

Joint Publication 3-85



Joint Electromagnetic Spectrum Operations



22 May 2020



PREFACE

1. Scope

This publication provides fundamental principles and guidance for planning, executing, and assessing joint electromagnetic spectrum operations across the competition continuum.

2. Purpose

This publication is the Chairman of the Joint Chiefs of Staff (CJCS) official advice concerning joint electromagnetic spectrum operations and provides considerations for military interaction with governmental and nongovernmental agencies, multinational forces, and other interorganizational partners. It does not restrict the authority of the Joint Force Commander (JFC) from organizing forces and executing the mission in a manner the JFC deems most appropriate to ensure unity of effort.

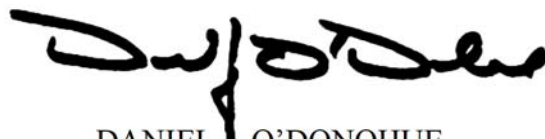
3. Application

a. Joint doctrine established in this publication applies to the Joint Staff, commanders of combatant commands, subordinate unified commands, joint task forces, subordinate components of these commands, the Services, the National Guard Bureau, and combat support agencies.

b. This doctrine constitutes official advice concerning the enclosed subject matter; however, the judgment of the commander is paramount in all situations.

c. If conflicts arise between the contents of this publication and the contents of Service publications, this publication will take precedence unless the CJCS, normally in coordination with the other members of the Joint Chiefs of Staff, provides more current and specific guidance. Commanders of forces operating as part of a multinational (alliance or coalition) military command should follow multinational doctrine and procedures ratified by the United States. For doctrine and procedures not ratified by the United States, commanders should evaluate and follow the multinational command's doctrine and procedures, where applicable and consistent with US law, regulations, and doctrine.

For the Chairman of the Joint Chiefs of Staff:



DANIEL A. O'DONOHUE
Lieutenant General, USMC
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EXECUTIVE SUMMARY COMMANDER'S OVERVIEW

- Provides an overview of joint electromagnetic spectrum operations through a discussion of electromagnetic environmental effects and their relation to joint functions.
- Discusses joint force responsibilities, organization, Service support, intelligence support organizations, and multinational force organization as they relate to organizing for joint electromagnetic spectrum operations.
- Discusses joint, multinational, and interorganizational planning considerations.
- Outlines execution and assessment of joint electromagnetic spectrum operations.
- Eliminates Joint Publication (JP) 3-13.1, *Electronic Warfare*, and JP 6-01, *Joint Electromagnetic Spectrum Management Operations*, effective immediately.

Overview of Joint Electromagnetic Spectrum Operations

The Electromagnetic Spectrum

The electromagnetic spectrum (EMS) is a maneuver space essential for facilitating control within the operational environment (OE) and impacts all portions of the OE and military operations. Military operations and training are executed in an environment complicated by increasingly challenging demands and constraints on the EMS. Just as in the physical domains and in cyberspace, military forces maneuver and conduct operations within the EMS to achieve tactical, operational, and strategic advantage. Freedom of maneuver and action within the EMS are essential to US and multinational operations.

Joint Electromagnetic Spectrum Operations (JEMSO)

This publication establishes a framework for the execution of joint electromagnetic spectrum operations (JEMSO). JEMSO support military operations throughout the competition continuum to achieve desired objectives and attain end states. During peacetime, JEMSO are conducted to ensure adequate access to the EMS and may include deconflicting use of the EMS between joint users and coordinating with a host nation (HN). As a crisis escalates toward armed conflict, JEMSO shift from EMS access coordination to EMS superiority, with coordinated military actions executed to exploit, attack, protect, and

manage the electromagnetic operational environment (EMOE).

The Electromagnetic Operational Environment

The EMOE 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. It includes the existing background radiation (i.e., electromagnetic environment) as well as the friendly, neutral, adversary, and enemy electromagnetic systems able to radiate within the electromagnetic area of influence. This includes systems currently radiating or receiving, or those that may radiate, that can potentially affect joint operations.

JEMSO Actions

JEMSO actions to exploit, attack, protect, and manage the EMOE rely on personnel and systems from electromagnetic warfare (EW), EMS management, intelligence, space, and cyberspace mission areas. Instead of these mission areas being planned and executed in a minimally coordinated and stovepiped fashion, JEMSO guidance and processes prioritize, integrate, synchronize, and deconflict all joint force operations in the EMOE, enhancing unity of effort. The result is a fully integrated scheme of maneuver in the EMOE to achieve EMS superiority and joint force commander (JFC) objectives.

JEMSO-Related Mission Areas

- **Cyberspace Operations.** The majority of military systems contain cyberspace- and EMS-dependent components, requiring close integration of JEMSO and cyberspace capabilities to ensure prioritization, synchronization, and deconfliction.
- **Space Operations.** All space operations rely on the EMS for command and control (C2), sensing, and information distribution. The vital nature of space operations to overall joint operations requires close coordination with other EMS activities to ensure proper prioritization, integration, synchronization, and deconfliction.
- **Air, Land, and Maritime Operations.** Since the EMS overlaps these physical domains simultaneously, JEMSO provide the processes to effectively prioritize, integrate, synchronize, and deconflict the EMS aspects of operations throughout the EMOE.

***Electromagnetic
Environmental Effects***

The impact of the EMOE upon the operational capability of military forces, equipment, systems, and platforms is referred to as electromagnetic environmental effects.

***Relationship to Joint
Functions***

Joint functions are related capabilities and activities grouped together to help JFCs integrate, synchronize, and direct joint operations. The joint force is critically dependent on the EMS for operations across all joint functions and throughout the EMOE. These operations are integrated and managed through JEMSO.

Organizing for Joint Electromagnetic Spectrum Operations

Responsibilities

Combatant commanders (CCDRs) and subordinate JFCs will normally establish a standing joint electromagnetic spectrum operations cell (JEMSOC) to support joint planning, coordination, and control of the EMS for assigned forces. Every supported CCDR establishes a command policy on how the EMS will be used throughout their combatant command (CCMD) and in their area of responsibility as applicable, obtains EMS clearance (i.e., approval) from HNs (through existing coordination procedures), and authorizes EMS use for assigned military forces to execute their designated mission(s). Every supported JFC conveys to subordinates guidance for achieving EMS superiority within the joint operations area through their concept of operations. At a minimum, this guidance will include an operational approach; mission statement; and commander's planning guidance, intent, and commander's critical information requirements.

Organizing for JEMSO

The CCDR or subordinate JFC usually delegates electromagnetic spectrum coordinating authority (EMSCA) to the JEMSOC director, which, when coupled with the JEMSOC's organizational responsibilities, enables the JFC to exercise unity of command for activities conducted in the EMS. Joint force unity of effort in the EMS derives from the JEMSOC's integration of all joint force EMS actions across both the joint force's functional staff elements and the joint force's components. The JEMSOC augments existing joint force C2 lines of authority with reporting and data structures that accelerate the flow of information required for electromagnetic spectrum operations (EMSO) integration. It assists JFCs in identifying EMSO priorities, communicating intent, and integrating supporting commander capabilities into operations. The JEMSOC maintains habitual

relationships with key individuals (e.g., component liaison officers) and enabling organizations, such as Service, functional, and multinational EW/EMS management cells, and other Department of Defense (DOD) EMSO-related organizations. The relationships are refined during training and exercises and optimized via a network of collaboration throughout planning, execution, and assessment.

Service Support

Each Service has a different approach to organizing:

- **Army.** Army commanders and their staffs conduct cyberspace electromagnetic activities (CEMA) to plan, integrate, and synchronize cyberspace and EW operations as a unified effort to project power in and through cyberspace and the EMS. Executing cyberspace and EW operations enables the Army to secure and defend friendly force networks and to protect personnel, facilities, and equipment. Spectrum management operations enable CEMA by ensuring access and deconfliction for the Army's use of the EMS. Planning, integration, and synchronization of the interrelated actions support the overall mission.
- **Marine Corps.** Headquarters, United States Marine Corps (HQMC), Deputy Commandant for Information, is the advocate for Marine Corps EMSO. HQMC CD&I [Combat Development and Integration] coordinates with other HQMC agencies, the operating forces, supporting organizations, and mission partners to identify, prioritize, and integrate EMSO EW capability solutions across the pillars of doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy and joint requirements.
- **Navy.** Electromagnetic maneuver warfare is the Navy's warfighting approach to gain decisive military advantage in the EMS and is the foundational concept that supports JEMSO. Sensing, assessing, and monitoring the EMOE and all EMS-related activities provides a strategic advantage and enables freedom of action across all Navy mission areas.
- **Air Force.** The Air Force organizes to conduct EMSO primarily through the non-kinetic operations coordination cell (NKOCC) located in the air operations

center. The NKOCC is the air component commander EMS capabilities integrator. It plans, directs, and assesses Air Force EMSO activities conducted in air, space, and cyberspace, which include actions to exploit, attack, protect, and manage the EMOE.

- **Coast Guard.** United States Coast Guard (USCG) JEMSO activities currently only include actions to monitor, assess, and provide intelligence products. The USCG may conduct JEMSO under Title 10, United States Code (USC), and Title 14, USC, authorities.
- **National Guard Bureau.** The National Guard (NG) provides mission-ready military forces (Army National Guard and Air National Guard) to assist local, state, and national authorities during normal, day-to-day operations; emergencies; incidents of national significance; homeland defense; and defense support of civil authorities operations. NG units may also be assigned to CCMDs for overseas active duty upon mobilization under Title 10, USC. There is a requirement for interoperable communications with local first responders and state and federal civilian agencies; Title 10, USC, forces also make JEMSO considerations a priority. The NG is under the C2 of a state governor when in state active duty or Title 32, USC, status. Title 10, USC, response force could be formed from either a standing joint task force or one configured for specific missions to provide emergency assistance across all lines of support. Title 10, USC, JFC coordinates with NG joint force headquarters-state through a dual-status command relationship, if a dual-status command is established, to achieve unity of effort between federal and state response forces.

Intelligence Support Organizations

National- and DOD-Level Intelligence Organizations.

At the national level, organizations and agencies such as the Central Intelligence Agency, National Security Agency, National Geospatial-Intelligence Agency, and Defense Intelligence Agency are constantly seeking to identify, catalog, and update the electromagnetic order of battle of threats. The National Security Agency/Central Security Service serves as an operationally focused analytical clearinghouse for all databases that provide signals intelligence support to CCMDs, subordinate commands and their staffs, and the joint force. National-

level organizations such as the National Air and Space Intelligence Center, the National Ground Intelligence Center, and the National Maritime Intelligence Center not only define EW target parameters and associated system performance but also analyze and provide intelligence on threat EMSO doctrine and tactics.

CCMD Intelligence Organizations. At the CCMD level, intelligence support to military operations is focused in the joint intelligence operations center (JIOC). The JIOC responds to theater-level, JEMSO-related intelligence requirements and forwards requests that require national-level assets to the Defense Collection Coordination Center or other national-level organizations according to established procedures. JEMSO planners within the JEMSOC at the CCMD level work closely with the JEMSOC J-2 [intelligence directorate of a joint staff] representative to satisfy intelligence requirements according to command-specific procedures established by each CCCR.

Multinational Force Organization

The multinational force commander provides guidance to plan and conduct JEMSO to the multinational force through the operations directorate of a joint staff's (J-3's) combined electromagnetic warfare coordination cell (EWCC). It should be recognized that the EWCC assumes responsibilities designated in paragraph 2.c., "JEMSOC" (see Chapter II, "Organizing for Joint Electromagnetic Spectrum Operations"). Note: North Atlantic Treaty Organization (NATO)/multinational terminology still references the EWCC. Therefore, EWCC, not JEMSOC, will be used when discussing NATO/multinational operations.

Planning Joint Electromagnetic Operations

JFCs centralize JEMSO planning under the designated EMSCA and decentralize execution to ensure JEMSO unity of effort while maintaining tactical flexibility. Operations in the EMS cross all joint functions, span the OE, and are often complex and interwoven. This requires detailed prioritization, integration, and synchronization to attain EMS superiority, achieve the commander's objectives, mitigate electromagnetic interference, and avoid friendly fire electromagnetic attack incidents (involving personnel or equipment).

Planning Process

The commander's guidance and estimate form the basis for determining components' objectives. During mission analysis, JEMSO planners develop a JEMSO staff estimate, which forms the basis for an EMS superiority approach. The staff estimate is used during course of action (COA) development and analysis to determine the EMS activities and capabilities required to accomplish the mission, the JEMSO capabilities required to support operations, and the risk to the operation if EMS superiority is not achieved. When a COA is chosen, it becomes the basis for developing the JEMSO appendix, which outlines JEMSO missions, priorities, policies, processes, and procedures across all phases of the operation. The joint force components will develop component EMSO plans and submit them to the JEMSOC for integration into the JEMSO appendix under annex C (Operations). The JEMSO planning process is a formal, top-down, centralized process that integrates EMSO into the JFC's plan.

Conducting Joint Electromagnetic Spectrum Operations

JEMSO are conducted using the same plan, execute, and assess cycle as other joint operations. The JFC issues EMSO guidance and instructions to components that prioritize, integrate, coordinate, direct, and deconflict all joint force EMS use within the operational area. While JEMSO are centrally planned to facilitate unity of effort, execution is decentralized to permit maximum tactical flexibility in a highly dynamic EMOE.

Execution

Control. The supported JFC designates an EMSCA, usually the J-3; however, core expertise and joint force-assigned mission will dictate EMSCA appointment. At the CCMD level, EMSCA is normally delegated to the JEMSOC director.

Battle Rhythm. The JEMSOC director establishes the battle rhythm for JEMSO planning and operations in accordance with the JEMSO appendix. This battle rhythm is based on the phase of operation, pace of operations, nature of the EMOE (i.e., how dynamic it is), and battle rhythms of related operations (e.g., air operations cycle, intelligence cycle). It includes the required participation in cross-functional staff organizations associated with JEMSO planning and execution.

EMSO Guidance. The JFC begins the JEMSO cycle by providing updated guidance to the components.

Prepare/Update Component EMSO Plans. Components update their respective EMSO plans based on the EMSO guidance.

EMS-Use Request. Components submit EMS-use requests to the JEMSOC to obtain authorization to transmit electromagnetic energy or reserve EMS frequencies/bands for sensing.

Non-Organic EMSO Support. Components that have EMSO requirements but lack organic capabilities should submit a support request to the JEMSOC for prioritization and approval.

Prepare Consolidated JEMSO Plan. The JEMSOC consolidates, prioritizes, integrates, and synchronizes the component EMSO plans and attendant EMS-use requests to produce a consolidated JEMSO plan.

Produce and Disseminate EMS Operating Instructions. When the JFC approves the JEMSO plan, the JEMSOC generates EMS operating instructions for release via order.

Build Detailed EMSO Execution Plans. Service/functional components conduct detailed EMSO planning as directed by the EMS operating instructions. If delegated authority for specific portions of the EMOE, components conduct the necessary EMSO prioritization, integration, and synchronization and publish orders.

JEMSO Execution. The JEMSOC monitors execution and recommends changes in JEMSO prioritization and tasking based on JFC direction and component inputs. The JEMSOC distributes these changes via order across the joint force for situational awareness.

Assessment

At the end of a JEMSO execution cycle, the JEMSOC collates Service component feedback reports to assess EMSO effectiveness. The assessment is conducted using the measures of effectiveness/measures of performance established in the JEMSO appendix.

CONCLUSION

This publication provides fundamental principles and guidance for planning, executing, and assessing JEMSO across the competition continuum.

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CHAPTER I

OVERVIEW OF JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS

“The next war will be won by the side that best exploits the electromagnetic spectrum.”

Soviet Admiral Sergei G. Gorshkov, 1973

1. Introduction

a. This publication focuses on military operations in and through the electromagnetic spectrum (EMS) across the competition continuum and explains the EMS-related relationships and responsibilities of combatant commands (CCMDs), joint force headquarters, Service components, functional components, and EMS users. It establishes a framework for the execution of joint electromagnetic spectrum operations (JEMSO).

(1) The EMS is a maneuver space essential for facilitating control within the operational environment (OE) and impacts all portions of the OE and military operations. The fight for EMS superiority has been ongoing for over a century; however, the way it is achieved is changing. Advances in EMS technologies over the last few decades have led to an exponential increase in civil, commercial, and military EMS-enabled and dependent capabilities. This proliferation, coupled with the US military’s critical reliance on the EMS and the low entry costs for adversaries, pose significant military challenges. Military operations and training are executed in an environment complicated by increasingly challenging demands and constraints on the EMS. Just as in the physical domains and in cyberspace, military forces maneuver and conduct operations within the EMS to achieve tactical, operational, and strategic advantage. Freedom of maneuver and action within the EMS are essential to US and multinational operations. To establish EMS superiority, military forces must integrate JEMSO into all joint operations.

(2) JEMSO support military operations throughout the competition continuum to achieve desired objectives and attain end states. During peacetime, JEMSO are conducted to ensure adequate access to the EMS and may include deconflicting use of the EMS between joint users and coordinating with a host nation (HN). As a crisis escalates toward armed conflict, JEMSO shift from EMS access coordination to EMS superiority, with coordinated military actions executed to exploit, attack, protect, and manage the electromagnetic operational environment (EMOE).

b. Military Operations and the EMS

(1) **JEMSO.** JEMSO are military actions undertaken by a joint force to exploit, attack, protect, and manage the EMOE. These actions include/impact all joint force transmissions and receptions of electromagnetic (EM) energy. JEMSO are offensively and defensively employed to achieve unity of effort and the commander’s objectives. JEMSO integrate and synchronize electromagnetic warfare (EW), EMS management, and intelligence, as well as other mission areas, to achieve EMS superiority.

(2) **EMS.** The EMS is a maneuver space consisting of all frequencies of EM radiation (oscillating electric and magnetic fields characterized by frequency and wavelength). The EMS is often organized by frequency bands, based on certain physical characteristics. The EMS includes radio waves, microwaves, infrared (IR) radiation, visible light, ultraviolet radiation, x-rays, and gamma rays (see Figure I-1).

(3) **Electromagnetic Environment (EME).** The EME is the actual EM radiation encountered in a particular operational area (OA). The EME is the resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted EM emission levels encountered by a military force, system, or platform when performing its mission in its intended OE. It is important to note that not all EM radiation encountered by joint forces will impact operations.

(4) **EMOE.** The EMOE is a composite of the actual and potential EM radiation, conditions, circumstances, and influences that affect the employment of capabilities and the decisions of the commander. It includes the existing background radiation (i.e., EME) as well as the friendly, neutral, adversary, and enemy EM systems able to radiate within the EM area of influence. This includes systems currently radiating or receiving, or those that may radiate, that can potentially affect joint operations.

(5) **Attributes.** The EMOE has the following attributes:

(a) **Physical.** The EMOE is part of the physical environment. EM radiation is a physical phenomenon. Both natural and manmade factors (e.g., terrain, weather, atmospheric conditions, sea state, transmitters, power lines, static electricity) influence EM radiation and the organizations and systems that employ it. Military forces maneuver through all environments, including the EMOE, to gain positions of advantage over adversaries and enemies. EMOE maneuver requires effective management of spectrum occupancy.

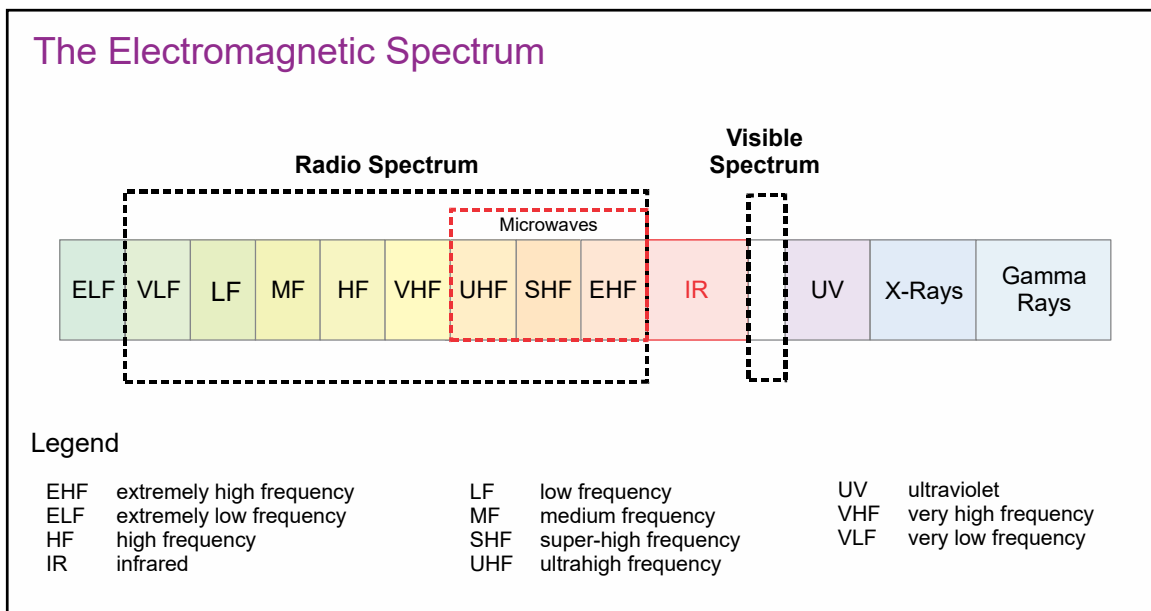


Figure I-1. The Electromagnetic Spectrum

(b) **Pervasive.** The EMS permeates all parts of the OE. Military forces use the EMOE to integrate, synchronize, and otherwise enhance their operations. The critical dependencies of modern military operations on EMS activities, coupled with the wide range of effects that can be created through electromagnetic spectrum operations (EMSO), are a potent force multiplier.

(c) **Constrained.** Although the EMS contains an unlimited number of frequencies, its use for military purposes is limited by physics, policy, and current technology. EM radiation has unique physical properties that dictate its use (e.g., short- or long-range communications, sensing). Additionally, use of the EMS is subject to international treaties and laws, as well as nation-state laws and regulations. Technology bounds those portions of the EMS that are accessible and exploitable (i.e., advances in technological capabilities will result in expanded use of the EMS).

(d) **Congested.** The EMOE encountered by joint forces is congested due to military and nonmilitary use, resulting in a commensurate increase in the number and density of EM emitters. As a result of physical characteristics and technology, civilian and military organizations increasingly seek to transmit and receive EM energy in the same or adjacent spectral bands. For instance, myriad stakeholders (e.g., cell phone and wireless Internet providers, media) continue to expand their EMS bandwidth requirements, reducing the open EM areas conducive to joint force maneuver. This congestion leads to electromagnetic interference (EMI) to a receiver. EMI is any EM disturbance, induced intentionally or unintentionally, that interrupts, obstructs, or otherwise degrades or limits the effective performance of EMS-dependent systems, electronics, and electrical equipment.

(e) **Contested.** Since modern military operations are critically dependent on the EMS, a key goal of our adversaries and enemies is to deny our ability to use it successfully. For example: antiradiation missiles and other destructive weapons are used to degrade or destroy transmitters and receivers, while EM energy can be used to disrupt or degrade a receiver's operation.

(f) **Dynamic.** The EMOE experienced by the joint force is continuously changing, as existing systems are modified, new systems are deployed, units change locations, threats transmit, or natural phenomena occur. Since EM energy travels at the speed of light, military activities in the EMS may provide a decisive advantage by enabling commanders to make decisions, conduct operations, and create effects more rapidly than the threat. Agility in spectrum operations provides joint force operations the flexibility and adaptability to achieve mission success in dynamic EMOEs.

(6) **Electromagnetic Order of Battle (EOB).** An EOB is a subset of the overall order of battle that consists of the identification, strength, command structure, disposition, and operating parameters of the EMS-dependent systems. This includes radiating, receiving, and inactive systems within an OA or those that could be readily deployed. The EOB is the identification of transmitters and receivers in an area of interest (AOI), a linkage to system and platform supported, a determination of their geographic location and range of mobility, a characterization of their signals, EMS parameters, and, where possible, a

determination of their role in the broader organizational order of battle. Given the nature of the EMS, JEMSO consider all emitters and receivers operating within a given EMOE, regardless of origin or intentions.

(7) **Military operations within the EMS.** Military operations in the EMS involve the transmission and reception of EM energy in the EMOE (e.g., communications, sensing, attack, deception). Examples of systems used to support military activities in the EMS include:

(a) Communications systems that transmit and receive EM energy encoded with information to underpin a wide range of activities. These include data transfers that enable command and control (C2); processing, exploitation, and dissemination links; signaling that supports positioning, navigation, and timing (PNT) (e.g., Global Positioning System [GPS]); identification, friend or foe (IFF) capabilities; and broadcasts that support information activities and data dissemination.

(b) Active and passive sensing systems that provide data supporting a wide range of activities in the EMOE, including intelligence collection, emitter location, situational awareness (SA), and targeting. Active sensing systems (e.g., air-to-air radars, ground radars, laser target designators) transmit EM signals and measure the received reflections to extract high-fidelity information intercept EM signals to support system characterization, identification, location, and targeting activities.

(c) Electromagnetic attack (EA) systems, to include directed energy (DE) (e.g., radio frequency [RF] jammers, laser dazzlers, millimeter wave, microwave capabilities), that transmit energy through the EMOE to disrupt or degrade an enemy's ability to receive signals, deliver data payloads supporting cyberspace operations (CO), or disable and destroy targets (e.g., electronics of vehicles, vessels, and unmanned aircraft systems' control modules) susceptible to high-energy EM radiation.

(8) **EMS Maneuver.** Maneuver in the EMS is similar to maneuver in the domains. For instance, maneuver in the air domain requires three-dimensional positioning and time, while EMS maneuver must also consider EMS operating parameters (e.g., frequency, power, modulation) to gain an advantage over the enemy.

(9) **EMS Readiness.** EMS readiness is the ability of military forces to operate, fight, and meet the demands of assigned missions given the following:

- (a) The EMOE with regard to the planned scheme of maneuver.
- (b) The required operations in the EMS and the amount of EMI expected.
- (c) The difference between EMS assets required and those assigned.
- (d) The EMS compatibility between assigned assets.

(10) **EMS Superiority.** EMS superiority is that degree of control in the EMS that permits the conduct of operations at a given time and place without prohibitive

interference, while affecting an enemy's ability to do the same. EMS superiority is achieved through JEMSO and is a critical enabler to superiority throughout the OE.

(11) **The EM Threat.** Worldwide, tens of thousands of EMS-dependent systems exist and are constantly being proliferated and enhanced. Current EMS threats include systems that can detect, exploit, degrade, disrupt, destroy, and deceive virtually all multinational operational capabilities, including navigation, weapon systems, communications, and sensors. In addition, DE weapons that attack personnel, sensors, platforms, C2, and infrastructure have been fielded or are under development. All of these threats to freedom of action in the EMS must be accounted and planned for, to support and achieve the commander's objectives. Concurrently, enemies seek access to secure communications and use navigational and sensing systems to facilitate their attacks. Threats also have access to commercial off-the-shelf systems, and are prepared to use them, often without regard to legal constraints. Enemy use of commercial off-the-shelf systems to hide among civilians increases targeting difficulty for US and multinational planners.

(12) **EW.** EW refers to military actions involving the use of EM and DE to control the EMS or to attack the enemy. EW consists of three distinct divisions: EA, electromagnetic support (ES), and electromagnetic protection (EP). EW is a key function of JEMSO and critical to joint force operations and success in the dynamic EMOE. Additional information on EW activities, capabilities, and effects is included in Appendix B, "Electromagnetic Warfare Activities."

(13) **EMS Management.** EMS management refers to operational, engineering, and administrative procedures to plan and coordinate use of the EMS. EMS management is composed of three interrelated functions: frequency management (FM), host-nation coordination (HNC), and joint spectrum interference resolution (JSIR). EMS management is a key function of JEMSO and critical to the success of joint force operations in a dynamic EMOE.

c. **JEMSO Actions.** JEMSO actions to exploit, attack, protect, and manage the EMOE rely on personnel and systems from EW, EMS management, intelligence, space, and cyberspace mission areas. Instead of these mission areas being planned and executed in a minimally coordinated and stovepiped fashion, JEMSO guidance and processes prioritize, integrate, synchronize, and deconflict all joint force operations in the EMOE, enhancing unity of effort. The result is a fully integrated scheme of maneuver in the EMOE to achieve EMS superiority and joint force commander (JFC) objectives.

(1) **Exploitation.** Exploitation takes full advantage of available information for tactical, operational, or strategic purposes. In a JEMSO context, exploitation refers to EMS systems capable of sensing the EMOE. Sensing systems support intelligence collection, SA, targeting, and warning. EMS sensors can be active (e.g., air-to-air radars, IFF interrogators) or passive (e.g., radar warning receivers, passive radars, IR weapons seekers). These sensing missions are typically executed through signals intelligence (SIGINT) and ES operations.

(a) SIGINT is a category of intelligence comprising, either individually or in combination, all communications intelligence, electronic intelligence (ELINT), and foreign instrumentation signals intelligence, however transmitted. SIGINT provides the basis for characterizing the EMOE, to include those frequencies associated with radio, radar, IR equipment, and DE systems. ELINT, a subcategory of SIGINT, is the technical and geolocation intelligence derived from foreign noncommunications EM radiations emanating from other than nuclear detonations or radioactive sources.

(b) ES is the division of EW involving actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate or localize sources of intentional and unintentional EM radiation for the purpose of immediate threat recognition, threat avoidance, homing, targeting, planning, and conduct of future operations. The joint electromagnetic spectrum operations cell (JEMSOC) synchronizes and integrates the planning and operational use of ES sensors, assets, and processes within a specific joint operations area (JOA) to reduce uncertainties concerning the threat, environment, time, and terrain. ES data can be used to support SIGINT production, support targeting for EA or other fires, provide SA of the EMOE, and produce measurement and signature intelligence.

(c) ES and SIGINT. ES is closely related to, but separate from, SIGINT. The distinction between an asset performing an ES mission or an intelligence mission is determined by who tasks or controls the collection assets, what they are tasked to provide, and for what purpose they are tasked. The distinction between ES and SIGINT is delineated by purpose, scope, and context. Operational commanders task ES assets to search for, intercept, identify, and locate or localize sources of intentional or unintentional radiated EM energy. In contrast, the Director, National Security Agency (NSA)/Chief, Central Security Service, or an operational commander delegated SIGINT operational tasking authority, task SIGINT assets. The purpose of ES is immediate threat recognition, support to planning, and conduct of future operations and other tactical actions such as threat avoidance, targeting, and homing. ES is intended to respond to an immediate operational requirement. ES and SIGINT operations often share the same or similar assets and resources and may be tasked to simultaneously collect information that meets both requirements. That is not to say that data collected for intelligence cannot meet immediate operational requirements. Information collected for ES purposes is normally also processed by the appropriate parts of the intelligence community (IC) for further exploitation after the operational commander's ES requirements are met. As such, it can be said that information collected from the EMS has "two lives." The first is as ES, unprocessed information used by operational forces to develop and maintain SA for an operationally defined period of time. The second is as SIGINT, retained and processed under appropriate intelligence authorities in response to specified intelligence requirements.

For further information on the ES and SIGINT relationship, see Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3320.01, (U) Joint Electromagnetic Spectrum Operations (JEMSO).

(2) **EA.** JEMSO capabilities can directly produce effects in the EMOE. These capabilities can be used to deny (i.e., disrupt, degrade, destroy) and/or deceive an enemy's military EMS activities. EA is the division of EW involving the use of EM energy, including DE or antiradiation weapons, to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability. Typical EA capabilities include EM jamming and intrusion. EM jamming is the deliberate radiation, reradiation, or reflection of EM energy for the purpose of preventing or reducing an enemy's effective use of the EMS, to degrade or neutralize the enemy's combat capability. EM intrusion involves the intentional insertion of EM energy into transmission paths to deceive or confuse enemy forces. EA can be either active (i.e., radiating) or passive (i.e., non-radiating/reradiating). Examples of active EA systems (to include lethal and nonlethal DE) include lasers, electro-optical, IR, and RF weapons such as high-power microwave (HPM) or those employing an electromagnetic pulse (EMP). Examples of passive EA systems are chaff and corner reflectors. EA can also be used for offensive and defensive purposes.

(a) **Offensive EA.** Offensive EA describes the use of EA to project power in support of operations within the time and tempo of the scheme of maneuver. JEMSO planners use JFC guidance to integrate EA during joint planning through the joint planning group or operational planning group, coordinating effects and incorporating risk mitigation techniques to reduce collateral damage. In many cases, these activities suppress a threat for only a limited period of time. Examples include employing self-propelled decoys; jamming radar or C2 systems; using antiradiation missiles to suppress air defenses; using EM deception techniques to confuse intelligence, surveillance, and reconnaissance (ISR) systems; and using DE weapons to disable personnel, facilities, or equipment and disable or destroy materiel (e.g., satellites in orbit, airborne optical sensors, or massed land forces).

