CJCSM 3320.01D
24 January 2025

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS

JOINT STAFF
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CHAIRMAN OF THE JOINT CHIEFS OF STAFF MANUAL

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References:
See Enclosure H

1. Purpose. This manual supplements Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3320.01E, "(U) Joint Electromagnetic Spectrum Operations," 13 January 2023, and combines previously separate Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3320.01C for electromagnetic spectrum (EMS) management and CJCSM 3320.04 for electromagnetic warfare (EW). The procedures in this manual are intended to:

a. Enable joint force commanders (JFCs) to achieve EMS superiority in the electromagnetic operational environment (EMOE) through EMS management and EW.

b. Enable JFCs to perform electromagnetic battle management (EMBM), which includes command and control (C2), of Joint Electromagnetic Spectrum Operations (JEMSO) in a congested, contested, and constrained EMOE.

2. Superseded/Cancellation

a. CJCSM 3320.01C, 5 February 2019, is hereby superseded.

b. CJCSM 3320.04, 21 January 2013, is hereby cancelled.

3. Applicability. This instruction applies to the Joint Staff, Services, Combatant Commands (CCMDs), U.S. elements of combined commands, Department of Defense (DoD) agencies, and joint activities.

4. Procedures. See Enclosures A through H.

5. Summary of Changes. This manual is rewritten in its entirety and should be thoroughly reviewed. It combines the two previous supporting publications into a single manual. The revision:

a. Incorporates EMS Operations planning, updates EMS management, and incorporates electromagnetic warfare.

b. Documents U.S. law, treaties, and other EMS management frameworks that apply across the DoD and the CCMDs that were not easily accessible for the broader DoD audience.

c. Adds frequency assignment, generation, and controlling authority.

d. Introduces and nests JEMSO Spectrum Management Activities within the formal joint planning process. This acknowledges joint planning actions currently supported by spectrum management (e.g., campaign, contingency, and crisis action) across the competition continuum.

e. Incorporates Joint and Service lessons learned.

f. Adds EMOE characterization, and incorporates data sources from outside of the spectrum management community to better assist with defining blue, incorporating neutral, and building red order of battle and electromagnetic order of battle.

g. Addresses EMS management support to discern the impact of red on blue command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems.

h. Replaces the term joint electromagnetic spectrum management operations (JEMSMO) with the current approved JP 3-85 term of EMS Management.

i. Removes command relationships within a JTF (redundant with JP 1 Vol 2).

j. Removes ESM relationships in a JTF Enclosure (redundant in JP 3-85 and Allied Communications Publication 190 US Supp 1).

k. Removes order templates. Formal JEMSO Appendix 23 to Annex C and ESM Tab 1 to Appendix 23 orders templates have been submitted pending final publication in the next revision of CJCSM 3130.03. This action migrates the ESM management from Annex K to a Tab to Annex C, Appendix 23.

l. Removes/updates expired references.

m. Adds ESM actions for EMOE Characterization during exercises and planning.

n. Adds Annex on Dynamic Spectrum Access.

o. Adds Annex on Spectrum Supportability Determination to assist in the Spectrum Supportability Risk Assessment process.

p. Adds Annex on joint, international, multinational, and multi-agency considerations.

q. Consolidates JEMSO orgs, boards, systems/software, and data sources.

r. Corrects disparities within the previous edition where use of the doctrine terms “area of influence” and “area of interest” were used synonymously.

6. Releasability. UNRESTRICTED. This directive is approved for public release; distribution is unlimited on the Nonclassified Internet Protocol Router Network (NIPRNET). DoD Components (to include the CCMDs), other Federal agencies, and the public may obtain copies of this directive through the Internet from the Chairman of the Joint Chiefs of Staff Directives Electronic Library at <http://www.jcs.mil/library>. Joint Staff activities may also obtain access via the SECRET Internet Protocol Router Network (SIPRNET) Electronic Library web sites.

7. Effective Date. This manual is effective upon signature.

For the Chairman of the Joint Chiefs of Staff:

STEPHEN E. LISZEWSKI, MajGen, USMC
Vice Director, Joint Staff

Enclosures:
- A – Joint Electromagnetic Spectrum Operations Command and Control
- B – Joint Electromagnetic Spectrum Operations Planning
- C – Joint Electromagnetic Spectrum Operations Execution
- D – Joint Electromagnetic Spectrum Operations Assessment
- E – Electromagnetic Spectrum Operational Environment Characterization

F – Joint Electromagnetic Spectrum Operations Spectrum Management Activities
G – Joint Electromagnetic Spectrum Operations Support Agencies, Boards, Automated Systems, and Information Sources
H – References

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Director, Combined Space Operations Center
Chairman, Interdepartment Radio Advisory Committee
GPS Warfighter Collaboration Cell

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JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS
COMMAND AND CONTROL

1. JEMSO Introduction

a. 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. Freedom of action in the EMS—at the time, place, and parameters of the commander's choosing—is required for successful conduct of operations in all domains.

b. JEMSO supports military operations throughout the competition continuum to achieve desired objectives and end states. Commanders must incorporate JEMSO into their decision-making cycle throughout operational planning and execution and must exercise C2 of JEMSO as they do with all forces and capabilities under their command. During peacetime, JEMSO is conducted to ensure adequate access to the EMS, which involves deconflicting EMS use between joint and other authorized users through coordination with a host nation (HN). As a crisis escalates toward armed conflict, JEMSO shifts from EMS access coordination to EMS superiority, with coordinated military actions executed to exploit, attack, protect, and manage within the EMOE.

c. The glossary contains definitions of most doctrinal JEMSO-related terms. See reference (e) for more detailed discussions of fundamental JEMSO terms and concepts.

2. JEMSO C2 Overview

a. Joint Force Commander. A JFC—the general term applied to a Combatant Commander (CCDR), subordinate unified commander, or joint task force (JTF) commander—is responsible for all military operations and activities, including EMS activities, occurring in their joint operations area (JOA), subject to allocations and other approvals obtained from the HN and compliance with international spectrum treaties and regulations. JFCs may organize their JOA into defined operational areas (OAs), as shown in Figure 1, to assist in integrating, coordinating, and deconflicting fires and maneuver between adjacent units, formations, or areas. The EMOE is a critical part of each OA. The JFC should address potential EMS propagation crossing OA boundaries via coordination measures and factor this into planning.

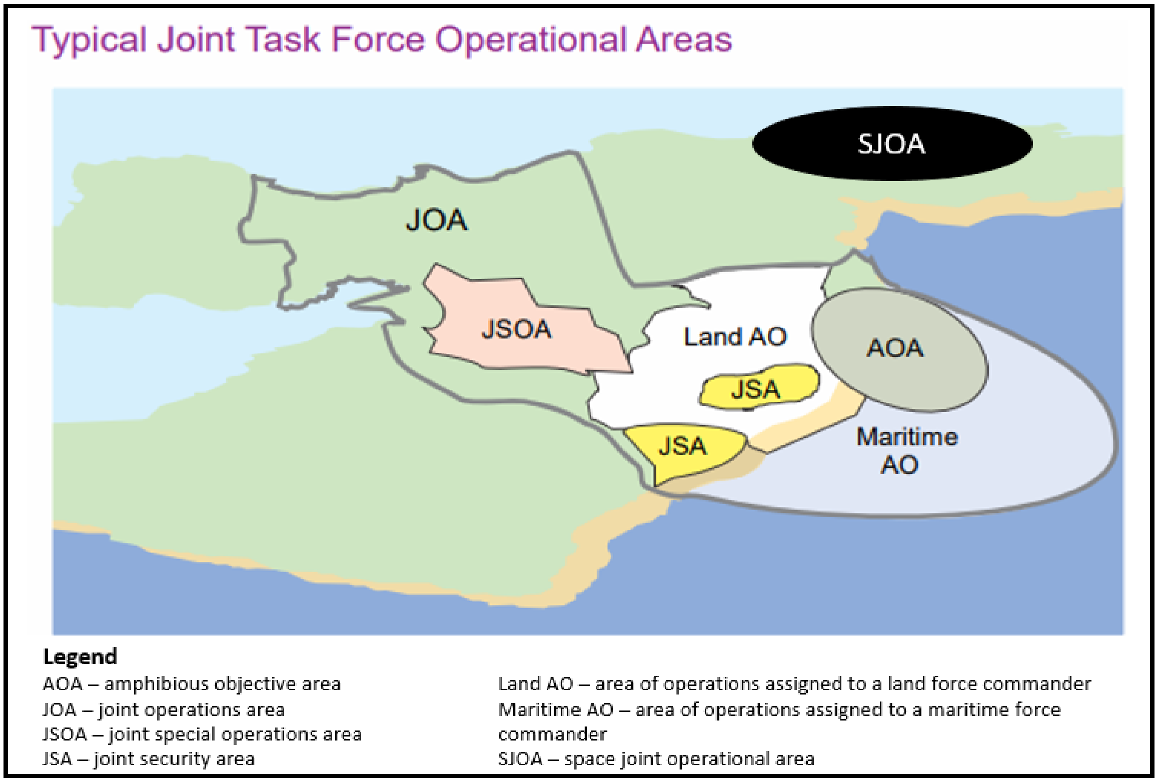


Figure 1. Joint Task Force Operational Areas

b. JEMSO and component electromagnetic spectrum operations (EMSO) C2 functions should reflect the basic doctrinal precepts of C2 associated with the operating domains.

(1) Commanders exercise C2, including EMSO C2, to effectively operate their forces and generate combat power. As with any forces and functions for which commanders exercise C2, they must organize, coordinate, plan, direct, monitor, and assess their EMS activities to create effects that protect friendly forces and consistently function with combatant command (command authority) (COCOM).

(2) JEMSO C2 integrates JEMSO to support the commander's scheme of maneuver, and creates conditions for success in a congested, contested, and constrained EMOE. EMOE complexity is determined by the degree to which it is contested by adversarial factors, congested by frequency crowding and/or interference, and constrained by regulatory, technological, or physical limitations. Commanders optimize JEMSO C2 in the JOA through centralized, collaborative planning within the JEMSO Cell (JEMSOC) and decentralized execution by the components. The JEMSOC plans, directs, monitors, and assesses actions in the JOA's EMOE. The component commanders establish

EMSO cells (EMSOCs) to exercise EMSO C2 in their respective portions of the JOA.

3. Establishing and Organizing for JEMSO C2. JFCs will organize their staff to plan and direct JEMSO as required to meet mission requirements.

a. JFCs should establish a JEMSOC to exercise unity of command for JEMSO activities. The JEMSOC will coordinate EMS actions across both the functional staff elements and the joint force's components and allies, and, when enabled, through respective agreements with other governmental entities and nongovernmental agencies (NGOs). The JEMSOC should be staffed with personnel possessing the appropriate skills, as discussed in reference (e).

b. JFCs should designate an EMS coordinating authority (EMSCA), which includes the authority to require components to consult with each other and with the JFC staff when planning their JEMSO. The JFC can delegate EMSCA to the J-3, while at the CCMD level it is normally delegated to the JEMSOC director—manning, expertise, and mission will dictate EMSCA appointment. On behalf of the JFC, the EMSCA determines the joint force's priorities for EMS activities. This encompasses coordinating and integrating EMS capabilities in the JOA, including those not geographically bound to the JOA (such as space and cyberspace capabilities), facilitating JEMSO unity of effort and assisting the JFC's staff and components to plan, execute, and assess their EMS activities. As the name implies, EMSCA is essentially a coordinating and guidance function that may assist in coordination and deconfliction when required but does not positively identify, track, and direct joint force EMS transmissions. Additional EMSCA roles and responsibilities are discussed in reference (e).

c. A JFC is responsible for establishing the EMS management structure governing use of the EMS in their assigned OA. At the CCMD and subordinate unified command levels, the CCMD JEMSOC subsumes all the responsibilities of the Joint Frequency Management Office (JFMO) (if the JFMO is fully incorporated in the JEMSOC). If the JFMO is not fully incorporated in the CCMD JEMSOC, the JFMO will retain responsibility for all JEMSO spectrum management activities, and the JFMO representative(s) within the CCMD JEMSOC will coordinate EMS management efforts with the JFMO. See reference (e) and Enclosure F for additional information on structure, EMS management functions, and authorities.

d. The JFC will establish a JEMSOC at the JTF to perform EMS management over the JOA and coordinate component EMSO. In lieu of a dedicated JTF JEMSOC, or until a dedicated JEMSOC is operational, the CCMD JEMSOC and JFMO should perform the duties of the JTF JEMSOC.

(1) Separate from EMSCA, radio frequency (RF) assignment authority enables the CCDR to plan, manage, and assign EMS resources within their area of responsibility (AOR). RF assignment authority is the power granted by a nation to an administration, or its designated or delegated leader or agency via treaty or law, to specify frequencies or frequency bands in the electromagnetic spectrum for use in systems or equipment. The CCDR retains RF assignment authority for all DoD forces within their respective AOR; it is an authority enabled or bound by U.S. law, international law, treaties, and respective HN agreements. This authority is generally delegated by the CCDR to the CCMD staff organization (i.e., JFMO, JEMSOC) and, where applicable, may be further delegated to a subordinate unified commander or JTF commander who may then delegate the authority to their respective staff elements (i.e., JEMSOC and JFMO). Alternatively, the CCDR may retain or delegate RF assignment authority in whole or in part to the appropriate staff element or subordinate JFC. For an example of two different approaches, Commander, U.S. Central Command (USCENTCOM) delegates RF assignment authority for the Iraq JOA to the Commander, U.S. Forces-Iraq or, on-order, the USCENTCOM JEMSOC assumes all roles and responsibilities of the CCMD JFMO.

