on page 77 provides a graphic representation of the collaboration process during defense support of civil authorities' missions. Refer to JP 3-28 for more information about defense support of civil authorities.

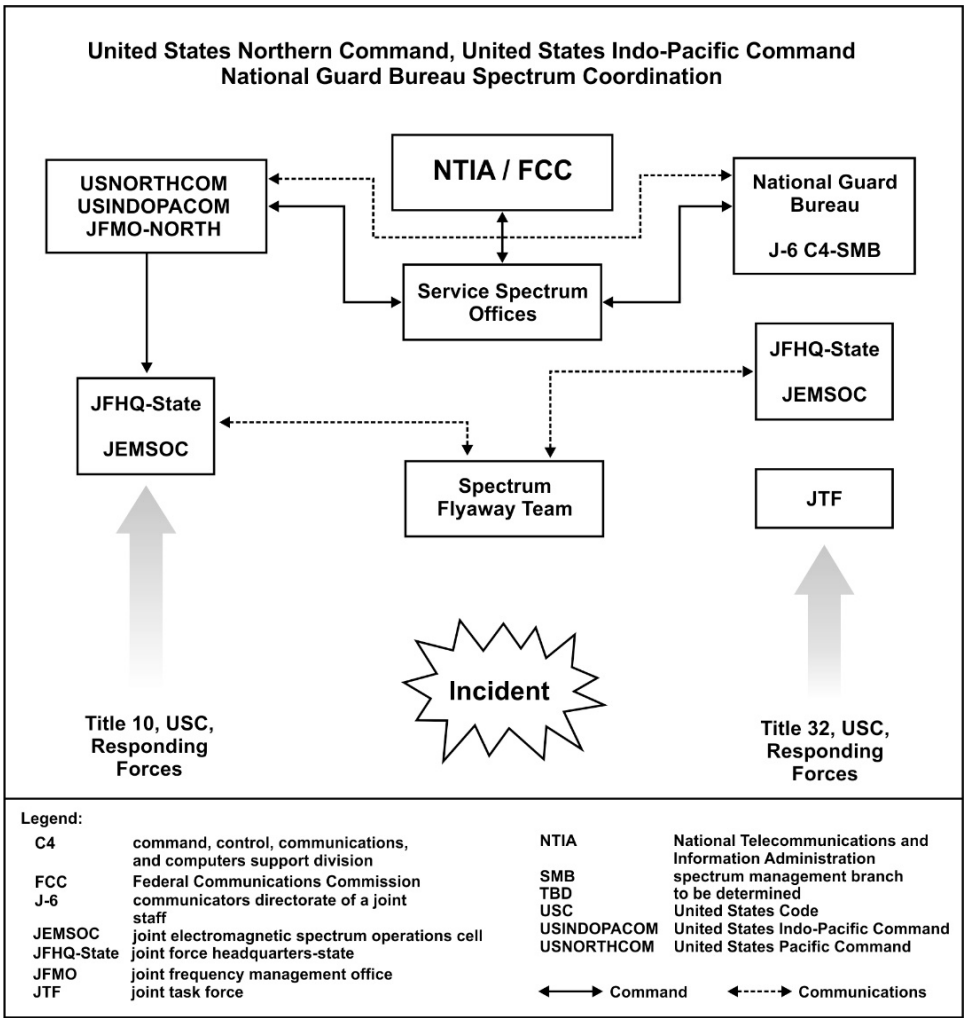


Figure E-4. Spectrum management support during defense support of civil authorities

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Glossary

The glossary lists acronyms and terms with Army or joint definitions. Where Army and joint definitions differ, (Army) precedes the definition. This publication is not the proponent for any Army terms. The proponent publication for other terms is listed in parentheses after the definition.