(b) **Defensive EA.** Defensive EA describes the use of EA to protect against threats by denying enemy use of the EMS to target, guide, and/or trigger weapons. EA used for defensive purposes in support of force protection or self-protection is often mistaken as EP. Although defensive EA actions and EP protect personnel, facilities, capabilities, and equipment, EP protects from the effects of EA or EMI, while defensive EA is primarily used to protect against lethal attacks by denying enemy use of the EMS to target, guide, and/or trigger weapons.

(3) **Protect.** As joint forces are critically dependent on exploiting the EMOE, JEMSO facilitate the necessary EMS access by minimizing EMI from friendly, neutral, adversary, and enemy actions. JEMSO integrate EW and EMS management protection actions throughout planning and execution, enabling joint force EMS-dependent systems to operate in the EMOE as intended. EP refers to the division of EW involving actions taken to protect personnel, facilities, and equipment from any effects of friendly, neutral, adversary, or enemy use of the EMS, as well as naturally occurring phenomena that degrade, neutralize, or destroy friendly combat capability. EP focuses on system or process attributes or capabilities that eliminate or mitigate the impact of EMI. These inherent hardware features; processes; and dedicated tactics, techniques, and procedures (TTP) combine to enable friendly capabilities to continue to function as intended in contested and congested EMOEs. Examples of EP include:

- (a) Frequency agility in a radio.
- (b) Variable pulse repetition frequency in a radar.
- (c) Receiver/signal processing.
- (d) Spread-spectrum technology.
- (e) Multispectral, low-observability (stealth) attributes. All equipment, personnel, and facilities emit and reflect EM energy as discernible and often characteristic signatures (e.g., thermal, light, magnetic, and RF) that can be collected and exploited. Assets involved in operations may incorporate low-observability EP attributes, thereby increasing their ability to operate in the physical domains by reducing the possibility of their detection and exploitation by enemies. Low-observability and other signature reduction techniques also improve the effectiveness of electro-optical-infrared countermeasures (EO-IR CMs).
- (f) EM hardening. Actions taken to protect personnel, facilities, and equipment by filtering, attenuating, grounding, bonding, blanking, and shielding against undesirable effects of EM energy. EM hardening is an EP activity against the effects of EA (e.g., laser, HPM, EMP).
- (g) Use of wartime reserve modes (WARMs). WARMs are characteristics and operating procedures of sensor, communications, navigation aids, threat recognition, weapons, and countermeasure systems that will contribute to military effectiveness if unknown to or misunderstood by opposing commanders before they are used but could be exploited or neutralized if known in advance.
- (h) IR missile flare rejection logic (e.g., multispectral seeker or rate bias).
- (i) Selective opacity (i.e., the phenomenon of not permitting the passage of EM radiation) through optical apertures (e.g., laser eye protection).
- (j) GPS and global navigation satellite systems (GNSSs) (e.g., BeiDou Navigation Satellite System [BDS] [China], Global Navigation Satellite System [GLONASS] [Russia], Galileo - European Union) signal protection measures to:
 - 1. Prevent stealth manipulation by threat system C2.
 - 2. Protect use of GNSS foreign receiver capability as a sensor to aid in combating GPS jamming.
- (k) EMS coordination measures (e.g., joint restricted frequency list [JRFL]) and emission control (EMCON).

For more information on EMS coordination measures, see Appendix F, “Electromagnetic Spectrum Coordination Measures.”

(l) EM Security. EM security is the protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from their interception and study of noncommunications EM radiations (e.g., radar).

(4) **Manage.** All joint force operations in the EMS must be managed to facilitate unity of effort in executing the planned scheme of maneuver within the EMOE. EMS management's objective is to enable EMS-dependent capabilities and systems to perform their functions as designed, without causing or suffering unacceptable EMI. EMS management provides the framework to utilize the EMS in the most effective and efficient manner. EMS management is analogous to the airspace management function in air operations, coordinating and integrating joint EMS use in terms of time, space, and frequency.

(a) Electromagnetic Battle Management (EMBM). EMBM includes actions to monitor, assess, plan, and direct operations in the EMS in support of the commander's objectives. It is the coordinated direction of all joint functions in the EMS to enable the orderly conduct of friendly EMSO. When exercised, EMBM is a commander's mechanism for informing all actions that shape the OE. EMBM is accomplished through an EMBM system that consists of the facilities, equipment, software, communications, procedures, and personnel essential for a commander to plan, direct, and control operations in the EMS. EMBM provides JEMSO SA, decision support, and C2 support.

(b) FM. FM encompasses interference analysis and requesting, nominating, coordinating, assigning, and promulgating frequencies for EMS-dependent capabilities and systems. FM assigns frequencies for non-EA EM transmissions, conducts frequency deconfliction, and mitigates EMI. FM is a key component for developing EMS operating instructions and coordination measures. FM includes spectrum analysis, engineering, and assessment of EMS-dependent systems and developing EMS products such as the JRFL, joint communications-electronics operating instructions (JCEOI), and others, as required. FM examples include assigning frequencies to radios on specific platforms, datalinks on unmanned aircraft systems and satellites, radars and weapon sensors, and networked information/communications systems.

(c) HNC. HNC is the coordination with nation states for authorization to operate EMS-dependent systems within national borders (includes use of systems that emanate across the border from other AOIs). Coordination is required when operating within foreign nations as well as the United States. Granting approval to transmit EM energy within a nation is a sovereign right. HNC is normally accomplished through procedures established by CCMD agreements with HNs. It should be conducted, when appropriate, with all nations in the JOA. The JFC and staff should be aware that unauthorized EMS use within an HN may be a violation of international treaties, international law, or national laws and regulations. Staff legal advisors can assist JFCs and their staff with understanding international treaties, regulations, and HN laws, where applicable.

(d) JSIR. A contested and congested EMS, coupled with dynamic military operations, makes encountering EMI in the EMOE very likely. In fact, most system

degradation can be attributed to EMI. As such, JSIR identifies, reports, analyzes, and mitigates or resolves incidents of EMI. JSIR uses a continuous systematic process to report and diagnose the cause or source of EMI. CCMDs should ensure incidents of EMI are reported immediately and are resolved or mitigated. EMI can be induced intentionally, as in EA, or unintentionally, as a result of harmonics, spurious emissions, intermodulation products, improper operation, or inadequate EMS management.

For further information on JSIR, see CJCSI 3320.02, Joint Spectrum Interference Resolution, and Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3320.02, Joint Spectrum Interference Resolution (JSIR) Procedures.

d. JEMSO-Related Mission Areas

(1) **CO.** The majority of military systems contain cyberspace- and EMS-dependent components, requiring close integration of JEMSO and cyberspace capabilities to ensure prioritization, synchronization, and deconfliction. Most JEMSO occur outside of cyberspace; however, many CO require use of the EMS to establish a communications path to the targets, especially at the tactical level. Examples of JEMSO activities in support of CO include:

(a) Exploit capabilities to identify the antenna locations and EM waveforms supporting threat CO.

(b) Attack capabilities to facilitate cyberspace attack objectives by delivering autonomous or interactive executable CO payloads into targets.

(c) Management capabilities to ensure the CO activity is deconflicted with other military EMS activities in the EMOE.

For more information on CO, refer to Joint Publication (JP) 3-12, Cyberspace Operations.

(2) **Space Operations.** All space operations rely on the EMS for C2, sensing, and information distribution. The vital nature of space operations to overall joint operations requires close coordination with other EMS activities to ensure proper prioritization, integration, synchronization, and deconfliction. Examples of JEMSO activities in support of space operations include:

(a) Exploit capabilities to identify the location of emitters jamming satellite links.

(b) Attack capabilities to deceive, disrupt, and degrade enemy satellite uplink, downlink, or crosslink signals.

(c) Protect capabilities to harden uplink, downlink, or crosslink satellite signals and sensors to EMI.

(d) Management capabilities to deconflict satellite EMS activities with other joint force activities to mitigate the risks of EMI and the potential for friendly fire EA incidents to personnel or equipment.

(e) Exploit, attack, protect, and manage capabilities to assure friendly use and prevent threat use of PNT information in support of navigation warfare (NAVWAR).

For more information on space operations, refer to JP 3-14, Space Operations.

(3) **Air, Land, and Maritime Operations.** Since the EMS overlaps these physical domains simultaneously, JEMSO provide the processes to effectively prioritize, integrate, synchronize, and deconflict the EMS aspects of operations throughout the EMOE.

2. Electromagnetic Environmental Effects

a. The impact of the EMOE upon the operational capability of military forces, equipment, systems, and platforms is referred to as electromagnetic environmental effects (E3). Examples of E3 include electromagnetic compatibility (EMC), EMI, EMP, and EM radiation hazards. EM radiation hazards include hazards of electromagnetic radiation to personnel (HERP); hazards of electromagnetic radiation to ordnance (HERO); hazards of electromagnetic radiation to fuels (HERF); and natural phenomena effects such as space weather, lightning, and precipitation static.

(1) EMC is the ability of systems, equipment, and devices that utilize the EMS to operate in the OE without suffering unacceptable degradation or causing unintentional degradation because of EM radiation or response. EMC involves the application of sound EMS management to maximize operational effectiveness.

(2) An EMP is a strong burst of EM radiation that can be produced by a nuclear explosion or a DE weapon or can be generated conventionally or occur naturally. An EMP may couple with electrical or electronic systems to produce damaging current and voltage surges. A high-altitude EMP can generate significant disruptive field strengths over a continental-size area, whereas a DE weapon can generate significant disruptive field strengths to a more localized area or a specific target. Shielding and protection (i.e., EP) of friendly equipment, personnel, and facilities against an EMP should be taken into account and planned for accordingly.

(3) Transmitters or antenna installations can generate EM radiation in excess of established safe levels in the vicinity of ordnance, personnel, or fueling operations. HERO, HERP, and HERF guidance must be followed to ensure safe operations.

b. Systems that operate in the EMS are susceptible to E3. When platforms, associated systems, and equipment (e.g., avionics, ordnance) are exposed to an EMOE different from those for which they were designed and tested, the potential for safety, interoperability, and reliability problems increases. A system is said to have an EM vulnerability if it suffers a definite degradation (incapability to perform the designated mission) after being subjected to a certain level of E3. JEMSO planners must identify and quantify the potential

critical impacts of E3 to manage and mitigate the hazards of EM radiation in joint operations. Examples of JEMSO-enabled E3 mitigation techniques include:

- (1) Positioning transmit and receive antennas to minimize the impact of E3.
- (2) Deconflicting EM transmissions and reception activities in time, location, and spectral attributes to minimize the impact of E3.
- (3) Implementing anti-jam techniques in a contested and congested environment (e.g., EM anti-jam waveforms, power, data rate reduction) to minimize the impact of E3.
- (4) Instituting EMCON procedures to protect friendly force emissions from observation.
- (5) Constructing EMS coordination measures to minimize of E3.

For more information on E3, refer to Department of Defense Instruction (DODI) 3222.03, DOD Electromagnetic Environmental Effects (E3) Program.

3. Relationship to Joint Functions

Joint functions are related capabilities and activities grouped together to help JFCs integrate, synchronize, and direct joint operations. The joint force is critically dependent on the EMS for operations across all joint functions and throughout the EMOE. These operations are integrated and managed through JEMSO.

a. **C2.** Commanders are dependent on the EMS for C2, especially the radio, microwave, and optical frequency bands. These bands are increasingly congested by civil, commercial, adversary, and enemy use and contested by enemies. JEMSO coordinate deconfliction of joint force communications from civil, commercial, adversary, and enemy use; prioritize and synchronize communications across components; and protect joint force communications from EA. Assured C2 requires gaining and maintaining EMS superiority during all phases of military operations. Additionally, operations within the EMS must be commanded and controlled similar to those of air, maritime, land, space, and cyberspace.

b. **Intelligence.** Understanding the OE is fundamental to joint operations. EMS-dependent sensors, active (e.g., synthetic aperture radars) and passive (e.g., ISR platforms, radio scanners, IR cameras), provide much of the information necessary to achieve near real time SA of the OE, as well as support development of the joint intelligence preparation of the operational environment (JIPOE). JIPOE is the analytical process used by joint intelligence organizations to produce intelligence estimates and other intelligence products in support of the JFC's decision-making process. By prioritizing, integrating, and synchronizing joint EMS use, JEMSO enhance intelligence activities with assured sensor C2, data dissemination, collection management prioritization, and optimized target collection.

For further information on JIPOE, see JP 2-01.3, Joint Intelligence Preparation of the Operational Environment; for further information on intelligence, see JP 2-01, Joint and National Intelligence Support to Military Operations.

c. **Fires.** JEMSO are critical enablers in supporting fires and, in the case of EA, are considered a form of fires. EA capabilities, to include DE, can produce a full range of scalable effects, including disruption, deception, degradation, and/or destruction. Many fires systems have EMS-dependent targeting sensors, PNT requirements, seekers, and C2 datalinks. JEMSO management functions deconflict these systems, prioritize and integrate them with other JEMSO (e.g., communications, sensing), and protect them from enemy EMSO. JEMSO, especially the EW and CO mission areas, integrate closely to produce synergistic effects on targets. As a form of fires, EA is capable of creating lethal or nonlethal effects, while ES and SIGINT provide targeting and weaponeering information for EA, as well as other forms of fires.

d. **Movement and Maneuver.** Joint forces maneuver in the EMOE to achieve a position of advantage over an enemy. EMS-dependent systems maneuver through the EMS by being adaptable and changing their operating modes and characteristics (e.g., power, frequency, direction, waveform). Joint forces can employ EA to occupy key frequency bands for channeling or denying enemy EMS use to enable lethal and nonlethal effects against that enemy. In addition, JEMSO provide maneuver forces assured access to the C2, intelligence, fires, protection, information, and sustainment functions necessary for effective joint operations.

e. **Protection.** JEMSO protect friendly forces through defensive EA, ES, and EP. JEMSO also deconflict joint force combat identification systems from civil, commercial, adversary, and enemy EMS use; prioritize and integrate them with other JEMSO (e.g., communications, fires); and protect them from enemy EA.

f. **Sustainment.** JEMSO deconflict joint force logistics communications from civil/commercial/adversary/enemy EMS use, prioritize and synchronize communications across components, and protect joint force communications from threat EA. JEMSO-supported sustainment activities ensure freedom of action, extend operational reach, and prolong combat endurance.

g. **Information.** JEMSO are key enablers for information activities (e.g., public affairs, military information support operations [MISO], CO) that transit the EMOE.

For further information on joint functions, see JP 3-0, Joint Operations.

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CHAPTER II

ORGANIZING FOR JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS

1. Introduction

How joint staffs organize to plan and execute JEMSO is a prerogative of the JFC. The size of the commander's staff, the number of available JEMSO experts, the mission(s) the joint force is tasked to accomplish, and the time allocated to accomplish the mission(s) are just some of the factors that affect the organization of the staff. This chapter provides an overview of requirements, organizations, and staff functions required to plan and execute JEMSO in joint operations. A brief introduction on how each Service is organized to plan and execute EMSO is included to provide background on how the JFC staff's JEMSO functions interact with Service/functional components.

2. Responsibilities

The JFC establishes and promulgates command-specific policy and guidance for JEMSO planning, execution, and assessment. These activities can be divided among multiple directorates of a joint staff based on long-, mid-, and near-term functionality and availability of trained JEMSO personnel.

a. JFC

(1) Combatant commanders (CCDRs) and subordinate JFCs will normally establish a standing JEMSOC to support joint planning, coordination, and control of the EMS for assigned forces. Every supported CCDR establishes a command policy on how the EMS will be used throughout their CCMD and in their area of responsibility (AOR) as applicable, obtains EMS clearance (i.e., approval) from HNs (through existing coordination procedures), and authorizes EMS use for assigned military forces to execute their designated mission(s). Every supported JFC conveys to subordinates guidance for achieving EMS superiority within the JOA through their concept of operations (CONOPS). At a minimum, this guidance will include an operational approach; mission statement; and commander's planning guidance, intent, and commander's critical information requirements (CCIRs). JFC responsibilities include:

(a) Organize to plan and execute JEMSO (e.g., JEMSOC augmentation/sustainment, infrastructure, data exchange, elimination of duplication of effort, mutual support, minimization of friendly EMI).

(b) Resolve EMS user prioritization issues not resolved at a lower level.

(c) Maintain close contact with appropriate foreign military forces and civil administrations to ensure mutual EMS support is considered in combined planning, operations, training, and exercises.

(d) Function as the controlling authority for EMS-use policy.

(e) Ensure procedures and policies are in place for the safeguarding, use, and transfer of reprogrammable EMS-dependent system waveforms (i.e., EMS technical data).

(f) Ensure friendly signature management, to include the awareness of neutral and threat signatures.

(2) Electromagnetic Spectrum Coordinating Authority (EMSCA). EMSCA plans, coordinates, monitors, manages, assesses, and prioritizes execution of JEMSO. The JFC normally delegates EMSCA to the operations directorate of a joint staff (J-3); however, core expertise and joint force-assigned mission will dictate actual assignment. The assigned delegate will normally grant direct liaison authority to the JEMSOC director for execution of responsibilities. EMSCA responsibilities include:

(a) Direct the planning, development, publication, and issuance of EMSO guidance (e.g., EMS superiority objectives, EMS-use prioritization), the JEMSO plan, and EMS operating instructions (e.g., JRFL, JCEOI), as well as other supporting JEMSO guidance.

(b) Coordinate support of JEMSO functions across the joint directorates (e.g., intelligence directorate of a joint staff [J-2], J-3, logistics directorate of a joint staff [J-4], plans directorate of a joint staff [J-5], communications system directorate of a joint staff [J-6]) to support JEMSO functions as required.

(c) Incorporate EMSO guidance into the respective plans and orders.

(d) Establish processes that integrate HN and other affected nations' constraints and requirements.

(e) Coordinate with the joint frequency management office (JFMO) (if not incorporated within the JEMSOC) to manage, prioritize, integrate, synchronize, and deconflict the use of the EMS.

(f) Develop broad policies and procedures for the coordination required among all joint EMS users.

(g) Develop policy, within IC guidelines, for sharing data to existing user-defined operational pictures.

(h) Consolidate component plans for operating in the EMS for JFC approval.

(i) Monitor joint force actions to assess their effects on EMS superiority and mission objectives.

(3) Electromagnetic Attack Control Authority (EACA). As a broader evolution of jamming control authority, EACA is the authority a commander has to issue orders to transmit (or cease transmission of) EM energy. This authority should be delegated from the JFC, through the component commanders, down to the lowest level possible that has the following attributes: SA of the EMOE, positive control of the EA capability, and ability

to monitor and assess EA transmission activity for determining corrective action. EACA responsibilities include:

- (a) Participate in EMS coordination measures development (e.g., JRFL).
- (b) Ensure compliance with the approved EMS coordination measures (e.g., JRFL).
- (c) Maintain SA of all EA-capable systems and related operational parameters in the JOA.
- (d) Resolve JEMSO prioritization recommendation issues.
- (e) Coordinate with components on EA requirements.
- (f) Develop, coordinate, update, and promulgate EACA guidance.
- (g) Monitor and assess joint force EA transmission activity for EACA compliance and determining corrective action when necessary.

(4) EMS Management Responsibilities. EMS management responsibilities are normally assigned to the J-6 and subsequently delegated to the JFMO. The JFMO representative(s) within the JEMSOC will coordinate EMS management efforts with the JFMO. If the JFMO is incorporated within the JEMSOC, which normally occurs during contingency operations, EMS management representatives will lead/coordinate EMS management efforts for JEMSOC. EMS management responsibilities include:

- (a) Provide guidance for EMS functions, to include FM and EMI resolution procedures.
- (b) Provide guidance for and manage the development of EMS coordination measures.
- (c) Coordinate EMS access for HN approval.
- (d) Disseminate guidance on restrictions for access to EMS in JOA, either applied by the HN or other mandate.
- (e) Disseminate guidance for the use of software-defined radios or implementation and sharing of smart radio technology.
- (f) Ensure compliance with the approved EMS coordination measures.
- (g) Maintain SA of all EM energy in the JOA.
- (h) Resolve JEMSO prioritization recommendation issues.
- (i) Coordinate with JEMSOC director on introduction of EMS-dependent systems into the JOA.

- (j) Coordinate with components on EMS requirements.
- (k) Analyze EMS parameter requirements as submitted by Service component or joint task force (JTF).
- (l) Promulgate frequency assignments.
- (m) Report and resolve EMI incidents.
- (n) Participate in developing, coordinating, updating, and promulgating JEMSO guidance.
- (o) Maintain the common frequency database necessary to plan, coordinate, and control friendly EMS use. The frequency database should contain all communication and noncommunication emitters and receivers such as radars, unmanned aircraft systems, and sensors.
- (p) Coordinate and deconflict requested EA actions against friendly force allocated assignments (e.g., C2 network architecture, sensors, missile defense, and base defense).

b. **JFC Staff.** The functional areas of the JFC's staff duties include:

(1) **Manpower and Personnel Directorate of a Joint Staff.** Coordinate personnel assignment of core members and augmentees for the standing JEMSOC.

(2) **J-2**

(a) Designate an individual to represent the J-2 as a JEMSOC core member for joint force EMS-use planning, prioritization, integration, synchronization, coordination, and deconfliction.

(b) Provide the JEMSOC with prioritized EMS-use requirements for intelligence operations and collection, to include JRFL inputs and collection plans.

(c) Support JEMSO staff estimate development by providing EMOE characterization information, to include adversary, enemy, HN, and neutral EOBs; civil emitters and respective EMS-use data, in accordance with (IAW) applicable constraints (e.g., releasability restrictions).

(d) Assist the JEMSOC in identifying sources of EMI.

(e) Integrate the appropriate intelligence systems into the JFC's EMBM system architecture.

(f) Support JEMSOC target development activities.

(g) Support JEMSO assessment activities.

(h) Ensure threat EMSO capabilities and EMS activities are included in the JIPOE.

(i) Ensure battle damage assessment (BDA) teams either include a full-time person trained in JEMSO/EW or ensure a liaison trained in JEMSO/EW is available when JEMSO or EW actions are employed, to accurately assess whether or not JEMSO or EW actions were successful.

(j) Assist the JEMSOC in identifying potential sources of C2 technical manipulation as a consequence of use of foreign PNT.

(3) J-3

(a) Execute the duties as EMSCA if designated by the JFC.

(b) Provide JEMSO staff estimate and associated EMS superiority approach.

(c) Prioritize available EMSO capabilities when there are insufficient resources.

(d) Provide EMS-use prioritization guidance for joint EMS-use conflict resolution.

(e) Approve and enforce HERO, HERP, and HERF guidelines.

(f) Ensure joint force EM capabilities requirements are communicated to higher headquarters (HHQ) or US-based organizations for sourcing or acquisition through appropriate channels.

(g) Provide the J-2 with prioritized JEMSO intelligence requirements.

(h) Incorporate JEMSO into planning.

(i) Provide the JEMSOC with atmospheric and space weather information affecting the EMOE (e.g., ducting, ionosphere, solar effects).

(4) J-4. Coordinate distribution, maintenance, and support of critical EM-related equipment to priority units as determined by the JEMSOC to support optimal force employment.

(5) J-5

(a) Coordinate with the JEMSOC and ensure JEMSO are incorporated into plans.

(b) Establish coordination channels, as required, for the J-6 to negotiate military EMS use with HN and multinational partner EMS organizations where procedures do not already exist.

(6) **J-6**

- (a) Perform EMS management responsibilities, normally delegated to the JFMO.
- (b) Execute the duties as EMSCA if designated by the JFC.
- (c) Designate a JEMSOC core member to represent the J-6 in joint force EMS-use planning, prioritization, integration, synchronization, coordination, and deconfliction.
- (d) Coordinate with the JEMSOC to identify joint force communications network EMS-use requirements to be included in the EMS operating instructions.
- (e) Assist the JEMSOC with resolution of reported instances of EMI or disruption.
- (f) Assist JEMSOC with development and maintenance of an EMS data repository.
- (g) Through the JFMO (if not incorporated within the JEMSOC), negotiate military EMS use with HN EMS organizations.
- (h) Provide the J-2 with prioritized intelligence requirements.
- (i) Serve as a single control agency for the management and operation of the joint communications network.
- (j) Provide communications EMS-use requirements (e.g., satellite communications [SATCOM]) to the JEMSOC.
- (k) Manage and exercise control over communications systems deployed during joint operations and exercises.

(7) **Force Structure, Resource, and Assessment Directorate of a Joint Staff.** Coordinate with the JEMSOC to determine joint force EM capability shortfalls and requirements, as well as to initiate requests of the appropriate urgency to HHQ or US-based organizations for sourcing or acquisition.

c. **JEMSOC.** The JEMSOC director serves as the commander's primary advisor on EMS-related issues. Specific duties include:

- (1) Develop an EMS superiority approach that supports the JFC's objectives.
- (2) Prepare JEMSO portion of estimates and tabs to joint force concept plans (CONPLANS), operation plans (OPLANs), and operation orders (OPORDs) and identify the necessary OPORD implementation authorities.

(3) Maintain cognizance of EMS-dependent systems and their related capabilities within the JOA/AOI.

(4) Maintain current assessment of EMS resources and capabilities available to the JFC (to include number, type, and status of assets) and analyze what resources are necessary to achieve the JFC's objectives.

(5) Coordinate the introduction of EMS-dependent systems into the JOA.

(6) Develop EMOE estimates, which establish the common baseline for planning and executing JEMSO and military activities in the EMS.

(7) Develop JOA- and AOI-specific guidance, policies, coordination measures, and procedures for conducting JEMSO.

(8) Translate JFC guidance into EMS priorities; coordinate with supporting organizations to identify EMS allocations required.

(9) Coordinate with supporting organizations, components, and multinational representatives to enable planning and execution of their military operations in the EMS.

(10) Develop EMSO guidance for component planning.

(11) Review component EMSO plans and identify cross-component conflicts in EMS use, threats to EMS activities, and gaps resolvable through inter-component support requests.

(12) Develop a consolidated JEMSO plan, coordinated through the JFMO, that includes the operations in the EMS and their related frequency assignments to occur over a specific time period.

(13) Generate EMS operating instructions for release via order.

(14) Maintain EME SA for integration into a common tactical picture of the EMOE.

(15) Monitor the execution of military operations in the EMS for compliance with orders and instructions, and coordinate with components for any changes.

(16) Establish and chair a JEMSO working group (WG) as necessary to address key issues requiring expertise outside the standing JEMSOC.

(17) Represent JEMSO within the joint force staff battle rhythm and appropriate cross-functional staff organizations.

(18) Coordinate and monitor EW reprogramming.

(19) Maintain JEMSO support to current and future plans.

(20) Identify and recommend EMS-related target elements to support the JFC's objectives.

(21) Coordinate EMS-use requirements with J-5 and JFMO (if not incorporated in the JEMSOC) for HNC.

(22) Provide JEMSO planning, execution, and assessment coordination expertise to the CCMD/JTF with an associated JEMSO battle rhythm.

(23) Define and develop intelligence requirements to support JEMSO.

(24) Coordinate with the J-2 to weigh intelligence gain/loss due to EA and make EMS-use prioritization recommendations to the J-3.

(25) Predict effects of friendly, neutral, and threat EMS activity on joint and multinational operations using applicable modeling, simulation, and analysis tools.

(26) Coordinate joint urgent operational needs statements that affect the EMS.

(27) Develop the JEMSO plan that recommends frequency assignments to the JFC for approval and promulgation.

(28) Reference information systems lessons learned during the planning process, archive JEMSO planning and execution data, and document JEMSO lessons learned IAW the joint lessons learned program.

(29) Perform JSIR functions IAW CJCSM 3320.02, *Joint Spectrum Interference Resolution (JSIR) Procedures*, and CJCSI 3320.02, *(U) Joint Spectrum Interference Resolution*.

(30) Provide guidance and procedures for post-conflict JEMSO transitions.

(31) Establish and promulgate EMBM system standards and processes.

(32) Assess JEMSO execution and assist in overall operation assessment.

d. JFMO (if not incorporated in the JEMSOC). Duties include:

(1) Participate as a member of the JEMSOC.

(2) Perform EMS management responsibilities if assigned.

(3) Perform HNC functions in coordination with the J-5. HNC may involve the spectrum authority of the HN(s) involved, the US embassy defense attaché office of military cooperation (OMC), and friendly forces coordination cell.

(4) Coordinate spectrum allocations in the JOA/AOI.

(5) Analyze new EMS-dependent systems/capabilities supporting defense acquisition programs.

(6) Provide guidance on HN restrictions for access to EMS in JOA.

(7) Provide guidance and procedures for post-conflict EMS management transitions.

(8) Combine J-2, J-3, and J-6 inputs to develop a proposed JRFL.

(9) Periodically update and distribute the JRFL.

(10) Assist and coordinate resolution of EMS conflicts.

e. Functional and Service Component Commanders. Responsibilities include:

(1) Keep the JEMSOC notified of EMS-dependent systems and capabilities available under their command and the operational status of each.

(2) Establish an EMSO cell to:

(a) Plan, coordinate, monitor, and assess component EMSO and military operations in the EMS.

(b) Coordinate with the JEMSOC on functional/Service component EMSO operational plans.

(c) Submit component EMSO plan to the JEMSOC. Plan should identify component EMS-use requirements, planned use of the spectrum, EMS capabilities to be employed, JCEOI (e.g., master net list [MNL], call words, smoke/pyrotechnics), gaps between requirements and capabilities, and requests for EMS capability support.

(3) Prioritize, consolidate, validate, and report component EMS-use requirements to the JEMSOC.

(4) Receive reports and identify and attempt to resolve component-specific EMI.

(5) Make recommendations for best force contributions and utilization to gain and maintain EMS superiority within the JOA.

(6) Monitor component activities in the EMOE, report on actual use of the EMS, and provide EME measurements to the JEMSOC for SA.

(7) Coordinate requested changes to EMS operating instructions with the JEMSOC.

(8) Assess component EMS-related activities IAW the approved JEMSO assessment plan.

f. EMS Users. Duties are to:

(1) Provide the JEMSOC prioritized EMS-use requirements through their component EMSO cell. Inputs will include receive-only systems to ensure prioritization and integration with joint force EM transmissions (e.g., sensing, communications, EA).

(2) Obtain RF authorization through their component EMSO cell.

(3) Ensure compliance with applicable EACA processes and rules of engagement (ROE) (EA users).

(4) Operate systems IAW parameters authorized by the frequency assignment process (e.g., frequency, bandwidth, power).

(5) Ensure EMS-dependent equipment is properly maintained to preclude unintentional violation of authorized EMS-use parameters.

(6) Make recommendations for best force contributions and utilization to gain and maintain EMS superiority within the JOA.

(7) Use JSIR procedures to report adverse EMS effects on operations.

3. Organization

a. Organizing for JEMSO

(1) CCDRs and subordinate JFCs will normally establish a standing JEMSOC as the primary staff element to plan, coordinate, execute, and assess JEMSO to achieve and maintain EMS superiority. The CCDR or subordinate JFC usually delegates EMSCA to the JEMSOC director, which, when coupled with the JEMSOC's organizational responsibilities, enables the JFC to exercise unity of command for activities conducted in the EMS. Joint force unity of effort in the EMS derives from the JEMSOC's integration of all joint force EMS actions across both the joint force's functional staff elements (e.g., SIGINT, EMS management, EW, CO, fires) and the joint force's components. The JEMSOC augments existing joint force C2 lines of authority with reporting and data structures that accelerate the flow of information required for EMSO integration. It assists JFCs in identifying EMSO priorities, communicating intent, and integrating supporting commander capabilities into operations. The JEMSOC maintains habitual relationships with key individuals (e.g., component liaison officers [LNOs]) and enabling organizations, such as Service, functional, and multinational EW/EMS management cells, and other Department of Defense (DOD) EMSO-related organizations. The relationships are refined during training and exercises and optimized via a network of collaboration throughout planning, execution, and assessment.

(2) A JTF may be established and authorized to execute assigned missions in the designated JOA. If established, the JFC is normally delegated all EMS authorities required to execute the assigned mission in the designated JOA. JEMSO in the JOA are optimized through centralized, collaborative planning within the JEMSOC and executed in a

decentralized manner by the components. JEMSO planning during JTF operations is continuous and linked to the JFC's decision cycle. To accomplish the mission, the JTF organizational construct often mirrors the CCMD organizational construct, enabling the JFC to leverage existing CCMD resources and infrastructure in support of execution.