(2) Primary RF assignment authority within the United States and its Possessions (US&P) is exercised by the National Telecommunications and Information Administration (NTIA) for the Federal Government and by the Federal Communications Commission (FCC) for non-Federal Government organizations. Both the NTIA and FCC are subordinate organizations to the Department of Commerce. See reference (b).

(3) International RF assignment authority is vested in the Radio Regulations Board of the International Telecommunication Union (ITU). Respectively, ITU member nations manage their portion of the EMS through their assigned administration. See Appendix F to Enclosure F and references (b) and (s).

(4) Generation authority is the authority placed upon a staff component, individual, or commands having overall responsibility for generating the Joint Communications-Electronics Operating Instructions (JCEOI). This includes gathering all information from subordinate elements, combining requirements, changing the original document, and creating reserve editions. See Appendix G to Enclosure F.

e. Component commanders should establish EMSOCs (or equivalent) to enable C2 of their respective EMSO and to coordinate their EMSO with the joint force through the JEMSOC.

4. Implementing JEMSO C2. JEMSO C2 is codified during the JFC's planning process. The JEMSOC assists the cross-functional staff in understanding the EMOE during mission analysis (MA), and for consideration during course of action (COA) development. The JEMSOC captures the JEMSO aspects of the planning effort by developing the JEMSO appendix (Appendix 23) to Annex C (Operations) of an operation plan (OPLAN) or operation order (OPORD). The JEMSO appendix describes the EMOE for the problem at hand, JEMSO objectives and desired effects to achieve the necessary degree of EMS superiority for overall mission success, the JEMSO concept of operations (CONOPS) for the operation, JEMSO tasks to components and other supporting commands, and EMS coordination measures (EMSCMs). See reference (e) and Appendix F to Enclosure F, rules of engagement (ROE), and JEMSO C2.

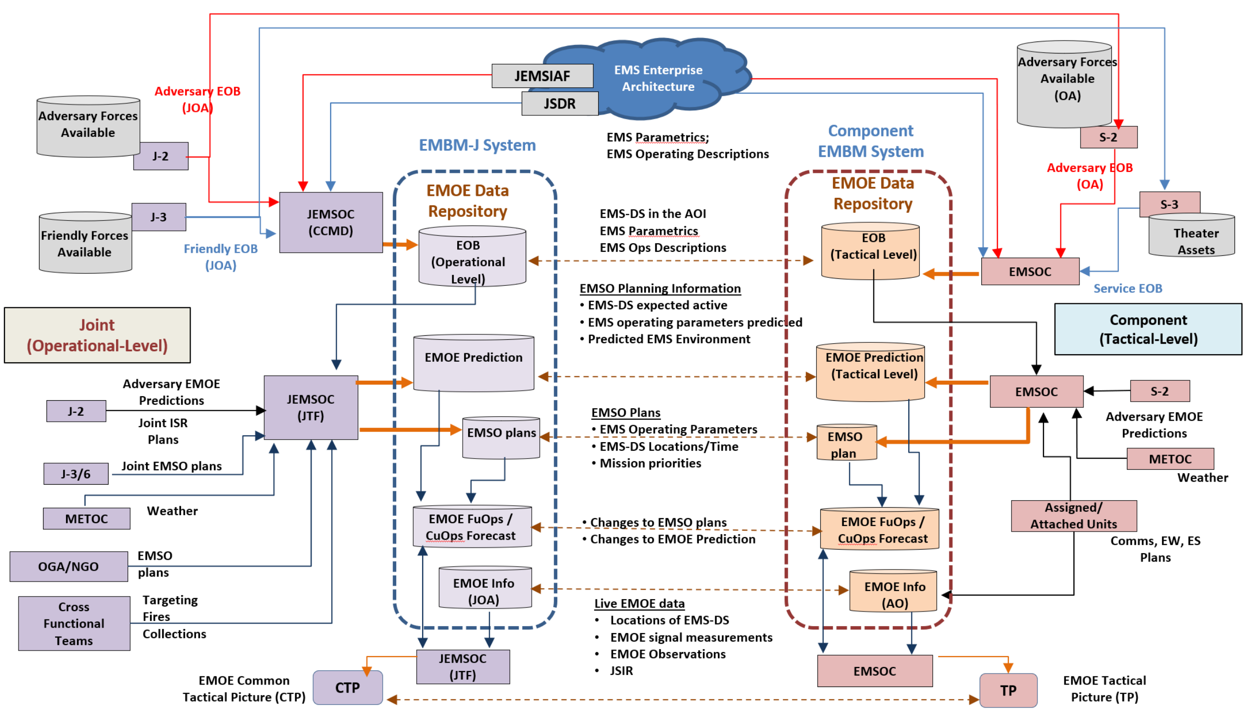
a. JFCs exercise JEMSO C2 through JEMSO spectrum management activities, evolving EMBM procedures, and joint-level EMBM capabilities that interface with component EMBM capabilities. EMBM, EMSCA, and EMS management enable the JFC to exercise unity of command for activities conducted in the EMOE.

b. 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. The JEMSOC identifies EMSO priorities, communicates intent, and integrates supporting commander capabilities into operations. The JEMSOC supports the JFC's EMSO C2 by promulgating directives, orders, and EMOE situational awareness (SA). The JEMSOC translates relevant EMOE characterization information and EMOE mission impact assessments into staff estimates and briefings.

c. The JEMSOC staff uses the JEMSO coordination cycle to plan, direct, monitor, and assess (the commander's decision cycle) EMSO to achieve EMS superiority. Enclosure C discusses the JEMSO coordination cycle in greater detail. This cycle is synchronized with, and driven by, the commander's battle rhythm. It establishes the framework for integrating JEMSOC activities with other cross-functional staff activities and the commander's decision cycle. Figure 2 illustrates an example providing informational, technical, and operational EMS-related touchpoints enabling the flow of authoritative data between the JEMSOC, components, and supporting organizations. Characterization of blue electromagnetic order of battle (EOB) occurs through the execution of JEMSO spectrum management activities. The Defense

Information Systems Agency (DISA) and the Joint Electromagnetic Warfare Center's (JEWC) Joint EMS Information Analysis and Fusion (JEMSIAF) activities, in collaboration with the Intelligence Community (IC), address the inclusion of adversary and neutral EOB data sources. This effort assists the JFC with the intensive task of EMOE-related data aggregation and fusion for the JEMSOC and JFC's respective staff in support of planning and operations across the spectrum of conflict. See Enclosure G for more information on the JEWC JEMSIAF and DISA activities. See Enclosure E for EMOE characterization.

d. Directly, or through the cross-functional staff, including functional CCMD entities (e.g., Joint Cyber Center, designated Space Coordinating Authority), the JEMSOC interfaces with and fosters coordination between component liaison officers (LNOs) and enables organizations such as Service, functional, and multinational electromagnetic warfare EW/EMS management cells, DoD EMSO-related organizations, NGOs, and other government entities to integrate EMS activities.



AOI area of interest
CuOps current operations
EMOE electromagnetic operating environment
EMS-DS electromagnetic spectrum – dependent systems
EMBM-J electromagnetic battle management-joint
EMSO electromagnetic spectrum operations
EMSOC Service / Coalition electromagnetic spectrum operations cell
EOB electromagnetic order of battle
ES electromagnetic support
EW electromagnetic warfare
FuOps future operations
ISR intelligence, surveillance, reconnaissance
JOA joint operational area
JEMSIAF joint EMS information analysis and fusion
JSDR joint spectrum data repository
JSIR joint spectrum interference resolution
METOC meteorological and oceanographic
NGO nongovernmental organizations
OA operational area
OGA other governmental organizations

Figure 2. Framework for JEMSO and EMSO

e. The JEMSOC must conduct the technical and operational analysis needed to generate a EMOE data repository for their JOA, which involves the following activities:

(1) Determine the relevant data, information, and intelligence requirements.

(2) Identify the organizations capable of providing this data, information, and intelligence.

(3) Establish the connections to acquire the data and information.

(4) Process the data and information to generate analytic information supporting modeling, simulation, and operational planning. See reference (e) for additional information on JEMSO modeling and simulation.

(5) Update the theater-level JOA data repository with the authoritative data, information, and models required to support operational planning and assessments.

f. JFCs provide direction, via orders, for their forces to plan and execute the military activities (including EMS activities) necessary to accomplish the mission. JEMSO capabilities provided to the JFC from other supporting geographic CCMDs should be integrated into the supported JFC's planning and execution processes. JEMSOC analysis and planning informs JEMSO C2, fostering EMOE SA to support planning and other processes across the JFC staff and for component EMSOCs. The following paragraphs discuss some of the products and authorities supporting JEMSO C2.

(1) Plans and orders for operations should have a JEMSO appendix (see reference (j)). The JEMSO appendix establishes C2 of JEMSO forces in the JOA. In addition to the actual "C2" section of the appendix—which covers the organizational structure of command JEMSO and EMSO elements, RF assignment authorities, electromagnetic attack control authority (EACA) (defined below), and a summary of supporting C3 systems—it addresses the application of C2 by promulgating EMSO tasks and responsibilities, coordinating instructions, EMSCMs, and ROE.

(2) When an operation transitions from future planning (FUPLANS) into execution, pursuant to an OPORD, the JEMSOC adjusts the JEMSO appendix, as required, to promulgate guidance and direction necessary for imminent execution. The JFC promulgates any changes to JEMSO orders via fragmentary order (FRAGORD) or whatever mechanisms necessary to

document execution directives. Enclosure C discusses the JEMSO appendix as the baseline for follow-on JEMSO portions of orders produced as operations proceed through execution.

(3) EMSCM

(a) EMSO cells establish EMSCMs to facilitate the efficient and effective use of the EMS to accomplish missions. The JEMSO appendix includes EMSCMs, either as stand-alone measures or integrated with other coordination measures. The EMS management concept and the spectrum management plan contribute to or define elements of EMSCMs. See Appendices A and E to Enclosure F. They contain rules, instructions, and guidance governing EMSO and the employment of EMS capabilities within a defined geographic area over specific time periods. JFCs establish various control and coordination measures to integrate joint operations, ensure deconfliction, avoid fratricide, and identify which parts of the OA require specialized considerations. EMSCMs facilitate freedom of action in the EMOE to the maximum extent possible while simultaneously allowing maximum flexibility at the lowest echelon possible. EMSCMs support gaining and maintaining EMS superiority and enhancing unity of effort in the EMOE.

(b) Developed during planning, the JEMSOC and component EMSOCs use EMSCMs to optimize, deconflict, coordinate, integrate, and synchronize EMS activities across the JOA during execution. They can be restrictive (e.g., define EMS parametric, geospatial, and temporal limitations on EMS activities) or permissive (e.g., define the EMS parametric, geospatial, and temporal boundaries where users are free to conduct their EMS activities without additional coordination or permission).

(4) EACA gives commanders the authority to issue orders to transmit (or cease transmission of) electromagnetic (EM) energy. The JFC should delegate this authority, through the component commanders, down to the lowest level possible having the following attributes: SA of the EMOE, positive control of electromagnetic attack (EA) capabilities, and ability to monitor and assess EA transmission activity for determining corrective action. Reference (e) lists additional EACA duties and responsibilities.

(5) When a JFC requires support from other geographic or functional CCMDs (i.e., supporting CCMDs), they should establish a coordinating authority to plan, integrate, and coordinate the supporting CCMD's operations in the supported JFC's JOA. The supported JFC's JEMSOC director (and the EMSCA, if not delegated to the JEMSOC director) will coordinate with the

supporting CCMD's staff through the designated coordinating authority, or directly when direct liaison authorized (DIRLAUTH) is established.

5. JEMSO Command and Control Summary

a. Commanders exercise EMSO C2 through inherent and delegated command authorities, and with assigned EMS-related resources and spectrum allotments. They must plan, direct, monitor, and assess EMSO just as they do with any other military activity. Commanders at the joint force level should establish and task a JEMSOC to accomplish these functions on their behalf. Component commanders should establish EMSOCs to facilitate C2 of their respective EMSO.

b. The JFC optimize JEMSO C2 through centralized, collaborative planning within the JEMSOC and decentralized execution by the components. The JEMSOC integrates all joint force EMS activities across the JFC's functional staff and with components, supporting commands, allies, other governmental entities, and NGOs. Commanders issue directives to subordinate commanders to assign responsibilities, coordinate their actions across the JOA, and control operations, including JEMSO. The JFC establishes coordination and control measures to further integrate joint actions within the JOA and across subordinate OAs in coordination with subordinate commanders. The JEMSOC monitors the components' execution of EMSO and assesses the operations to inform and advise the commander on progress toward achieving EMS superiority in support of the operation's overall objectives.