SECTION I – ACRONYMS AND ABBREVIATIONS

ACES	Automated Communications Engineering Software
ADP	Army doctrine publication
AR	Army regulation
ATP	Army techniques publication
CEMA	cyberspace electromagnetic activities
CEOI	communications-electronics operating instructions
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
COMSEC	communications security
CNR	combat net radio
CSV	comma-separated values
DA	Department of the Army
DD	Department of Defense
DODI	Department of Defense instruction
EWPMT	Electromagnetic Warfare Planning and Management Tool
FM	field manual
FORSCOM	United States Army Forces Command
G-2	assistant chief of staff, intelligence
G-3	assistant chief of staff, operations
G-6	assistant chief of staff, signal
GEMSIS	Global Electromagnetic Spectrum Information System
GHz	gigahertz
HNSWDO	Host-Nation Spectrum Worldwide Database Online
HTML	Hypertext Markup Language
Hz	hertz
J-3	operations directorate of a joint staff
J-6	communications system directorate of a joint staff
JACS	Joint Automated Communications Engineering Software
JDAWS	Joint Spectrum Center Data Access Web Server
JEMSOC	joint electromagnetic spectrum operations cell
JP	joint publication
JRFL	joint restricted frequency list

kHz	kilohertz
MANCAT	Multi-Spectral Ambient Noise Collection and Analysis Tool
MHz	megahertz
NCO	noncommissioned officer
RF	radio frequency
RTSO	Real-Time Spectrum Operations
S-2	battalion or brigade intelligence staff officer
S-3	battalion or brigade operations staff officer
S-6	battalion or brigade signal staff officer
S2AS	Spectrum Situational Awareness System
SINCGARS	single-channel ground and airborne radio system
SIPRNET	SECRET Internet Protocol Router Network
SPEED	Systems Planning, Engineering, and Evaluation Device
TC	training circular
USINDOPACOM	United States Indo-Pacific Command
USNORTHCOM	United States Northern Command
XML	Extensible Markup Language

SECTION II – TERMS

common operational picture

A single, identical display of relevant information shared by more than one command that facilitates collaborative planning and assists all echelons to achieve situational awareness. (JP 3-0)

cyberspace domain

(Army) The interdependent networks of information technology infrastructures and resident data, including the Internet, telecommunication networks, computer systems, embedded processors and controllers, and relevant portions of the electromagnetic spectrum. (FM 3-0)

electromagnetic environmental effects

The impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. (JP 3-85)

electromagnetic interference

Any electromagnetic disturbance, induced intentionally or unintentionally, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electromagnetic spectrum-dependent systems and electrical equipment. (JP 3-85)

electromagnetic operational environment

Is a composite of the actual and potential electromagnetic energy radiation, conditions, circumstances, and influences that affect the employment of capabilities and the decisions of the commander. (JP 3-85)

electromagnetic pulse

A strong burst of electromagnetic radiation caused by a nuclear explosion, energy weapon, or natural phenomenon that may couple with electrical or electronic systems to produce damaging current and voltage surges. (JP 3-85)

electromagnetic radiation hazards

Transmitter or antenna installation that generates or increases electromagnetic radiation in the vicinity of ordnance, personnel, or fueling operations in excess of established safe levels. (JP 3-85)

frequency deconfliction

A systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. (JP 3-85)

guarded frequencies

A list of time-oriented, enemy frequencies that are currently being exploited for combat information and intelligence or jammed after the commander has weighed the potential operational gain against the loss of the technical information. (JP 3-85)

joint restricted frequency list

A time and geographically oriented listing of TABOO, protected, and guarded functions, nets, and frequencies and limited to the minimum number of frequencies necessary for friendly forces to accomplish objectives. (JP 3-85)

military decision-making process

An iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order. (ADP 5-0)

protected frequencies

Friendly, generally time-oriented, frequencies used for a particular operation, identified and protected to prevent them from being inadvertently jammed by friendly forces while active electromagnetic warfare operations are directed against hostile forces. (JP 3-85)

spectrum management operations

The interrelated functions of spectrum management, frequency assignment, host-nation coordination, and policy that enable the planning, management, and execution of operations within the electromagnetic operational environment during all phases of military operations. (FM 6-02)

TABOO frequencies

Any friendly frequency of such importance that it must never be deliberately jammed or interfered with by friendly forces including international distress, safety, and controller frequencies. (JP 3-85)

unified action partners

Those military forces, governmental and nongovernmental organizations, and elements of the private sector with whom Army forces plan, coordinate, synchronize, and integrate during the conduct of operations. (FM 3-0)

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ATP 6-02.70

16 September 2025

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PIN: 105928-000