For more information on external EMSO support organizations, see Appendix D, "Organizations Supporting Joint Electromagnetic Spectrum Operations."

b. JEMSO Organizational Construct

(1) **JEMSOC Organization.** The JEMSOC is the standing organization within a joint force responsible for JEMSO. It is composed of a core membership of experts in EMS sensing (e.g., SIGINT collection management, ES), communications (e.g., EMS management, frequency assignment), attack (e.g., EA), and data management (e.g., EMS database management, EM modeling). A JEMSOC requires continuity of membership and expertise, and members should be designated spokespersons for their respective organizations. The JEMSOC should also coordinate with representatives from joint force components (Service and/or functional) and other supporting organizations or agencies. The JEMSOC normally resides in the J-3, but its composition and directorate location may vary for each CCMD and may change with operations tempo. For example, the JEMSOC may reside within the J-6 during peacetime operations and in the J-3 during contingency operations. One CDR may also elect to have the JEMSOC operate as a networked structure, reaching into the J-6/JFMO, J-2, J-3, and other related organizations for support, while another CDR may consolidate appropriate personnel from the key EMS organizations (e.g., J-2, J-3, J-5, J-6/JFMO) into a single organization. A notional JEMSOC organization structure is depicted in Figure II-1.

For more information on JEMSO modeling, see Appendix J, "Joint Electromagnetic Spectrum Operations Modeling."

(a) **JEMSOC Organization by Joint Force Level.** The CCMD JEMSOC will normally carry out the operational planning, execution, and assessment unless subordinate joint commands (i.e., JTFs) are established. In this case, JEMSOC manning will vary by echelon with the CCMD JEMSOC organized for theater-level JEMSO planning, coordination, and guidance. Subordinate JEMSOCs will be organized for continuous operational planning and execution. At all joint force levels, the JEMSOC maintains the appropriate core membership skill sets to carry out assigned tasks and missions.

1. **CCMD JEMSOC relationship to JFMO and joint force commander's electromagnetic warfare staff.** At the CCMD and subordinate unified command levels, the JEMSOC subsumes all the responsibilities of the JFMO (if the JFMO is fully incorporated in the JEMSOC). If the JFMO is not incorporated in the JEMSOC, the JFMO will retain responsibility for coordinating joint force EMS use with US and HN authorities.

2. **JTF JEMSOC.** At the JTF level, the JEMSOC subsumes all the responsibilities previously held by the joint spectrum management element (JSME) and EM warfare cell.

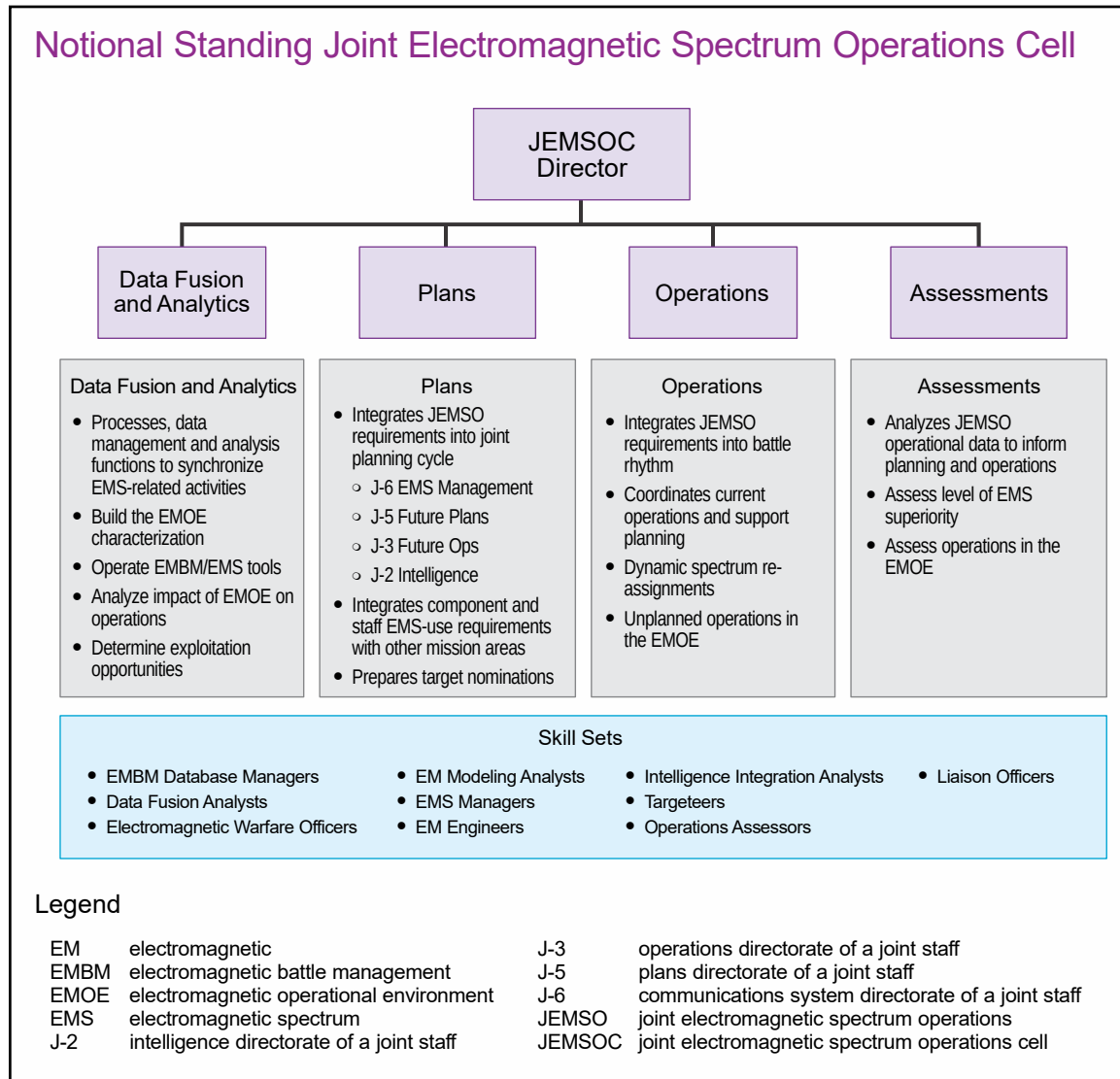


Figure II-1. Notional Standing Joint Electromagnetic Spectrum Operations Cell

(b) Potential interactions between the JEMSOC elements. Each function of the JEMSOC coordinates with the other functions. Figure II-2 illustrates some key interactions that should occur.

(c) Notional JEMSOC Structure

Potential Interactions Among the Joint Electromagnetic Spectrum Operations Cell Elements

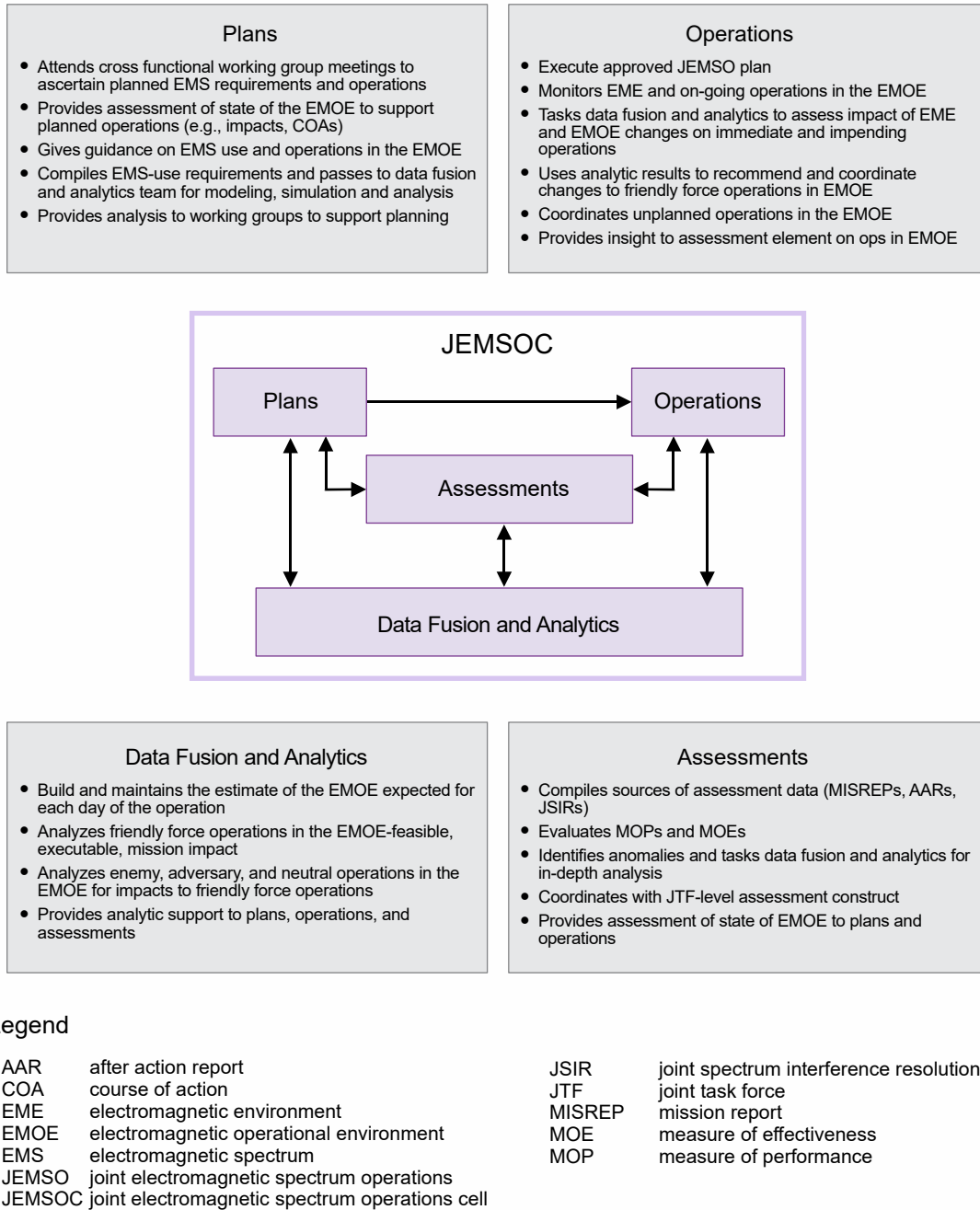


Figure II-2. Potential Interactions Among the Joint Electromagnetic Spectrum Operations Cell Elements

1. JEMSOC Director. The JEMSOC director is the commander's primary advisor on EMS-related issues. When delegated EMSCA, the JEMSOC director provides the JFC unity of command for JEMSO. The director is normally assigned based on core expertise (e.g., EMS management, EW, SIGINT) and the joint force's assigned mission. If the mission/tasking requires a JEMSOC deputy director, personnel with complementary core expertise should be assigned from current personnel.

2. Data Fusion and Analytics Section. Provides the processes, data management, and analysis functions to synchronize EMS-related data across the joint force staff, components, and external agencies. Characterizes and analyzes the EMOE for joint force impacts/exploitation/operations.

3. Plans Section. Provides the core JEMSO planning expertise and integrates JEMSO requirements into joint planning. Integrates principal JEMSO EMS-use requirements (e.g., sensing, communications, attack) with other mission areas and component EMS-use requirements. Prepares target nominations for EMS-related target elements.

4. Operations Section. Provides the core JEMSO expertise and integrates JEMSO requirements into the battle rhythm. This section may also contain LNOs (to include multinational personnel) to coordinate current operations and support planning.

5. Assessment Section. Collates and analyzes EMS-related operational data to inform the JEMSO planning and operations cycles and assists BDA teams after conducting operations.

(d) A fully staffed JEMSOC should include:

1. Director.
2. Deputy (if mission/tasking required – normally taken from personnel already assigned).
3. EMBM system database manager(s).
4. Data fusion analyst(s).
5. EM modeling analyst(s).
6. EMS manager(s) (normally within JFMO if not incorporated within the JEMSOC).
7. Electromagnetic warfare officer(s) (EWO[s]).
8. Intelligence integration analyst(s).
9. Targeteer(s).

10. Intelligence integration manager(s).

11. Operations assessor(s).

12. EM engineer(s).

(e) JEMSOC networked representation should include:

1. NAVWAR representative.

2. Electro-optical-infrared (EO-IR) representative.

3. Space operations representative.

4. DE representative.

5. CO representative.

6. Counter-improvised explosive device (C-IED) representative.

7. Joint interface control officer.

8. Communications planner.

9. SATCOM planner.

10. Information planner.

11. MISO planner.

12. Military deception (MILDEC) planner.

13. National Air and Space Intelligence Center (NASIC) representative.

14. National Reconnaissance Office representative.

15. National Ground Intelligence Center (NGIC) representative.

16. LNO(s).

17. Legal representative.

18. Counter air and missile planner.

19. Other IC organizations (e.g., NSA, Office of Naval Intelligence) identified as being relevant to the JEMSO or JEMSO support activities at issue.

(2) **EMSO Cell.** Component-level JEMSO support activities are referred to as EMSO cells. A component EMSO cell may be tasked with JEMSO integration responsibilities until a JEMSOC can be designated and sufficiently manned. As soon as practical, the JEMSOC should be aligned organizationally and, if possible, geographically co-located with the JFC. A notional component EMSO organization structure is depicted in Figure II-3.

c. **JEMSOC Security Requirements.** The JEMSOC should be located in, or have access to, a sensitive compartmented information facility to enable appropriate security/operations. JEMSOC personnel should have the appropriate clearance to support their respective duties (e.g., MILDEC, MISO). Optimal JEMSOC staffing will include special technical operations (STO) cleared personnel to coordinate and deconflict STO issues and capabilities. The JEMSOC will also require access to the administrative, intelligence, logistics, legal, communications, computer network, and partner nation systems support.

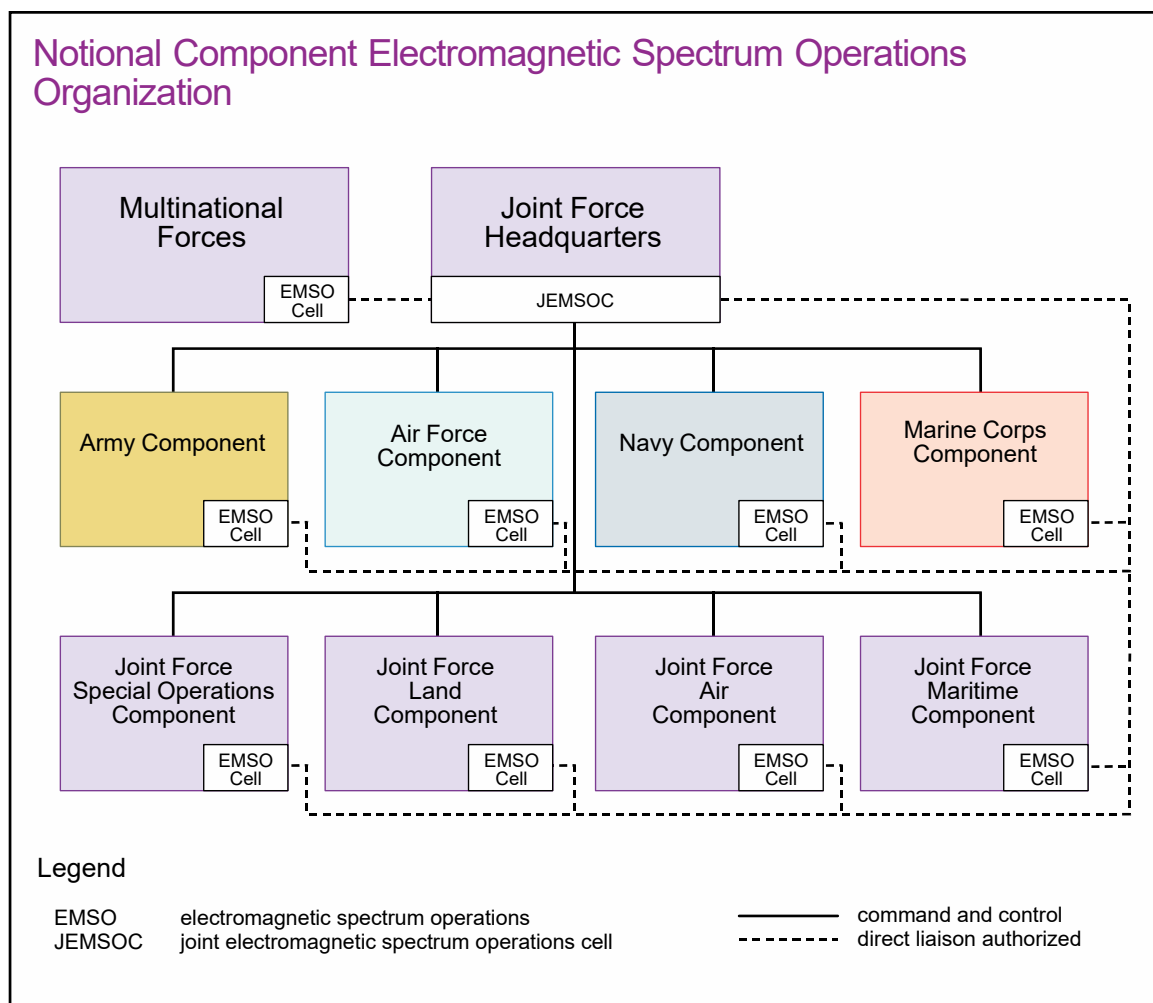


Figure II-3. Notional Component Electromagnetic Spectrum Operations Organization

4. Service Support

Each Service has a different approach to organizing its forces. Therefore, the information below provides an overview of how each Service's EMSO facilitate planning and coordination at the joint level.

a. **Army.** Army commanders and their staffs conduct cyberspace electromagnetic activities (CEMA) to plan, integrate, and synchronize cyberspace and EW operations as a unified effort to project power in and through cyberspace and the EMS. Executing cyberspace and EW operations enables the Army to secure and defend friendly force networks and to protect personnel, facilities, and equipment. Spectrum management (SM) operations enable CEMA by ensuring access and deconfliction for the Army's use of the EMS. Planning, integration, and synchronization of the interrelated actions support the overall mission.

For more information on Army CEMA, refer to Field Manual 3-12, Cyberspace and Electromagnetic Warfare Operations.

b. **Marine Corps**

(1) Headquarters, United States Marine Corps (HQMC), Deputy Commandant for Information, is the advocate for Marine Corps EMSO. HQMC CD&I [Combat Development and Integration] coordinates with other HQMC agencies, the operating forces, supporting organizations, and mission partners to identify, prioritize, and integrate EMSO EW capability solutions across the pillars of doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy and joint requirements. Principle HQMC stakeholders include the Deputy Commandants for Plans, Policies, and Operations; Aviation; and Information.

(2) EMSO facilitate Marine air-ground task force (MAGTF) C2 while simultaneously denying unimpeded EMS access to threats. This facilitates MAGTF efforts to dictate operational tempo in support of commander's objectives. Based upon accurate, timely, and shared understanding of the EMOE, coordinated MAGTF EMSO can more effectively target enemies while minimizing interference of friendly and neutral systems within a congested and contested EMS.

(3) The Marine Corps approach to EMSO reflects a five-element design. This design provides the intellectual foundation for how the Marine Corps approaches EMSO to maintain EMS superiority in a congested, contested, and competitive EMOE. With this understanding, a more detailed concept of employment can be developed. Each element builds upon the next, and together they support how the MAGTF achieves and maintains EMS superiority:

- (a) Network-enabled systems.
- (b) Networks and connectivity.
- (c) Common data sources and formats.

- (d) Common service framework.
- (e) Common user environment.

(4) The electromagnetic spectrum operations cell (EMSOC) and the CO cell coordinate the integrated planning, execution, and assessment of EMS and CO across the MAGTF's OE to increase operational tempo and achieve military advantage. The EMSOC construct originates from the traditional electromagnetic warfare coordination cell (EWCC) but with additional capability for planning, requesting, and/or coordinating organic and external support for CO. The EMSOC is the principal means for the commander to plan, coordinate, synchronize, and deconflict operations in and through the EMS and their potential impacts on the EMOE. The EMSOC will use EMS coordination documents to define supporting and supported roles and determine specific control measures to synchronize operations occurring in and through the EMS.

(5) The HQMC C4 [Director, Command, Control, Communications, and Computer Systems] provides Marine Corps EMS policy and oversees EMS use, requirements, and operations. HQMC C4 establishes Marine Corps policy; provides oversight, guidance, and procedures relating to the proper and efficient management of the EMS; provides Marine Corps representation (at the policy level) to various national, DOD, joint, and Department of the Navy organizations, WGs, and forums; and provides administrative, technical, and operational support to the operating forces and supporting establishment in support of Marine Corps EMS operational requirements.

(6) The Navy and Marine Corps spectrum offices (NMCSOs) are the Department of the Navy's principal regional offices providing administrative EMS management support and assistance for all unit, installation, and Navy customers requiring tactical and non-tactical communications and noncommunications frequency assignment requests for the United States and its territories. Outside the continental United States, EMS support must follow CCMD guidance.

(7) While the Marine Corps is evaluating multiple staff organizational options for EMSO, EW management activities are still doctrinally coordinated and deconflicted through an EWCC under the staff cognizance of the MAGTF operations staff. Personnel may also be assigned to liaison teams for HHQ EW coordination organizations, when required, such as the JFC's EW staff or the JEMSOC. The MAGTF's primary mechanism for SM is the Service-level restricted frequency list, which identifies friendly and threat frequencies that cannot be jammed for various reasons.

For more information on Marine Corps EMSO, refer to Marine Corps Reference Publication 3-32D.1, Electronic Warfare.

c. Navy

(1) Electromagnetic maneuver warfare is the Navy's warfighting approach to gain decisive military advantage in the EMS and is the foundational concept that supports JEMSO. Sensing, assessing, and monitoring the EMOE and all EMS-related activities provides a strategic advantage and enables freedom of action across all Navy mission areas.

(2) The maritime operations center (MOC) is the organization and process that supports the Navy's role as a joint force maritime component commander (JFMCC) or numbered fleet commander. The MOC is the bridge between strategic-level guidance and tactical execution. The various MOC cells and cross-functional WGs will interpret strategic and operational JEMSO guidance to plan, coordinate, synchronize, and assess (to include BDA assistance) EMBM-related actions with subordinate forces. The MOC performs EMBM and C2 functions to enable the JFMCC or numbered fleet commander to dynamically plan, direct, monitor, and assess operations within the EMOE. The MOC provides maritime component requirements to the JEMSOC, and joint SM office and/or NMCSO, and coordinates all maritime changes/inputs, to include modifications of the JRFL and to assist with JSIR reporting and mitigation.

(3) EMS readiness is a key consideration for the Navy. It is the ability of an EMS-dependent system/platform to perform its functions as designed in a congested EMOE. EMS readiness considers:

- (a) The impact of the planned physical scheme of maneuver on the EMOE.
- (b) The required operations in the EMS to be executed and the amount of EMI expected.
- (c) The difference between assets and resources required and those assigned.
- (d) The compatibility between assigned assets and resources.

For more information concerning Navy support, see JP 3-32, Joint Maritime Operations, and Navy Tactics, Techniques, and Procedures (NTTP) 3-32.1, Maritime Operations Center.

d. **Air Force.** The Air Force organizes to conduct EMSO primarily through the non-kinetic operations coordination cell (NKOCC) located in the air operations center (AOC). The NKOCC is the air component commander (ACC) EMS capabilities integrator. It plans, directs, and assesses Air Force EMSO activities conducted in air, space, and cyberspace, which include actions to exploit, attack, protect, and manage the EMOE. The NKOCC works to convey across the force and up the chain of command the ACC's plan for achieving EMS superiority. The NKOCC leads Air Force EMBM system efforts. It also prioritizes EMS-user requirements and promulgates frequency authorizations for the AOC and subordinate Air Force units. The NKOCC provides guidance for Air Force JEMSO activities through the EMS control plan. The ACC relies on the NKOCC to interface with all joint and multinational JEMSO staffs. Key personnel involved in the planning and coordination of EMSO in and with the NKOCC include:

- (1) AOC EMSO planners.
- (2) AOC EW planners.
- (3) AOC spectrum managers.

- (4) ACC A-2 [intelligence staff].
- (5) ACC A-3 [operations staff].
- (6) ACC A-5 [plans staff].
- (7) ACC A-6 [communications staff].
- (8) AOC space planners.
- (9) AOC CO planners.
- (10) AOC meteorological and oceanographic (METOC) planners.

“Use of the term ‘non-kinetic’ in this context is an Air Force organizational name only, and in no way is meant to describe a type of military activity or operation.”

For more information on Air Force JEMSO capabilities, see Air Force Doctrine Annex 3-51, Electromagnetic Warfare and Electromagnetic Spectrum Operations.

e. **Coast Guard.** United States Coast Guard (USCG) JEMSO activities currently only include actions to monitor, assess, and provide intelligence products. The USCG may conduct JEMSO under Title 10, United States Code (USC), and Title 14, USC, authorities. USCG planning and execution of JEMSO require coordination among several USCG organizations:

(1) The USCG CG-672 [Communications Policy Division] is the USCG Service-level office responsible for spectrum policy and equipment certification-related matters. CG-672 falls under the Deputy Commandant for Mission Support and USCG chief information officer (CIO)/CG-6 [Assistant Commandant for Command, Control, Communications, Computers, and Information Technology].

(2) The C4IT-FSD [Command, Control, Communications, Computers, and Information Technology Service Center Field Services Division] Spectrum Management Branch (SMB) manages RF spectrum and represents the USCG in the coordination of SM issues with civil, military, and national regulatory organizations. C4IT-FSD SMB directs USCG-wide SM activities, develops and implements SM doctrine, allocates frequency resources and assignments to support USCG missions, and serves as the principal advisor to the USCG CIO/CG-6 and CG-672 for RF SM and frequency spectrum regulatory matters.

(3) Coast Guard district commands have principal spectrum managers located throughout the United States. The principal spectrum managers serve as the principal field office representative providing SM support for their assigned district, including all USCG units, installations, and special-case USCG customers.

For more information on USCG support to JEMSO, see Commandant Instruction (COMDTINST) M2400.1, Spectrum Management Policy and Procedures.

f. National Guard Bureau (NGB)

(1) The National Guard (NG) provides mission-ready military forces (Army National Guard and Air National Guard) to assist local, state, and national authorities during normal, day-to-day operations; emergencies; incidents of national significance; homeland defense (HD); and defense support of civil authorities (DSCA) operations. NG units may also be assigned to CCMDs for overseas active duty upon mobilization under Title 10, USC. There is a requirement for interoperable communications with local first responders and state and federal civilian agencies; Title 10, USC, forces also make JEMSO considerations a priority. The NG is under the C2 of a state governor when in state active duty or Title 32, USC, status. Title 10, USC, response force could be formed from either a standing JTF or one configured for specific missions to provide emergency assistance across all lines of support. Title 10, USC, JFC coordinates with National Guard joint force headquarters-state (NG JFHQ-State) through a dual-status command relationship, if a dual-status command is established, to achieve unity of effort between federal and state response forces.

(2) NGB J6's [Command, Control, Communicators, and Computers Directorate] SMB is the designated office within the NGB for planning and executing SM for the states, territories, District of Columbia, and other assigned forces. It also provides support to NG JFHQ-States with communications to United States Northern Command (USNORTHCOM) or United States Indo-Pacific Command (USINDOPACOM) and all other US Government departments and agencies on spectrum usage during HD and DSCA operations. NGB J6 SMB, provides spectrum support to NG forces in state active duty and Title 32, USC, status to facilitate this coordination. NGB J6 SMB works with the state J6s to provide support for their emergency communications plans and deployed response forces. NGB J6 SMB, in coordination with the Army Frequency Management Office and Army Network Enterprise Technology Command, provides a National Guard Interoperability Field Operations Guide (NG-IFOG) to states and territories. This RF resource, upon official notification, authorizes and provides guidance for conducting interstate and regional communications efforts while conducting domestic operations. The NG-IFOG provides guidance for use of land mobile radios, NG joint incident site communications capability assemblages, and other NG-specific communications elements and equipment.

(3) As needed, NGB J6 spectrum managers will form or perform as an element of a JSME within a supported J-6 element. The JSME will establish and implement policies and procedures governing military use of the RF spectrum within the limits imposed by higher authority. The JSME will compile and publish JCEOI to provide more definitive guidance for all participants in the response forces.

(4) NG JFHQ-State spectrum managers will ensure their assigned spectrum resources are utilized IAW current laws, regulations, and procedures, to ensure unity of effort with respect to state active duty, Title 32, USC, or Title 10, USC, forces conducting

domestic operations. The JFC and staff need to be aware that conducting operations in a state requires coordination with the NG JFHQ-state spectrum manager and state emergency operations center, in addition to any other military or federal operations, to facilitate unity of effort and an interference-free EMOE.

5. Intelligence Support Organizations

a. **National- and DOD-Level Intelligence Organizations.** At the national level, organizations and agencies such as the Central Intelligence Agency (CIA), NSA, National Geospatial-Intelligence Agency (NGA), and Defense Intelligence Agency (DIA) are constantly seeking to identify, catalog, and update the EOB of threats. The National Security Agency/Central Security Service serves as an operationally focused analytical clearinghouse for all databases that provide SIGINT support to CCMDs, subordinate commands and their staffs, and the joint force. National-level organizations such as the NASIC, NGIC, and National Maritime Intelligence Center (NMIC) not only define EW target parameters and associated system performance but also analyze and provide intelligence on threat EMSO doctrine and tactics. National-level collection efforts also provide much of the intelligence gathered about threat EM infrastructures. The DIA Defense Collection Coordination Center (DCCC) is the focal point for tasking national assets to collect intelligence in response to JEMSO intelligence requirements. JEMSO intelligence requirements that cannot be met by lower-level intelligence assets are forwarded to the DCCC or other national-level organizations according to established procedures for prioritization and tasking to national assets.

For more information on the organization of national-level intelligence support, refer to JP 2-01, Joint and National Intelligence Support to Military Operations.

b. **CCMD Intelligence Organizations.** At the CCMD level, intelligence support to military operations is focused in the joint intelligence operations center (JIOC). The JIOC responds to theater-level, JEMSO-related intelligence requirements and forwards requests that require national-level assets to the DCCC or other national-level organizations according to established procedures. JEMSO planners within the JEMSOC at the CCMD level work closely with the JEMSOC J-2 representative to satisfy intelligence requirements according to command-specific procedures established by each CCDR.

For more information on theater-level intelligence support, refer to JP 2-0, Joint Intelligence.

c. **Subordinate Joint Force.** The J-2 is the primary point of contact for providing intelligence support to JEMSO. At the discretion of the JFC, a JTF joint intelligence support element (JISE) may be established to augment the subordinate joint force J-2 element. Under the direction of the joint force J-2, a JISE normally manages the intelligence collection, production, and dissemination of a joint force. The J-2 will normally assign one or more members of its staff to the JEMSOC to liaise between the J-2 and the JEMSOC. The purpose of this liaison is to coordinate collection requirements and analytical support for compartmented and non-compartmented JEMSO. Because of the

close interrelationship between some ES and SIGINT activities, JEMSO planners may find it necessary to work with a wide variety of personnel in the intelligence section of the staff.

For more information on how the IC is organized to support joint military operations, refer to JP 2-01, Joint and National Intelligence Support to Military Operations.

6. Multinational Force Organization

a. **Multinational Force Commander (MNFC).** The MNFC provides guidance to plan and conduct JEMSO to the multinational force (MNF) through the J-3's combined EWCC. It should be recognized that the EWCC assumes responsibilities designated in paragraph 2.c., "JEMSOC." Note: North Atlantic Treaty Organization (NATO)/multinational terminology still references the EWCC. Therefore, EWCC, not JEMSOC, will be used when discussing NATO/multinational operations.

b. **Multinational Staff.** The MNFC should assign responsibilities among the staff for management of JEMSO resources in multinational operations as follows:

(1) **Operations Officer.** The multinational staff's operations directorate has primary responsibility for planning and integrating JEMSO with other mission areas.

(2) **JEMSO Staff.** The JEMSO staff's primary responsibility should be to ensure the MNFC is provided the same JEMSO support that a US JFC would expect. In addition to performing the JEMSOC duties previously described, the EWCC chief will:

(a) Ensure all component commanders of the MNF provide qualified members to the MNFC's EWCC staff (e.g., EWOs, EMS managers, intelligence, EW assistance to BDA). The rationale for augmentee status is that partner nation officers are normally full members of the multinational JEMSO planning cell and responsible to the chain of command. This enhances unity of command better than having a liaison.