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ENCLOSURE B

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS PLANNING

1. Introduction

a. The Joint Planning Process. Joint planning is the deliberate process of determining how to implement strategic guidance using military capabilities in time and space to achieve objectives within an acceptable level of risk. This enclosure provides a JEMSOC with guidelines for integrating JEMSO into the Joint Planning Process (JPP). Reference (e) identifies the CCMD JEMSOC as the lead staff element for JEMSO planning. JEMSOC and JEMSO planners need to proactively participate in the staff's planning process to ensure integration into operations. This enclosure discusses JEMSO integration through the seven steps of the JPP.

b. The Competition Continuum. The joint force employs many constructs and procedures in environments ranging from peace without significant military competition to armed conflict. Rather than describing the state of the environment as either "at peace" or "at war," the competition continuum describes a state of enduring competition in which the joint force works and operates—applying a mixture of cooperation, competition below armed conflict, and armed conflict—to achieve objectives.

2. JEMSO JPP Seven-Step Overview. Figure 3 displays the general flow of JEMSO planning through the seven steps of the JPP. Process actions in each of the seven steps are discussed in the following paragraphs.

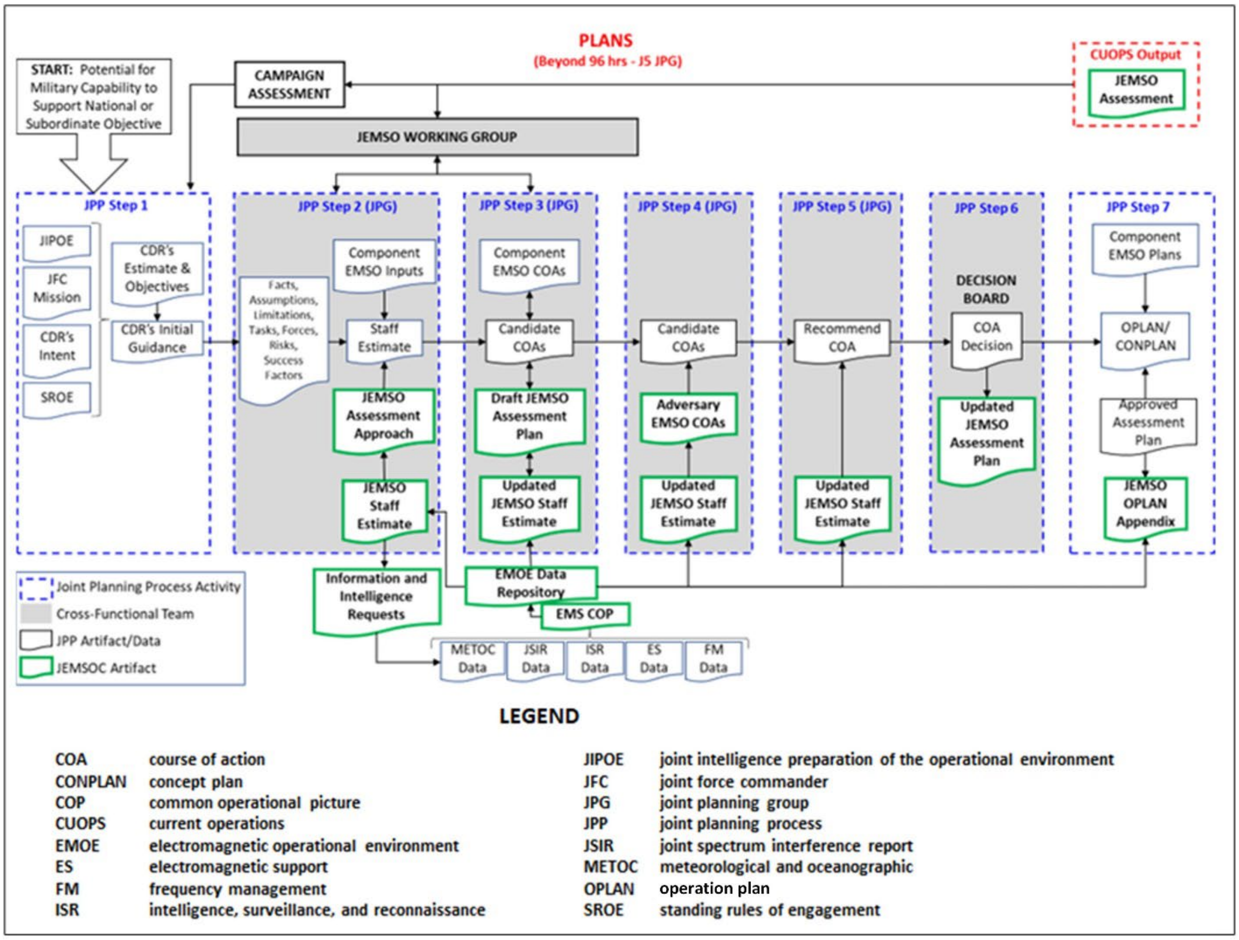


Figure 3. JEMSO JPP Seven-Step Overview

a. JEMSO Planning Initiation (JPP Step 1). During planning initiation, the JEMSOC focuses on identifying and updating EMOE-related information from existing guidance and sources, such as current staff estimates, joint intelligence preparation of the operational environment (JIPOE), staff cross-functional working groups and liaisons, capability requirement updates, and assessment plans. Although there are no doctrinally required outputs to planning initiation, individual staffs might provide templates for staff elements to record input to the overarching planning effort. All materials and work during plan initiation will be used or further developed during subsequent JPP steps.

(1) JEMSOC Planning Initiation Inputs and Planning Actions. Table 1 summarizes planning initiation inputs. The planning actions depict the identification, compilation, and review of material and information that help answer some of the following fundamental questions and guide subsequent planning.

(a) What do we know (facts relevant to the planning problem)?

(b) What do we **not** know (information gaps and assumptions)?

(c) Who else needs to know (who we need to communicate and coordinate with)?

(d) What timeline are we on (drives planning battle rhythm and informs planning time management)?

JEMSOC Planning Initiation Inputs	JEMSOC Planning Initiation Actions
• Strategic or operational level guidance and planning directive documents. • CCMD-/JFC-level planning directives and/or planning guidance. o Problem statement, end state, mission statement, specified tasks from higher (or strategic) directives/guidance. • Existing campaign and/or contingency plans related to the new plan or operation that the staff is embarking on. • Strategic estimate and intelligence products to include JIPOE.	• Review relevant plans, orders, guidance. • Review EMOE data. • Determine JEMSO Organization, Cross-Functional Team Integration, and Coordination with External Organizations. • Review relevant JIPOE and EMOE information, desired end state, strategic effects, and objectives. • Determine Preliminary JEMSO Assessment Approach. • Establish EMS Management Guidance, Responsibilities, and Tools. • Identify information requirements and request for information (RFI).

Table 1. JEMSOC Planning Initiation Inputs and Planning Actions

(2) Review Relevant Plans, Orders, Guidance

(a) The JEMSOC reviews plans, orders, guidance, and other existing information pertinent to the current planning effort, especially any EMSO-related information. Material to gather and review, if available, includes:

1. Higher problem statement.

2. Higher end state.

3. Higher mission.

4. Specified tasks.

5. Facts, limitations, restraints, constraints.

6. Forces apportioned/expected in the area of operations (AO) (current locations and deployment timelines).

7. Existing objectives and effects.

8. Existing information requests.

9. Existing assessment plans, especially JEMSO assessment plans or information.

10. Existing adversary, friendly force, neutral actor (A/F/N) EMOE data (requires identifying who constitutes A/F/N from higher directive/order/guidance).

(b) Generally, the higher-level documents provide objectives, mission, primary task, purpose, methods, and end states; however, these are usually stated at a macro (i.e., strategic) level, and unlikely to be JEMSO-specific. Based on these key portions of the higher-level documents, the JEMSOC can discern JEMSO tasks (e.g., gain and maintain EMS superiority) and submit them for consideration to the joint planning group (JPG)/operational planning team (OPT).

(c) Review EMOE Data

1. During planning initiation, JEMSO planners should identify, gather, and review EMOE data pertaining to A/F/N for the area of interest (AOI) from the existing theater-wide EMOE data repository and intelligence sources. The EMOE data repository is discussed in more detail in Enclosure E.

2. An EOB, containing the EMS attributes of all EMS-dependent systems in the JOA, becomes part of the EMOE data repository. Based on the adversary systems provided in the overall order of battle, the JEMSOC should coordinate with the J-2 to build the EOB. The J-3, J-6, and components contribute the information necessary to build friendly EOB. For a list of EOB data sources, see Enclosure E and Enclosure G.

3. Potential sources of friendly-force availability information necessary for compiling EMOE data include:

a. Component status of forces documents or slides that are usually part of commander's update briefings and/or hosted on JFC or component web sites.

b. The Global Force Management Implementation Guidance (GFMIG).

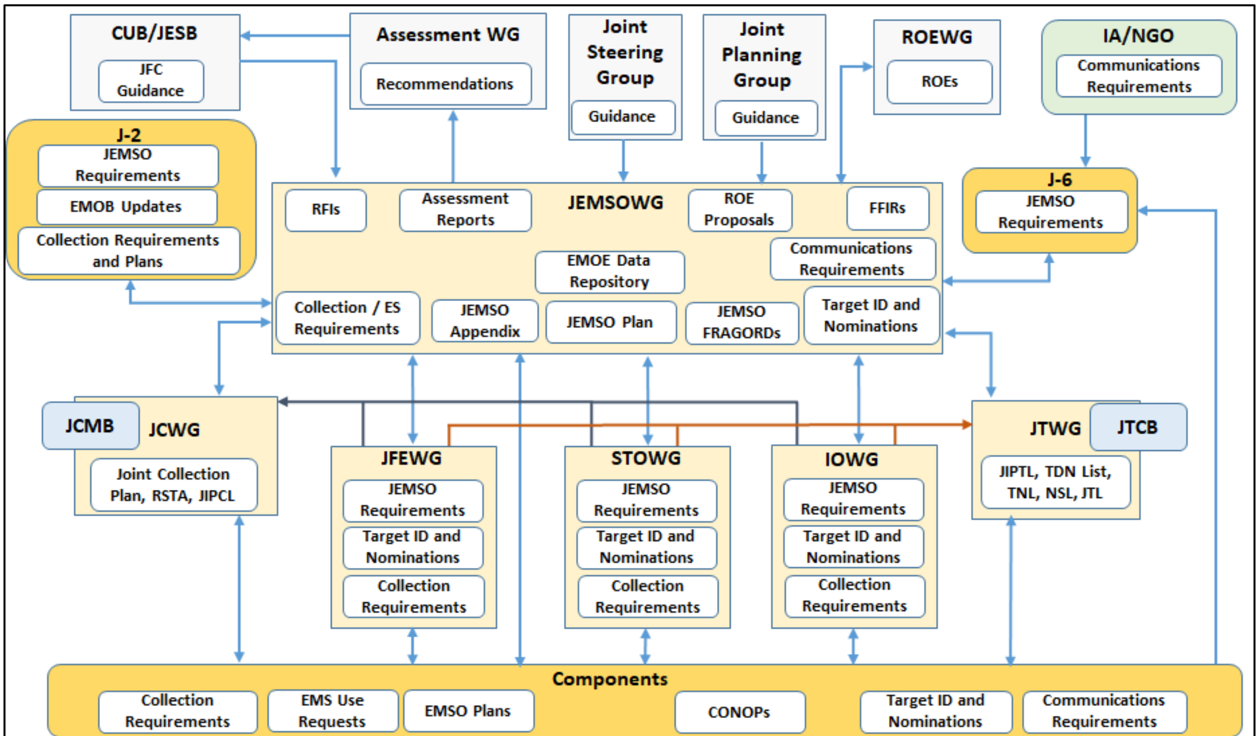
c. The Global Force Management Allocation Plan (GFMAP).

d. A time-phased force and deployment list (TPFDL) or time-phased force and deployment data (TPFDD) would likely not yet exist at this point in planning, unless the planning effort involves updates or FRAGORDs to an existing plan. If friendly-force information remains unknown, obtaining it becomes a tasked friendly force information requirement (FFIR).

(d) Determine JEMSOC organization, cross-functional team integration, and coordination with external organizations. The JEMSOC director should ensure JEMSOC manning is sufficient for representation in other cells and working groups, and for participation in cross-functional teams. The JEMSOC's organizational construct, functions, and duties are discussed in Enclosure A. The JEMSO working group's (JEMSOWG's) recommended integration with other cross-functional teams is shown in Figure 4 and is discussed in a JEMSO execution context in Enclosure C.

1. JEMSOC integration in the J-5-/J-35-led planning effort is critical to planning and executing JEMSO. The JPG/OPT (J-5/J-35, respectively) will set the overall planning effort agenda. For JEMSO integration, JEMSOC planners must participate in JPG/OPT meetings and determine which other working groups require participation. Figure 4 depicts working groups that the JEMSOC should typically interact with. Participation will vary depending on the staff element, manpower and time availability, and the degree of EMSO's criticality to the other working groups' roles in the operation. The JEMSOC's priorities for cross-functional working group integration might change as planning progresses but, at the outset of planning, it is critical to integrate JEMSO to the maximum extent practical.