(b) Determine the need for placing US JEMSO LNOs with multinational commands to ensure the MNFC's JEMSO plans and procedures are correctly interpreted.

(c) Integrate partner nation JEMSO augmentees at the initial planning stage, delegating to them duties and responsibilities similar to those given to equivalent US officers.

(d) Coordinate the necessary JEMSO communications connectivity for assigned forces. Particular emphasis should be given to equipment, encryption devices and keying material, and procedural compatibility when integrating MNFs.

(e) Ensure constant liaison with the multinational staff's intelligence directorate and cryptologic support group to provide the most adaptive and effective intelligence support to JEMSO efforts. Ensure planned EW targeting efforts have minimal impact on friendly collection efforts.

(f) Integrate partner nation communications system directorate processes into JEMSO planning and oversight. Integrate JEMSO C2 requirements into the JRFL. Coordinate with the multinational staff's communications system directorate to ensure tracking and remediation of JSIR events.

(g) Provide MNFs with current US JEMSO doctrine and planning guidelines at the earliest possible stage.

(h) Ensure timely EW reprogramming coordination and support.

(3) **Partner Nation JEMSO Officers.** Partner nation commanders should assign qualified JEMSO personnel (e.g., EWOs, EMS managers, intelligence staff) to the MNF JEMSO planning cell. These officers should:

(a) Have an in-depth knowledge of their forces' operational SIGINT and JEMSO requirements, organization, capabilities, national support facilities, and C2 structure.

(b) Possess national clearances equivalent with the level of classified US military information they are eligible to receive IAW US national disclosure policy. This may require officer (O-3 or O-4) pay grade level or equivalent. As a result, they may be augmentees drawn from national sources other than the unit(s) involved in the MNF.

For further information on MNF operations, see JP 3-16, Multinational Operations.

CHAPTER III

PLANNING JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS

1. Introduction

JFCs centralize JEMSO planning under the designated EMSCA and decentralize execution to ensure JEMSO unity of effort while maintaining tactical flexibility. Operations in the EMS cross all joint functions, span the OE, and are often complex and interwoven. This requires detailed prioritization, integration, and synchronization to attain EMS superiority, achieve the commander's objectives, mitigate EMI, and avoid friendly fire EA incidents (involving personnel or equipment). JEMSO planning provides the basis for the prioritization, integration, and synchronization of joint force EMS operations between the staff functions (primarily J-2, J-3, and J-6), components, and multinational partners across all phases of military operations. The CCMD JEMSOC is the lead staff element for JEMSO planning. JEMSO planning uses the joint planning process (JPP) to frame the problem; examine mission objectives; develop, analyze, and compare alternative courses of action (COAs); select the best COA; and produce the JEMSO plan or order. The JPP normally results in the development of CONOPS, OPLANs, and OPORDs. The JEMSOC ensures JEMSO are integrated throughout the command's planning process.

2. Planning Process

The commander's guidance and estimate form the basis for determining components' objectives. During mission analysis, JEMSO planners develop a JEMSO staff estimate, which forms the basis for an EMS superiority approach. The staff estimate is used during COA development and analysis to determine the EMS activities and capabilities required to accomplish the mission, the JEMSO capabilities required to support operations, and the risk to the operation if EMS superiority is not achieved. When a COA is chosen, it becomes the basis for developing the JEMSO appendix, which outlines JEMSO missions, priorities, policies, processes, and procedures across all phases of the operation. The joint force components will develop component EMSO plans and submit them to the JEMSOC for integration into the JEMSO appendix under annex C (Operations). The JEMSO planning process is a formal, top-down, centralized process that integrates EMSO into the JFC's plan. Figure III-1 shows the types of tasks and products the JEMSOC should develop during each JPP step.

For information on joint planning, refer to JP 5-0, Joint Planning, and CJCSM 3130.03, Planning and Execution Formats and Guidance.

a. **EOB.** The EOB is a key product the JEMSOC updates to support planning. The EOB details the strength, command structure, disposition, and operating parameters of friendly force, threat, and neutral EMS-dependent systems identified in the order of battle. This includes the identification of transmitters and receivers in an AOI, a link to systems and platforms supported, determination of their geographic location or range of mobility, characterization of their signals, EMS parameters, and, where possible, a determination of their role in the broader organizational order of battle. While the J-2 provides the information required to build the threat and neutral EOBs, the J-3, J-6, components, and

Joint Electromagnetic Spectrum Operations Cell Actions and Outputs as Part of Joint Planning

Planning Process Steps	Joint Electromagnetic Spectrum Operations Cell (JEMSOC) Planning Actions	JEMSOC Planning Outputs
Planning Initiation	- Review appropriate documents such as warning order and strategic assessment. - Review joint intelligence preparation of the operational environment, desired end state, strategic effects and objectives - Obtain order of battle and begin building electromagnetic order of battle (EOB) - Review rules of engagement (ROE), guidance, and operational estimates - Review operational factors within theater to identify risk to mission - Identify organizational construct for the JEMSOC - Identify US/multinational electromagnetic spectrum (EMS) considerations - Identify EMS-use restrictions - Disseminate electromagnetic interference reporting procedures - Disseminate joint restricted frequency list requirements - Disseminate EMS management tools and procedures	- Initial EOB - Requests for information (RFIs) on threats - Friendly force information requirements (FFIRs) - Data call message - EMS management concept - Multinational frequency assignment agreement(s) initiated - Initiate host nation (HN) frequency coordination
Mission Analysis	- Support development of intelligence estimate - Describe how threat uses the electromagnetic operational environment (EMOE) to support operations - Describe threat capability to deny friendly force EMS use - Identify specified, implied, and essential electromagnetic spectrum operations (EMSO) tasks - Identify assumptions, constraints, and restraints relevant to EMSO - Identify planning support requirements, issue support requests - Review available EMSO assets, identify employment authorities - Define the EMOE area of interest - Describe EMOE physical and environmental characteristics - Provide EMSO perspective in support of mission requirements - Identify EMSO opportunities for EMSO and risk to mission - Support center of gravity (COG) decomposition and analysis - Determine EMSO role in defeating COG	- Updated EOB - Draft initial EMS staff estimate - List of EMSO tasks - Assumptions, limits, constraints, and restraints - EMSO planning guidance - JEMSOC augmentation request - List of EMSO capabilities potentially required
Course of Action (COA) Development	- Build EOB and EMOE estimate for each COA - Review intelligence estimate of threat and friendly force COAs - Identify electromagnetic warfare (EW) requirements and opportunities for each COA - Determine how EMOE must be shaped to support the COA - Identify EMSO capabilities required to meet EW tasks - Revise EMSO portion of COA to develop staff estimate - Analyze COA from EMSO perspective, build mitigation methods	- List of objectives, tasks, capabilities - EOB and EMOE for each COA - Threat and friendly force targets vulnerable to electromagnetic attack (EA) - Initial joint task force (JTF) EMS requirements summary developed
COA Analysis and Wargaming	- Analyze each COA from EMSO perspective - Identify operations in the EMS supporting all component missions - Identify threat capabilities that impact friendly force operations - Identify opportunities to exploit or attack threat electromagnetic operations - Identify possible targets for EA - Recommend EMSO critical information requirements - Identify the activities required to shape the electromagnetic environment to support operations and the risk to COA if EMOE is not shaped accordingly	- List of EMSO assets - Assessment of COA risk from EMSO view - List of EA vulnerable targets - List of targets to enable friendly force EMSO - JTF EMS requirements summary developed
COA Approval	- Compare each COA based on mission and EMSO tasks - Compare EMSO requirements from each COA - Review EMSO assets and capabilities needed to execute COAs - Identify risk to COA execution from EMSO perspective - Prepare EMSO risk assessment portion of decision brief - Obtain EMS resources and HN approval	- COA EMSO strengths and weaknesses - EMSO risk assessment for each COA - Risk mitigation methods - JTF allotment plan
Plan or Order Development	- Update EOB and EMS staff estimate based on COA decision - Develop EMSO guidance - Review joint and component concept of operations and schemes of maneuver - Develop EMSO portion of a synchronization matrix - Submit EMSO-related information requests and ROE - Refine EMSO tasks from the approved COA - Identify EMSO capability shortfalls and recommend solutions - Update EMSO portions of operations plan - Advise commander on EMSO issues and concerns	- Initial EMOE estimate - EMS staff estimate - Joint electromagnetic spectrum operations (JEMSO) appendix - Request for EMS forces - EMSO ROEs, RFIs, and FFIRs - Initial master net list - JEMSO plan (includes EMS plan)

Figure III-1. Joint Electromagnetic Spectrum Operations Cell Actions and Outputs as Part of Joint Planning

supporting units provide the information necessary to build the friendly force EOB. The J-2 will also contribute to the friendly force EOB by providing information regarding ISR within the EMOE.

b. **EMOE Estimate.** The JEMSOC defines and characterizes the EMOE within the AOI associated with a given OA. The EMOE estimate includes sections that describe the background EME; identify factors that affect signal propagation (e.g., environmental characteristics and terrain); create a database of the known spectrum-use information; review historic EMI events within the area; and integrate the friendly, neutral, and threat EOBs.

(1) Define and characterize the EMOE.

(a) The situation analysis portion of the JEMSO staff estimate is where the EMOE is initially defined and characterized, forming the foundation for the JEMSO aspects of COA development, analysis, and selection.

(b) Characterizing the EMOE is an iterative process that employs many of the tasks and methodologies associated with JIPOE. An EMOE tends to be dynamic, requiring the associated databases and analyses be updated periodically, often on a very short timeline. The physics of the EMS dictate that the military usefulness and properties of a given set of frequencies may vary periodically, based on environmental factors outside of JFC control. JEMSO planners not only must anticipate changes in both neutral and threat operations in the EMS but also need to consider potential naturally occurring EMOE changes as well. Sources and areas subject to EMI (e.g., local civilian infrastructure such as airports) should be identified as part of the EMOE.

(c) EMOE information should be current, accurate, and accessible to authorized users. JEMSO planners should designate primary EMOE data sources to facilitate this. This source designation should be accompanied by information on the organization(s) responsible for maintaining the data sources, the associated processes and timelines for source population, requirements for access (user clearances and timelines), and the processes for dealing with data source conflicts.

(d) Meteorological, oceanographic, and space conditions should be considered. JEMSO planners should include the effects of atmospheric and space weather on both the EMOE and all EMS-dependent systems. The various types of atmospheric conditions and phenomena can positively or negatively affect these systems. For example, atmospheric temperature inversions can increase the propagation of radio signals with frequencies in excess of 30 megahertz; high humidity and rainy climates are detrimental to IR systems; and ionospheric scintillation can adversely affect GPS, high frequency, and ultrahigh frequency transmissions. Some atmospheric effects are well known and are categorized by season and location. Planners should consult with the CCMD meteorological, oceanographic, and space staffs to determine the type of support available for their operation.

(2) The JEMSOC will use this information to create EMOE estimates that support each step of the JPP. These EMOE estimates describe the predicted state of the EMOE at a future time and location. Components of an EMOE estimate include:

- (a) Expected state of the physical environment (e.g., METOC predictions).
- (b) Threat, neutral, and friendly force EMS-dependent systems expected to be active during that time.
- (c) Level of readiness and predicted role of the EMS-dependent systems in support of operations.
- (d) Most likely locations and range of operation of the EMS-dependent systems.
- (e) Predicted set of EMS parameters to be used.

c. **JEMSO Staff Estimate.** The purpose of the JEMSO staff estimate is to inform the commander, staff, and subordinate commands how EMSO support mission accomplishment. The commander and staff use this information to support COA development and selection. JEMSO planners use the staff estimate (a primary product of mission analysis) to prepare evaluation request messages to solicit COA input from subordinate components and units to subsequently develop preliminary COAs. The JFC's JEMSOC uses the CCMD's mission, commander's estimate, objectives, intent, and CONOPS to develop COAs. During COA development and selection, JEMSO planners fully develop their estimate, providing an EMS analysis of the COAs, as well as recommendations on which COAs can be adequately supported by JEMSO. Planners should identify critical shortfalls or obstacles that impact mission accomplishment. The JEMSO staff estimate is continually updated, based on changes in the situation.

For information on JEMSO staff estimates, see Appendix G, "Joint Electromagnetic Spectrum Operations Staff Estimate Template."

For information on staff estimates, refer to JP 5-0, Joint Planning.

(1) **EMS Superiority Approach.** The EMS superiority approach ensures joint forces achieve the advantage in the EMS that permits the conduct of operations at a given time and place without prohibitive interference, while affecting an enemy's ability to do the same. The approach is comprised of the mission analysis and mission statement portions of the JEMSO staff estimate and should be documented in the EMSO section of the CONPLAN OPLAN/OPORD. This approach outlines the key missions and tasks the joint force components will carry out to achieve EMS superiority and establishes the basic relationships between the exploit, attack, protect, and manage activities the joint force will accomplish. The approach identifies key EMS users throughout the OE. It provides the framework for detailed JEMSO planning. Key elements of the EMS superiority approach include:

(a) JEMSO missions that joint forces are expected to perform (e.g., mitigating an enemy's ability to contest friendly force operations through the EMS, denying the enemy from maneuvering in the EMS to support their operations, HNC).

(b) Assumptions (e.g., HN EMS-use authorizations, EMS availability).

(c) Key considerations based on the expected EMOE.

(d) Anticipated scale of operations and the number and type of friendly forces (to include multinational partners).

(e) Establishment of JEMSO organizations.

(f) Relationships among EMS organizations internal and external to the joint force.

(2) Determine Friendly EMS-Use Requirements

(a) A joint force employs EMS-dependent systems across all functions and activities. The JEMSOC establishes the process to solicit, compile, and process joint EMS-use requirements. Components identify the EMS-dependent systems they will employ in the OE, describe the capabilities and associated EMS-use requirements, and request EMS support. The resultant data is used to build the friendly force EOB, develop the EMS superiority approach, define and characterize the EMOE, determine the supportability of each COA, build the joint EMSO plan (i.e., identifies all component and supporting unit military activities in the EMS), and provide EMSO input to OPLAN or OPORD (i.e., authorizes component military EMS activities).

1. JEMSO planners at all echelons and components should account for any special classification requirements and communicate them to the JEMSOC to ensure proper clearances and need-to-know are established.

2. Proliferating network-enabled joint warfighting capabilities have increased the number of EMS-dependent links between previously autonomous capabilities. JEMSO planners should review EMS-use requirements submissions to ensure cross-capability and cross-functional EMS links have been properly captured. In high-threat or high-activity environments, an SM capability may need to be deployed to tactical levels to support EMS-dependent activities.

(b) The EMSCA issues guidance to the joint force staff elements, components, and supporting agencies on how to request JEMSO support for EMS-dependent systems that operate under their control within the joint force's OE. The guidance includes requirements for all EMS-dependent systems, including those that are receive-only. Units are required to submit their EMS-use requirements to the JEMSOC. The EMSCA guidance typically includes the following:

1. Joint force JEMSO policy and guidance.

2. Security classification guidance.
3. Procedures for submitting EMS-use requests (e.g., frequency and HNC requirements) to support EMS-dependent equipment or request non-organic JEMSO support, including lead times and request format.
4. EMBM system guidance and processes.
5. MNL requirements collection process, including the need for identifying nets requiring call signs, procedure words (prowords), and possible frequency sharing.
6. EMS coordination measure (e.g., JRFL) submission procedures, including lead times and restrictions.
7. JSIR reporting requirements, routing procedures, and EMI monitoring.
8. Targeting requirements.
9. Intelligence collection requirements.

d. JEMSO Appendix to Annex C

(1) Once a COA is chosen, the JEMSOC develops the JEMSO appendix within annex C (Operations) for the JFC's approval. This appendix establishes procedures for C2 of forces conducting JEMSO in the JOA and includes EMS coordination measures, specifying procedures, and ROE for joint force EMS use. To provide effective operational procedures, the JEMSO appendix is integrated across all portions of the JFC's COPLANs, OPLANs, and orders. The appendix considers procedures and interfaces with the international or national frequency control authorities/systems necessary to effectively support JEMSO, augmenting forces, and JFC objectives. For more information, see Appendix A, "Electromagnetic Spectrum Management." Consequently, the JEMSO appendix should be planned in advance to the highest degree possible and maintained in a basic, understandable format. This section provides an overview of key components of the JEMSO appendix. An example JEMSO appendix is in Appendix C, "Notional Joint Electromagnetic Spectrum Operations Appendix."

(a) The JEMSO appendix is coordinated with the JFMO (if not incorporated in the JEMSOC) for HN concerns.

(b) Planning factors to be addressed when developing the JEMSO appendix include understanding of the basic CONPLAN, OPLAN, or OPORD; knowledge of both HN and multinational considerations; consideration of lessons learned; an understanding of the operational and mission variables; a familiarity with the capabilities and procedures of JEMSO and military and civil communications agencies; and the general locations of friendly, neutral, and threat forces.

(c) The JEMSO appendix supports transitions throughout the competition continuum. Such transitions may occur during a period of increasing and/or decreasing tensions or without warning. The JEMSO appendix should support all phases of an operation with flexibility to respond to current requirements.

(2) **Policy and ROE.** JEMSO activities frequently involve a unique set of complex issues. There are legal and policy requirements, including DOD directives and instructions, national laws, international law (i.e., international treaties, the law of war), and ROE, which may affect JEMSO activities. Staff legal advisors can help JFCs navigate these issues when they are included throughout planning and execution process. Laws, policies, and guidelines become especially critical during peacetime operations when international and domestic laws, treaty provisions, and agreements (e.g., status-of-forces agreements [SOFAs], International Telecommunication Union Radio Regulations, International Civil Aviation Organization regulations) are more likely to affect JEMSO planning and execution. JFCs seek a legal review during all phases of JEMSO planning and execution, to include development of ROE. While ROE will be considered during the planning process, it should not inhibit developing a plan that employs available capabilities to their maximum potential. If, during the planning process, an ROE-induced restriction is identified, planners should consult with staff legal advisors to clarify the ROE or develop and obtain approval of supplemental ROE applicable to JEMSO. This ROE guides the destructive means.

(3) **Prioritization.** JFC EMS-use prioritization guidance is a key planning factor used by the JEMSOC to rank EMS-use requests in congested EMOEs and by the components to rank assigned tasks. The JEMSOC regularly reviews the JFC's priorities, solicits component inputs, and recommends EMS-use prioritization changes to the JFC.

(4) **EMBM System Processes and Capabilities.** EMBM system guidance establishes which capabilities (e.g., tools and software) and related databases will be used and how they should exchange data using approved DOD architectures for vertical and horizontal interoperability. This interoperability facilitates timely and routine JEMSO data exchanges. This exchange should be conducted via common, secure, jam-resistant means. The ability to exchange data (such as targeting information) to enhance SA and combat coordination among various force elements is a critical combat requirement. EMBM system guidance should include:

- (a) Type and version of EMSO planning tools used.
- (b) Secure connectivity to components.
- (c) Availability of C2 networks.
- (d) Compatible data exchange format and processes.
- (e) EMS coordination processes (e.g., frequency assignment, targeting, EMI resolution).
- (f) Interfaces to EMS-related databases.

(g) Interfaces to battlefield sensors.

(5) EMS Management

(a) EMS Coordination Measures and Products. The EMS management section of the JEMSO appendix outlines the spectrum requirements for achieving EMS superiority, to include EMS coordination measures. EMS coordination measures are rules, mechanisms, and directions governed by joint doctrine and discussed in the JEMSO appendix. They are products of the JEMSOC and JFMO (if not incorporated in the JEMSOC). These measures direct activities within the EMS in specified dimensions (e.g., space, time, frequency, power, waveform). The JEMSO appendix specifies EMS coordination measures (e.g., JRFL) to be used in the JOA and how these measures will be distributed and implemented. EMSO cells establish EMS coordination measures to accomplish one or more functions during specific time windows and geographical areas:

1. Establish reserved EMS bands for specific EMS activities.
2. Restrict the actions of some EMS users.
3. Create EMS bands in which units can use EMS-dependent systems with minimal risk of EMI.
4. Require EMS users to accomplish specific actions.

5. JRFL. The JRFL is an EMS coordination measure that operational, intelligence, and support elements use to identify the level of protection desired for various networks and frequencies. The JRFL is a time and geographically oriented listing of TABOO, PROTECTED, and GUARDED functions, nets, and frequencies and is limited to the minimum number of frequencies necessary for friendly forces to achieve objectives. Although the JRFL is the primary coordination method, it may be necessary to coordinate the protection of intelligence collection frequencies via the immediate joint EMS-use request process to meet the time-sensitive needs of collection activities. The JRFL is developed prior to initiating joint force operations and is continually updated during operations.

a. 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.

b. PROTECTED frequencies. Friendly frequencies used for a particular operation, identified and protected for a period of time to prevent them from being inadvertently jammed by friendly forces while active EW operations are directed against hostile forces.

c. GUARDED frequencies. A list of enemy frequencies that are, for a special time period, 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.

For information on EMS coordination measures, see Appendix F, “Electromagnetic Spectrum Coordination Measures.”

(b) HNC procedures, including lead times and restrictions.

(c) JSIR Requirements. The JSIR program ensures timely resolution of EMI. The JFMO (if not incorporated with the JEMSOC) establishes JSIR TTP that delineate reporting requirements, resolution actions, and responsibilities and ensure timely updates to JSIR online reports.

(d) MNL requirements collection process, including the need to identify nets requiring call signs, prowords, and possible frequency sharing.

For information on JSIR, see CJCSI 3320.02, Joint Spectrum Interference Resolution; CJCSI 3320.02E-1, (U) Classified Supplement to the Joint Spectrum Interference Resolution (JSIR) Procedures; and CJCSM 3320.02, Joint Spectrum Interference Resolution (JSIR) Procedures.

(6) **EM Signature Control.** JEMSO planners determine the overall OA threat and identify the known EMS capabilities. Signature control includes actions to:

- (a) Assess threat ES and SIGINT capabilities against friendly forces.
- (b) Plan and implement appropriate EMCON measures by task and phase.
- (c) Provide EMCON guidance to components.
- (d) Nominate threat ES and SIGINT systems for targeting.
- (e) Support MILDEC plans.

(7) **EW.** The JEMSO appendix of a plan outlines the EW requirements for achieving EMS superiority. Specific planning actions include:

- (a) Review EMS superiority approach.
- (b) Identify the purpose and intent of performing EW, the immediate desired effects, and authority to conduct EW.
- (c) Determine the status of EW capability of available forces relative to threat capability and determine if sufficient assets are available to perform the identified EW tasks. Draft requests for support if in-place assets are insufficient.
- (d) Consider friendly EMS use with respect to the anticipated operations, tactical threat expected, and EMI possibilities. Once identified, these requirements should be entered into the JRFL.
- (e) Identify measures to deny operations security (OPSEC) indicators to threat passive EM sensors.

(f) Establish and update appropriate EMS coordination measures (e.g., JRFL).

(g) Determine the processes necessary to eliminate or mitigate EMI from EW activity.

(h) Identify the EMS-related CCIRs. These CCIRs should be included in annex B (Intelligence) of the CONPLAN/OPLAN to facilitate timely and comprehensive ES.

(i) Coordinate and establish procedures to ensure fulfillment of EW planning tasks.

(j) Review ROE and applicable legal factors to determine the authorities needed or the restrictions, if any, that apply.

(k) Identify EM target element categories to guide collection priorities and support EM target element development.

(l) Analyze the vulnerabilities of friendly force EMS-dependent systems, determine the ability of the threat to exploit those vulnerabilities, and evaluate the resulting mission impact.

(m) Analyze the vulnerabilities of threat EMS-dependent systems and networks, determine the ability of friendly forces to exploit those vulnerabilities, and evaluate the resulting mission impact.

(n) Develop JEMSO targeting and EA priorities and ensure JRFL deconfliction.

(8) **EMSO Guidance and EMS Operating Instructions.** EMSO guidance and EMS operating instructions provide direction to prioritize, integrate, coordinate, direct, and deconflict all joint force EMS use within the JOA. Since the EMSO guidance and EMS operating instructions are integral to the JEMSO execution cycle, they are discussed in further depth in Chapter IV, “Conducting Joint Electromagnetic Spectrum Operations.”

3. Planning Considerations

a. HNC

(1) HNC is the activity to obtain authorization to operate EMS-dependent systems within another sovereign nation. EMS access and HN approval cannot be overlooked or ignored when planning for operations in the EMOE. The JFMO (or JEMSOC, if JFMO incorporated) normally has standing EMS coordination channels with the nations in the AOR. HNC is based on the fostering of mutual trust and rapport between the United States and the HN. Attempts at coordination outside the established process may disrupt or damage this relationship, making support more difficult to obtain.

(2) Effective HNC requires a technical understanding of how a nation manages its sovereign EMS, as well as a cultural understanding of the HN (i.e., how they conduct business) to procure the EMS-use authorizations required to conduct joint operations. An HN may seek to protect its commercial interests by restricting access to the EMS, thus limiting a JFC's ability to maneuver. HNC includes:

(a) Reviewing HN allocation/channel plan and usage/broadcast schedules for joint use suitability.

(b) Determining if joint force emitters comply with the HN allocation tables (e.g., emission bandwidth, type of service).

(c) Determining if pre-approved allocations are sufficient to support the JFC's EMS-use requirements:

1. Cooperatively devise coordination plan with appropriate HN EMS organizations/representatives to resolve HN and joint EMS-use conflicts.

2. In coordination with the J-5 and staff judge advocate, prepare command brief of HN agreement status and the mitigation plan or COAs for concerns or shortfalls.

(3) The unauthorized use of the EMS in HNs may be considered a violation of international treaties law or HN laws/regulations. JFCs, subordinate commanders, or operators may be held criminally and/or financially liable for HN EMS allocation violations.

(4) The JEMSOC coordinates with the JFMO (if not incorporated in the JEMSOC) for operational requirements within a HN.

b. Intelligence

(1) IC-operated sensors can provide near real time EMOE information for augmenting the ES activities organic to the joint force. A major part of intelligence efforts prior to and during an operation is collection activity (e.g., EM surveillance and reconnaissance) targeted against threat activity within the EMS. EM reconnaissance is the detection, location, identification, and evaluation of foreign EM radiation. Processing that data through SIGINT channels and combining it with other sources of intelligence data yields threat and neutral EOB information. JEMSO planners use this information to define/characterize the EMOE, conduct EA targeting, enhance EP, conduct JSIR, address gaps in ES sensing, plan communications and data networks, and support component EMS-dependent system reprogramming.

(2) The J-2 and J-3 coordinate to ensure priorities are maximized to support all aspects of the JFC's objectives.

(3) Joint forces transmitting EM energy must maintain awareness of and follow applicable EMS operating instructions. Conversely, intelligence personnel should keep

inputs into the JRFL as current as possible to support coordination and eliminate or mitigate EMI. The primary conduit for this coordination is through the JEMSOC, which may require further coordination with the IC.

(4) The JEMSOC analyzes IC collection plans for potential friendly force EMI and recommend alternatives to the IC and components to minimize mission impacts.

(5) The JEMSOC analyzes foreign PNT satellite systems and indirect use of these foreign PNT satellite systems for unforeseen C2 functionality prior to endorsing their widespread use by the joint force.

For information, refer to JP 2-01, Joint and National Intelligence Support to Military Operations.

c. CO

(1) Modern military operations are inherently reliant on networked capabilities enabled by EMS access. CO are enabled by JEMSO for the transport of information through the EMS within the JOA but can be conducted from remote locations well outside the JOA.

(2) The increasing prevalence of wireless networks in the OE creates opportunities when JEMSO and CO capabilities are used synergistically. When wired access to a particular network is limited, EMS access may be required for successful CO. The EMS can also be used as a vector for conveying an attack directly against the infrastructure of cyberspace. For instance, EA (e.g., high-energy laser, HPM, EMP weapons) or an EMS-enabled cyberspace attack can be employed to damage or destroy computers that support CO. EA, ES, and EP can each assist in setting the conditions in cyberspace to ensure availability of the area requiring access, provide the ability to engage enemies decisively, and conduct CO to enable the creation of the desired effects.

(3) The effectiveness of the Department of Defense information network (DODIN) is measured in terms of confidentiality, availability, and integrity. DODIN EMS-use requests are addressed in the same manner as any other joint EMS requirements. JEMSO planners review the requirements and integrate them into the EMSO guidance and EMS operating instructions. The JEMSOC will then provide this approved allotment of frequencies to DODIN in the same DOD-approved format. JEMSO planners review DODIN operations plans to ensure they are synchronized with EP activities.

For information on CO, refer to JP 3-12, Cyberspace Operations, and its classified appendix.

d. **PNT.** Due to the dual civil/military nature of GPS/GNSS (e.g., BDS, GLONASS, Galileo) and other PNT services, potential impacts from NAVWAR efforts on nonmilitary users and the civil/commercial critical infrastructure are thoroughly analyzed during COA development and may need to be coordinated through JFMO with HN EMS authorities. NAVWAR considers the impact of enemy GPS jammers on friendly force systems, provides guidance on the type of GPS receivers needed to support mission execution, aids

in determining the quantity and types of GPS-aided munitions required to execute a COA, and recommends GPS jammers as targets. Additional attention is focused on ensuring GPS jamming reports consider the specific GPS receiver configuration and internal clock setting, as well as possible future use of a US Naval Observatory timing standard in local use.

(1) Military and civil users depend on assured PNT, which is essential to effective joint operations and defense/civil critical infrastructure. GPS is the primary source of space-based PNT for US and multinational warfighters. The threat recognizes the United States' dependence on GPS and is developing and fielding increasingly capable jammers to deny GPS and other GNSS services to friendly forces.

(2) JEMSO supports NAVWAR operations by establishing EMS superiority at a specific time, duration, and place, ensuring freedom of access for mission critical PNT operations. The majority of PNT operations rely on GPS, to include the necessary space, ground, and link segments of the system.

For more discussion on PNT and NAVWAR, refer to JP 3-14, Space Operations.

e. Information Activities

(1) The information function encompasses the management and application of information and its deliberate integration with other joint functions to change or maintain perceptions, attitudes, and other elements that drive desired behaviors and to support human and automated decision making. The information function helps commanders and staffs understand and leverage the pervasive nature of information, its military uses, and its application during all military operations. This function provides JFCs the ability to integrate the generation and preservation of friendly information while leveraging the inherent informational aspects of military activities to achieve the commander's objectives and attain the end state. JEMSO enable information activities by coordinating and integrating EMS-use requirements to eliminate or mitigate EMI caused by friendly or threat forces. JEMSO also provide information activities with the means of transmitting information through the EMS.

(2) The JFC or designated staff element may establish an information cell to coordinate the inherent informational aspects of activities that support the CONOPS. Nearly all information activities depend on, use, or exploit the EMS for at least some of their functions. JEMSO prioritization, integration, and synchronization are continuous processes and a constant consideration in information planning efforts.

(3) EA can create decisive and enhanced effects in the information environment that provide the JFC with an operational advantage by contributing to the gaining and maintaining of information superiority. Information superiority is the operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying a threat's ability to do the same.

(4) When EA is employed as nonlethal fires, it can often be employed with little or no associated physical destruction. EA in support of information activities is integrated

at the JFC level, through the joint targeting coordination board (JTCB) or like body, to predict collateral damage and/or effects and incorporate risk mitigation techniques.

For more discussion on the information joint function, refer to JP 3-0, Joint Operations.

f. **MISO.** JEMSO support and enable the joint MISO communications plan by ensuring frequencies are available for broadcast services when these are controlled by the CCDR. MISO units depend on information gathered through JEMSO (e.g., ES) and intelligence (e.g., SIGINT) sensors to warn them of threats and provide feedback about reaction to MISO broadcasts and other activities. MISO uses EP and JSIR processes to eliminate or mitigate threat EA activities or inadvertent EMI from disrupting their efforts. MISO and JEMSO coordination, especially with regards to EA, depends on timely updates to EMS operating instructions.

For information on MISO, refer to JP 3-13.2, Military Information Support Operations.

g. **OPSEC.** JEMSO support OPSEC by degrading threat intelligence collection against friendly units and activities. ES supports OPSEC by providing information about threat capabilities and intent to collect intelligence on friendly forces through the EMS. ES can also be used to evaluate the effectiveness of friendly force EMCON measures and recommend modifications or improvements. An effective and disciplined EMCON plan and other appropriate EP measures are important aspects of good OPSEC. OPSEC supports EMSO by concealing units and systems to deny information on the extent of EMSO capabilities. During operations, OPSEC and JEMSO staff personnel should frequently review the CCIRs in light of the dynamics of the operation. Adjustments should be recommended to the EMCON posture and other EP measures as necessary to maintain effective OPSEC.