2. The JEMSOC should provide planning support guidance and requirements to components, agencies, and other inter-organizational partners with EMS equities, via the JFC's established orders process, e.g., planning orders (PLANORDs) and planning directives (PLANDIRs). This codifies and mandates the required information exchanges for subsequent planning and execution.



CONOPS – concept of operations
CUB – commanders update brief
EMOB – electromagnetic order of battle
EMOE – electromagnetic operational environment
EMS – electromagnetic spectrum
FFIR – friendly force information requirement
FRAGORD – fragmentary order
IOWG – information operations working group
ID – identification
JCMB – joint collection management board
JCWG – joint collection working group
JEMSOWG – joint electromagnetic spectrum operations working group
JESB – joint effects steering board
JFC – joint force commander
JFEWG - joint fires effects working group
JIPCL – joint integrated collection list
JIPTL – joint integrated prioritized target list
JPG – joint planning group
JSG – joint steering group
JTL – joint target list
JTCB – joint targeting coordination board
JTWG – joint targeting working group
NSL – no strike list
RFI – request for information
ROE – rules of engagement
RSTA – reconnaissance, surveillance, tracking and assessment
TDN – target development nomination
TNL – target nomination list
STOWG – special technical operations working group
WG – working group

Figure 4. Planning-Related Working Groups and Cross-Functional Staff

(e) Determine Preliminary JEMSO Assessment Approach. During planning initiation, JEMSOC planners should gather existing assessment-related guidance and ascertain staff assessment formats and processes to inform development of the JEMSO assessment plan during COA development. Preparatory efforts during planning initiation will streamline assessments in subsequent planning steps. Enclosure D contains additional detail on JEMSO assessment. Assessment groundwork that can be accomplished during planning initiation includes:

1. Coordinating with the JFC's assessment cell and other staff elements to gain understanding of the assessment process, and to determine required format and content of the JEMSO assessment plan.

2. Coordinating with component EMSOCs to establish lines of communication and to identify reporting mechanisms for task accomplishment

that will provide measure of performance (MOP) and measure of effectiveness (MOE) data.

3. Coordinating with the J-2 for mutual understanding of the collection requirements process, and acknowledgment that it will be required for obtaining indicator information supporting JEMSO assessment.

(f) Establish EMS Management Guidance, Responsibilities, and Tools

1. JEMSO planners must identify and review existing EMS management guidance, such as an existing joint restricted frequency list (JRFL), JCEOI, and joint spectrum interference resolution (JSIR) procedures. These EMS management functions are normally performed by the JFMO, which can either be assigned to the J-6 or the JEMSOC. JFMO personnel lead or coordinate EMS management efforts on behalf of the EMSCA (if not delegated to the JEMSOC director), RF assignment authority (discussed in Enclosures A and F), and the JEMSOC. The JFMO can begin performing the following duties during planning initiation, but many of them require data and information obtained through the planning process for implementation during execution:

a. Gather existing data for JRFL considerations.

b. Gather guidance provided on electromagnetic interference (EMI) resolution (e.g., JSIR).

c. Review EMSCMs and RF assignment authority.

d. Begin EMS access coordination for HN approval.

e. Review GFMAP for EMS-dependent systems entering the JOA.

f. Review EMS access requirements with components and other operators in the JOA.

g. Participate in developing, coordinating, updating, and promulgating JEMSO guidance.

h. Identify frequencies for inclusion in the EMOE data repository.

2. JEMSO planners must be familiar with Joint and Service EMBM tools and systems, and their use in JEMSO planning. This includes familiarity with EMBM system data requirements, inputs/outputs, and the interoperability between Joint and Service systems to maximize their effectiveness in supporting JEMSO.

3. JEMSO planners must be familiar with Joint, coalition, and Service C2 interoperability standards, such as Universal Command and Control, to enable and ensure effective coordination and integration of electromagnetic spectrum operations.

(g) Identify Information and Intelligence Requirements and RFIs. Even at this early stage in the planning process, the JEMSOC's process of gathering and reviewing information will spawn information and intelligence requirements. The JEMSOC may also have to respond to EMOE-related information and intelligence requirements, and RFIs from other entities during planning. For example, having insufficient or outdated EMOE data should induce a requirement to satisfy the information gap. An ongoing need for information spans the entire planning process to inform decisions as planning proceeds. The JEMSOC must document and actively track each of its information and intelligence requirements and RFIs.

(3) JEMSO Planning Initiation Summary. Although there are no standardized doctrinal outputs of planning initiation, the JEMSOC must accomplish two fundamental milestones: (1) solidify the JEMSOC's integration with the rest of the JFC staff and the components, and (2) review existing directives and guidance containing the information necessary for proceeding to MA, paying particular attention to JEMSO-relevant information. The plan lacks granularity at this early point in planning, but time spent establishing JEMSOC integration across the staff, tailoring an EMOE data repository for the planned AO, formalizing lines of communication with components and reach-back resources, and preparing formats for upcoming planning products will help streamline subsequent planning.

b. JEMSO Mission Analysis (JPP Step 2)

(1) Mission Analysis Overview

(a) The goal of MA is to define the problem, understand the OE, and further develop guidance to drive the rest of the planning process. During MA, the JFC and staff develop an understanding of the mission to generate a mission statement and intent that summarize what actions need to be taken (tasks) and why (purpose). Subordinate and supporting commanders use the mission statement and intent as guidance to begin their own estimates and planning efforts. The JEMSOC conducts MA to develop an initial strategy for gaining EMS superiority, and the tasks to achieve it, in support of the JFC's mission. The JEMSOC documents these planning efforts and other supporting analysis in a JEMSO staff estimate that begins in MA and builds as planning progresses, ultimately becoming the basis for the JEMSO Appendix to the final JFC plan or order. JEMSOC MA inputs, planning actions, and outputs are listed in Table 2.

Key Inputs	Mission Analysis	Key Outputs
• Strategic guidance/estimate, higher headquarters' (HHQs') planning directive. • JFC's initial planning guidance (may include description of OE, definition of problem, operational approach, initial intent). • EMOE-relevant JIPOE and other intel products. • Initial EMOE data repository (adversary, friendly, neutral, environmental factors). • JEMSO limitations, constraints, vulnerabilities, and challenges. • Initial JEMSO-tailored RFIs and information and intelligence requirements for submission to J-2. • Initial JEMSO-tailored FFIRs to J-5, J-6. • EMOE data repository.	• Build initial JEMSO staff estimate. o Analyze strategic guidance and HHQs' planning guidance. o Determine JEMSO-related facts and assumptions. o Determine specified, implied, and essential Tasks. o Develop JEMSO mission statement. o Identify forces available and corresponding friendly EMOE data. o Identify JEMSO limitations. o Develop risk assessment. o Develop initial JEMSO objectives. o Identify JEMSO information and intelligence requirements and potential commander's critical information requirements (CCIR). o Develop COA evaluation criteria. • Update EMOE data repository.	• Staff estimates. • Mission statement. • Commander's refined approach including: o JFC's intent statement. o JFC's updated planning guidance. • Problem framing, initial force identification, mission success criteria, initial risk assessment, mission analysis briefing, and planning directive (as necessary). • Initial commander's critical information requirements. • Course of action evaluation criteria. • Identified essential, specified, and implied tasks. • Friendly and threat centers of gravity. • Updated EMOE data repository.

Table 2. JEMSOC Mission Analysis

(b) A suggested technique in MA and throughout the planning process is for JEMSO planners to keep a running list of items such as tasks (planning process tasks and actual EMSO mission tasks), information and intelligence requirements and RFIs (including follow-up and tracking), and anything noteworthy that is not a dictated planning action but could be necessary in follow-on planning steps. By the end of MA, the JEMSOC should have determined:

1. The purpose of the mission.

2. The potential impact of the EMS on the mission (adversary, friendly, and neutral EMS).

3. JEMSO objectives and effects necessary to accomplish the mission.

(2) JEMSOC MA Planning Actions

(a) Update the EMOE Data Repository

1. JEMSO planners should maintain EMOE SA, built by compiling and analyzing EMOE data for the AO. During planning, the JEMSOC devotes time and effort to building and maintaining a mission-tailored EMOE data repository, which is a subset of the theater-wide steady-state EMOE data repository. It should include all the EMOE data necessary to develop objectives, effects, and tasks for the JFC to gain and maintain EMS superiority to support the overall mission. Enclosure E discusses the EMOE data repository and Enclosure F discusses spectrum management development and contribution to EMOE characterization.

2. As planning progresses, the JEMSO planner should incorporate additional information such as JEMSO risks and limitations necessary for determining COA supportability in JPP steps three and four. Table 3 contains examples of data included in the EMOE data repository.

• Spectrum access requirements (satellite communications (SATCOM), datalinks, Global Positioning System (GPS) dependencies, terrestrial communications, radar, electro-optical/infrared).
• Prioritization (EMOE-related critical requirements and vulnerabilities).
• EOB data and C2 information, including:
  o Telecommunications structure (landline, fiber-optic, cellular, Wi-Fi, SATCOM).
  o Integrated air defense system (IADS) (EMS-dependent system components and C2 EMS linkages).
  o Air, maritime, ground, and space forces (EMS-dependent systems and C2 EMS dependencies and structures).
  o Signals intelligence (SIGINT)/imagery intelligence/measurement and signals intelligence/processing, exploitation, and dissemination (PED) systems, and intelligence-related C2 and data dissemination dependencies structures.

Table 3. Examples of Data in the EMOE Data Repository

(b) Analyze Strategic Guidance, Intent, and Higher Headquarters' Planning Guidance. JEMSO planners will analyze higher headquarters' (HHQ) planning guidance and JFC commander's guidance and intent for JEMSO-related facts, limitations, specified tasks, mission statements, risk, and other pertinent information that describes the situation, adversary, and mission. If the source documents do not expressly task JEMSO, the JEMSOC's planning effort will focus on conveying implied JEMSO actions necessary to support the mission.

(c) Determine JEMSO-Related Facts and Assumptions

1. A fact is a statement of information known to be true (such as verified locations of friendly and adversary force dispositions) and is necessary to state because it bears on mission planning. The EMOE data repository contains factual data, but not everything in it is a planning "fact" in this context. Planning facts are particularly significant pieces of information that affect subsequent planning, drive decision points, or are critical to the mission. EMOE data of such significance will likely be identified in the JEMSO aspects of friendly and adversary center of gravity (COG) analyses.

2. In a JPP context, an assumption is a supposition about the current situation or future course of events, presumed to be true but not yet proven, based on an assessment of available facts. Valid assumptions should be logical (i.e., reasonable to assume based on relevant facts), realistic (i.e., not far-fetched or exaggerated), and essential for planning to continue (i.e., they influence junctures or priorities in planning, such as decision points and force employment). The relevant facts upon which JEMSO assumptions are based

come from the EMOE data repository. Assumptions fill gaps where facts could not be determined, so they inherently bring about information and intelligence requirements to verify their factuality. Predictive assumptions will likely not be verified until mission execution (i.e., until observed in actual operations), while other assumptions can be verified via pre-execution research or intelligence collection. In either case, planning proceeds as if the assumptions were validated. Examples of JEMSO-related facts and assumptions are depicted in Table 4.

FACTS	ASSUMPTIONS
• Country X possesses EW and Information Warfare (IW) capabilities, including denial and deception capabilities, which are part of their warfighting doctrine. They also have a doctrinal approach to combat similar to anti-access/area denial.	• Country X will employ those capabilities in Phase X, and they will hamper friendly operations.
• Country X has fielded a wide range of EW systems to counter friendly positioning, navigation, and timing (PNT); SATCOM; terrestrial communications; datalinks; and radar.	• Country X will use those capabilities in Phase X, and they will impact friendly EMS-dependent C2 systems.
• Friendly EA capabilities, can support interception and disruption, and will be used versus (vs.) adversary targets.	• ROE and authorities will permit use of EA. • Friendly EW will have an adverse impact on adversary operations.
• Friendly freedom of action and maneuver in the EMOE will be required to support operations.	• Freedom of action/maneuver in the EMOE will be contested, congested, and constrained.

Table 4. Notional Examples of JEMSO-Related Facts and Assumptions

(d) Determine Specified, Implied, and Essential Tasks

1. Specified tasks are expressly assigned to a commander in a planning directive. Implied tasks are additional tasks, not explicitly stated in the planning directive, that are necessary for accomplishing the specified tasks, and are usually identified at the level of a functional cell or working group. Essential tasks must be executed successfully to attain the desired end state. The JFC commander and staff will identify and review their assigned specified tasks and identify implied tasks. Once tasks have been compiled and reviewed, the commander and staff will identify essential tasks. The JEMSOC should be involved early in this process to ensure JEMSO tasks are included in the JFC's task list.

2. At the JEMSOC level, gaining and maintaining EMS superiority is the essential task for operations in any contested EMOE. Characterizing the EMOE is an implied task in that it informs the actions necessary to achieve EMS superiority. The JEMSOC generates implied tasks that support the key and essential tasks and typically become actionable JEMSO objectives. The following are examples of specified, implied, and essential tasks identified at this point in planning. They are like tasks in actual CCMD plans but are sufficiently broad to be applicable to most operational planning efforts.

a. Gain and maintain EMS superiority (essential task).

b. Characterize the EMOE (implied task).

c. Mitigate adversary ability to contest friendly force operations in the EMOE (implied task).

d. Degrade adversary's ability to transmit and receive EM energy for sensing and communicating (implied task).

e. Integrate friendly force operations in the EMOE with joint force operations in all domains (implied task).