For more information on OPSEC, refer to JP 3-13.3, Operations Security.

h. **MILDEC**

(1) JEMSO support MILDEC by using EA as deception measures; degrading threat capabilities to see, report, and process competing observables; providing threats with information received by EM means that is prone to misinterpretation; and using EP and EMCON to control EM activity observable by a threat. MILDEC frequently relies on the EMS to convey the deception to threat intelligence or tactical sensors. JEMSO planners should ensure EMS frequencies necessary to support deception plans are accounted for in EMS management databases and in the EMS operating instructions without disclosing that specific frequencies are related to deception.

(2) Designated JEMSO planners work through the J-3 staff to coordinate and integrate JEMSO support to MILDEC operations.

(a) Friendly EA assets may be an integral part of the deception effort by selectively jamming, interfering, or masking the EM profile of the main operational effort. EM masking is the controlled radiation of EM energy on friendly frequencies in a manner to protect the emissions of friendly communications and EM-dependent systems against

threat ES measures/SIGINT without significantly degrading the operation of friendly systems. EM masking is used to disguise, distort, or manipulate friendly EMS radiation to conceal military operations information and/or present false perceptions to threat commanders.

(b) Friendly assets can also be used to stimulate air defense systems (communications and radar) through either EM or physical means. Stimulation of an air defense system enables the ability to target or map the EOB and causes the enemy to commit assets (air or ground).

(3) Disciplined EMCON and other appropriate EP efforts, by both deception assets and those of the main effort, are essential to preventing the threat from distinguishing deception activities from the main effort.

(4) ES assets can provide immediate warning to deception forces about threat forces reacting to their presence or actions. ES assets are also an important means to determine that the threat is capable of receiving the EM aspects of a deception. Since deception forces are often positioned “off axis” from the main effort, ES platforms positioned with the deception effort may assist in location of enemy forces by assisting with triangulation in direction-finding activities. Direction finding is a procedure for obtaining bearings of RF emitters by using a highly directional antenna and a display unit on an intercept receiver or ancillary equipment.

(5) Designated JEMSO staff personnel should have the security clearances and access necessary to work with MILDEC planners during planning and execution of an operation that involves MILDEC. During the execution of an operation, JEMSO staff personnel should monitor EW support to the MILDEC effort and coordinate any changes or resolve conflicts in a timely manner.

For information on MILDEC, refer to JP 3-13.4, Military Deception.

i. **Interoperability.** Interoperability is essential to effective JEMSO. JEMSO planners must know and integrate the EMS-dependent capabilities in theater and how they will interact during execution to minimize EMS conflicts and enhance EMSO effectiveness.

j. **Suppression of Enemy Air Defenses (SEAD).** SEAD is a specific type of mission intended to neutralize, destroy, or temporarily degrade surface-based enemy air defenses with destructive and/or disruptive means. Joint SEAD is a broad term that includes all SEAD activities provided by one component of the joint force in support of another. SEAD missions are of critical importance to the success of any joint operation when control of the air is contested. SEAD relies on a variety of EW platforms to conduct ES and EA in its support, and JEMSO planners should coordinate closely with joint and component air planners to ensure support to SEAD missions is integrated into the overall JEMSO plan.

For information on SEAD, refer to JP 3-01, Countering Air and Missile Threats, and JP 3-09.3, Close Air Support.

k. **EW Reprogramming.** EW reprogramming is the deliberate alteration or modification of EW or target sensing systems (TSSs), or the tactics and procedures that employ them, in response to validated changes in equipment, tactics, or the EME. The purpose of EW reprogramming is to maintain or enhance the effectiveness of EW and TSS equipment. EW reprogramming includes changes to self-defense systems, offensive weapons systems, and ES systems. The reprogramming of EW and TSS equipment is the responsibility of each Service or organization through its respective EW reprogramming support programs. The swift identification and resolution of reprogramming efforts is vital in gaining EMS superiority in a rapidly evolving, congested, and contested EMOE. Service reprogramming efforts include coordination with the JEMSOC to ensure those reprogramming requirements are identified, processed, deconflicted, and implemented in a timely manner by all affected friendly forces. The JEMSOC includes the status of EW reprogramming efforts during planning to account for potential platform vulnerabilities.

For additional information, see Appendix E, “Electromagnetic Warfare Reprogramming.”

l. **Cybersecurity.** The DOD cybersecurity program is concerned with preventative, protective, and restorative measures for information systems and the information contained therein. Many of these measures involve the use of the EMS. EP equipment, attributes, and processes assist in assuring the availability and integrity of modulated data traversing the EMOE. EA TTP assist in compromising those same qualities which threat cybersecurity seeks to protect. EMS management procedures, particularly EMI resolution, assist the application of cybersecurity policy in overcoming the problem of EM friendly fire incidents.

m. **Chemical, Biological, Radiological, and Nuclear (CBRN) Environments.** In a CBRN threat environment, JEMSO planners should consider the potential effects of a CBRN attack on EMS-dependent systems. Chemical contaminants and most decontamination solutions can be corrosive and may damage sensitive equipment. A high-altitude EMP from a nuclear detonation can damage or destroy electronic, electrical, and EMS-dependent devices that are not appropriately hardened. Additionally, systems’ operations may be impeded if operators are required to wear CBRN-protective ensembles. Redundancy, dispersal, protection, hardening, and decontamination of mission-critical EMSO equipment may help ensure mission continuation following a CBRN attack.

For information on CBRN environments, see JP 3-11, Operations in Chemical, Biological, Radiological, and Nuclear Environments; JP 3-40, Countering Weapons of Mass Destruction; and JP 3-41, Chemical, Biological, Radiological, and Nuclear Response.

n. **Targeting and Fire Support**

(1) JEMSO exploitation activities, including ES and SIGINT, are foundational to joint force targeting and fire support. ES and SIGINT data are used to dynamically map the EMOE for targeting and threat avoidance planning. ES assets provide timely warning of enemy reaction to friendly strike and other physical destruction actions. ES and SIGINT also perform an important combat assessment role by providing feedback on the results of

friendly attack actions. ES can also be used to evaluate the effectiveness of friendly force EMCON measures and recommend modifications or improvements.

(2) EA degrades, disrupts, or destroys susceptible enemy assets and performs vital screening functions (including the use of standoff weapons) for friendly strike actions. EA also plays an important role in countering enemy attacks using EMS-dependent sensors and precision strike weapons. EA can create effects with instantaneous time of flight, low collateral damage, and low cost per shot. JEMSO personnel participate in the JTCEB and related processes to integrate EA and other fires-related joint force EMS-use requirements with other JEMSO actions.

(3) EP protects friendly targeting sensors, navigation, and communications from enemy activity. Lethal fires support JEMSO by destroying enemy EM transmitters and receivers, including targeting, communications, and EA systems. Disciplined EMCON and other EP measures protect friendly maneuver and strike elements from enemy intelligence collection. EP measures also protect friendly forces handling or operating around live ordnance during combat operations by preventing inadvertent detonations due to HERO.

(4) EMS management and associated EMBM system capabilities integrate joint force EMS use to minimize and mitigate EMI, ensuring friendly EMS-dependent sensors, data links, and weapons seekers are able to operate in a congested and contested EMOE.

For information on joint fire support, refer to JP 3-09, Joint Fire Support, and JP 3-60, Joint Targeting.

o. Physical Security. JEMSO support physical security by using EP to safeguard communications used in protecting facilities, to include EMCON. Additionally, EP features may guard personnel, facilities, and equipment from the broader effects (both intended and unintended) of EM energy. Physical security supports JEMSO by safeguarding equipment used in EW.

p. Civil-Military Operations (CMO). In operations such as foreign humanitarian assistance (FHA), EW assets may be used to map the EMS and broadcast civil defense information similar to the way they have been used successfully to broadcast MISO messages. CMO frequencies should be coordinated and integrated with EW activities. As requirements for EW assets expand into peacetime contingency roles, it becomes more imperative that planners consider diplomatic clearance requirements of HN as early as possible.

For information on CMO, refer to JP 3-57, Civil-Military Operations.

4. Planning Considerations in Multinational Operations

a. Information Sharing Considerations

(1) The JEMSOC must prepare to integrate joint EMS-use requirements into a multinational EMS-use plan to support the mission. The development of specific

procedures to support this requirement is made more difficult because of restrictive security guidance, differences in the level of training, different automation tools, and some language and terminology barriers.

(2) An EMS superiority approach with an associated CONOPS is required to execute EMBM during multinational operations. It should address the multinational organizational structure and processes and security requirements/concerns.

(3) An EMSO structure should be established for each operation. The structure should identify the location and responsibilities of EMS users. Multinational operations may require that all forces operate in the same area, or the OE may be subdivided and national forces will be given responsibility for particular geographic areas. The first is generally the most complicated because the number and types of equipment will vary greatly between the MNFs. Even when the OE is divided, it is necessary to plan and coordinate among adjacent EMS users.

(4) The joint force foreign disclosure officer (FDO) provides foreign disclosure guidelines at the beginning of planning to facilitate the flow of information. EMS releasability and classification information must be distributed and available at all levels.

(5) Multinational EMS users may not be trained to the same standards as joint EMS managers. They have different automation capabilities, responsibilities, and national requirements. Joint EMS managers can be expected to lead the overall database management effort and provide training to their multinational counterparts when DOD automation tools are used. Commanders should resource the multinational EMS office with experienced EMS users commensurate with the size and scope of the operation.

b. NATO Considerations. Although NATO EW policy contained in Military Committee (MC) 0064, *NATO Electronic Warfare Policy*, is consistent with much of US JEMSO policy, the perspective and procedures of an MNF EM battlestaff, NATO signals intelligence/electronic warfare operations centre (SEWOC), or EWCC will be new to most.

(1) MC 515, *Concept for the NATO SIGINT and EW Operations Centre (SEWOC)*, provides the operational requirements and the operational procedures for an interoperable SEWOC to support the full range of possible NATO and NATO-led multinational operations. It also provides a standard of operations among agencies, Services, organizations, and nodes. In addition, it outlines the basic principles, relationships, establishments, and specific details required to manage SIGINT and EW in support of NATO operations and to exercise the capability in peacetime.

(2) MC 486, *Concept for NATO Joint Electronic Warfare Core Staff (JEWCS)*, describes the functions of the joint electronic warfare core staff (JEWCS). The primary functions of the JEWCS is to provide a core staff to augment EWCCs, serve as the primary EWCC element for the NATO response force, and provide an operational planning capability for NATO operations and exercises. EWCCs and the primary EWCC element for the NATO response force are to be augmented by those nations contributing to the operation with assets using EW. The JEWCS provides EW training for NATO forces and

Alliance members and provides EW support for, and analysis of, NATO and Alliance member EW systems and capabilities. At best, participants may have worked joint issues and served in adjacent forces who have exchanged EW LNOs. However, precedent exists; maritime forces have, for many years, worked multinational issues with little difficulty.

(3) Allied Joint Publication (AJP)-3.6, *Allied Joint Doctrine for Electronic Warfare*, provides electronic warfare doctrine for forces operating in NATO and NATO-led operations and training or involving forces representing NATO. This AJP establishes the fundamentals and principles required to plan and conduct electronic warfare operations in coherence with EM operations in the EME. This doctrine is based on the policy set in MC 0064, *NATO EW Policy*, and MC Memorandum 0142-2007, *Military Committee Transformation Concept for Future NATO Electronic Warfare*. It reflects and is harmonized with AJP-01, *Allied Joint Doctrine*, and AJP-3, *Allied Joint Doctrine for the Conduct of Operations*. It is the senior publication in the central hierarchy of NATO electronic warfare operational doctrine. This publication, along with Allied Tactical Publication (ATP)-3.6.2, *Electronic Warfare in the Land Battle*; ATP-3.6.3, *Electronic Warfare in Air Operations*; and the future NATO Emitter Database manual doctrinal publication, provide the core doctrine for electronic warfare. NATO members invariably base their national electronic warfare doctrine on that approved by NATO. However, there is a need to ensure the most recent, releasable, US JEMSO publications are provided to supporting MNFs. NATO has also established a NATO emitter database to exchange information about member nations' and non-member nations' EM emissions and facilitate the coordination of EM operations. EM operations in NATO are equivalent to US EMSO.

c. **Five Eyes Considerations.** United Kingdom, Canada, Australia, and New Zealand have a traditional relationship with the United States and exchange much information at the national level. Five Eyes nations have been working together in development of JEMSO cells and supporting doctrine.

d. **Other MNF Considerations.** The MNFC should include EWOs from supporting MNFs within the EWCC. Should this not be practical for security reasons or availability, the MNFC should, based on the mission, be prepared to provide EW support and the appropriate LNOs to the multinational units.

e. **Exchange of SIGINT** in support of NATO electronic warfare operations should be conducted IAW standard NATO; American, British, Canadian, Australian, and New Zealand (ABCANZ) Electronic Warfare Forum; SIGINT Functional Manager (Director, NSA); and Air and Space Interoperability Council procedures, as appropriate. Care should be taken not to violate SIGINT security rules when exercising mutual support procedures. The information data elements are also contained in appropriate Allied publications—notably, NATO's supplement to ATP-8(A), *EW in Amphibious Operations*; ATP-44, *Electronic Warfare (EW) in Air Operations*; ATP-51, *Electronic Warfare in the Land Battle*; MC 101, *NATO Signals Intelligence Policy and Directive*; and ABCANZ's Quadripartite Standardization Agreement (QSTAG) 593, *Doctrine on Mutual Support Between EW Units*.

f. **Exchange of EOB.** In peacetime, this type of exchange is normally conducted under bilateral agreement. NATO has procedures in place within the major NATO commanders' precautionary system that can be put into effect during times of tension. They include the requirement to exchange information on WARMS. The procedures also determine at what stage MNFs change to the use of WARMS; however, in low-level conflict, they are unlikely to be activated. Therefore, the EWCC chief, through the EW intelligence support organization and the theater joint analysis center or theater JIOC, should ensure maintenance of an up-to-date EOB. Multinational staff officers should be included and should ensure their national commands provide appropriate updates to theater joint analysis in discussions on EOB. These staff officers should ensure their national commands provide appropriate updates to theater JCEOI and JIOCs. MC 521, *Concept for Resources and Methods to Support an Operational NATO EWCC/SEWOC*, describes a NATO EOB and who is responsible for its development and upkeep.

g. **US EW Planning Aids.** Significant improvements have been made within the United States in the automation of EW planning aids. These improvements enable US EW planners to extract information from theater and national databases and depict it in graphic format for planning and briefing purposes. Supporting MNFs are unlikely to have an equal level of automation. By working with multinational officers, the EWCC chief should determine what EW information would assist the MNF at the planning and unit level and ensure that they receive it. To do this, EWCC personnel should understand security issues that preclude the release of some data and its source but do not necessarily preclude the release of EW mission-planning tools.

For more information, see Appendix H, "Tools and Planning Aids."

h. **Releasability.** A clear, easily understood policy on the disclosure of EW information requested by multinational partners should be developed by the commander's FDO as early as possible.

i. **Reprogramming.** Reprogramming of EW equipment is a national responsibility. However, the EWCC chief should be aware of reprogramming efforts being conducted within the MNF. The EWCC chief should keep the MNFC aware of limitations that could result in EM interference and, when necessary, seek the MNFC's guidance. To do this, national and multinational commands should provide the EWCC chief with the following information on request:

- (1) Capabilities and limitations of MNF electronic and warfare equipment.
- (2) Electronic and warfare reprogramming support available within MNF units.
- (3) Nation-specific letters of agreement on reprogramming support for MNF units employing US EW equipment, to include any agreement on flagging support.
- (4) Nation-specific letters of agreement on exchange of EW reprogramming information with those nations not employing US EW equipment.

(5) Reports from friendly units experiencing reprogramming difficulties, to include information on efforts being made to rectify the problem.

(6) Immediate reports on incidents that could have resulted in EMI.

(7) Operational change requests sent to US reprogramming organizations that identify deficiencies in the partner nation's electronic warfare equipment and their request for reprogramming support. In turn, the EWCC chief should ensure all units in the MNF receive the most recent data held within the theater tactical EOB database and, as appropriate, the associated parametric information. This should enable MNF units to address the operational change requests, judge the reliability of their current reprogramming data, and, if necessary, identify problems to the MNF EWCC and national support agencies. Without this level of EW mutual support, EMI on friendly systems may occur.

j. **FHA.** FHA normally consists of DOD activities in support of the United States Agency for International Development or Department of State (DOS), conducted outside the United States and its territories, to relieve or reduce human suffering, disease, hunger, or privation. Military forces may be deployed to provide aid to the civil administration in a mix of civil and military humanitarian relief agencies. The civil administration (if one exists) should provide an EMS management framework for the deployed military force. JEMSOC, through the CCMD JFMO (if not incorporated in the JEMSOC), would focus on HNC and ensuring that disruption to civil systems would be minimized through coordination. Where administration does not exist, this responsibility may be delegated to a lead military force as directed by the CDR.

5. Interorganizational Planning Considerations

a. JEMSO during HD and DSCA missions are likely to affect operations being conducted by other EMS users. HD and DSCA missions require an extraordinary level of interoperability and cooperation between federal, state, and local governments; civilian first responders; and the public.

b. JFMO NORTH is the office within the USNORTHCOM AOR designated to plan and execute EMS management for HD and DSCA operations. It provides support to Title 10, USC, forces that are planning or executing operations in support of HD and DSCA missions. When contingency operations, missions, and training for joint and multinational exercises are in areas where AORs intersect, JFMO NORTH will coordinate EMS-use requirements with the respective CCMD JFMO.

c. All JFMO NORTH component, supporting, and subordinate commands will submit frequency requests through JFMO NORTH. USNORTHCOM Title 10, USC, forces may be ordered into the impacted area by the President, normally at the request of the governor. USNORTHCOM EMS manager will join the spectrum flyaway team to resolve EMS issues at the lowest level possible. On request, EMS managers will support the joint force formed of Title 10, USC, forces that are supporting the contingency. Frequency requests follow the process used by Title 10, USC, forces.

d. Existing contingency plans provide for rapid response to most HD or DSCA events. The majority of contingency plans identify command structures and relationships necessary to execute various options within the plan. It is imperative that the basic EMS-use requirements for implementation of a plan are identified in advance and incorporated into that plan.

CHAPTER IV

CONDUCTING JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS

1. Introduction

JEMSO are conducted using the same plan, execute, and assess cycle as other joint operations. The JFC issues EMSO guidance and instructions to components that prioritize, integrate, coordinate, direct, and deconflict all joint force EMS use within the OA. While JEMSO are centrally planned to facilitate unity of effort, execution is decentralized to permit maximum tactical flexibility in a highly dynamic EMOE.

2. Execution

a. **Control.** The supported JFC designates an EMSCA, usually the J-3; however, core expertise and joint force-assigned mission will dictate EMSCA appointment. At the CCMD level, EMSCA is normally delegated to the JEMSOC director. The joint directorate assigned EMSCA (e.g., J-2, J-3, J-6) issues EMS operating instructions and provides timely updates via order. The EMSCA may assist in coordination and deconfliction when required but does not positively identify, track, and direct joint force EMS transmissions.

b. **Battle Rhythm.** The JEMSOC director establishes the battle rhythm for JEMSO planning and operations IAW the JEMSO appendix. This battle rhythm is based on the phase of operation, pace of operations, nature of the EMOE (i.e., how dynamic it is), and battle rhythms of related operations (e.g., air operations cycle, intelligence cycle). It includes the required participation in cross-functional staff organizations associated with JEMSO planning and execution. The JEMSOC will participate in key joint force battle rhythm processes (e.g., joint planning team, operational planning group) throughout the entire JEMSO execution cycle (see Figure IV-1).

c. **EMSO Guidance.** The JFC begins the JEMSO cycle by providing updated guidance to the components. EMSO guidance includes:

- (1) Commander's JEMSO-related guidance.
 - (a) EMS superiority objectives.
 - (b) EMOE
 - (c) ROE.
 - (d) Operational priorities.
- (2) EMS-related JIPOE information (e.g., EOB updates, EMS-related METOC data).
- (3) EMS-use prioritization.
- (4) EACA/EMS management responsibility delegation.

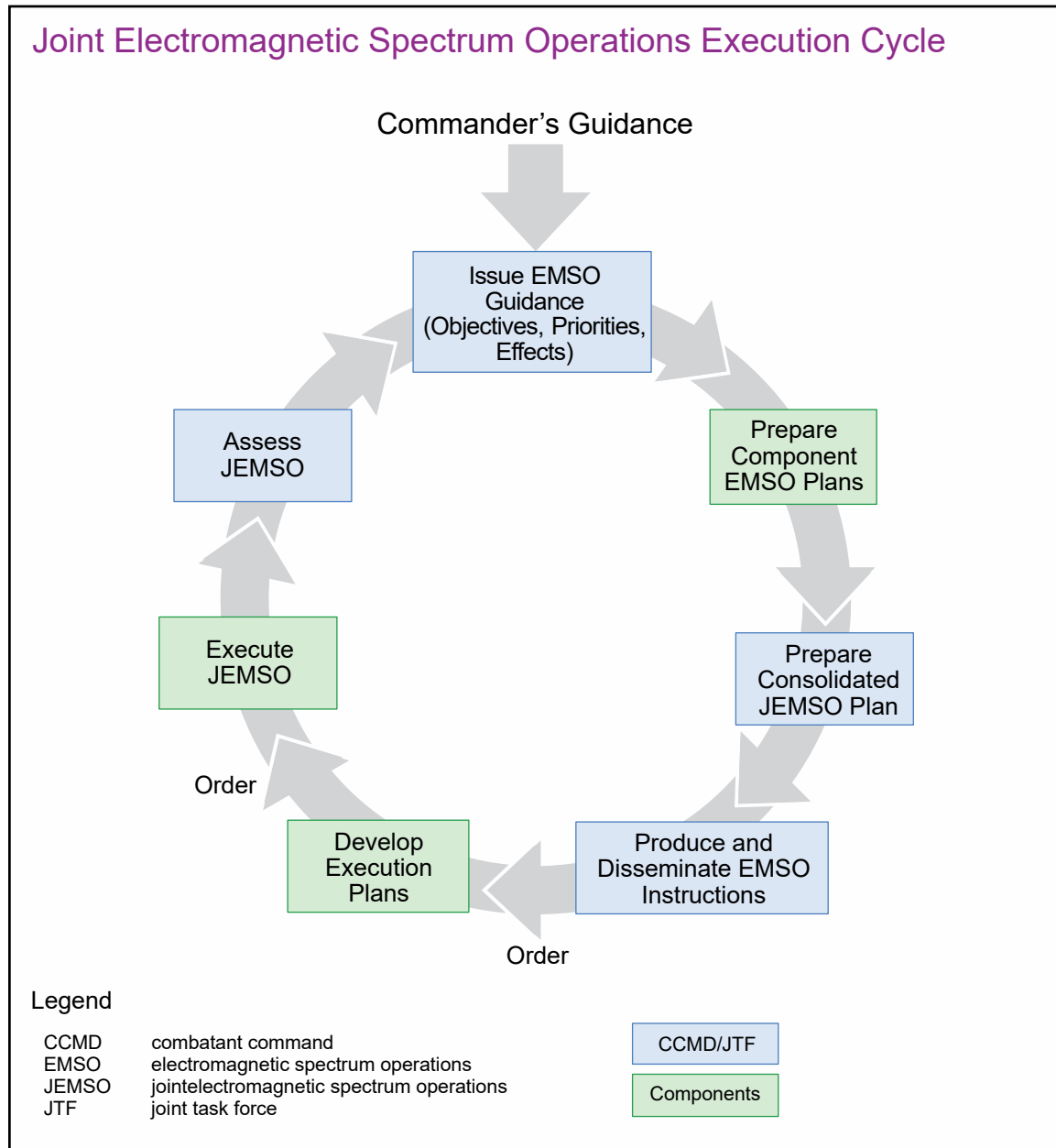


Figure IV-1. Joint Electromagnetic Spectrum Operations Execution Cycle

- (5) EMS coordination measure activation/deactivation.
- (6) Projected EMS use.
- (7) EMS-use tasking.
 - (a) Branch/sequel execution.
 - (b) New operations.
 - (c) EMS use associated with JTCB-approved, EMS-related target elements.

(d) JRFL.

d. Prepare/Update Component EMSO Plans. Components update their respective EMSO plans based on the EMSO guidance. Components should analyze the latest EMOE estimate and conduct sufficiently detailed EMSO planning to identify changes in their EMS requirements, along with any EMSO shortfalls, and generate prioritized EMS-use requests, which are passed to the JEMSOC.

(1) **EMS-Use Request.** Components submit EMS-use requests to the JEMSOC to obtain authorization to transmit EM energy or reserve EMS frequencies/bands for sensing. The EMS operating instructions list all authorized EMS use, including EMS-authorization delegation. It also lists prioritized approved EMS-use requests along with the tasked components.

(2) **Non-Organic EMSO Support.** Components that have EMSO requirements but lack organic capabilities should submit a support request to the JEMSOC for prioritization and approval.

e. Prepare Consolidated JEMSO Plan. The JEMSOC consolidates, prioritizes, integrates, and synchronizes the component EMSO plans and attendant EMS-use requests to produce a consolidated JEMSO plan. The JEMSOC reviews the JEMSO plan for EM policy compliance and conducts engineering analyses on critical aspects to ensure feasibility. The JEMSOC briefs the EMSCA on the JEMSO plan and its impact on joint force operations and then presents the final plan for JFC approval.

f. Produce and Disseminate EMS Operating Instructions. When the JFC approves the JEMSO plan, the JEMSOC generates EMS operating instructions for release via order. The EMS operating instructions contain the following information:

- (1) Classification/releasability guidance.
- (2) Objectives.
- (3) EMOE.
- (4) ROE.
- (5) EMS-use prioritization.
- (6) EACA/EMS management responsibility delegation.
- (7) Specified transmission authorizations.
 - (a) EMS allotments (including EM parametric restrictions).
 - (b) JCEOI.
 - (c) Master rapper tables (i.e., EA jamming coordination card).

- (d) Other authorizations as required.
- (8) Active EMS coordination measures.
 - (a) JRFL.
 - (b) Other measures as required.
- (9) JEMSO support tasking.

g. **Build Detailed EMSO Execution Plans.** Service/functional components conduct detailed EMSO planning as directed by the EMS operating instructions. If delegated authority for specific portions of the EMOE, components conduct the necessary EMSO prioritization, integration, and synchronization and publish orders. Service, functional component orders, and other orders will be forwarded to the JEMSOC, who will review for cross-component interference, advise affected components, and distribute across the joint force for SA.

h. **JEMSO Execution.** The JEMSOC monitors execution and recommends changes in JEMSO prioritization and tasking based on JFC direction and component inputs. The JEMSOC distributes these changes via order across the joint force for SA. Key processes include the immediate support process and the JSIR process.

(1) **Immediate JEMSO Requests.** Service components submit EMS-use requests that arise after the JEMSO planning cycle deadline directly to the JEMSOC. The JEMSOC conducts an abbreviated staff coordination and analysis cycle to determine request priority and feasibility. The JEMSOC distributes approved requests across the joint force via order and notifies impacted units directly.

(2) **EMI Resolution.** The JEMSOC assists components with EMI incidents IAW JSIR procedures documented in the JEMSO appendix, EMSO guidance, and orders. If the JEMSOC cannot resolve or mitigate the EMI, it will develop COAs IAW the published EMS operating instructions.

(3) **Capability Status.** The JEMSOC monitors the status and availability of significant EMSO capabilities across the OA and provides alerts when any changes place an operation or mission at risk.

(4) **EMOE Update.** This is a continuous process whereby the EME is monitored and compared against the EMOE estimate. Any differences are analyzed so that the EMOE estimate can be updated.

3. Assessment

a. At the end of a JEMSO execution cycle, the JEMSOC collates Service component feedback reports to assess EMSO effectiveness. The assessment is conducted using the measures of effectiveness (MOEs)/measures of performance established in the JEMSO appendix.

(1) **Operation Assessments.** Operation assessments involve measuring progress in achieving the JFC's objectives and attaining the end states. The JEMSOC provides expertise and perspective as it measures and evaluates progress. EMS operational assessors help the command determine progress toward mission accomplishment. The assessors also evaluate actions to identify operational deficiencies and develop methods to improve operations' effectiveness. Lastly, assessors develop response options for the joint force to address emerging EMS threats.

(2) **MOEs.** The JEMSOC measures the effectiveness of EMSO actions. This is a technically focused assessment analyzing both cause and effect (e.g., collateral damage assessment due to EA). MOEs may drive changes to the various planning outputs (e.g., new frequency assignments, updated load sets for EA systems, special instructions [SPINS] to operators). Some forms of EA may need to be included in the air tasking order. When this is the case, the JEMSO execution cycle should synchronize with the air tasking order cycle to enable EW assessments and improve BDA accuracy.

b. JEMSO Assessment Data Uses

(1) **JEMSO Effectiveness and Shortfalls.** The JEMSOC uses the assessment information to identify capability shortfalls; drive changes to the EMSO guidance; resolve EMI; generate requests for information for intelligence support; nominate targets impacting friendly force use of the EMS; nominate targets; conduct EW reprogramming; and update the EMSCA on JEMSO effectiveness, process efficiency, and capability shortfalls.

(2) **Lessons Learned.** The JEMSOC develops lessons learned for dissemination to the Service components as well as the relevant joint and Service organizations. Lessons learned can be used for current operations but also form the basis for future planning. JEMSO observations are reported in the Joint Lessons Learned Information System (<https://www.jllis.mil> or <http://www.jllis.smil.mil>).

For further information on lessons learned, see CJCSI 3150.25, Joint Lessons Learned Program.

(3) **Intelligence Assessments.** Assessments are a key element for supporting JEMSO. Assessments ensure timely JEMSO activity feedback is distributed across the joint force.

(4) **EW Reprogramming.** Assessment data is provided to a Service or organization's EW reprogramming support program to maintain or enhance the effectiveness of EW and TSSs. Service reprogramming efforts include coordination with the JEMSOC to ensure those reprogramming requirements are identified, processed, deconflicted, and implemented in a timely manner by all affected friendly forces.

(5) **Software Reprogrammable, EMS-Dependent System Waveforms.** Provide software control of a variety of modulation techniques, wide-band or narrow-band modulation, communications security functions, and waveform requirements of current and evolving standards over a broad frequency range. The purpose of software defined

radio policy updates is to maintain or enhance the effectiveness of automated communications equipment in a rapidly evolving, congested, and contested EMOE.

APPENDIX A

ELECTROMAGNETIC SPECTRUM MANAGEMENT

1. Introduction

This appendix provides additional information on international and national SM.

2. International and National Spectrum Management

All nations have a sovereign right to allocate the EMS as needed to support their interests. At the international and national levels, the primary concern for the use of the EMS is economic and not military. Successful conduct of operations requires the JFC to work with the nation(s) at issue to balance these rights with the need to maintain security of US forces and MNFs. The CCDR and staff need to be familiar with national spectrum allocations within their AOR (as applicable), as the majority of these will conflict with US allocations for military systems. Since both operational and tactical spectrum policy and decisions are based on international and national policy, it is important to understand the organizations and processes involved in international spectrum operations. This section provides an overview of international, national, joint, and Service organizations and agencies that are primarily responsible for policy concerning spectrum use.

a. International EMS Management

(1) **International Telecommunications Union (ITU).** To promote international telecommunications cooperation to support trade, transportation, communications, and mutual protection against interference, most nations have agreed to follow ITU allocations, standards, and radio regulations for spectrum use. The ITU allocations for civil and military EMS use in North and South America are different from those used in the Middle East and Asia. Maintaining a good understanding of ITU and HN allocations for the AOI enhances the JTF staff's ability to prevent EMS-use conflicts that could negatively affect military operations or civilian infrastructure.

(2) **Allied EMS Management Authorities.** When operations are conducted with Allied forces, it is necessary to understand SM roles, responsibilities, and processes within the alliance. The United States is a member of two long-standing organizations: NATO and the Combined Communications-Electronics Board (CCEB).

(3) **NATO.** NATO organizations that have a role in EMS management operations are:

(a) **MC.** The senior military authority in NATO, providing NATO's civilian decision-making bodies—the North Atlantic Council, the Defense Planning Committee, and the Nuclear Planning Group—with advice on military matters.

(b) **NATO Civilian/Military Spectrum Capability Panel.** This panel is the sole, competent source of advice and decisions on the management of the RF spectrum within the NATO Alliance. It supports the NATO MC and the Consultation, Command and Control Board and works with the member-nation military strategic commands to

satisfy NATO RF spectrum requirements during peace, emergency, crisis, and wartime. In addition to the Allied spectrum publication (ASP) series, the panel is also responsible for various NATO documents, such as the NATO Joint Civil/Military Frequency Agreement, the NATO Frequency Management Handbook, and the NATO position for the world radio communication conference.

1. The NATO Civil/Military Spectrum Capability Panel is composed of representatives from the military and civil SM authorities of NATO member and partner nations, the strategic commands, and the NATO Communications and Information Agency (an acquisition, research, and development service provisioning and maintenance organization).

2. The panel also interacts with non-NATO nations in support of cooperative efforts involving frequency and SM issues. Additionally, it deals with the military frequency and spectrum problems of other agencies and organizations, any separate NATO command that may be established later, or of the NATO nations (when called upon), provided this does not interfere with its primary mission.

(c) NATO Headquarters Consultation, Command, and Control Staff/Spectrum Infrastructure Branch is charged with carrying out the necessary day-to-day staff and operational work in support of the NATO Civil/Military Spectrum Capability Panel Consultation, Command, and Control Board, with its related substructure and NATO nations and commands. Staff work includes cooperation with all relevant international, regional, and national civil and military regulatory spectrum authorities/bodies; developing and maintaining NATO spectrum policy and doctrine; providing advice to nations, organizations, and acquisition programs for spectrum-dependent equipment; coordinating supportability assessments; performing other tasks in support of the Civil/Military Spectrum Capability Panel terms of reference; and assigning and managing frequencies allocated to NATO for use in specific operations. Additionally, the branch coordinates frequencies among NATO nations and between NATO and non-NATO nations upon request. In this unique capacity, the branch functions as a SM office through all three levels (strategic, operational, and tactical).

(d) National Radio Frequency Agency. The SM office equivalent for the ministry of defense or chief of defense that acts as the national military frequency agency for a nation is usually called a national RF agency. This agency exists as the primary interface for spectrum coordination and management issues between the NATO Headquarters Consultation, Command, and Control Staff SMB staff and the NATO nations on a national military level. Each nation's national RF agency will vary slightly in specific duties, procedures, and processes. See Allied Communications Publication (ACP) 190, US Supplement (SUPP) 1, *Guide to Spectrum Management in Military Operations*; ASP 01, Parts 1 and 2, *Spectrum Management in Military Operations*; NATO Frequency Management Handbook; and CCEB Publication 1, *Organisation, Roles, and Responsibilities*, for more information on Allied SM organizations.

(4) **CCEB.** The CCEB is a five-nation, joint military communications-electronics (C-E) organization whose mission is the coordination of any military C-E matter referred to it by a member nation.

(a) The CCEB consist of the “Five Eyes” nations.

(b) The CCEB has no standing forces, so their focus is on interoperability between member nations. The CCEB principals consist of a senior communications representative from the member nations.

(c) The spectrum WG is the CCEB WG concerned with CCEB SM issues. Refer to CCEB Publication 1, *Organisation, Roles, and Responsibilities*, for a full description of the organization and mission of the CCEB.

(d) Historically, CCEB nations have had a positive impact on NATO’s wider allied communications (technical) interoperability through the generation and distribution of communications procedural documents titled ACPs and ASPs. ACPs and ASPs are issued for use by allied forces of the nations represented on the CCEB and are appropriate for use in any theater or part of the world. The base publications do not contain national or local theater, command, or geographically significant information. ACP supplements cover specific national, command, or geographic issues. Two key ACPs/ASP’s pertaining to SM are ACP 194, *Policy for the Coordination of Military Radio Frequency Allocations and Assignments Between Cooperating Nations*, and ASP-01, Parts 1 and 2, *Spectrum Management in Military Operations*.

(5) **Spectrum Support Outside the United States**

(a) The CCDRs, through the JFMO/JEMSOC, coordinate through the US liaison office or US OMC to obtain spectrum support and negotiate frequency assignments from HN EMS authorities to support military operations and exercises in their respective nations. To streamline the coordination process, the US liaison office or OMC may authorize direct coordination between the CCMD JFMO or JTF JEMSOC and the HN EMS authorities. Because it may be easier to include spectrum use in other agreements, the CCDR may want to include EMS access by US military forces in agreements such as:

1. SOFAs.
2. HN security agreements with US forces.
3. Protection of HN political, military, economic, social, information, and infrastructure considerations.
4. Military and civil aviation agreements.
5. JTF support agreements with the HN, other government departments and agencies, and nongovernmental organizations (NGOs), either directly or through DOS.

(b) The JTF staff should ensure the JTF commander understands the impact of these agreements on the force's ability to conduct the mission. Any agreement that addresses EMS access shall include provisions for joint forces to utilize the EMS for self-protection.

(c) The joint force or JTF personnel do not initiate or conduct a negotiation of an international agreement without the prior written approval of the DOD official who has been assigned responsibility for agreements concerning EMS management, access, and use.

b. National EMS Management

(1) Commanders require awareness of the policy and processes for national SM. This is especially important because critical events occurring within the homeland, such as weapons of mass destruction events or natural disasters, require coordination among federal, state, local, and tribal authorities whose equipment may operate, by law, in different frequency bands. This difference in frequency band usage is because, within the United States, commanders comply with the statutory EMS management requirements of the Department of Commerce's National Telecommunications and Information Administration (NTIA) for federal systems and Federal Communications Commission regulations for civil systems.

(2) Spectrum supportability is addressed in both regulation and policy, but it is important for commanders to be familiar with the process and its implementation so compliance can be maintained. The Military Command, Control, Communications, and Computers Executive Board (MC4EB) provides spectrum support guidance to DOD. This guidance outlines the general considerations, provisions, and restrictions that apply to a particular system concerning the use of the EMS.

(a) The MC4EB is the principal DOD coordinating agency for EMS management. The MC4EB functions under the policies and directives of the Secretary of Defense and the Joint Chiefs of Staff. The MC4EB guides DOD in preparing and coordinating technical directives and agreements and in allocating spectrum from the NTIA. Its mission is three-fold: coordinate among DOD components, among DOD and other US Government departments and agencies, and among DOD and foreign nations.

(b) Membership of the MC4EB is composed of the Joint Staff J-8 [Force Structure, Resource, and Assessment]; Director J-6 [Command, Control, Communications and Computers/Cyber] (who also serves as chairman); representatives of each Service; USCG; Defense Information Systems Agency (DISA); DIA; NSA; and the Assistant Deputy Director for Communications and Networks, who represents the CCDRs. Other DOD elements may participate when appropriate.

(3) The spectrum certification process is used to facilitate the timely provision of technical characteristics to determine compatibility and interoperability of EMS-dependent systems and ascertain whether these systems will operate IAW the DOD, national, and international technical standards, rules, and regulations. Close coordination among

operations, SM, and procurement personnel ensures effective/efficient use of the spectrum for peacetime and wartime operations. It is important for commanders to understand the relationship between operational phases, acquisition categories, program milestone events, and the ability to gain approval for frequencies.

For more information on spectrum supportability, see Manual of Regulations and Procedures for Federal Radio Frequency Management, and ASP-01, Parts 1 and 2, Spectrum Management in Military Operations.

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APPENDIX B

ELECTROMAGNETIC WARFARE ACTIVITIES

1. Introduction

This appendix provides additional information on EW activities.

2. Electromagnetic Warfare Activities

a. **EA Activities.** To conduct operational planning, targeting, execution, and assessment, the joint force requires a clear understanding of the effects that can be created by EW. EA can be conducted for both offensive and defensive purposes. Since an EA system transmits EM energy just like any other transmitter, it can also be used to transmit EM energy for purposes other than for EA. This is most commonly done for MISO or to create effects in cyberspace. In such cases, it is important that those effects are created using the proper legal authorities and also that their use complies with the law of war and applicable ROE. The effects that can be created by EA systems include destruction, degradation, disruption, and deception. The first three effects are denial effects that can be placed on a continuum of temporary to permanent and partial to complete. Thus, an effect on a capability could be described as disrupted for a short time period, destroyed, or degraded at varying levels for varying time periods.

(1) **Destroy.** Destruction makes the condition of a target so damaged that it can neither function nor be restored to a usable condition in a time frame relevant to the current operation. When used in the EW context, destruction is the use of EA to eliminate targeted enemy personnel, facilities, or equipment. Sensors and C2 nodes are lucrative targets because their destruction strongly influences the enemy's perceptions and ability to coordinate actions. Space assets in orbit, as well as computer services in cyberspace, are potentially lucrative targets as well. EW, through ES, supports destruction by providing actionable target locations and/or information. While destruction of enemy equipment is an effective means to permanently eliminate aspects of an enemy's capability, the duration of the effect on operations will depend on the enemy's ability to reconstitute.

(2) **Degrade.** Degradation reduces the effectiveness or efficiency of an enemy EMS-dependent system. The impact of degradation may last a few seconds or remain throughout the entire operation. For example, degradation may confuse or delay the actions of an enemy, but a proficient operator may be able to work around the effects to reduce or eliminate its impact. Degradation is accomplished with EM jamming, EM deception, and EM intrusion. Degradation may be the best choice to stimulate the enemy to determine the adversary's response or for EA conditioning. Degradation may be adequate to achieve overall mission success.

(3) **Disrupt.** Disruption temporarily interrupts the operation of an enemy EMS-dependent system. Disruption interferes with the enemy's use of the EMS to limit its combat capabilities. A trained enemy operator may be able to thwart disruption through effective EP actions (e.g., changing frequency, EM shielding). The objective of disruption

is to confuse or delay enemy action. Advanced EA techniques offer the opportunity to nondestructively disrupt enemy infrastructure.

(4) **Deceive.** Deception measures are designed to mislead the enemy by manipulation, distortion, or falsification of evidence to induce them to react in a manner prejudicial to their interests. Deception in an EW context presents enemy operators and higher-level processing functions with erroneous inputs, either directly through the sensors themselves or through EMS-based networks such as voice communications or data links. Through use of the EMS, EW manipulates the enemy's decision loop, making it difficult to establish an accurate perception of objective reality. Deception is often used for defensive purposes to avoid being targeted by an enemy in a tactical engagement or by injection of false signals into a sensor such as a radar. This is not to be confused with MISO or MILDEC, which are often used to present false messages to decision makers, usually at a higher level. The distinction is important because the required legal authorities governing EA differ from those governing MISO or MILDEC.

b. **ES Activities.** ES is conducted in support of operations and is crucial for supporting other EW activities. ES can be used in support of offensive or defensive operations and can provide general information for SA or more detailed information in support of planning or targeting. ES should not be confused with SIGINT, which requires different authorities and ROE. There are two effects that can be created by ES:

(1) **Detect.** Detection occurs when potential threat EM emissions are discovered and identified through use of ES measures. It is the essential first step in any follow-on EW activity.

(2) **Exploit.** Exploitation takes full advantage of any information that has come to hand for tactical, operational, or strategic purposes. In an EW context, exploitation is ES that takes full advantage of radiated EM energy to collect, characterize, locate, and track EM radiation sources to support current and future operations. Exploitation may be enhanced or enabled by EA to stimulate EMS-dependent systems or by herding an enemy to the use of exploitable systems.

c. **EP Activities.** EP is conducted to ensure forces are able to operate despite any potentially adverse effects of EM radiation regardless of the source (friendly, neutral, adversary/enemy, or natural). To protect is to cover or shield from exposure, damage, or destruction. In the context of EP, the effect of protection is to be able to continue the use of EMS-dependent systems despite the effects of adverse EM radiation. EP should not be confused with defensive EA. Defensive EA is used to protect from physical attack while EP ensures the ability to operate in a congested and/or contested EMOE.

d. **Additional EW Capabilities and Activities.** EW capabilities and activities have been captured throughout this document as an integral part of JEMSO. Some of these capabilities and activities were briefly touched on and warrant examination in further depth.

(1) **DE.** DE is an umbrella term covering technologies that produce concentrated EM energy and atomic or subatomic particles.

(a) A DE weapon is an EA capability using DE primarily as a means to incapacitate, damage, disable, or destroy enemy equipment, facilities, and/or personnel. DE warfare is military action involving the use of DE weapons, devices, and countermeasures to incapacitate; cause direct damage or destruction of enemy equipment, facilities, and/or personnel; or to determine, exploit, reduce, or prevent hostile use of the EMS through damage, destruction, and disruption. It also includes actions taken to protect friendly equipment, facilities, and personnel and retain friendly use of the EMS. With the maturation of DE technology, weaponized DE systems are becoming more prolific, powerful, and a significant subset of the EW mission area. DE examples include active denial technology, lasers, RF weapons, and DE antisatellite and HPM weapon systems.

(b) DE weapon applications exist in their traditional EW roles and also fit into evolving fires applications. For example, specific EA applications include a laser designed to blind or disrupt optical sensors or a more powerful laser targeted to destroy the aperture or chassis of a satellite on orbit. A laser warning receiver designed to detect and analyze a laser signal is ES, while a visor or goggle designed to filter out the harmful wavelength of laser light is EP.

(c) Intelligence efforts and assets can be tasked to collect information about this threat, and joint planning should include the development of COAs to mitigate the effects of an enemy's use of these weapons against friendly forces. Intelligence or other data concerning deliberate use of a blinding laser weapon should be preserved as evidence of a possible violation of international law (e.g., additional Protocol IV to the 1980 Convention on Certain Conventional Weapons, which prohibits the use of laser weapons specifically designed to cause permanent blindness to unenhanced vision).

(d) DE weapons and devices create effects on designated targets, to include personnel and materiel. DE weapons may provide precise engagement of a target with limited or no collateral damage. DE weapons also support "escalation of force" efforts when directed by the JFC.

(2) **Countermeasures.** Countermeasures are that form of military science that, by the employment of devices and/or techniques, is designed to impair the operational effectiveness of enemy activity. Countermeasures can be active or passive and deployed preemptively or reactively. EW-related examples include EO-IR and RF countermeasures such as flares or chaff. Chaff consists of radar confusion reflectors—thin, narrow, metallic strips of various lengths and frequency responses, which are used to reflect echoes.

(a) **EO-IR CMs.** Any device or technique employing EO-IR materials or technology that is intended to impair the effectiveness of enemy activity, particularly with respect to precision-guided weapons and sensor systems. EO-IR CMs may use laser jammers, smokes/aerosols, signature suppressants, decoys, pyrotechnics/pyrophorics, high-energy lasers, or directed IR energy countermeasures.

(b) **RF Countermeasures.** Devices and techniques that employ RF technology to impair the effectiveness of enemy activity (e.g., precision-guided or radio-controlled weapons, communications equipment, and sensor systems).

(3) **EM Probing.** EM probing is the intentional introduction of radiation into the devices or systems of adversaries for the purpose of learning the functions and operational capabilities of the devices or systems.

(4) **Meaconing.** Meaconing consists of receiving radio beacon signals and rebroadcasting them on the same frequency to confuse navigation. The meaconing stations cause inaccurate bearings for aircraft or ground stations.

(5) **Precision Geolocation.** Precision geolocation involves planning, coordinating, and managing friendly assets to perform the function of geolocating threat RF systems for the purposes of targeting, using EW assets among other sources of information, and intelligence data.

(6) **EW Frequency Deconfliction.** Actions taken to integrate those frequencies used by EW systems into the overall frequency deconfliction process.

APPENDIX C

NOTIONAL JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS APPENDIX

1. Introduction

This appendix provides a nominal format for a JEMSO appendix to the applicable CONPLAN, OPLAN, or OPORD.

2. Notional Format

Copy no ___ of ___ copies

Issuing Headquarters

Place of Issue

Date/Time Group when signed

Appendix JEMSO to CONPLAN, OPLAN or OPORD yy-nnnn – Issuing Headquarters

(X) References: List Annex C of the next higher commands CONPLAN, OPLAN or OPORD and other documents, maps, overlays and standard operating procedures that provide guidance and information for use with this appendix.

(X) Time Zone Used Throughout the Order:

a. **Situation:** Describe EMS aspects related to situation, threat, friendly forces, and neutral nations.

(1) (X) General. Describe planned and available JEMSO support to the CONPLAN/OPLAN. Explain how to obtain and coordinate JEMSO support. List operational constraints and shortfalls. Describe support relationships. Refer to other annexes or provide enough information about the overall situation to give subordinate and supporting units a clear understanding of the operations contemplated that require JEMSO support.

(2) (X) Threat. Provide a clear understanding of the magnitude of the threat from an EMS perspective. Summarize the threat situation, force disposition, EMS capabilities and possible COAs the enemy could use to affect friendly force operations by denying friendly force use of the EMS. Describe how the threat uses the EMS to support operations.

(a) (X) Describe major/critical threat electromagnetic spectrum operations (EMSO) capabilities, how they will be used, and their value to the threat.

1. (X) Estimate the impact of threat EMS capabilities on friendly operations. Identify threat sensing, communications, and EA capabilities. Describe notification or warning methods to friendly units of threat EMS activities to include threat C2, communication, and cyberspace systems, active sensors (e.g., radars), passive sensors (e.g., SIGINT), and jammers. Discuss the threat's ability to detect and exploit friendly EMS use to support operations. Refer to Annex B, Intelligence, for amplifying information.

2. (X) Identify how the threat uses the EMS to support operations (e.g., integrated air defense system, C2, and communication systems). Identify EMS aspects of threat COGs and network nodes and links. Identify threat EMS weaknesses, susceptibilities, and vulnerabilities such as EMS dependencies, poor emissions security, lack of encryption, geolocation of EMS dependent systems and their supported units, new operating modes, or gaps in frequency coverage of friendly EMS systems.

(b) (X) Describe what the threat is capable of doing and probably will do with space, air, surface, subsurface, or cyberspace assets to interfere with friendly force EMS-dependent system operations. Identify hostile EMS activities that deny unrestricted friendly access to the EMS, deny the full capabilities of friendly EMS dependent assets, or restrict friendly operations affected by the EMS. This includes denying the PNT and communications links (terrestrial and space) that support the missions and tasks envisioned in this plan. Account for threat reserve mobilization. Refer to Annex B, Intelligence, for amplifying information.

(3) (X) Friendly. In numbered sub-paragraphs, state the capabilities of external commands, units, forces, or agencies to provide JEMSO support for the operation (e.g., United States Strategic Command [USSTRATCOM], USCYBERCOM, Joint Navigation Warfare Center (JNWC), Joint Spectrum Center, NSA, DIA). Include non-US agencies and systems such as Five Eyes partners and NATO. Identify systems available for C2 and communication, environmental characterization, navigation/PNT, collection, EMS deconfliction and allocation, tasking, or other application categories. Identify friendly EMS dependencies and vulnerabilities. Describe changes or modifications to established procedures, memorandums of agreement (MOAs), or memorandums of understanding (MOUs) that may be in effect. Use appendix for detailed information. Refer to the Annex C, Operations, of the next higher command and adjacent commands.

(a) (X) Describe major friendly force EMSO capabilities, how they will be used, and their value to the joint force.

1. (X) Estimate the impact of friendly force EMS-related capabilities (e.g., EA, ES, SIGINT, and sensor systems) on threat operations. Include key threat WMD systems; C2 and communication systems; processing, exploitation, and dissemination (PED) networks, active sensors (e.g., radars), passive sensors (e.g., SIGINT) and EA systems. Refer to Annex B, Intelligence, for amplifying information.

2. (X) Identify how friendly forces plan to use the EMS to support operations (e.g., integrated air defense system, C2 and communication systems, PED networks). Identify EMS aspects of friendly force COGs and network nodes and links. Identify EMS weaknesses, susceptibilities, and vulnerabilities requiring protection.

(b) (X) Describe the potential for friendly force operations to deny the threat use of the EMS to support operations. This includes the application of EA with friendly force EMS-dependent system operations. Identify hostile EMS activities that deny threat unrestricted friendly access to the EMS or restrict threat operations affected by the EMS. This includes denying the threat PNT, C2 and communication links (terrestrial and space),

integrated air defense systems, and space surveillance systems. Refer to Annex B, Intelligence, for amplifying information.

(4) (X) Neutrals. In numbered sub-paragraphs, describe the neutral (e.g., HN, neutral or unaligned nations, non-states, and NGOs) capabilities and use of the EMS within the AOI.

(a) (X) Describe major/critical neutral nation transmitter and receiver systems within the AOI and their projected EMS-use requirements.

(b) (X) Describe neutral nation use and dependencies upon the EMS to include C2 and communication network, air traffic control systems, first responder systems, broadcast systems, environment sensing networks, PNT dependencies, and cellular networks. Identify neutral nation dependencies and vulnerabilities.

(c) (X) Describe any constraints on EMS use imposed by host or neutral nations, to include HN agreements, SOFAs, and international regulations. Describe changes or modifications to established procedures, MOAs, or MOUs that may be in effect.

(5) (X) Assumptions. State any assumptions, not included in the base plan or order, relating to friendly, threat, or neutral nations' capabilities and operations that may affect, negate, or compromise JEMSO capabilities. If any assumptions are critical to the success of the plan, indicate alternative COAs.

b. **Mission:** Describe the JEMSOC mission in support of the JTF. Per JP 5-0, *Joint Planning*, a mission is a task or set of tasks, together with the purpose, that clearly indicates the action to be taken and the reason for doing so. State in concise terms the JEMSO tasks to be accomplished in support of the operations in the base plan, state why those specific tasks are being undertaken, and describe desired results in support of this CONPLAN/OPLAN. Furthermore, the JEMSO mission should nest within the plan's mission statement but should be far more detailed and descriptive.

c. **Execution:** Describe the CONOPS for the JEMSOC, the tasks the JEMSOC is to accomplish, and the instructions for coordinating across the components, joint staff, and NGOs as well as with the CCMD JFMO. JEMSO activities range from EMS management and frequency allocation to EA operations. The functions required may vary greatly within the area of operations or between phases of the operation and will occur within all of the domains, along with the EMS, simultaneously. This appendix will, therefore, require considerable detail to effectively guide joint operations and accomplishment of the JFC's mission. Additional tabs should be used as necessary to provide more detailed guidance. Describe how JEMSO are organized at the CCMD and how they fit into the CONOPS presented by the Services.

(1) (X) JEMSO CONOPS. Describe how JEMSO will support the JFC's operational mission. When an operation involves various phases, the CONOPS should be prepared describing the role and application of JEMSO in each phase. Provide targeting and collections guidance, spectrum allotment estimates, big-picture priorities, and JEMSO activities by phase.

(2) (X) Tasks and Responsibilities. In numbered paragraphs, assign individual tasks and responsibilities to each applicable subordinate unit, supporting command, or agency that provides support to the plan. Include tasks to JTF staff directorates, tasks to components, tasks to mission areas (when appropriate), and tasks to support agencies. Example tasks are included in an attachment to this template.

(3) (X) Coordinating Instructions. List the instructions applicable to the entire command, or two or more elements of the command, that are necessary for proper coordination of the operation but are not appropriate for inclusion in a particular annex. Provide necessary guidance common to two or more components, subdivisions, or agencies. Describe liaison requirements, if any. Examples might include the following:

- (a) Coordinating EMS use inside allotments given to a component.
- (b) Requesting non-organic EA and ES support from a separate Service.
- (c) Coordinating EACA within a decentralized EMS management architecture.
- (d) Coordinating activities between the CCMD JFMO and the JTF JEMSOC.

d. Administration and Logistics: Describe support needed to deploy/establish/sustain the JEMSOC. Provide broad guidance concerning administrative and logistic support for JEMSO. Address support of mobile or fixed EMS-dependent assets within the area of operations or refer to another annex where this information is available. Describe support needed and who will provide it for any JEMSO-related assets supporting the command. Refer to annex D, Logistics, or pertinent command directives for amplifying information.

- e. **C2:** Describe the C2 structure of the JEMSOC as well as any C2 requirements.

(1) (X) C2 Structure. State the command structure for JEMSO, frequency assignment authorities, and EACA. Indicate the difference, if any, between the command channels for the conduct of JEMSO activities and the command relationships established in Annex J, Command Relationships. If applicable, state requirements for augmentation of appropriate headquarters with JEMSO (EW, SM, information, intelligence, cyberspace, and communication) personnel. Refer to the appropriate section of Annex J; Annex K, Command, Control, Communications, and Computer (C4) Systems; or the base plan for general C2 support of JEMSO activities.

(2) (X) Command, Control, and Communications Systems. Summarize requirements for general C2 systems support of JEMSO activities. Identify all the feeds needed for intelligence support from local/CONUS EMS-data repositories; real-time data feeds from theater and national sensors; and communications links between the JEMSOC and components, staff units, NGOs, and other organizations. Refer to appropriate sections of Annex K.

Tabs

Tab A: JEMSO Framework:

Enclosure A—JEMSO policy and guidance
Enclosure B—JEMSO security classification guidance
Enclosure C—Procedures for requesting frequencies to support EMS-dependent systems, including lead times and request format
Enclosure D—EMBM system guidance, tools, and configuration
Enclosure E—JSIR reporting requirements and routing procedures
Tab B: EMS Management
Enclosure A—EMS coordination measure (e.g., JRFL) submission procedures, including lead times
Enclosure B—HNC procedures, including lead times and restrictions
Enclosure C—EMI Reporting
Enclosure D—MNL requirements collection process, including the need for identifying nets requiring call signs, prowords, and possible frequency sharing
Tab C: Electromagnetic Warfare
Tab D: EMSO Guidance
Enclosure A—Commander’s JEMSO-related guidance (updated EMS superiority objectives, AOI for the EMOE, ROE changes)
Enclosure B—JIPOE information (Threat, neutral, and friendly-force EOB updates; impact of physical and environmental state on the EMOE)
Enclosure C—EMS-use prioritization changes
Enclosure D—EMSCA delegation
Enclosure E—EMS coordination measure activation/deactivation
Enclosure F—Friendly EOB changes
Enclosure G—Projected EMS-use allotment changes
Enclosure H—EMS-use tasking changes
Enclosure I—Branch/sequel execution
Enclosure J—New operations
Tab E – EMS Operating Instructions
Enclosure A—Objectives
Enclosure B—EMOE
Enclosure C—ROE
Enclosure D—EMS-use prioritization
Enclosure E—EMSCA delegation
Enclosure F—EMS band allotments (including EM parametric restrictions)
Enclosure G—Specified transmission authorizations (JCEOI, master rapper tables, other as required)
Enclosure H—Active EMS coordination measures (e.g., JRFL)
Enclosure I—JEMSO support tasking
Enclosure J—EMBM reporting procedures

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APPENDIX D
ORGANIZATIONS SUPPORTING JOINT ELECTROMAGNETIC
SPECTRUM OPERATIONS

Annex A	United States Strategic Command
Annex B	Joint Navigation Warfare Center
Annex C	Joint Spectrum Center

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ANNEX A TO APPENDIX D

UNITED STATES STRATEGIC COMMAND

1. General

USSTRATCOM/J-3E [Joint Electromagnetic Spectrum Operations] is Commander, USSTRATCOM's, principal organization for executing command JEMSO responsibilities. The J-3E JEMSO office, along with USSTRATCOM headquarters, will support the command's JEMSO responsibilities. The J-3E oversees two centers (Joint Electromagnetic Warfare Center [JEWEC], Joint Base San Antonio, Texas, and Joint Electromagnetic Preparedness for Advanced Combat [JEPAC], Nellis Air Force Base [AFB], Nevada) providing JEMSO support. JEWEC provides operational EW subject matter expertise, deployable experts, modeling, oversight, and advocacy of evolving EW capabilities, training, and products to enable EMS superiority. JEPAC assesses joint force readiness and JEMSO capabilities.

2. Mission

USSTRATCOM enables EMS superiority through joint training, planning, operations support, and assessments. USSTRATCOM and its JEMSO centers assess readiness of joint and operational JEMSO capabilities; identify gaps and limitations; and deliver timely, relevant assessment results that enable data-driven decisions.

3. United States Strategic Command Support to Joint Electromagnetic Spectrum Operations

a. USSTRATCOM/J-3E

(1) Coordinates with CCMDs, Services, the Joint Staff, the Office of the Secretary of Defense, DISA's Defense Spectrum Organization (DSO), interagency organizations, multinational partners, and others, as required on EMSO issues.

(2) Responds to emergent EMS-related requirements and requests for support for CCMDs.

(3) Provides Commander, USSTRATCOM, EMS SA and an effective capability to support other CCMDs' daily operations.

(4) Supports planning through a JEMSO WG.

(5) Approves EA or planned interference against GPS signals in tests, training, and exercises conducted or sponsored by DOD entities and not approved through an NTIA frequency allocation. USSTRATCOM ensures appropriate coordination occurs with CCMDs, Services, the Joint Staff, DOD agencies, interagency organizations, multinational partners, and others as required.

b. JEWEC

(1) Serves as the central DOD repository for EW-related subject matter expertise supporting the Secretary of Defense, Joint Staff, CCMRs, Services, JFCs, and multinational partners.

(2) Provides CCMDs and their component and subordinate commands with EW-related engineering and analytical assistance in support of planning, near real time reachback support, and post-event reconstructive analysis.

(3) Provides both predictive and reconstructive modeling, simulation, and analysis at the engineering, engagement, and mission levels. JEWc products include RF propagation and three-dimensional terrain modeling/analysis for airborne, ground-based, and surface/subsurface EMS-dependent systems in support of tactical mission and operational planning. JEWc supports CCMD-integrated joint STO evaluation requests and special access program planning support, as required. The JEWc tailors products for each planning effort as requested by CCMDs and their components.

(4) Maintains a deployable EW planning and coordination cell capable of rapid deployment in support of planning and operations. When deployed, the cell provides a CCMD with the expertise necessary to plan, coordinate, and manage JEMSO in times of crisis for up to 60 days.

(5) Maintains the Joint Electromagnetic Warfare Theater Operations Course, a certified and required course for joint EWOs that transforms Service EW experts into theater EW staff officers capable of shaping the EMOE for JFCs.

(6) Maintains an EM opposing force capable of replicating a coherent, realistic EME that mirrors threat and civilian infrastructure to train US Government forces and enhance EM capabilities, processes, and TTP proficiency.

(7) Collaborates with laboratories, joint and Service analysis centers, weapons schools, battle labs, centers of excellence, US and allied operational JEMSO communities, and academia, to explore innovative JEMSO employment options and concepts for capabilities against existing and emerging EM targets throughout the OE.

(8) Manages, as the Joint Staff's lead agent and technical advisor, US participation in the NATO Emitter Database, and performs management and coordination functions of the US Electromagnetic Systems Database.

c. JEPAC

(1) Performs EMS vulnerability assessments (to include emerging RF-enabled cyberspace threats) and delivers timely and relevant results to the Services and CCMDs on identified vulnerabilities with supported doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy mitigation strategies; validates solutions; and enhances combat capabilities throughout the OE.

(2) Advances friendly force survivability capabilities.

(3) Provides oversight and presents an advanced threat representative EME for joint training events.

(4) Bolsters EMS training with developed and demonstrated EW capabilities and education across the joint force.

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ANNEX B TO APPENDIX D

JOINT NAVIGATION WARFARE CENTER

1. General

NAVWAR plays a significant role in the transregional, all-domain, and multifunctional crises and contingencies the joint forces face today.

2. Joint Navigation Warfare Center

a. As the DOD Center of Excellence for NAVWAR, the JNWC at Kirtland AFB, New Mexico, leads coordination of NAVWAR activities across DOD on behalf of Commander, United States Space Command (USSPACECOM). In this role, the JNWC conducts outreach and training events with Services and joint force component/CCMD planners to enhance their NAVWAR knowledge, operationalize NAVWAR, and integrate NAVWAR into training and exercise activities; conducts PNT operational field assessments; provides combat development support to the joint force; and develops formal, joint, accredited NAVWAR training to institutionalize NAVWAR. The JNWC supports the warfighter to achieve the following objectives:

(1) Protect the effective use of military GPS and other PNT services by US and partner nation forces anywhere in the world.

(2) Prevent the effective use of PNT services by enemies in areas of military operations.

(3) Preserve civil PNT services to noncombatants outside areas of military operations.

b. These three principle functions equate to PNT information advantage—the essence of NAVWAR. PNT and NAVWAR are inextricably linked. PNT is information emitted from a source. NAVWAR is the management of that information. While GPS is the primary source of precise PNT information for DOD, it is not the only PNT source available.