(e) Determine JEMSO-Related Facts and Assumptions. Having identified specified, implied, and essential tasks, the JPG/OPT will draft a JFC-level mission statement. The JFC-level tasks and draft mission statement, along with JEMSO specified, implied, and essential tasks and objectives, enable development of a supporting JEMSO mission statement. Developing a JEMSO mission statement is not mandated, but it is common for functional areas and components to develop one to articulate their particular role in supporting the overall JFC mission. A JEMSO mission statement should use the JFC's mission statement as a template then add JEMSO specified, implied, and essential tasks. This nests the JEMSO mission statement under the JFC-level mission statement and allows subordinate and supporting EMSO entities to begin concurrent planning. The example JEMSO mission statement in Figure 5 restates the JFC's mission statement with JEMSO specified, implied, and essential tasks inserted (underlined).

*On order, (CCMD/JFC) in conjunction with allies and partners, **characterizes the EMOE** and conducts operations designed to **gain/maintain EMS superiority** in support of operations to deter (adversary name) aggression, signal allied resolve, preserve (entity or country) sovereignty and, if necessary, defeat a military incursion while setting conditions for offensive operations as a larger (coalition/allied) force.*

Figure 5. Example JEMSO Mission Statement

(f) Identify Forces Available and Corresponding Friendly EMOE Data

1. The JEMSOC identifies capabilities required for the mission and compares this to forces and capabilities assigned or allocated. Force availability references include the GFMIG, GFMAP, previously submitted requests for forces (RFFs), and other resourcing documents. These force management documents and processes are covered in reference (w). The JEMSOC determines the EMS-dependent/-enabled systems and associated infrastructure required to support operations, what is immediately available, and what additional forces/capabilities need to be requested. This appraisal of requirements-to-capabilities imposes the following planning requirements on the JEMSOC:

a. Populate the EMOE data repository with applicable friendly EMS-dependent system data.

b. Determine shortfalls or mismatches in the requirements-to-capabilities calculus and a plan for resolving them, or the risk to EMSO supportability and overall mission success if unresolved.

2. Both planning tasks above involve coordination with supporting and component EMSO elements to incorporate their EMSO capabilities and requirements.

3. The JEMSOC should:

a. Use force structure estimates (e.g., TPFDD, TPFDL) to determine what forces are readily available and what additional forces/capabilities will require RFFs for planning purposes.

b. Coordinate with components to review, update, and verify forces and capabilities available.

c. Determine the EMS requirements and signatures of forces' EMS-dependent systems for inclusion in the EMOE data repository.

d. Identify critical communications links and EMS characteristics (e.g., PED, tactical data links, SATCOM).

e. Begin drafting requests for required capabilities and capacities not assigned or allocated.

f. Provide estimated force status, including the status of requests for additional capabilities/capacities, to pertinent cross-functional teams to include risk associated with reallocation or diversion of assets.

g. Identify known or expected contested, congested, and constrained aspects of the EMOE likely to impact JEMSO by frequency, time, and location.

h. Begin determining required EMS allotments to resolve EMS access conflicts.

(g) Identify JEMSO Limitations. In planning lexicon, limitations are defined in terms of constraints (required actions), restraints (prohibited actions), or other restrictions imposed by higher/other authorities. Sources of limitations include diplomatic agreements, ROE, political and economic conditions in the AOI, and HN restrictions. JEMSO-related limitations can hamper freedom of action in the EMOE and can become risks that potentially impede JEMSO COA supportability and EMS superiority. COA supportability assessment is discussed in the JPP steps 3 and 4 sections below. During MA, JEMSO planners identify constraints, restraints, and other restrictions, then preliminarily assess how they limit EMOE freedom of action. An example of a constraint and restraint is:

1. Constraint: Forces must comply with HN spectrum restrictions (potential limitation on friendly EMSO).

2. Restraint: Do not conduct offensive EA without appropriate approval.

(h) Develop Risk Assessment

1. JEMSO planners conduct a preliminary risk assessment by identifying the obstacles or limitations that may impede or preclude accomplishing JEMSO objectives and overall mission accomplishment. Risk

assessment is initiated in MA and done with more specificity in the context of supporting COAs (discussed in the JEMSO COA development, analysis, and wargaming sections below). JEMSO planners use the following sources of information to perform an initial risk assessment during MA:

a. The EMOE data repository.

b. JEMSO-related specified, implied, and essential tasks.

c. A COG analysis with EMOE aspects of A/F/N critical capabilities (CCs), critical requirements (CRs), and critical vulnerabilities (CVs) identified.

2. In accordance with (IAW) references (x) and (y) and Service-level doctrine, risk assessment and management involve assigning risks a probability (or likelihood) level and a consequence level that together equate to a risk level (low, medium, high, severe), and then identifying potential mitigation. The JEMSOC will determine processes, formats, and required level of detail. Some of these guidelines should have been identified during planning initiation while gathering guidance and information on risk assessment formats and processes.

3. Risk statements derived from risk analysis are commonly categorized as risk to force or risk to mission. The following broadly stated examples of JEMSO-related risk statements can fall into one or more of the risk categories:

a. Risk when proceeding without EMS superiority or delaying operations until an acceptable level of EMS superiority is established.

b. Estimate the adversary's ability to contest friendly-force EMS access.

c. Assess the risk to operations from failure to degrade the adversary's use of the EMS.

d. Assess the impact of delaying operations until all EMS capabilities are in place or until EMS superiority is established.

e. Risk imposed by host- and neutral-nation restrictions on access to the EMS.

f. Risk of EMI between components or AOs.

g. Risk of exposing sensitive EMSO capabilities to adversaries or non-aligned parties.

h. Risk that man-made or natural environmental factors will adversely impact EMSO.

4. The JEMSOC should query and compile EMOE-related risk inputs from across the staff and from component EMSOCs. Mitigation actions for the risk areas above should also be considered. The level of effort and detail devoted to risk assessment during MA is time- and situation-dependent, and it will be refined during subsequent JPP steps using JEMSO objectives and tasks, and component EMSO plans, in the context of supporting friendly COAs.

(h) Develop Initial JEMSO Objectives. Reference (y) discusses developing military objectives during MA at the JFC level, based on higher orders or guidance, to describe in broad terms what the JFC wants to achieve within each line of the operational approach. This process is illustrated in Table 5.

JEMSO Objective	Effects
Mitigate adversary's ability to contest friendly force operations in the EMOE.	• Adversary SATCOM jammers unable to deny friendly force SATCOM. • Adversary PNT jammers unable to deny friendly use of GPS system for PNT. • Adversary RADAR jammers unable to disrupt friendly force RADAR. • Adversary LASER systems unable to disrupt friendly force optical systems.
Degrade adversary ability to transmit and receive EM Energy for sensing and communicating.	• Adversary unable to effectively employ their IADS. • Adversary ability to C2 forces is degraded. • Adversary ability to conduct intelligence, surveillance, and reconnaissance (ISR) is degraded. • Adversary use of PNT is degraded.

Integrate friendly force operations in the EMOE with Joint Forces in all domains for unity of effort in the EMOE.	• Friendly EMI within and between domains is negated/minimized. • Friendly forces are able to maneuver effectively in a congested, contested, and constrained EMOE. • Primary, Alternate, Contingency, and Emergency plans developed and integrated. • EMS Allocation Requirements identified. • EMSCMs developed and published.

Table 5. Example of JEMSO Objective Development

(i) Identify JEMSO Information and Intelligence Requirements and Potential commander's critical information requirements. Reference (y) states, "during mission analysis, the joint force staff identifies significant information gaps about the adversary and other relevant aspects of the OE." During MA, the staff, including the JEMSOC, identifies and lists requirements necessary for planning and earmarks the most significant ones; both priority intelligence requirements (PIRs) and FFIRs to recommend as CCIRs. Additionally, information and intelligence requirements can be ongoing, whereas RFIs are usually a one-time occurrence.

1. Regardless of whether the JEMSOC's information requirements become CCIRs, they are still necessary for JEMSO planning. JEMSO-related requirements can be submitted as RFIs for intelligence requirements or, for FFIRs, satisfied with information gathered via friendly channels.

2. CCIRs are the focus of the J-2 staff estimate and the intelligence annex (Annex B) of the final plan or order. In addition, PIRs are captured in the final plan or order and used by the US Intelligence Community (IC) to create the National Intelligence Support Plan. From an EMS perspective, potential CCIRs must be analyzed to determine any EMS dependencies. The following tasks and Table 6 summarize JEMSOC actions regarding information and intelligence requirements:

a. Review CCIRs and PIRs in existing JFC plans (Annex B, Intelligence) for similar operations and in component plans, to glean information that might guide information and intelligence requirements development in the current planning effort.

b. Develop FFIRs to characterize the EMS requirements and capabilities of theater forces.

c. Develop information and intelligence requirements (and RFIs, as required) to characterize the adversary EOB and incorporate acquired information, as appropriate, into the EMOE data repository.

d. Determine which EMSO-related requirements should be recommended as CCIRs.

e. Analyze CCIRs to determine EMOE relevance and EMS dependencies.

f. Track all EMS-related RFIs, information and intelligence requirements, FFIRs, PIRs, and CCIRs toward resolution.

FFIRs	• List relevant/critical EMS-dependent systems. • Availability and changes in operational status of EA, electromagnetic support (ES), electromagnetic protection (EP), spectrum-dependent (S-D) systems, and ISR assets. • Availability and changes in operational status of space-based capability. • Arrival of new EMSO forces/capabilities (including additional spectrum requirements). • HN spectrum authorizations (baseline authorizations and changes).
Intelligence Requirements	Note: Intelligence requirements (IRs) have the potential to be priority intelligence (or information) requirements. Plus, RFIs might be needed for IRs not addressed in existing intelligence reports or data. • List the key adversary EMS-dependent systems. • Fielding new ISR capabilities and/or increasing the posture of ISR capabilities. • Change in anti-access/area denial posture. • Increase/decrease in EMI (adversary EA/directed energy) and effectiveness. • Increase in counter-space posture and attacks. • Command, Control, Communications, Computers, and Intelligence (C4I) analysis by domain. • Employment of unconventional or new equipment or weapon systems. • Employment of ISR platforms (unmanned aerial vehicle [UAV], surveillance radars, unattended ground surveillance, etc.). • Fixed and mobile communications equipment and methods used by the adversary or their PNs, or neutral actors, to relay information, including the use of SATCOM. • Manipulation of identification friend-or-foe (IFF), GPS spoofing, or any capability/intent to employ EM deception, including tactics, techniques, and procedures (TTP), forces, locations. • Identification of new adversary and enemy EMS-dependent systems brought into the AOI.

	• Prediction of the location time and EMS-operating parameters to be used by adversary systems.
RFIs	• What are the EMS-enabled C2 pathways between air defense units and their command entity? • How many transponders/channels can adversary jammers (or a particular jamming system) deny simultaneously? • How many transponders channels are in the range of adversary jammers? • What type of jamming techniques do adversary jammers (or a particular jamming system) use? • How will adversary jammers (or a specific system) operate when deployed out of garrison (duration, TTP/methods unique to deployed operations)? • What impact do adversary jammers (or specific systems) have on friendly communications and ISR systems (or other friendly EMS-dependent systems) (i.e., what friendly systems are vulnerable to adversary jamming)?

Table 6. JEMSOC Information and Intelligence Task Summary

(j) Develop COA Evaluation Criteria

1. Evaluation criteria are standards the staff generates during MA, refines during COA development, analysis, and wargaming, and applies during COA comparison to evaluate the relative effectiveness of multiple COAs.

2. The JPG/OPT will provide overall potential COA evaluation criteria (e.g., risk, force protection, flexibility, surprise) and solicit inputs from the staff before presenting them to the commander for approval in the MA briefing. The JEMSOC can recommend changes or additional objective criteria from a JEMSO perspective, assess the EMOE's impact on the criteria, and use the criteria as guidelines to inform EMOE maneuver.

(k) Prepare JEMSO Staff Estimate (if required). Although staff estimates are not necessarily a command requirement, they are a good mechanism for describing how the staff section's functional area (e.g., JEMSO) supports and impacts the mission. If generated, the JEMSO staff estimate is started during MA and summarizes the results of MA planning (i.e., the planning actions discussed above) in as much detail as time and circumstances permit. The JEMSO staff estimate is a living document in that the JEMSOC will build upon it in subsequent planning steps. The staff estimate, together with the JEMSO CONOPS generated during COA development and refined in the subsequent COA-related JPP steps, provides most of the information required for the JEMSO Appendix to the final plan or order. It also feeds into, and builds progressively with, the overall JFC staff estimate to convey JEMSO's support to the mission. See reference (e) for more detail and a JEMSO staff estimate template.

(3) JEMSO MA Summary. The purpose of MA is to understand the mission and the OE, including the EMOE, and to determine the fundamental tasks necessary to accomplish the mission. The JEMSO planner captures the MA results in the initial JEMSO staff estimate and are appropriately integrated and summarized in the JFC's MA brief. Information requirements generated during MA—regardless of whether they become CCIRs—are still necessary for JEMSO planning. The JEMSOC planners can submit RFIs for intelligence requirements, or FFIRs to be resolved with information gathered via friendly channels. During MA, the JEMSOC initiated or developed the planning products in Table 2.

e. JEMSO COA Development (JPP Step 3)

(1) COA Development Overview. In COA development, the JEMSOC planners, in conjunction with component EMSO planners, determine what JEMSO actions (represented by component EMSO tasks) are required to generate the desired effects for each JEMSO objective (consummating in achieving EMS superiority). The objectives, effects, and subsequent component tasks are prioritized by phase of the operation based on the overarching COA developed in the JPG/OPT. The JEMSOC updates its staff estimate (if one is developed) for each COA developed in this JPP step and incorporates the approved COA(s) into the "execution" paragraph of the JEMSO appendix to the OPLAN/OPORD. Table 7 lists the inputs, planning actions, and outputs for this JPP step, followed by explanatory paragraphs.

JEMSOC COA Development Inputs	JEMSOC COA Development Planning Actions	JEMSOC COA Development Outputs
• Staff estimates. • Mission statement. • Commander's refined operational approach. • JFC intent statement. • JFC updated planning guidance. • Information requirements. • Assumptions. • Adversary's most likely and most dangerous COAs. • Friendly forces and capabilities. • Main and supporting efforts. • Component tasks.	• Determine EMS effects and tasks by component. • Develop JEMSO assessment plan. • Determine force/capability requirements and shortfalls. • Determine JEMSO risk and mitigation. • Compile information and intelligence requirements. • Provide input to COA narrative and sketch.	• Revised JEMSO staff estimate. • JEMSO COA support narratives/sketches and draft CONOPS including: ○ Prioritized objectives/ effects for each COA. ○ Specified, implied, and essential tasks. ○ Major capabilities required. ○ Timeline. ○ Task organization. ○ Identification of required joint (staff) director (JDIR), component, and interagency tasks.

Table 7. JEMSOC COA Development Inputs, Planning Actions, and Outputs

(2) JPG/OPT COA Guidance and JEMSO Integration. The JPG/OPT will provide COA guidance, through an operational approach, for components and functional areas to develop their supporting CONOPS. Provided COA details will likely include the following at the operational level: objectives, implied/essential/specified tasks, current and desired conditions, main and supporting lines of effort, COA descriptions, phase timelines, and phase transition conditions.

(a) The JEMSOC will apply objectives and effects from the COA guidance and work with the components to link them to JEMSO objectives and tasks. JEMSOC interaction with the cross-functional teams is the mechanism for integrating JEMSO through the operation on behalf of the components.

(b) The JEMSOC planners and component EMSO planners may benefit by using a worksheet similar to Figure 6 as a tool to annotate and organize information for COA development. The data fields and information on the worksheet can assist JEMSOC representatives in providing inputs to various working groups. The JEMSOC COA development planning actions discussed in the paragraphs below the worksheet correlate with data fields on the worksheet.

<table>
<tr><td>PHASE:
From JPG/OPT</td><td colspan="4">Flexible Deterrent Option (FDO) or Flexible Response Option (FRO) # From JPG/OPT</td><td>COMPONENT:</td></tr>
<tr><td>COA #</td><td colspan="5">Narrative Description of the COA</td></tr>
<tr><td rowspan="2">Prioritized Tasks</td><td>TASK 1</td><td colspan="2">TASK 2</td><td colspan="2">TASK 3</td></tr>
<tr><td>Component Task Number and Description from JPG/OPT</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>JEMSO Effects</td><td>List applicable JEMSO Effects supporting Task 1</td><td colspan="2">1.3 xxxxx
1.4 xxxxx
2.1 xxxxx</td><td colspan="2">1.1 xxxxx
1.4 xxxxx
2.2 xxxxx</td></tr>
<tr><td>Planned AO</td><td>Location (e.g., AO Alpha)</td><td colspan="2">AO: Bravo</td><td colspan="2">AO: Charlie</td></tr>
<tr><td>Friendly Forces Planned</td><td>Friendly forces available for executing this task—usually major weapon systems</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>EMS Requirements</td><td>EMS requirements to accomplish Task 1 in “AO Alpha” by friendly forces above (cont’d in next column)</td><td colspan="2">Component spectral needs based on system types and corresponding frequency bands</td><td colspan="2">Examples: Directed Energy, GPS, terrestrial comms, SATCOM, radars, datalinks</td></tr>
<tr><td>Risk</td><td>Risk to mission caused by above threats, limitations, or other risk factors</td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td rowspan="2">Collection Requirements</td><td>PIR</td><td>NAI</td><td>PIR</td><td>NAI</td><td>PIR</td><td>NAI</td></tr>
<tr><td>(priority intelligence requirement)</td><td>(named area of interest)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Other Working Groups as required</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Dependencies/Needs: Include EMS requirements/risks for Cyber, Space, special technical operations (STO), ISR, and integration into plans</td></tr>
<tr><td colspan="4">Examples Include:</td><td colspan="3"></td></tr>
<tr><td colspan="4">Supporting effects required for success</td><td colspan="3">Changes to ROE/Authorities</td></tr>
<tr><td colspan="4">Requests for forces/support</td><td colspan="3">Timing and Tempo concerns</td></tr>
</table>

Figure 6. JEMSOC COA Development Worksheet

(3) Determine EMS Effects and Tasks by Component. From the operational-level component tasks (at the top of Figure 6 worksheet), each component identifies the JEMSO effect(s) supporting the task. JEMSO objectives and effects were identified in MA. Enclosure D includes a more detailed breakdown of JEMSO objectives and effects, using the same notional objectives used in this enclosure.

(4) Develop JEMSO Assessment Plan. Assessments are used to determine the overall progress of operations toward achieving objectives. The JEMSOC integrates JEMSO assessment into the JFC's overall assessment process. Enclosure D contains a more detailed discussion of JEMSO assessment and developing the assessment plan during COA development.

(5) Determine Force/Capability Requirements and Shortages. JEMSO planners determine what forces are required to execute the tasks developed for each COA. Some JEMSO capabilities could involve special access programs (SAPs) or special technical operations (STO) that generate JEMSO effects and should be integrated. JEMSO planners must identify force and capability gaps and shortfalls, which are considered risks or limitations until resolved or accepted, or the COA is adjusted.

(6) Determine JEMSO Risk and Mitigation. The JEMSOC planners should identify EMS-related risks for each proposed COA. The JPG/OPT combines risk assessment inputs from across the staff, including JEMSO risk assessment, to assess risk to overall operations. Initial risk assessments developed during COA development are revisited and refined as necessary in subsequent JPP steps.

(a) Risk assessment can be graphically depicted with charts, numerical scoring, etc., which helps alleviate subjectivity in briefings and staff estimates. Typical JEMSO risks include:

1. Shortfalls in EMS accessibility due to HN, ROE, or other constraints.

2. Shortfalls in EMSO capabilities (technological or quantitative).

3. Shortfalls in ES/SIGINT collection to support targeting and EMSO assessments.

4. Enemy ability to contest friendly EMSO.

5. Unresolved EMI, EMS fratricide, or intelligence gain/loss issues.

6. Potential collateral effects of EA on civilian or neutral-actor EMS activities, and corresponding adverse reactions.

7. Risk to operations if the EMOE cannot be shaped to support friendly force operations.

8. Risk to PNT if GPS jammers are not suppressed.

9. Risk to fires missions due to a congested and contested EMOE.

10. Risk to C2 link operations if adversary communications jammers are not suppressed.

11. Risk to ISR, ES, and other EMS sensing systems from adversary EA.

12. Risk of friendly force detection by adversary sensors intercepting EMS signatures.

(b) The level of EMS-dependency of the COA or overall mission will determine the degree to which JEMSO risk contributes to the overall COA/mission risk. Generally, all modern-day operations will have at least some degree of EMS dependency, so JEMSO risk will contribute to overall risk; therefore, JEMSO planners must assess EMS dependency and risk levels attributable to JEMSO.

(c) JEMSO planners must identify ways to reduce or mitigate risks and assess the level of residual risk after mitigation. Table 8 lists some typical JEMSO-related risks and potential mitigation actions.

Risk	Potential Mitigation Actions
• Shortfalls in EMS availability due to HN, restrictive ROE, or other constraints. • Potential adverse collateral effects of EA on civilian or neutral actor EMS activities and corresponding adverse reactions.	• Work with the HN (via the JFMO) for broader/less constrained EMS access. • Ensure JRFL addresses HN or other EMOE conflicts. • Coordinate/request ROE revisions to permit friendly EMS actions.
• Shortfalls in EMSO capabilities (technological or quantitative).	• Submit requests for support/forces (RFSs/RFFs) and enforce JFC capability allotments. • Prioritization of capabilities across component AOs. • Develop new capabilities via joint urgent operational needs statement or service urgent operational needs statement. • Identify SAP/STO capabilities.
• Adversary ability to contest friendly EMSO.	• Implement potential friendly-force EP TTP. • Target adversary systems contesting EMSO.

Table 8. Typical JEMSO-Related Risks and Potential Mitigation Actions

(7) Compile Information and Intelligence Requirements. The analysis conducted in COA development may lead to new requirements and RFIs that affect intelligence collection plans. The JEMSOC must prioritize its requirements and RFIs and track them to completion. The following list recaps COA development planning actions that generate collection requirements:

(a) EMOE data repository updates and EMOE characterization pertinent to the COAs.

(b) JEMSO-related information on targets and collections that support the COAs.

(c) Assessment plan indicator information to support battle damage assessment (BDA), MOPs, and MOEs.

(8) Develop Inputs to COA Narrative and Sketch. The COA narrative describes how forces will accomplish the commander's intent. The JEMSOC director should advocate for JEMSO analysis results inclusion into COA sketch graphics, and in section 3 of the overall staff estimate, for COAs heavily dependent on EMSO for mission success.

(9) JEMSO COA Development Summary. A COA is a potential means to accomplish the assigned mission. The staff develops COAs to provide unique options to the commander, all oriented to achieving the commander's intent and achieving the desired military end state. During COA development, the JEMSO planners develop a plan for supporting each COA, identifies forces, capabilities, and risks involved, and articulates its COA support in updating the JEMSO staff estimate.

d. JEMSO COA Analysis and Wargaming (JPP Step 4). COA analysis is the process of closely examining potential friendly COAs, enabling the commander and staff to evaluate each COA's validity. Doctrinally, validity is determined by assessing each COA based on suitability, feasibility, acceptability, distinguishability, and completeness. Wargaming is a prevalent means of COA analysis because it helps planners assess a COA's validity and likelihood of success in execution by simulating enemy opposition to the COA's friendly scheme of maneuver, including EMOE maneuver. During COA analysis, the JEMSOC assesses supportability for each COA. Table 9 lists JEMSOC inputs, planning actions, and outputs of JPP step 4.

JEMSOC COA Analysis & Wargaming Inputs	JEMSOC COA Analysis & Wargaming Planning Actions	JEMSOC COA Analysis & Wargaming Outputs
• Revised JEMSO staff estimate. • COA alternatives with concept narrative and sketch. • Risk identification and assessment.	• Assess risk and COA supportability. • Conduct wargaming and evaluate results.	• JEMSO supportability & risk assessment for each COA. • Updated JEMSO staff estimate and CONOPS for each COA. • Updated information and intelligence requirements.

Table 9. JEMSOC COA Analysis & Wargaming Inputs, Planning Actions, and Outputs

(1) JEMSO Risk and COA Supportability Assessment. The JEMSOC must assess EMS supportability for each COA. Actions that enable supportability assessment include determine critical friendly EMS dependencies and vulnerabilities requiring protection (as identified by components); identify critical adversary EMS dependencies and vulnerabilities for potential targeting; and determine the potential for EMI (intentional and unintentional) on friendly-forces and its impact on the scheme of maneuver for each COA.

(2) The JEMSOC consolidates EMS-dependent/enabled systems and corresponding EMS-access requirements that enable JEMSO aspects of the COA. Examples of systems include beyond-line-of-sight communications (e.g., high frequency (HF) radio), line-of-sight (LOS) communications (e.g., ultra-high frequency (UHF) radio), radars, jamming systems, etc.

(3) The JEMSOC determines the impact of EMOE by assessing the significance of JEMSO and EMS-dependent/-enabled systems to the COA, and EMS-related dependencies/vulnerabilities identified via COG analysis. The JPG/OPT performs analysis, with supporting JEMSOC inputs identifying the relevant EMS aspects, for both friendly and adversary COGs. The analyses reveal EMS-related CC, CR and CV.

(4) The JEMSOC needs to coordinate with the JPG/OPT to determine specific methods and formats for including EMOE-related assessments into staff planning documents and briefings. The volume of EMOE data and the intricacy of describing interdependence between EMOE impact, JEMSO risk (including limitations), and JEMSO supportability for a COA lend themselves to using graphics to generate and convey these analytical points.

(5) Table 10 contains JEMSO objectives developed during MA and tasks aimed at providing information and baseline assessments that will feed subsequent JEMSO COA supportability assessment.