3. Joint Navigation Warfare Center Roles and Responsibilities

a. Develops and maintains current information on NAVWAR matters of interest to the warfighter and JFCs. These include assessments of threat capabilities, assessments of multinational capabilities and vulnerabilities, and NAVWAR topics of special interest. The JNWC actively integrates and disseminates NAVWAR information to warfighters and JFCs, as well as joint and Service training organizations.

b. Analyzes and tests ES system capabilities, EA system TTP, and EP vulnerabilities in relation to NAVWAR and submits recommendations to the Joint Staff, warfighters, trainers, and weapon system developers.

c. Provides a capability for independent field testing of EA/EP/ES capabilities against rapidly emerging NAVWAR threats.

d. Supports CCMD JEMSOC CONOPS with NAVWAR intelligence preparation of the OE and NAVWAR estimates for the EMOE running estimate.

4. Navigation Warfare Support to Joint Electromagnetic Spectrum Operations

a. NAVWAR subject matter expert (SME) teams are critical to the success of NAVWAR operational planning. The NAVWAR SME teams have a habitual relationship with specific CCMDs and are regionally aligned. Currently, the JNWC fields four NAVWAR SME teams and are aligned as follows and directly support their respective CCMDs operations:

(1) US European Command/US Africa Command/NATO.

(2) US Central Command/US Special Operations Command.

(3) USINDOPACOM/US Forces, Korea.

(4) USNORTHCOM/US Southern Command.

b. These NAVWAR SME teams are deployable entities that will remain under USSPACECOM operational control if deployed, while maintaining a support relationship with the supported command in the deployed theater.

c. The Joint NAVWAR Operations Center, working hand-in-hand with the NAVWAR SME teams, augments current operations, joint planning, exercise support, and training to the warfighters and provides continuous reachback for all NAVWAR planning and operations. Reachback capabilities include GPS jamming, modeling, and simulation; access to the NAVWAR capabilities and vulnerabilities database repository; current nation-specific NAVWAR threat briefs; functional staff estimates; and consultation with operational planners.

ANNEX C TO APPENDIX D JOINT SPECTRUM CENTER

1. Introduction

a. DISA is a combat support agency that provides, operates, and assures C2 and information-sharing capabilities and a globally accessible enterprise information infrastructure in direct support to joint warfighters, national-level leaders, and other mission and multinational partners.

b. The DSO provides direct CCMD/JTF support, strategic EMS planning, engineering analysis, and enterprise capabilities and services to enable effective global spectrum operations for joint warfighters, national-level leaders, and multinational partners.

2. Joint Spectrum Center Mission

DISA DSO's Joint Spectrum Center (JSC) provides direct support to the Joint Staff, CCMDs, JTFs, the Services, and combat support agencies by providing expertise in defining, managing, restoring, defending, and protecting spectrum operations.

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APPENDIX E

ELECTROMAGNETIC WARFARE REPROGRAMMING

1. Electromagnetic Warfare Reprogramming

a. **Purpose.** The purpose of EW reprogramming is to maintain or enhance the effectiveness of EW equipment and TSSs. EW reprogramming includes changes to self-defense systems, offensive weapons systems, and intelligence collection systems. The reprogramming of EW equipment and TSSs is the responsibility of each Service through its respective EW reprogramming support programs.

b. **Types of Changes.** There are three categories of EW reprogramming:

(1) **Tactics.** Tactics changes include changes in procedures, equipment settings, or EW systems mission-planning data. These changes are usually created at the Service level by tactics developers and implemented at the unit level using organic equipment and personnel.

(2) **Software.** Software changes include changes to the programming of computer-based EW and TSS equipment. This type of change requires the support of a software-support activity to alter programmed look-up tables, threat libraries, or signal sorting routines.

(3) **Hardware.** Hardware changes and/or long-term system development is necessary when tactics or software changes cannot correct equipment deficiencies. These changes usually occur when the complex nature of a change leads to a system modification.

c. **EW Reprogramming Actions.** During a crisis or hostilities, EW reconfiguration provides operational commanders with a timely capability to respond to changes in threat systems, correct EW and TSS equipment deficiencies, and tailor equipment to meet unique theater or mission requirements.

(1) **Threat Changes.** Service EW reprogramming support programs are primarily designed to respond to threat changes affecting the combat effectiveness of EW and TSS equipment. A threat change may be any change in the operation or EM signature of a threat system.

(2) **Geographic Tailoring.** Geographic tailoring is the reprogramming of EW and TSS equipment for operations in a specific area or region of the world. Geographic tailoring usually reduces the number of threats in system memory. This results in decreased processing time and a reduction in system display ambiguities.

(3) **Mission Tailoring.** Mission tailoring is the reprogramming of EW and TSS equipment for the mission of the host platform. Mission tailoring may be desirable to improve system response to the priority threat(s) to the host platform.

d. **General Reprogramming Process.** The reprogramming process for EW and TSS equipment has four phases. The last three phases of the reprogramming process are unique by Service and are further defined in respective Service doctrine.

(1) **Determine the Threat.** The first phase of reprogramming is to develop and maintain an accurate description of the equipment's OE, specifically threat systems and tactics. Since EW and TSS equipment are programmed to identify and respond to particular threat or target signature data, intelligence requirements must be identified to ensure an accurate description of the EMOE is maintained at all times. Maintaining an accurate description of the environment requires fusion of known EM data with the collection, analysis, and validation of threat signature changes. This first phase of the reprogramming process has three steps:

(a) **Collect Data.** Threat signature data collection (e.g., collection of threat system parametric information) is the responsibility of combatant and component command collection managers. Signature data may be collected as a matter of routine intelligence or tactical information collection against targeted systems, while other data collection may occur as the result of urgent intelligence production requests. Regardless of the means of collection, signature data is disseminated to appropriate intelligence production centers and Service equipment support and flagging activities for analysis.

(b) **Identify Changes.** At Service equipment support and flagging activities, collected signature data is analyzed for EW and TSS equipment compatibility. Incompatible data is flagged for further analysis and system impact assessment. At the intelligence production centers, collected data is processed and analyzed to identify threat signature changes in the EMOE. Identified changes are further analyzed to ensure collector bias (i.e., collector contamination or manipulation of signature data attributed to the collector or its reporting architecture) was addressed during the analysis process.

(c) **Validate Changes.** The most important step of this initial phase of reprogramming is to validate threat signature changes. Therefore, once an identified signature change is correlated to a threat system and analyzed to ensure the reported parameters are correct and not a collector anomaly, it is further analyzed to validate it as an actual system capability change or identify it as a probable malfunction. Information on threat system engineering and tactical employment is critical to this validation process. Technical analysis and validation of threat changes are normally provided by one of three Service scientific and technical intelligence production centers or the DIA. During times of crisis, the CCMD ensures this phase of the reprogramming process provides for the expeditious identification, technical analysis, and dissemination of threat-change validation messages to component commands and Service reprogramming centers.

(2) **Determine the Response.** During this second phase of reprogramming, validated threat-change information is used to assess its impact upon friendly EW and TSS equipment, and a decision whether or not to initiate a reprogramming change is made. If the equipment fails to provide appropriate threat warning or countermeasures in response to a threat change, a decision is made to change tactics, software, or hardware to correct the deficiency. To support this decision-making process, the Service reprogramming

analysis or flagging activities normally generate a system impact message (SIM) to inform combatant and component command staffs of the operational impact of the threat change to EW and TSS equipment performance. The SIM often recommends appropriate responses for each identified threat change. The Service component employing the affected equipment is ultimately responsible for determining the appropriate response to validated threat changes.

(3) **Create the Change.** The third phase of the reprogramming process is to develop tactics, software, or hardware changes to regain or improve equipment performance and combat effectiveness. A change in tactics (e.g., avoiding the threat) is usually the first option considered because software and hardware changes take time. Often, a combination of changes (e.g., tactics and software) is prescribed to provide an immediate and long-term fix to equipment deficiencies. Regardless of the type of change created, reprogramming support activities will verify equipment combat effectiveness through modeling and simulation, bench tests, or test range employments simulating operational conditions. Following the verification of effectiveness, the reprogramming change and implementation instructions are made available to appropriate units worldwide.

(4) **Implement the Change.** The final phase of the reprogramming process is to implement the change to regain or enhance combat effectiveness by the tactics, software, or hardware change(s). To accomplish this task, component commands ensure tactics changes are incorporated into mission pre-briefs, and software and hardware changes are electronically or mechanically installed in host-platform EW and TSS equipment.

2. Joint Coordination of Electromagnetic Warfare Reprogramming

a. **General.** Coordination of EW reprogramming is critical because threat signature changes and equipment reprogramming changes will affect the EMOE and, therefore, communications and all three divisions of joint EW operations conducted by US forces, MNFs, NGOs, and international organizations. CCMDs ensure joint coordination of electromagnetic warfare reprogramming (JCEWR) policy and procedures are developed and exercised during all major training events and real-world operations.

b. **Policy.** The Joint Staff is responsible for JCEWR policy. Each Service is responsible for its individual EW reprogramming policies and procedures. The establishment and execution of JCEWR procedures is the responsibility of the CCMDs, component commands, and subordinate joint force commands. CJCSI 3210.04, *(U) Joint Electronic Warfare Reprogramming Policy*, outlines policy and the responsibilities of the Joint Staff, Services, CCMDs, Service components, NSA, and DIA regarding the JCEWR process. The instruction also sets forth joint procedures, guidelines, and criteria governing joint intelligence support to EW reprogramming.

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APPENDIX F

ELECTROMAGNETIC SPECTRUM COORDINATION MEASURES

1. Introduction

This appendix provides additional information on EMS coordination measures.

2. Electromagnetic Spectrum Coordination Measures

EMS coordination measures are rules and mechanisms that control how to use the EMS in specified dimensions (i.e., spatial, time, frequency, power, waveform). EMSO cells establish EMS coordination measures to accomplish one or more functions:

a. Establish reserved EMS bands for specific EMS users.

(1) Allotment Plan. An allotment plan identifies frequency bands or groups of frequencies within a specified spectrum-use plan for use by a specific organization or for a particular function. The use of an allotment plan enables the control of spectrum use and at the same time allows the commander to decentralize authority to the lowest level.

(2) Collection Requirements Matrix. The J-2-developed worksheet that compiles collection requirements to inform the initial integrated collection planning efforts. Complete EMS collection requirements may be published in other documents, to include air tasking orders, SPINS, or the ISR synchronization matrix. EMS collection requirements should be coordinated and consolidated in the EMS operating instructions.

b. Restrict the actions of some EMS users.

(1) EMCON plan. The selective and controlled use of EM, acoustic, or other emitters to optimize C2 capabilities while minimizing detection by threat sensors; mitigating mutual interference among friendly systems; supporting OPSEC requirements; and/or to support the execution of MILDEC activities.

(2) JRFL. The JEMSOC compiles the JRFL based on the coordinated inputs from the operations, intelligence, and communications staffs within the command and affected subordinate commands. The restrictions imposed by the JRFL may only be removed, by direction of the EMSCA, if the EMSCA or delegated representative determines the benefit of EA on a restricted frequency surpasses the immediate criticality of exploited or required information to friendly forces. However, the self-protection of friendly forces has priority over all controls.

c. List EMS bands in which units can use EMS-dependent systems with minimal risk of friendly EMI. The MNL is a communications list that, at a minimum, includes the circuit and/or net name, frequency or frequency band, call sign and/or call word requirements, and share group information.

d. Control actions of specific EMS users. The JCEOI is the primary controlling document and net directory for frequency hopping radio communications in joint operations. The JCEOI details radio information pertaining to daily changing and non-changing frequency assignments, call sign assignments, prowords, sign and countersign words, document handling instructions, controlling authority data, effective dates and reproduction instructions.

APPENDIX G

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS STAFF ESTIMATE TEMPLATE

1. Overview

Staff estimates are a primary product of mission analysis used by planners to support preparation, analysis, and comparison of COAs. The JEMSO staff estimate informs the JFC, staff, and subordinate commands how JEMSO support COA mission accomplishment. During COA development and selection, JEMSO planners fully develop their estimate, providing an EMS analysis of the COAs, as well as recommendations on which COAs are JEMSO supportable.

2. Mission

a. Mission Analysis

(1) Analyze the JFC's OE, mission, situation, and guidance for the JEMSO-related context. Examine the factors and assumptions for JEMSO.

(2) Determine specified, implied, and essential JEMSO tasks and their priorities.

(3) Determine JEMSO objectives and consider desired and undesired effects.

(4) Reassess if the strategic direction and guidance support the desired JEMSO objectives and end states.

b. Mission Statement

(1) Express JEMSO in terms of who, what, when, where, and why (purpose).

(2) Frame as a clear, concise statement of the essential JEMSO tasks to be accomplished and the objectives to be achieved.

3. Situation and Courses of Action

a. **Situation Analysis.** JEMSO-tailored JIPOE products can facilitate the JEMSO staff estimate by providing a system of systems perspective within a geostrategic context of the OE, to include enemy, adversary, neutral, and friendly situation overviews.

(1) **EMOE Characterization.** Provide a system's JEMSO perspective for all relevant political, military, economic, social, information, infrastructure, and other aspects. Summarize significant characteristics of the EMOE and the effects on military operations.

(a) **Physical Domains.** How will the terrain, weather, solar conditions, civil infrastructure, and populace affect the employment of joint EMS-dependent systems? EMI caused by or encountered by friendly forces will impact mission-critical capabilities and should be considered.

(b) Information Environment. How will EMS in the JOA and its quality, distribution, and flow affect the functions of military information systems?

(2) Analysis of the Enemy, Adversary, and Competitors. Scrutiny of the enemy, adversary, and competitor situation, dispositions, composition, strength, capabilities, vulnerabilities, and COAs that affect the EMOE.

- (a) Dependencies on the EMS and potential vulnerabilities.
- (b) Use of the EMS to support operations.
- (c) Ability to exploit friendly force EMS dependencies.
- (d) Ability to impact friendly force operations by employing EMS capabilities.

(3) Friendly Situation. Should follow the same pattern used for the analysis of the enemy, adversary, competitors. Friendly situation, dispositions, composition, strength, capabilities, vulnerabilities, and COAs that affect the EMOE.

(a) Status of joint, interagency, and multinational assets available to create effects in the EMS.

- (b) Dependencies on the EMS and potential vulnerabilities.
- (c) Use of the EMS to support operations.
- (d) Ability to exploit and/or attack enemy or adversary EMS dependencies.

(4) Neutral Situation (Neutral Nations)

- (a) Military, commercial, and civil EMS use.
- (b) Host and neutral nation EMOE restrictions and limitations.

(5) Operational Limitations. Actions either required or prohibited, such as constraints or restraints, and other restrictions impacting the employment of joint EMS-dependent and EMS-enabled systems (e.g., international treaties, international law, HN limitations, ROE) or the targeting of adversary EMS-dependent systems (e.g., safety of life networks, navigation systems).

(6) Assumptions. Assumptions are intrinsically important factors upon which the conduct of the operation is based and must be noted as such. Assumptions should only be made when necessary to continue planning.

(7) Deductions. Deductions from the above analysis should yield estimates of relative JEMSO combat power, including enemy capabilities that can affect mission accomplishment.

b. **COA Development and Analysis.** The JEMSO portions of COAs are based on the above analysis and a creative determination of how the JEMSO aspects of the mission will be accomplished. Each COA must be adequate, feasible, and acceptable from a JEMSO standpoint. Each COA will typically constitute an alternative theater strategic or operational concept and should outline the following JEMSO considerations:

(1) Major JEMSO strategic and operational tasks to be accomplished in the order in which they are to be accomplished.

(2) Major forces or capabilities required (to include joint, interagency, and multinational).

(3) Comparison of available EMS maneuver space to requirements.

(4) Determine if any COA elements cannot be supported by JEMSO. If any COA elements are unsupportable, determine if the entire COA is infeasible.

(5) EMS superiority approach.

4. Analysis of Threat Capabilities and Intentions

a. Determine the probable effect of possible threat JEMSO capabilities and intentions on the success of each friendly COA.

b. Conduct this analysis in an orderly manner by time phasing, geographic location, and functional event. Consider:

(1) The potential actions of subordinates two echelons down.

(2) Conflict termination issues; think through own action, adversary/competitor reaction, and counteraction.

(3) The potential impact on friendly desired effects and the likelihood that the threat actions will cause specific undesired effects.

c. Conclude with revalidation of friendly JEMSO actions in support of COAs. Determine additional requirements, make required modifications, and list advantages and disadvantages of each threat capability.

5. Comparison of Own Courses of Action

a. Evaluate the advantages and disadvantages of each COA from a JEMSO perspective.

b. Compare with respect to evaluation criteria.

(1) Fixed values for joint operations (the principles of joint operations, the fundamentals of joint warfare, and the elements of operational design).

- (2) Other factors (e.g., strategic limitations).
- (3) Mission accomplishment.
- c. If appropriate, merge elements of different COAs into one.

6. Recommendation

Provide an assessment of which COAs can be adequately supported by JEMSO resources, an analysis of the risk for each, and a concise statement of the recommended COA with its JEMSO requirements.

7. Joint Electromagnetic Spectrum Operations Staff Estimate Template

The following template is provided as an aid for developing the JEMSO staff estimate.

JEMSO STAFF ESTIMATE TEMPLATE

SECURITY CLASSIFICATION

Originating Division, Issuing Headquarters

Place of Issue

Date-Time Group

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS (JEMSO) ESTIMATE
NUMBER _____

REFERENCES:

- a. Maps and charts.
- b. (X) CJCSM 3320.01, *Joint Electromagnetic Spectrum Management Operations in the Electromagnetic Operational Environment*.
- c. (X) Other pertinent documents.

(1) (X) Mission. State the mission of the command as a whole, taken from the commander's mission analysis, planning guidance or other statements, and the JEMSO mission developed during mission analysis.

(2) (X) Situation and Considerations

(a) (X) Characteristics of the EMOE. Summarize significant characteristics of the EM environment and the effects on military operations.

1. Physical environment. How will the terrain, weather, solar conditions, civil infrastructure, and populace affect the employment of military information systems and linking of information systems into networks?

2. Information environment. How will the EMS in the JOA and its quality, distribution, and flow affect the functions of military information systems?

3. Cognitive dimension. How will populace and third party perceptions, awareness, and understanding impact military operations.

(b) (X) Enemy Forces. Enemy dispositions, composition, strength, capabilities, vulnerabilities, and COAs that affect the EMOE.

1. Dependencies on the EMS and potential vulnerabilities.

2. Use of the EMS to support operations.

3. Ability to attack friendly force dependencies on the EMS.

(c) (X) Friendly Forces. System dispositions, composition, strength, capabilities, vulnerabilities, and COAs that affect the EMOE.

1. Dependencies on the EMS and potential vulnerabilities.

2. Use of the EMS to support operations.

3. Ability to attack adversary dependencies on the EMS.

4. Ability to impact friendly force missions through application of EMS capabilities.

5. Friendly COAs and how JEMSO concept of support for each COA.

6. Current status of major elements or resources. The status of available organic EW and EMS assets (as translated into capabilities to operate in the information environment).

7. Current status of other resources. The status of national-level, commercial and allied assets available for JEMSO.

8. Comparison of requirements versus capabilities and recommended solutions.

9. Key considerations (evaluation criteria) for COA supportability.

(d) (X) Neutral

1. List HN and other nations in area of influence.

2. EMS military, commercial, and civil capabilities and EMS use.

3. Host/neutral nation EMOE restrictions and limitations.

(e) (X) Assumptions. JEMSO assumptions developed during mission analysis.

(f) (X) Special Features. State special features that are not covered elsewhere in the estimate but that may influence the EMOE (e.g., weather, geography).

(g) (X) JEMSO Situation. Consider the EMS requirements, spectrum availability, and potential for interference (intentional and unintentional) for impacting spectrum-dependent system operations across all domains.

1. Active/passive precision-guided missions (e.g., GPS-guided, radar-guided, data link-guided, homing).

2. Integrated air defense networks (e.g., radar, data links).

3. Space object surveillance and identification networks (e.g., Air Force Satellite Control Network).

4. IFF systems.

5. Missile warning and area air defense networks (e.g., PATRIOT).

6. Self-protection jammers (e.g., counter remote-controlled improvised explosive device EW, airborne self-protection jammer).

7. Communications systems and networks (see command, control, communications, and computer systems estimate).

(3) (X) JEMSO Analysis of Own COA

(a) (X) Analyze each COA from a JEMSO point of view. Estimate the likelihood of accomplishing the JEMSO objectives given the available time and capabilities. Determine the potential for unintended consequences of JEMSO tasks and the possible impacts on friendly and enemy COAs.

(b) (X) The JEMSO factors in paragraph 2 are the elements to be analyzed for each COA under consideration. Examine these factors realistically and include considerations of climate and weather, hydrography, time and space, enemy capabilities, and other significant factors that may have an impact on the EMOE as it affects the COAs.

(4) (X) Comparison of Own COAs

(a) (X) List advantages and disadvantages of each proposed COA from the JEMSO point of view.

(b) (X) Compare COAs using evaluation criteria. Rank order COAs for each criterion. If possible, use a decision matrix to support.

(5) (X) Conclusion/Recommendation. State whether or not the mission set forth in paragraph 1 can be supported from an EMS point of view. Identify EMS issues, deficiencies, risks, and recommendation to mission impacts.

APPENDIX H

TOOLS AND PLANNING AIDS

1. General

There are a number of automated planning aids and software tools available to help JEMSO planners carry out their responsibilities. These tools can be divided into three broad categories: databases, planning process aids, and modeling and simulation software. Databases can assist JEMSO planners by providing easy access to a wide variety of EMS-specific technical data. Planning process aids include aids that automate plan development and automated FM tools. Software tools, including spatial and propagation modeling tools, enable analysis and display of geographically referenced information.

2. Databases

There are a large number of databases available to military planners. Planners need to understand the sources of data being used for specific JEMSO planning. This includes coordination with organizations that maintain important sources of JEMSO data to ensure the data is current and suitable for the operation. The sources of data being used for planning should be a topic of coordination among JEMSO planners. Databases are maintained by the Services and other intelligence agencies. Information from other agencies, DOD organizations, allied organizations, and open sources may also be used to populate databases used for planning. Commonly used, EMS-relevant databases include:

- a. The primary approved sources for threat system data are DIA-responsible producers:

- (1) NASIC. The Electronic Warfare Integrated Reprogramming Database is a DIA-managed database, maintained and distributed by NASIC. It is the primary DOD-approved source for technical parametric and performance data on noncommunications emitters and associated systems.

- (2) Missile and Space Intelligence Center, NGIC, and the 53rd Electronic Warfare Group are the sources for data on early warning radars, surface-to-air missile systems, and communication systems.

- (3) Modernized Integrated Database. Contains DIA EOB foreign equipment locations.

- b. Global EMS Information System.

- (1) Joint Spectrum Data Repository features the following spectrum-related databases:

- (a) The Joint Equipment, Tactical, and Space (JETS) Database includes: parametric data for DOD, JETS-E [commercial and multinational equipment], JETS-T [platform data, including equipment complements], JETS-T [US military unit names, locations and hierarchy], JETS-T [US military unit equipment and platform complements], and JETS-S [space satellite parametric and orbital data].

(b) The Equipment Location-Certification Information Database is the central archive repository for all DOD Spectrum certification system data, including information from the J/F-12 [Joint Frequency Allocation-to-Equipment Process] Application for Equipment Frequency Allocation.

(c) The Background Environmental Information Database currently includes ITU, Federal Communications Commission, Canadian, and radio astronomy assignments.

(d) The Government Master File Database is a data source containing records of the frequency assigned to all US Government departments and agencies in the United States and its territories. Data is obtained from NTIA.

(e) The Frequency Resource Record System Database contains information on DOD frequency assignments used throughout the world that is controlled by the CCDRs and the Military Departments.

(f) The EOB database—contains nearly 25,000 DIA EOB foreign equipment locations.

(2) The Host Nation Spectrum Worldwide Database Online allows online viewing and maintenance of HN equipment supportability comments.

3. Planning Process Aids

There are several automated aids available that assist in the planning process. These include aids that automate plan development and automated FM tools. Use of automated tools to consider disparate mission area requirements with respect to JEMSO effects and capability employment will normally be determined by the JEMSOC director and the director's planning staff. JEMSO planners should ensure any planning input developed separately from such systems is created in a format compatible with, and electronically transferable to, the designated planning tools. Planning input from subordinate and supporting commands should follow the desired format.

a. SPECTRUM XXI is the standard software used by frequency managers within DOD for managing EMS use of friendly emitters and consists of 12 modules that accomplish EMS-use planning, maintain the EMS assignment database, and perform propagation modeling.

b. Joint Automated Communication-Electronics Operating Instructions System Software is the standard tool within DOD for management of the JCEOI and transfer of data between spectrum managers and communication planners.

c. Joint Spectrum Interference Resolution Online is a DOD web-based tool for reporting and tracking EMI.

d. Service Planning aids:

(1) Electronic Warfare Planning and Management Tool is an Army capability that provides the commander the ability to control and manage the EMS. It provides the ability to conduct remote control and management of EW assets to conduct offensive and defensive targeting and enable maneuver by synchronizing EW and EMS management.

(2) The Real-Time Spectrum Operations (RTSO) tool is a Windows-based Navy Non-Program of Record used to ensure optimal frequency compatibility among radars, communication systems, and navigation aids, as well as monitor compliance with current frequency restrictions within a carrier strike group, amphibious ready group, or other naval task force and between known land-based radars. It is a sophisticated, interactive program deployed aboard US Navy warship, USCG cutters, and allied combatant vessels to coordinate radar, EW, communications, navigational aids, and other frequencies.

(a) RTSO minimizes or eliminates EMI that occurs as a result of intra- and inter-ship, antenna-to-antenna coupling. This complex, mission-critical software application performs rigorous computations to coordinate frequencies for shipboard missiles and search and track radars. It is also used as a modeling and simulation tool for EMI.

(b) RTSO maintains a database of nets (circuits) and, provided a frequency resource, will assign frequencies to those nets by applying required separation criteria and produce the operational tasking communication (message) (OPTASK COMM) by the RTSO Communication Planner. The OPTASK COMM is the Navy equivalent of a JCEOI.

(c) RTSO maintains a database of emitters that may include non-Navy radars and provides output in standard frequency action format.

(3) The Coalition Joint Spectrum Management Planning Tool (CJSMP) provides spectrum operations support throughout all phases of spectrum mission planning. It provides spectrum managers with an enhanced capability to identify potential friendly force RF spectrum conflicts and a means to resolve these conflicts in an AOI. CJSMP collects unit (force structure), platform, and equipment characteristics data pertaining to a specific mission or exercise that can be used for analysis and simulation to more effectively manage the EMOE. Using CJSMP analysis capabilities, the spectrum manager can gain a better understanding of adverse EMOE impacts and, if required, recommend a corrective COA. CJSMP analysis of a mission can be captured electronically to assist development of lessons learned that can be leveraged in the planning and execution of future missions.

4. Modeling and Simulation

Geographic information, simulation systems, and modeling systems enable analysis and display of geographically referenced information. These spatial modeling tools can, for example, enhance targeting, awareness, and planning for GPS-denied environments and facilitate trends analysis. The variables that affect the propagation of EM energy are known and subject to mathematical predictability. The use of propagation modeling tools that graphically display transmission paths of EM energy has become widespread in EW planning. However, the accuracy, speed, and flexibility of these tools depend greatly on the accuracy of the data provided to the tool and the sophistication of the software and

hardware used to manipulate the data. These tools are essentially models for EM propagation. JEMSO planners need to have a comprehensive understanding as to the exact meaning of the data presented by such software tools. Such an understanding, combined with operational experience, is the basis on which planners judge the strengths and weaknesses of different modeling tools and determine what is, and is not, an appropriate use of such systems.

a. Interactive Scenario Builder is a three-dimensional, interactive RF tactical decision aid. As a mission planning tool, Interactive Scenario Builder aids warfighters in the tactical decision-making process by providing insight into and visualization of the RF capabilities of platforms, in addition to providing geospatial and temporal SA. Interactive Scenario Builder models communication and radar systems by calculating one- and two-way RF propagation loss. Computations incorporate complex antenna and radar cross section pattern data, as well as the effects of meteorology, terrain, and countermeasures. Interactive Scenario Builder enhances the warfighter's geospatial SA by visualizing NGA map products, including compressed ADRG [ARC {arc-second raster chart/map} digitalized raster graphics] and controlled image base imagery and digital terrain elevation data. Interactive Scenario Builder can be used for pre-mission planning, near real time SA, and after action debriefing. Interactive Scenario Builder is the only model approved by the Federal Aviation Administration for coordination of C-IED testing. Interactive Scenario Builder generates signal strength plots which identify C-IED test impact areas in Federal Aviation Administration safety-of-life bands.

b. The Global Positioning System Interference and Navigation Tool is a many-versus-many constructive and repeatable government off-the-shelf simulation tool that computes GPS/GNSS and other navigation system performance and mission impacts in a permissive, uncertain, or hostile environment.

c. The Improved Many on Many is an electronic combat analysis tool that provides the capability to analyze the EM threat and graphically portray the EOB and radar coverage as affected by terrain, as well as jamming and weapon systems envelopes.

APPENDIX J

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS MODELING

1. General

Modeling and simulation tools are essential for the evaluation of JEMSO capabilities and vulnerabilities. These tools cover the full JEMSO analytical spectrum from the basic engineering/physics level through the aggregate effects at tactical, operational, and strategic applications levels. Simulations are critical because of the high cost associated with system development, field testing, and training exercises. Additionally, it is often impossible to replicate the scenarios in the field required to test or exercise the multitude of variables, conditions, and interactions that occur at various levels of combat operations.

2. Application

a. **Operational Test Support.** Laboratory and range agencies use simulations to assist in test planning, scenario development, test equipment configuration, and data reduction and verification, as well as for extrapolating or expanding the use of test results.

b. **Analysis Support.** Combat developers and other analysis activities use simulations to conduct cost and operational effectiveness studies, assist in defining requirements, perform force mix and trade-off analyses, and develop TTP.

c. **Operational Support.** Operational commands use simulations to provide training from the individual to theater staff levels, serve as tactical decision aids, develop and evaluate OPLANs, conduct detailed mission planning, and reconstruct past events.

d. **Weapon System Development.** Materiel developers use simulations to support engineering development and design, capability/vulnerability and survivability analyses, and value-added assessments.

e. **Intelligence Support.** Intelligence agencies use simulations to evaluate raw intelligence, reverse-engineer developing threats, develop threat projections, analyze threat design options, and evaluate threat tactics and employment options.

3. Modeling Agencies

There are numerous government agencies and contractors involved in JEMSO modeling. The Defense Modeling and Simulation Coordination Office operates the defense modeling and simulation catalog. This is the most comprehensive catalog of models available and identifies most agencies involved in JEMSO modeling. Listed below are some of the joint and Service organizations involved with JEMSO modeling and simulation.

a. **Joint.** Defense Modeling and Simulation Office, JEWEC, Joint Warfare Analysis Center, Joint Training and Simulation Center, JSC, Warrior Preparation Center, and Joint Staff Hampton Roads.

b. **Army.** Aviation and Missile Command, NGIC, Air Defense Center and School, Intelligence Center and School, US Army Training and Doctrine Command Analysis Center, 1st Information Operations Command (Land), Electronic Proving Ground, Communications Electronics Command, Army Materiel Systems Analysis Agency, Test and Evaluation Command, Signal Center and School, Space and Missile Defense Command Future Warfare Center, and National Simulation Center.

c. **Navy.** Navy Information Operation Commands, Naval Command and Control and Ocean Surveillance Center, Naval Air Warfare Center, Naval Research Laboratory, Navy Modeling and Simulation Office, Naval Oceanographic Office, Center for Naval Analyses, Naval Information Warfare Systems Command, and Naval Surface Warfare Center.

d. **Air Force.** Air Force Agency for Modeling and Simulation, Air Force Research Laboratory, NASIC, 53rd Electronic Warfare Group, Air Force Operational Test and Evaluation Center, Air Force A-9 [Studies, Analysis, and Assessments], Aeronautical Systems Center, Survivability and Vulnerability Information Analysis Center, Air Armaments Center, Air and Space C2 Agency, Aeronautical Systems Center Simulation and Analysis Facility, and Air Force Wargaming Center.

e. **Marine Corps.** Commandant's Warfighting Lab, Marine Corps Combat Development Command's Wargaming and Combat Simulated Division, and Marine Air-Ground Task Force Staff Training Program's Modeling and Simulation Branch.

4. Fidelity Requirements

Fidelity is the degree of accuracy and detail to which the environment, physical entities, and their interactions are represented. Fidelity requirements vary widely depending on the particular purpose and application. Considerations in determining the proper fidelity should be based on scope (e.g., individual versus corps staff, engineering versus operational), consequences of inaccurate results (e.g., strike planning and execution), time available (minutes/hours to weeks/months), computer resources available (e.g., processing speed, networking requirements, data feeds and memory/storage), accuracy and availability of data (e.g., level of detail, confidence level, and form/format), and risk tolerance of results. Regardless of the fidelity required, a consistent methodology is required to define and guide the process. This typically entails problem definition (scope and objective), research (data gathering), analytical methodology development (how the data is used or applied), and the results/reporting format (satisfy objective/answer question). Outputs from high-fidelity tools are often used as inputs to low-fidelity tools. For example, modeling at the engineering level informs modeling at the engagement level. In general, the setup time, input data requirements, model processing time, computer resources, and user knowledge/expertise increase proportionally with the model scope, fidelity, and flexibility of the modeling and simulation tools.

5. Model Design

a. **User Interface, Preprocessors, and Postprocessors.** These requirements will drive the development of the model and will vary widely depending on the particular

application. For example, an engineering-level model will require complex mathematical parameter input, to produce an in-depth, system-on-system (one-on-one) level modeling product. At the tactical level, an analyst would have limited time and computing resources for the development of a tactical decision aid. Other than purpose, setup, and analysis, time requirements and user expertise are key considerations in designing preprocessors and postprocessors and the user interface. In general, maximum use should be made of standard graphic user interfaces.

b. **JEMSO Functions.** Depending on the level of complexity, any one JEMSO function, or various combinations of functions, may need to be replicated in the model. JEMSO model functions and capabilities address areas such as RF and EO-IR wavelength propagation, radar line of sight, terrain masking, self-protect jamming, standoff jamming (communications and noncommunications), ES systems, expendables (chaff and flares), decoys (active and passive), SEAD targeting, acquisition and tracking sensors (radar, EO-IR), clutter (land/sea/atmospheric), satellite coverage (polar/geosynchronous), link analysis, missile guidance and flyout, evasive maneuvers, communications processes, EP, communications targeting, and doctrinal issues.

c. **Software Architecture.** The design of a JEMSO model or system of models should be modular and object oriented. Existing standards and commonly used commercial software packages should be used where appropriate. Standards include those from the Institute of Electrical and Electronics Engineers, American National Standards Institute, Federal Information Processing Standards, Open Software Foundation, and NSA. Standards should be tailored to meet the user requirements for documentation. Standards are particularly important with regard to interfaces. The primary objective of standardization is to make the simulation as machine independent as possible.

6. Verification and Validation

a. **Verification.** Model verification is related to the logic and mathematical accuracy of the propagation algorithms within a model. Verification is accomplished through such processes as design reviews, structured walk-throughs, and numerous test runs of the propagation algorithms within a model. Test runs are conducted to debug the algorithms, as well as determine the sensitivity of the propagation output to the full range and accuracy of input parameters. Included in verification is a review of input data for consistency, accuracy, and source. Ultimately, verification determines if the model functions as designed and advertised. Verification is rather straightforward but time-consuming.

b. **Validation.** Model validation relates to the correlation of the model with reality. In general, as the scope of a simulation increases, validation becomes more difficult. At the engineering level for a limited scope problem, it is often possible to design a laboratory experiment or field test to replicate reality. At the force level, it is not possible to replicate all the variables in the OE and their interaction. It may be possible to validate individual functional modules by comparison with test data or previously validated engineering-level or high-to-medium-resolution models. A model cannot predict with 100 percent accuracy in given scenarios and the number of assumptions and limitations increase as the model scope increases. At the force level, models typically rely on statistical methods but can

provide relative answers, insights, and trends so alternatives may be rank ordered. Model users should thoroughly understand the capabilities, limitations, and assumptions built into the tool and integrate results with off-line or manual methods, during post-processing, to compensate for these shortfalls. Although the above methods may be used for the validation of individual modules in a force level model, three techniques are used for validating the bottom-line output of force-on-force simulations: benchmarking with an accepted simulation, comparing with historical data, and using sound military judgment. As rapidly moving technological advances are incorporated in modern force structures, availability of useful historical data becomes less prevalent for predicting outcomes in future mid- to high-intensity conflicts. The use of forecasts and assumptions becomes necessary but such efforts tend to be less reliable the further into the future one tries to project. Benchmarking against widely accepted simulations provides a straightforward and less biased method of validation. However, problems are caused by differences in input data structures, assumptions, and output formats between the models. To the extent possible, careful review, analysis, and data manipulation are applied to minimize the potential of creating apparent discrepancies that can result from attempts to compare disparate data.

7. Databases

Numerous databases are available to support JEMSO modeling. Data include doctrinal, order of battle, parametric, signature, antenna pattern, communications networks, and topographic. One of the most comprehensive database catalogs available is the directory of DOD-sponsored research and development databases produced by the Defense Technical Information Center. Some sources of data for EW modeling include the following:

a. **Doctrinal or Scenario Order of Battle and Communications Networks.** DIA, NSA, Joint Training and Simulation Center, Combined Arms Center, NGIC, NASIC, 688th Information Operations Wing, Naval Air Warfare Center Weapons Division, NMIC, Marine Corps Intelligence Activity, and Air Force Air Warfare Center.

b. **Parametric, Signature, and Antenna Pattern.** NSA, DIA, NGIC, NMIC, Missile and Space Intelligence Center, Office of Naval Intelligence, nuclear weapons reconnaissance list, Navy Information Operations Command, NASIC, JSC, Air Force Research Lab, Army Research Lab, Navy Research Lab, and 688th Information Operations Wing.

c. **Topographic.** NGA, CIA, US Geological Survey, Army Geospatial Center, and Waterways Experiment Station.

d. **Weather/Atmospherics.** 557 Weather Wing, Fleet Numerical Meteorology and Oceanography Center.

APPENDIX K POINTS OF CONTACT

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Comm: 703-571-1893

Website: <https://intelshare.intelink.gov/sites/ocs/>

E-mail: js.pentagon.dom.list.j4-ocs-connect@mail.mil

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APPENDIX L REFERENCES

The development of this publication is based upon the following primary references.

1. General

Department of Defense Electromagnetic Spectrum Strategy: A Call to Action, 2013.

2. Department of Defense Publications

- a. Department of Defense Directive (DODD) 3222.04, *Electronic Warfare (EW) Policy*.
- b. DODD 3700.01, *DOD Command and Control (C2) Enabling Capabilities*.
- c. DODD 4650.05, *Positioning, Navigation, and Timing (PNT)*.
- d. DODI 3222.03, *DOD Electromagnetic Environmental Effects (E3) Program*.
- e. DODI 4630.09, *Communications Waveform Management and Standardization*.
- f. DODI 4650.01, *Policy and Procedures for Management and Use of the Electromagnetic Spectrum*.
- g. DODI 4650.08, *Positioning, Navigation, and Timing (PNT) and Navigation Warfare (NAVWAR)*.
- h. DODI 8320.05, *Electromagnetic Spectrum Data Sharing*.

3. Chairman of the Joint Chiefs of Staff Publications

- a. CJCSI 3121.01B, *(U) Standing Rules of Engagement/Standing Rules for the Use of Force for US Forces*.
- b. CJCSI 3210.04A, *(U) Joint Electronic Warfare Reprogramming Policy*.
- c. CJCSI 3320.01D, *(U) Joint Electromagnetic Spectrum Operations (JEMSO)*.
- d. CJCSI 3320.02F, *Joint Spectrum Interference Resolution*.
- e. CJCSI 3320.03D, *Joint Communications Electronics Operating Instructions*.
- f. CJCSI 3500.02B, *Universal Joint Task List Program*.
- g. CJCSI 3810.01E, *Meteorological and Oceanographic Operations*.
- h. CJCSI 6130.01G, *2019 Chairman of the Joint Chiefs of Staff Master Positioning, Navigation, and Timing Plan*.

- i. CJCSI 6740.01C, *Military Telecommunications Agreements and Arrangements Between the United States and Regional Defense Organizations or Friendly Foreign Nations*.
- j. CJCSM 3130.03A, *Planning and Execution Formats and Guidance*.
- k. CJCSM 3212.02D, *Performing Electronic Attack in the United States and Canada for Tests, Training, and Exercises*.
- l. CJCSM 3320.01C, *Joint Electromagnetic Spectrum Management Operations in the Electromagnetic Operational Environment*.
- m. CJCSM 3320.02D, *Joint Spectrum Interference Resolution (JSIR) Procedures*.
- n. CJCSM 3320.04, (U) *Electronic Warfare in Support of Joint Electromagnetic Spectrum Operations*.
- o. JP 2-01.3, *Joint Intelligence Preparation of the Operational Environment*.
- p. JP 3-0, *Joint Operations*.
- q. JP 3-09, *Joint Fire Support*.
- r. JP 3-12, *Cyberspace Operations*.
- s. JP 3-13.2, *Military Information Support Operations*.
- t. JP 3-13.3, *Operations Security*.
- u. JP 3-13.4, *Military Deception*.
- v. JP 3-14, *Space Operations*.
- w. JP 3-59, *Meteorological and Oceanographic Operations*.
- x. JP 3-60, *Joint Targeting*.
- y. JP 5-0, *Joint Planning*.
- z. JP 6-0, *Joint Communications System*.
- aa. Chairman of the Joint Chiefs of Staff, *Joint Concept for Electromagnetic Spectrum Operations (JCEMSO)*.
- bb. Chairman of the Joint Chiefs of Staff, *National Military Strategic Plan for Electronic Warfare*.
- cc. *Capstone Concept for Joint Operations: Joint Force 2030*.

4. Service Publications

- a. Air Force Doctrine Annex 3-13, *Information Operations*.
- b. Air Force Doctrine Annex 3-51, *Electromagnetic Warfare and Electromagnetic Spectrum Operations*.
- c. Air Force Instruction 10-703, *Electronic Warfare (EW) Integrated Reprogramming*.
- d. Air Force Instruction 33-580, *Communications and Information Spectrum Management*.
- e. Army Regulation 5-12, *Management Army Use of the Electromagnetic Spectrum*.
- f. Army Regulation 525-22, *US Army Electronic Warfare*.
- g. Field Manual 2-0, *Intelligence*.
- h. Field Manual 3-0, *Operations*.
- i. Naval Telecommunications Procedures 6 (E), *Navy Electromagnetic Spectrum (EMS) Guide*.
- j. NTTP 3-51.1, *Navy Electronic Warfare*.
- k. Marine Corps Order 2400.2A, *Marine Corps Management and Use of the Electromagnetic Spectrum*.
- l. COMDTINST M2400.1G, *Spectrum Management Policy Procedures*.

5. Multinational Publications

- a. MC 64/10 NATO, *Electronic Warfare Policy*.
- b. MC 101/10 NATO, *SIGINT Policy and Directive*.
- c. MC 486 NATO, *Concept for NATO Joint Electronic Warfare Core Staff (JEWCS)*.
- d. MC 515, *Concept for the NATO SIGINT & Electronic Warfare Operations Centre (SEWOC)*.
- e. MC 521, *Concept for Resources and Methods to Support an Operational NATO EW Coordination Cell/SIGINT & EW Operations Centre (EWCC/SEWOC)*.
- f. AJP-01(C), *Allied Joint Doctrine*.
- g. AJP-2, *Allied Joint Doctrine for Intelligence, Counter Intelligence and Security*.

- h. AJP-3.6(A), *Allied Joint Doctrine for Electronic Warfare*.
- i. ATP-08 Vol 1 (D), *Doctrine for Amphibious Operations*.
- j. ATP-44(C), *Electronic Warfare (EW) in Air Operations*.
- k. ATP-51(A), *Electronic Warfare in the Land Battle*.
- l. QSTAG 593, *Doctrine on Mutual Support Between EW Units*.
- m. QSTAG 1022, *Electronic Warfare in the Land Battles*.
- n. ACP 190 US SUPP 1, *Guide Spectrum Management in Military Operations*.
- o. ASP-01, Part 1, *Spectrum Management in Military Operations*, NATO Standard.
- p. ASP-01, Part 2, *Spectrum Management in Military Operations*, Standardization Agreement 5641 (NATO Confidential).

6. Other Publications

- a. USSTRATCOM, *Operational Concept for Electromagnetic Battle Management*.
- b. Joint Electromagnetic Warfare Center, *Operational Employment Guide (OEG) Joint Electromagnetic Spectrum Operations Cell (JEMSOC)*.

APPENDIX M

ADMINISTRATIVE INSTRUCTIONS

1. User Comments

Users in the field are highly encouraged to submit comments on this publication using the Joint Doctrine Feedback Form located at: https://jdeis.js.mil/jdeis/jel/jp_feedback_form.pdf and e-mail it to: js.pentagon.j7.mbx.jedd-support@mail.mil. These comments should address content (accuracy, usefulness, consistency, and organization), writing, and appearance.

2. Authorship

a. The lead agent for this publication is the USSTRATCOM. The Joint Staff doctrine sponsor for this publication is the Joint Staff, J-3 [Operations].

b. The following staff, in conjunction with the joint doctrine development community, made a valuable contribution to the revision of this joint publication: lead agent, Mr. Mitch Houchin, Mr. Scott Kollmansberger, and Mr. Dan Rocha; Joint Staff doctrine sponsor, Mr. Tim Kochman; Joint Staff J-7, LTC Joshua Darling.

3. Supersession and Cancellation

This publication supersedes and cancels JP 3-13.1, *Electronic Warfare*, 8 February 2012; JP 6-01, *Joint Electromagnetic Spectrum Management Operations*, 20 March 2012; and Joint Doctrine Note 3-16, *Joint Electromagnetic Spectrum Operations*, 20 October 2016. Relevant material from these publications has been incorporated into the main body and appendices of this publication. Accordingly, JP 3-13.1, *Electronic Warfare*; JP 6-01, *Joint Electromagnetic Spectrum Management Operations*; and Joint Doctrine Note 3-16, *Joint Electromagnetic Spectrum Operations*, will be removed from the joint doctrine hierarchy.

4. Change Recommendations

a. To provide recommendations for urgent and/or routine changes to this publication, please complete the Joint Doctrine Feedback Form located at: https://jdeis.js.mil/jdeis/jel/jp_feedback_form.pdf and e-mail it to: js.pentagon.j7.mbx.jedd-support@mail.mil.

b. When a Joint Staff directorate submits a proposal to the CJCS that would change source document information reflected in this publication, that directorate will include a proposed change to this publication as an enclosure to its proposal. The Services and other organizations are requested to notify the Joint Staff J-7 when changes to source documents reflected in this publication are initiated.

5. Lessons Learned

The Joint Lessons Learned Program (JLLP) primary objective is to enhance joint force readiness and effectiveness by contributing to improvements in doctrine, organization,

training, materiel, leadership and education, personnel, facilities, and policy. The Joint Lessons Learned Information System (JLLIS) is the DOD system of record for lessons learned and facilitates the collection, tracking, management, sharing, collaborative resolution, and dissemination of lessons learned to improve the development and readiness of the joint force. The JLLP integrates with joint doctrine through the joint doctrine development process by providing lessons and lessons learned derived from operations, events, and exercises. As these inputs are incorporated into joint doctrine, they become institutionalized for future use, a major goal of the JLLP. Lessons and lessons learned are routinely sought and incorporated into draft JPs throughout formal staffing of the development process. The JLLIS Web site can be found at <https://www.jllis.mil> (NIPRNET) or <http://www.jllis.smil.mil> (SIPRNET).

6. Distribution of Publications

Local reproduction is authorized, and access to unclassified publications is unrestricted. However, access to and reproduction authorization for classified JPs must be IAW DOD Manual 5200.01, Volume 1, *DOD Information Security Program: Overview, Classification, and Declassification*, and DOD Manual 5200.01, Volume 3, *DOD Information Security Program: Protection of Classified Information*.

7. Distribution of Electronic Publications

a. Joint Staff J-7 will not print copies of JPs for distribution. Electronic versions are available on JDEIS Joint Electronic Library Plus (JEL+) at <https://jdeis.js.mil/jdeis/index.jsp> (NIPRNET) and <https://jdeis.js.smil.mil/jdeis/index.jsp> (SIPRNET), and on the JEL at <http://www.jcs.mil/Doctrine/> (NIPRNET).

b. Only approved JPs are releasable outside the combatant commands, Services, and Joint Staff. Defense attachés may request classified JPs by sending written requests to Defense Intelligence Agency (DIA)/IE-3, 200 MacDill Blvd., Joint Base Anacostia-Bolling, Washington, DC 20340-5100.

c. JEL CD-ROM. Upon request of a joint doctrine development community member, the Joint Staff J-7 will produce and deliver one CD-ROM with current JPs. This JEL CD-ROM will be updated not less than semiannually and when received can be locally reproduced for use within the combatant commands, Services, and combat support agencies.

GLOSSARY

PART I—ABBREVIATIONS, ACRONYMS, AND INITIALISMS

ABCANZ	American, British, Canadian, Australian, and New Zealand
ACC	air component commander
ACP	Allied communications publication
AFB	Air Force base
AJP	Allied joint publication
AOC	air operations center
AOI	area of interest
AOR	area of responsibility
ASP	Allied spectrum publication
ATP	Allied tactical publication
BDA	battle damage assessment
BDS	BeiDou Navigation Satellite System
C2	command and control
CBRN	chemical, biological, radiological, and nuclear
CCDR	combatant commander
CCEB	Combined Communications-Electronics Board
CCIR	commander's critical information requirement
CCMD	combatant command
C-E	communications-electronics
CEMA	cyberspace electromagnetic activities (USA)
CIA	Central Intelligence Agency
C-IED	counter-improvised explosive device
CIO	chief information officer
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
CJSMPT	Coalition Joint Spectrum Management Planning Tool
CMO	civil-military operations
CO	cyberspace operations
COA	course of action
COMDTINST	Commandant instruction (USCG)
CONOPS	concept of operations
CONPLAN	concept plan
DCCC	Defense Collection Coordination Center (DIA)
DE	directed energy
DIA	Defense Intelligence Agency
DISA	Defense Information Systems Agency
DOD	Department of Defense
DODD	Department of Defense directive
DODI	Department of Defense instruction

DODIN	Department of Defense information network
DOS	Department of State
DSCA	defense support of civil authorities
DSO	Defense Spectrum Organization (DISA)
E3	electromagnetic environmental effects
EA	electromagnetic attack
EACA	electromagnetic attack control authority
ELINT	electronic intelligence
EM	electromagnetic
EMBM	electromagnetic battle management
EMC	electromagnetic compatibility
EMCON	emission control
EME	electromagnetic environment
EMI	electromagnetic interference
EMOE	electromagnetic operational environment
EMP	electromagnetic pulse
EMS	electromagnetic spectrum
EMSCA	electromagnetic spectrum coordinating authority
EMSO	electromagnetic spectrum operations
EMSOC	electromagnetic spectrum operations cell (USMC)
EOB	electromagnetic order of battle
EO-IR	electro-optical-infrared
EO-IR CM	electro-optical-infrared countermeasure
EP	electromagnetic protection
ES	electromagnetic support
EW	electromagnetic warfare
EWCC	electromagnetic warfare coordination cell
EWO	electromagnetic warfare officer
FDO	foreign disclosure officer
FHA	foreign humanitarian assistance
FM	frequency management
GLONASS	Global Navigation Satellite System
GNSS	global navigation satellite system
GPS	Global Positioning System
HD	homeland defense
HERF	hazards of electromagnetic radiation to fuels
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation to personnel
HHQ	higher headquarters
HN	host nation
HNC	host-nation coordination
HPM	high-power microwave

HQMC	Headquarters, United States Marine Corps
IAW	in accordance with
IC	intelligence community
IFF	identification, friend or foe
IR	infrared
ISR	intelligence, surveillance, and reconnaissance
ITU	International Telecommunications Union
J-2	intelligence directorate of a joint staff
J-3	operations directorate of a joint staff
J-4	logistics directorate of a joint staff
J-5	plans directorate of a joint staff
J-6	communications system directorate of a joint staff
JCEOI	joint communications-electronics operating instructions
JCEWR	joint coordination of electromagnetic warfare reprogramming
JEMSO	joint electromagnetic spectrum operations
JEMSOC	joint electromagnetic spectrum operations cell
JEPAC	Joint Electromagnetic Preparedness for Advanced Combat (USSTRATCOM)
JETS	joint equipment, tactical, and space
JEWC	Joint Electromagnetic Warfare Center (USSTRATCOM)
JEWCS	joint electronic warfare core staff (NATO)
JFC	joint force commander
JFMCC	joint force maritime component commander
JFMO	joint frequency management office
JIOC	joint intelligence operations center
JIPOE	joint intelligence preparation of the operational environment
JISE	joint intelligence support element
JNWC	Joint Navigation Warfare Center
JOA	joint operations area
JP	joint publication
JPP	joint planning process
JRFL	joint restricted frequency list
JSC	Joint Spectrum Center (DISA)
JSIR	joint spectrum interference resolution
JSME	joint spectrum management element
JTCB	joint targeting coordination board
JTF	joint task force
LNO	liaison officer
MAGTF	Marine air-ground task force (USMC)
MC	Military Committee (NATO)

MC4EB	Military Command, Control, Communications, and Computers Executive Board
METOC	meteorological and oceanographic
MILDEC	military deception
MISO	military information support operations
MNF	multinational force
MNFC	multinational force commander
MNL	master net list
MOA	memorandum of agreement
MOC	maritime operations center
MOE	measure of effectiveness
MOU	memorandum of understanding
NASIC	National Air and Space Intelligence Center
NATO	North Atlantic Treaty Organization
NAVWAR	navigation warfare
NG	National Guard
NGA	National Geospatial-Intelligence Agency
NGB	National Guard Bureau
NGIC	National Ground Intelligence Center
NG-IFOG	National Guard Interoperability Field Operations Guide
NG JFHQ-State	National Guard joint force headquarters-state
NGO	nongovernmental organization
NKOCC	non-kinetic operations coordination cell (USAF)
NMCSO	Navy and Marine Corps spectrum office
NMIC	National Maritime Intelligence Center
NSA	National Security Agency
NTIA	National Telecommunications and Information Administration (DOC)
NTTP	Navy tactics, techniques, and procedures
OA	operational area
OE	operational environment
OMC	office of military cooperation
OPLAN	operation plan
OPORD	operation order
OPSEC	operations security
OPTASK COMM	operational tasking communication (message) (USN)
PED	processing, exploitation, and dissemination
PNT	positioning, navigation, and timing
prowords	procedure words
QSTAG	quadripartite standardization agreement
RF	radio frequency

ROE	rules of engagement
RTSO	real-time spectrum operations
SA	situational awareness
SATCOM	satellite communications
SEAD	suppression of enemy air defenses
SEWOC	signals intelligence/electronic warfare operations centre (NATO)
SIGINT	signals intelligence
SIM	system impact message
SM	spectrum management
SMB	spectrum management branch
SME	subject matter expert
SOFA	status-of-forces agreement
SPINS	special instructions
STO	special technical operations
SUPP	supplement
TSS	target sensing system
TTP	tactics, techniques, and procedures
USC	United States Code
USCG	United States Coast Guard
USINDOPACOM	United States Indo-Pacific Command
USNORTHCOM	United States Northern Command
USSPACECOM	United States Space Command
USSTRATCOM	United States Strategic Command
WARM	wartime reserve mode
WG	working group

PART II—TERMS AND DEFINITIONS

chaff. Radar confusion reflectors, consisting of thin, narrow metallic strips of various lengths and frequency responses, which are used to reflect echoes for confusion purposes. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

countermeasures. That form of military science that, by the employment of devices and/or techniques, has as its objective the impairment of the operational effectiveness of enemy activity. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

directed energy. An umbrella term covering technologies that relate to the production of a beam of concentrated electromagnetic energy or atomic or subatomic particles. Also called **DE**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

directed-energy warfare. Military action involving the use of directed-energy weapons, devices, and countermeasures. Also called **DEW**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

directed-energy weapon. A weapon or system that uses directed energy to incapacitate, damage, or destroy enemy equipment, facilities, and/or personnel. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

direction finding. A procedure for obtaining bearings of radio frequency emitters by using a highly directional antenna and a display unit on an intercept receiver or ancillary equipment. Also called **DF**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic attack. Division of electromagnetic warfare involving the use of electromagnetic energy, directed energy, or antiradiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires. Also called **EA**. (Approved for replacement of “electronic attack” and its definition in the DOD Dictionary.)

electromagnetic battle management. The dynamic monitoring, assessing, planning, and directing of operations in the electromagnetic spectrum in support of the commander’s concept of the operation. Also called **EMBM**. (Approved for incorporation into the DOD Dictionary.)

electromagnetic battle management system. The facilities, equipment, software, communications, procedures, and personnel essential for a commander to plan, direct, monitor, and assess operations in the electromagnetic spectrum. (Approved for inclusion in the DOD Dictionary.)

electromagnetic compatibility. The ability of systems, equipment, and devices that use the electromagnetic spectrum to operate in their intended environments without

causing or suffering unacceptable or unintentional degradation because of electromagnetic radiation or response. Also called **EMC**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic environment. The resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted electromagnetic emission levels encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment. Also called **EME**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic environmental effects. The impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. Also called **E3**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic hardening. Action taken to protect personnel, facilities, and/or equipment by blanking, filtering, attenuating, grounding, bonding, and/or shielding against undesirable effects of electromagnetic energy. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

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. Also called **EMI**. (Approved for incorporation into the DOD Dictionary.)

electromagnetic intrusion. The intentional insertion of electromagnetic energy into transmission paths in any manner, with the objective of deceiving operators or of causing confusion. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic jamming. The deliberate radiation, reradiation, or reflection of electromagnetic energy for the purpose of preventing or reducing an enemy's effective use of the electromagnetic spectrum, with the intent of degrading or neutralizing the enemy's combat capability. (Approved for incorporation into the DOD Dictionary.)

electromagnetic masking. The controlled radiation of electromagnetic energy on friendly frequencies in a manner to protect the emissions of friendly communications and electronic systems against enemy electromagnetic support measures/signals intelligence without significantly degrading the operation of friendly systems. (Approved for replacement of "electronic masking" and its definition in the DOD Dictionary.)

electromagnetic probing. Intentional radiation designed to be introduced into the devices or systems of an adversary for the purpose of learning the functions and operational capabilities of the devices or systems. (Approved for replacement of "electronic probing" and its definition in DOD Dictionary.)

electromagnetic protection. Division of electromagnetic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy use of the electromagnetic spectrum that degrade, neutralize, or destroy friendly combat capability. Also called **EP**. (Approved for replacement of “electronic protection” and its definition in the DOD Dictionary.)

electromagnetic pulse. A strong burst of electromagnetic radiation caused by a nuclear explosion, energy weapon, or by natural phenomenon, that may couple with electrical or electronic systems to produce damaging current and voltage surges. Also called **EMP**. (Approved for incorporation into the DOD Dictionary.)

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. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic reconnaissance. The detection, location, identification, and evaluation of foreign electromagnetic radiations. (Approved for replacement of “electronic reconnaissance” and incorporation into the DOD Dictionary.)

electromagnetic security. The protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from their interception and study of noncommunications electromagnetic radiations (e.g., radar). (Approved for replacement of “electronics security” and its definition in the DOD Dictionary.)

electromagnetic spectrum management. The operational, engineering, and administrative procedures to plan, and coordinate operations within the electromagnetic operational environment. (Approved for incorporation into the DOD Dictionary.)

electromagnetic spectrum operations. Coordinated military actions to exploit, attack, protect, and manage the electromagnetic environment. Also called **EMSO**. (Approved for inclusion in the DOD Dictionary.)

electromagnetic spectrum superiority. That degree of control in the electromagnetic spectrum that permits the conduct of operations at a given time and place without prohibitive interference, while affecting the threat’s ability to do the same. (Approved for inclusion in the DOD Dictionary.)

electromagnetic support. Division of electromagnetic warfare involving actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate or localize sources of intentional and unintentional radiated electromagnetic energy for the purpose of immediate threat recognition, targeting, planning and conduct of future operations. Also called **ES**. (Approved for replacement of “electronic warfare support” and its definition in the DOD Dictionary.)

electromagnetic vulnerability. The characteristics of a system that cause it to suffer a definite degradation (incapability to perform the designated mission) as a result of

having been subjected to a certain level of electromagnetic environmental effects. Also called **EMV**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electromagnetic warfare. Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Also called **EW**. (Approved for replacement of “electronic warfare” in the DOD Dictionary.)

electromagnetic warfare frequency deconfliction. Actions taken to integrate those frequencies used by electromagnetic warfare systems into the overall frequency deconfliction process. (Approved for replacement of “electronic warfare frequency deconfliction” and its definition in the DOD Dictionary.)

electromagnetic warfare reprogramming. The deliberate alteration or modification of electromagnetic warfare or target sensing systems, or the tactics and procedures that employ them, in response to validated changes in equipment, tactics, or the electromagnetic environment. (Approved for replacement of “electronic warfare reprogramming” and its definition in the DOD Dictionary.)

electronic intelligence. Technical and geolocation intelligence derived from foreign noncommunications electromagnetic radiations emanating from other than nuclear detonations or radioactive sources. Also called **ELINT**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

electro-optical-infrared countermeasure. A device or technique employing electro-optical-infrared materials or technology that is intended to impair the effectiveness of enemy activity, particularly with respect to precision-guided weapons and sensor systems. Also called **EO-IR CM**. (Approved for incorporation into the DOD Dictionary.)

emission control. The selective and controlled use of electromagnetic, acoustic, or other emitters to optimize command and control capabilities while minimizing, for operations security: a. detection by enemy sensors, b. mutual interference among friendly systems, and/or c. enemy interference with the ability to execute a military deception plan. Also called **EMCON**. (Approved for incorporation into the DOD Dictionary.)

frequency deconfliction. A systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. (Approved for incorporation into the DOD Dictionary.)

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. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

joint electromagnetic spectrum operations. Military actions undertaken by a joint force to exploit, attack, protect, and manage the electromagnetic environment. Also called **JEMSO**. (Approved for incorporation into the DOD Dictionary.)

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. Also called **JRFL**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

precipitation static. Charged precipitation particles that strike antennas and gradually charge the antenna, which ultimately discharges across the insulator, causing a burst of static. Also called **P-STATIC**. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

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. (Approved for incorporation into the DOD Dictionary.)

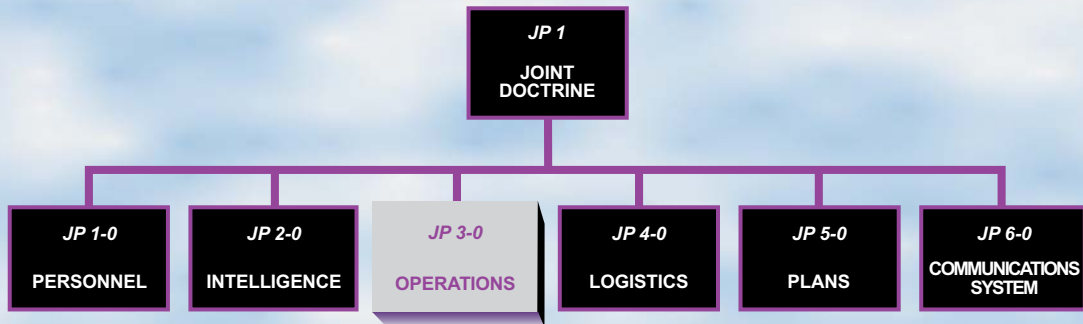
radio frequency countermeasures. Any device or technique employing radio frequency materials or technology that is intended to impair the effectiveness of enemy activity, particularly with respect to precision-guided weapons and sensor systems. Also called **RF CM**. (Approved for incorporation into the DOD Dictionary.)

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. (Approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

verification. 1. In arms control, any action, including inspection, detection, and identification, taken to ascertain compliance with agreed measures. (JP 3-41) 2. In computer modeling and simulation, the process of determining that a model or simulation implementation accurately represents the developer's conceptual description and specifications. (Definition #2 approved for incorporation into the DOD Dictionary with JP 3-85 as the source JP.)

wartime reserve modes. Characteristics and operating procedures of sensor, communications, navigation aids, threat recognition, weapons, and countermeasures systems that will contribute to military effectiveness if unknown to, or misunderstood by, opposing commanders before they are used but could be exploited or neutralized if known in advance. Also called **WARMs**. (Approved for incorporation into the DOD Dictionary.)

JOINT DOCTRINE PUBLICATIONS HIERARCHY



All joint publications are organized into a comprehensive hierarchy as shown in the chart above. **Joint Publication (JP) 3-85** is in the **Operations** series of joint doctrine publications. The diagram below illustrates an overview of the development process.