JEMSO Objective	Analysis Tasks
Mitigate adversary's ability to contest friendly force operations in the EMOE.	• Identify friendly-force EMS-dependent/-enabled networks/systems and EMS activities. • Identify the EMS-related friendly-force CVs and determine potential mission impacts. • Identify adversary capability and intent to contest friendly EMS access and potential mitigation/defense options.
Degrade adversary ability to transmit and receive EM Energy for sensing and communicating.	• Identify adversary EMS-dependent/-enabled networks/systems and EMS activities. • Identify the EMS-related adversary CVs and determine potential mission impacts. • Identify friendly capability and intent to contest adversary EMS access.
Integrate friendly force operations in the EMOE with Joint Forces in all domains for unity of effort in the EMOE.	• Assess the potential for, and operational impact of, friendly-force EMS fratricide, and identify potential mitigation actions. • Assess the impact of friendly-force JEMSO on neutral actor activities. • Assess the impact of neutral actor EMS activities on friendly-force EMS access and EMOE maneuver. • Assess the impact of physical environment effects on the ability to maneuver in the EMOE and potential to mitigate adverse effects.

Table 10. Example of JEMSO Objectives and Supporting Analysis Tasks

(6) The JEMSOC can benefit from developing graphics to depict progressive analysis for determining a COA's level of EMS dependency, EMSO risk and contribution to overall mission risk, and JEMSO's overall COA supportability. The number of graphics and detail involved in assessing EMS dependency, risk, and COA supportability depends on command standards and processes for these analyses, planning time constraints, size and expanse of the operation, number of proposed COAs, level of detail required, and other variables. JEMSO planners should focus on analysis efforts and products that will integrate with those of the cross-functional staff, so JEMSO is considered in overall COA analysis and is prepared for participation in wargaming.

(7) <u>Conduct Wargaming and Evaluate Results</u>

(a) Wargaming analyzes each COA independently using the friendly scheme of maneuver, including JEMSO actions, against the enemy's most dangerous and most likely COAs. Wargaming will help determine whether adversary actions and reactions (as estimated in their COAs) were expected or if they cause surprise. Unanticipated results could indicate a need to amend or revise the COA. The JEMSOC compiles the results of analyses up to this point for participation in wargaming.

(b) Wargaming will help the JEMSOC assess COA supportability and validity from an EMSO perspective by either verifying or illuminating required changes to estimates of force/capability sufficiency, risk, limitations, and enemy opposition in the EMOE. New information and intelligence requirements will likely arise out of COA analysis and wargaming that will spawn collection requirements and EMOE data repository updates. The JEMSOC will update its staff estimate and other products as required.

(8) JEMSO COA Analysis and Wargaming Summary. COA analysis and wargaming is the process of closely examining potential COAs to reveal details that will allow the JPG to assess COA validity and determine each COA's advantages and disadvantages. Each COA will have different EMS-related requirements that JEMSO planners must understand and assess for JEMSO supportability and risk, so they can take informed action to optimize JEMSO's support to the COAs.

e. JEMSO COA Comparison (JPP Step 5). During COA comparison, COAs are independently evaluated then compared against the criteria generated in MA. The purpose is to identify and recommend the COA with the highest probability of accomplishing the mission while meeting evaluation criteria. The JEMSOC provides JEMSO-specific COA evaluation and comparison input for the overall COA comparison effort and subsequent COA recommendations. JEMSO COA comparison inputs, planning actions, and outputs are depicted in Table 11.

JEMSOC COA Comparison Inputs	JEMSOC COA Comparison Planning Action	JEMSOC COA Comparison Outputs
• COA evaluation criteria. • Wargaming results. • JEMSO supportability & risk assessment for each COA. • JEMSO staff estimate and CONOPS.	• Evaluate COAs based on JEMSO risk/supportability and COA evaluation criteria, and record results.	• Evaluated COAs. • Recommended COA & rationale. • Revised JEMSO staff estimate and CONOPS. • JEMSO input to COA recommendation and briefing.

Table 11. JEMSOC COA Comparison Inputs, Planning Actions, and Outputs

(1) Evaluate COAs based on JEMSO risk and supportability, and COA evaluation criteria.

(a) During MA, the JPG/OPT generated the COA evaluation criteria used during COA comparison. The JEMSOC uses its COA risk and supportability assessments and the overall COA evaluation criteria to compare COAs from a JEMSO standpoint.

(b) JEMSO planners may choose to develop a graphic or matrix depicting the relationship between EMOE/JEMSO impacts to each COA, with a weighting factor based on overall COA evaluation criteria. Reference (y) discusses multiple methods for comparing COAs and shows examples of decision support matrices like the notional JEMSO-focused matrix in Table 12. More detail and analysis contribute to the numerical priority and weighting factors than are shown here, but even a basic visual/numerical tool adds quantitative rigor to otherwise subjective analyses for COA comparison. It also enhances analytical credibility when coordinating with other working groups and can supplement textual or narrative JEMSOC inputs to staff-wide COA comparison.

	COA Evaluation Criteria (Prioritized 1-3, where 1 is highest priority)		
Assessed COA EMOE/JEMSO Impact Rating (1-3, 3 is higher impact)	**Force Protection** (Pri 1) (multiply COA EMOE impact rating by 3)	**Speed** (Pri 2) (multiply COA EMOE impact rating by 2)	**Economy of Force** (Pri 3) (multiply COA EMOE impact rating by 1)
COA 1 impact rating 1	**3**	**2**	**1**
COA 2 impact rating 2	**6**	**4**	**2**
COA 3 impact rating 3	**9**	**6**	**3**

Table 12. Notional JEMSO COA Evaluation and Comparison Rating Matrix

(c) The JEMSOC's EMOE/JEMSO COA impact evaluation and comparison uses the same COA evaluation criteria as the rest of the staff but applies a JEMSO functional area perspective to feed into the JPG's overall COA comparison process. The JEMSOC will provide COA scoring and recommendations to the JPG.

(2) JEMSO COA Comparison Summary. In COA comparison, the JPG evaluates all COAs against established evaluation criteria and selects a COA to

recommend to the commander. Key JEMSO COA evaluation and comparison factors include the level of EMS impact (or dependency) of each COA and JEMSO risks and limitations. The JEMSOC should apply a quantitative method to rate each COA from a JEMSO perspective and provide any JEMSO-related COA recommendations to the JPG.

f. JEMSO COA Approval (JPP Step 6). The JPG briefs the JFC on the results of COA comparison and recommends a COA for the commander's approval. The COA approval briefing should include any critical risks or other issues pertinent to JEMSO supportability and EMS superiority in executing the COA. The commander is responsible for selecting, rejecting, or directing modifications to a particular COA. The approved COA will then be developed into a detailed CONOPS. The JEMSOC finalizes its staff estimate based on the approved COA and any updated guidance and provides inputs to the overall staff estimate and CONOPS. This prepares the JEMSOC for writing the JEMSO Appendix to the final plan or order generated in JPP step 7, and for providing any required JEMSO-related inputs to other portions of the plan or order.

g. JEMSO Plan or Order Development (JPP Step 7)

(1) Once the JFC has approved a COA, the staff completes the commander's estimate, refines the CONOPS, and writes the OPLAN or OPORD. Deliberate planning will normally result in an OPLAN, while crisis action planning will typically result in an OPORD. Development of the JFC CONOPS and corresponding plans/orders are the culminating planning milestones for the JFC staff.

(2) The JEMSOC will finalize the JEMSO Appendix to Annex C of the plan/order that articulates JEMSO support to operations. This is when planners should refer to the running list of items (e.g., JEMSO mission tasks or staff coordination tasks, information and intelligence requirements) generated throughout planning that may need to be incorporated into the JEMSO Appendix. In addition, the JEMSOC should review other pertinent annexes and appendices to integrate JEMSO activities and effects as required across domains and functions of the operation. References (e) and (j) contain example templates for a JEMSO appendix and tabs to the appendix. Also, Enclosure F discusses the spectrum management tab to the JEMSO appendix.

3. JEMSO Planning Summary. Achieving EMS superiority results from unified, integrated joint force EMSO planning and exaction to create conditions for operational success in congested, contested, and constrained EMOEs. These conditions contribute to enable critical EMS enabled capabilities across all domains and joint functions. Responsible to the JFC, the JEMSOC plans

and orchestrates activities and capabilities in the EMOE in pursuit of EMS superiority.

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ENCLOSURE C

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS EXECUTION

1. Introduction. This enclosure describes the transition from OPLAN/OPORD development in FUPLANS to the execution of operations in future operations (FUOPS) and current operations (CUOPS). It begins with an overview of the hand-off from J-5–led planning to J-3–led planning and the relationship between FUPLANS products and FUOPS/CUOPS products. It then discusses JEMSO activities and products in FUOPS/CUOPS. The JEMSO coordination cycle integrates with the commander's decision cycle and drives JEMSO activities during FUOPS/CUOPS.

2. Plan/OPORD in Execution and the JEMSO Coordination Cycle

a. The transition from J-5–led planning to J-3–led planning is depicted in Figure 7. The OPLAN/concept plan (CONPLAN) produced by the J-5–led JPG is a primary input to the J-3–led OPT in FUOPS/CUOPS. The J-3 OPT will make changes as required to the OPLAN/CONPLAN and will lead execution planning.

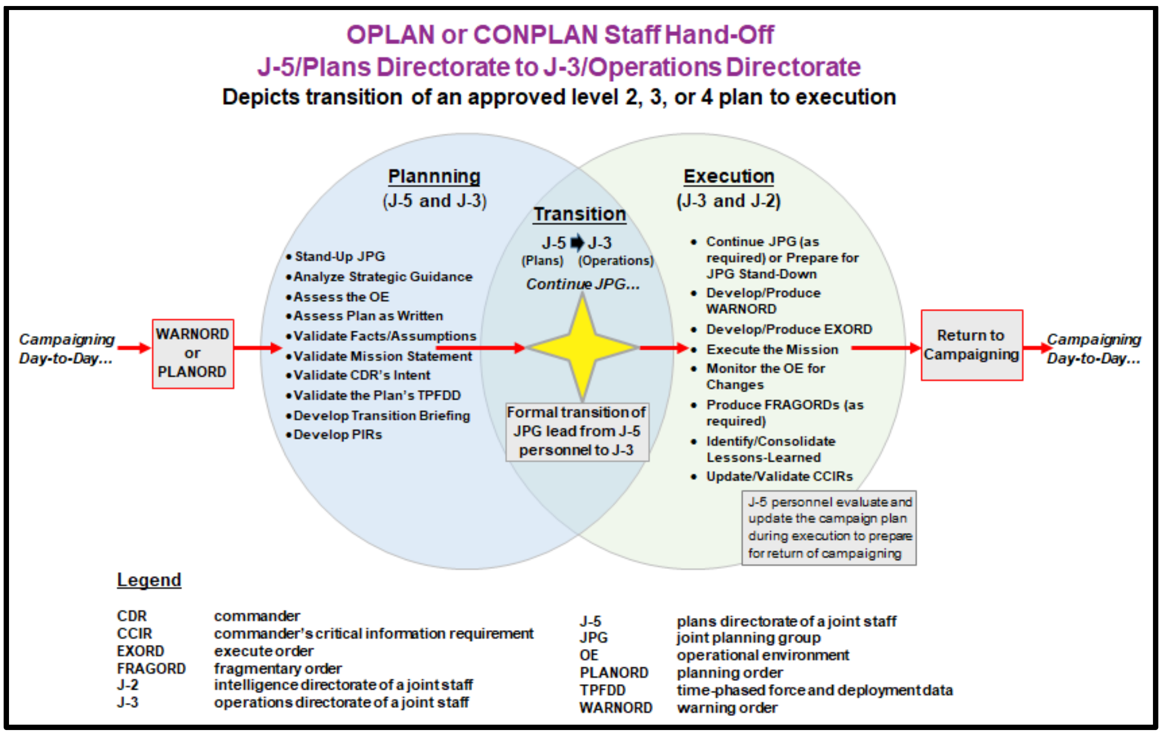

Figure 7. OPLAN/CONPLAN Staff Hand-Off for Planning-to-Execution Transition

b. Figure 8 depicts a linear view of JEMSO JPP actions/products and the transition into FUOPS/CUOPS. FUPLANS produces an OPLAN or CONPLAN, which can transition to an OPORD for execution. FUPLANS can also produce an OPORD for operations known to be imminent (i.e., operations expected to occur between 24 and 96 hours).

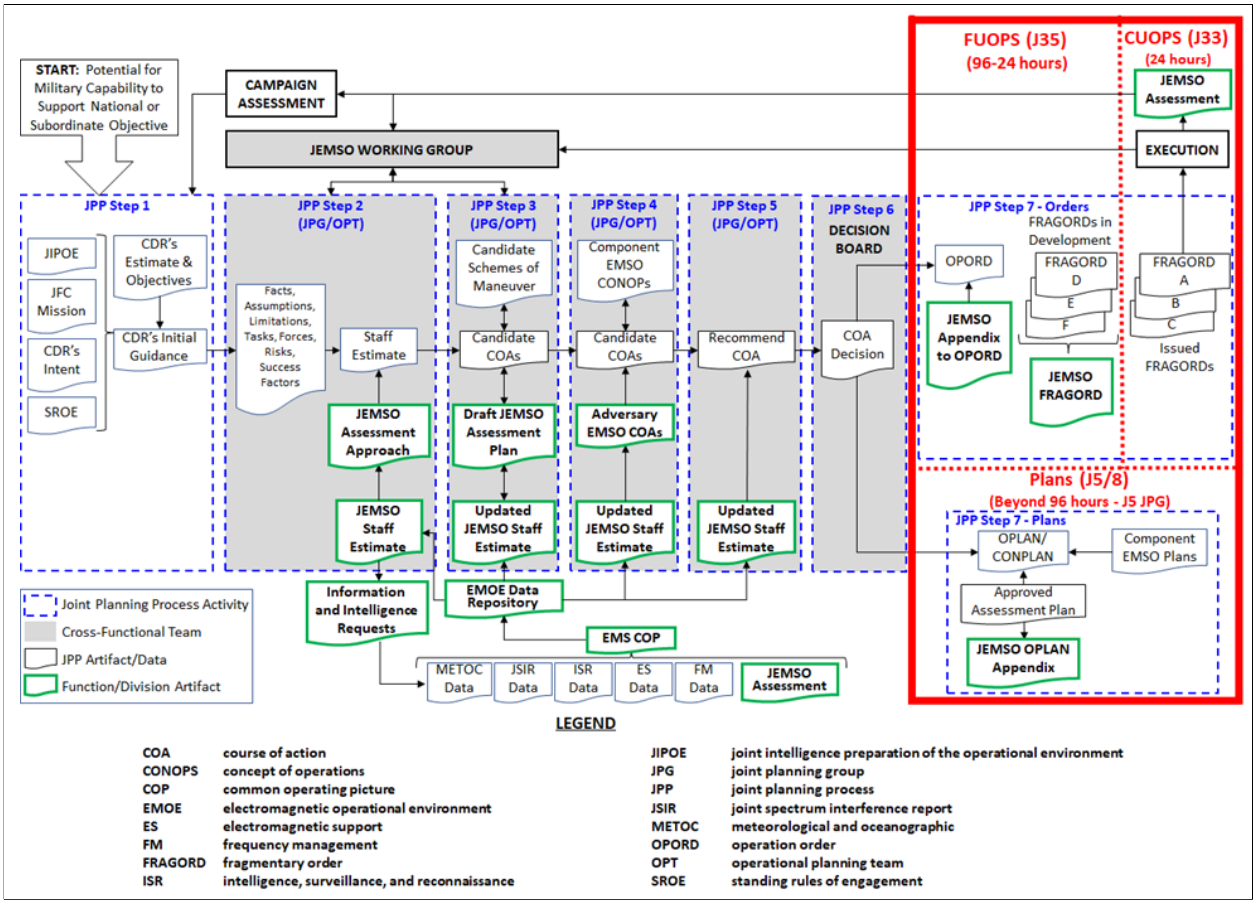

Figure 8. JEMSOC JPP Planning and Transition to FUOPS/CUOPS

c. The JEMSO appendix to the OPORD and the EMOE data repository establish the foundation for execution planning. The JEMSO appendix reflects commander's guidance and current data at the time the JFC approves and establishes the baseline direction for imminent operations. The JEMSO planner adjusts the appendix to the OPORD via JEMSO addendums to FRAGORDs or TASKORDs that cover shorter (e.g., daily) execution time-periods and more specific JEMSO direction.

d. The tempo and battle rhythm during FUOPS/CUOPS is driven by the commander's decision cycle (plan, direct, monitor, assess). The JEMSO coordination cycle, shown in Figure 9, aligns with the commander's decision cycle, and includes key JEMSO products and planning activities integrated to support overall joint force planning and execution. Much of the day-to-day tasking and activity occurs via an interrelated series of information exchanges, related to planning and assessing military EMS activities.

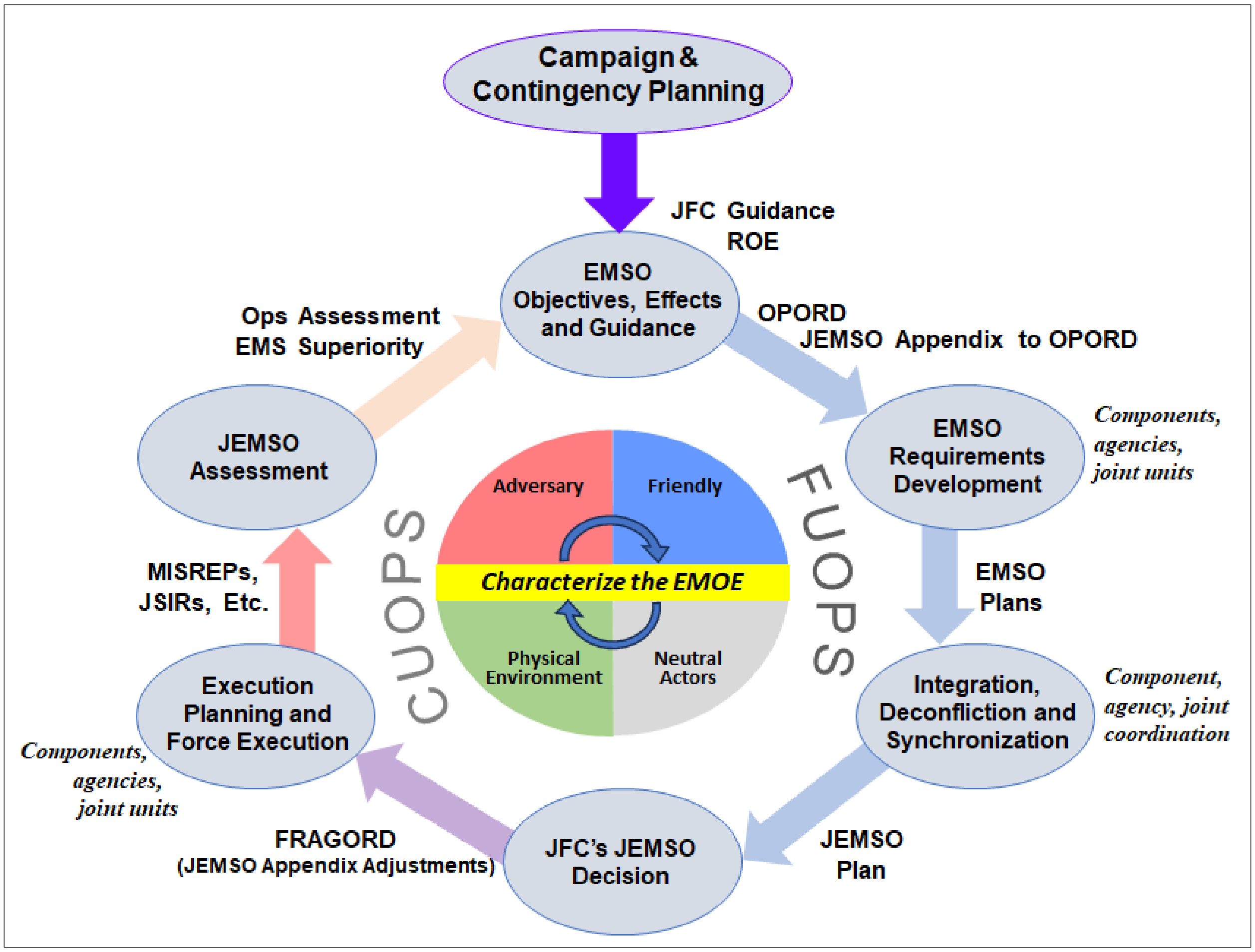

Figure 9. Notional JEMSO Coordination Cycle with Planning and FUOPS/CUOPS Products

e. The JEMSO coordination cycle begins with JEMSOC personnel building an EMOE data repository that underpins defining the EMOE and building the EMOE prediction. Defining, predicting, and updating the EMOE data repository enables collaborative JEMSO planning as operations proceed through execution. The EMOE data repository and prediction provides the common, authoritative sources for spectrum-use information. The repository should contain all EMS-dependent systems (i.e., friendly, enemy, neutral, and civil emitters and receivers) relevant to joint force operations. Updating the EMOE data repository throughout the cycle as depicted at the hub in Figure 9.

(1) The EMOE data repository incorporates the EOBs relevant to operations. The EOBs contain the aggregated electromagnetic characteristics, parametric data, EMS use information, operational descriptions, and temporal/ geospatial information for every EMS-dependent system across the JOA.

(2) The EMOE data repository is based on the current approved JEMSO plan (which integrates component EMSO plans) and includes the EMS operating parameters (e.g., RF assignments) for every friendly-force EMS dependent system that will potentially be used in operations. The JEMSO plan and associated EMOE data repository both contribute to and draw from information in the JRFL, JCEOI, other EMS authorizations, and the description of the EMOE. The JEMSO plan includes EMS activities associated with friendly force radars, data links, communication nets, enemy communications nets, C2 networks, PNT, EW, and ISR.

(3) The EMOE prediction for a specific execution period is also derived from the information sources above, with tailoring to provide the specific information below.

(a) The annotation of those EMS-dependent systems expected to be active in the AOI and their time and location of operation.

(b) The disposition of each of those EMS-dependent systems.

(c) A forecast of their modes of operation and expected EMS operating parameters (i.e., subset of possible ranges specified in EOB).

(d) Descriptions of how the adversary will conduct their EMS activities to support operations and contest friendly force EMSO.

(e) Probable EMS use and dependencies associated with critical capabilities.

(f) Expected role of the adversary EMSO in support of military operations.

(g) Predictions on how the adversary will conduct their EMS activities to support their operations.

(h) Predictions on how the adversary will contest friendly force EMSO.

(i) Predictions on how the adversary will conduct their EMS activities in reaction to friendly-force EMSO and the physical environment (e.g., enemy's most likely/dangerous EMS COAs).

(4) To build the EMOE prediction, the JEMSOC coordinates with cross-functional staff organizations to obtain updated information, including: updated adversary EOB and EMS use information from the J-2; updates to friendly-force EOBs and EMSO plans from the components and other EMS users; neutral actor EOB and EMS use information from the J-2 and J-6; and updated environmental information from meteorological and oceanographic (METOC) operations and other agencies.

f. Figure 10 below describes focus areas and activities during each stage of the JEMSO coordination cycle. The cycle covers the FUOPS/CUOPS execution of an OPORD, but can begin several days before execution, depending on the timeline from planning to execution. Once initiated, the cycle continues throughout operations.

Stage 1: Objectives, Effects, and Guidance. The JEMSOC either (1) participates in the planning process to develop a new JEMSO appendix for the operation/OPORD being planned, or (2) reviews refined JFC guidance to develop the JEMSO appendix for an OPORD derived from an OPLAN that is transitioning (from FUPLANS) into execution.

- The JFC provides updates to guidance, priorities, and objectives based on joint force progress toward objectives.
- The JFC staff, with inputs from the JEMSOC director, refines the commander's CONOPS.
  - Factors the projected state of the EMOE over the next planning cycle.
  - Incorporates assessments findings and recommendations of previous operations cycles.
- The JEMSOC, with support from the component EMSO cells, defines the EMOE by updating the EMOE data repository and promulgating the repository to the components, enabling collaborative EMSO planning. This involves the following tasks:
  - Review changes to the orders of battle.
  - Update the EOB in coordination with Intelligence directorate.
  - Review assessment findings from previous cycles.
  - Review planning factors influencing the EMOE (e.g., intelligence updates, environmental updates, targeting plans/requirements and associated ISR requirements, EMS use requirements [components, other governmental entity/NGOs]).
  - Builds/updates a prediction of the EMOE.
- The JEMSOC analyzes the EMOE prediction to determine operational impacts, which entails the following tasks:
  - Review JFC guidance and objectives.

  - Conduct electromagnetic environmental effects (E3) analysis on all EMS-dependent systems to predict potential for EMI.
  - Identify areas in the EMOE that are constrained, congested, and contested by estimating:
    - The adversary's ability to impact operations by contesting friendly force EMS activities across all joint functions.
    - The potential for friendly force, adversary, and neutral actor use of the EMOE to impact friendly force and adversary operations.
    - The impact of EMOE-related restraints/constraints on operations.
  - Determine potential to exploit and shape the EMOE to enhance friendly-force operations and to attack the enemy.
  - Coordinate with components/services and EMS to discern the impact of the predicted EMOE on operations.
  - Identify physical environment (meteorological, oceanic, and space) impacts on the EMOE.
- The JEMSOC combines the JFC's guidance with this EMOE situational understanding to develop and disseminate a refined JEMSO appendix that provides guidance for components to plan their EMSO. Example contents of the JEMSO appendix to an OPORD are shown in Figure 11.
  - Defines command-specific EMS management policy/guidance applicable to the current cycle.
  - Promulgates updates to the EMS management plan to include specific guidance applicable to the current cycle for managing, requesting, coordinating, and assigning EMS use, the JRFL process, generating and updating the JCEOI, and other processes.

Stage 2: EMSO Requirements Development. Component planners use the JEMSO appendix to build their EMSO plans that support their component's CONOPS and assigned missions.

- The JEMSOC updates the cross-functional staff elements on JEMSO.
  - Summary of JEMSO based on assessments.
  - The EMOE prediction for the next cycle.
  - EMSO activities completed and those ongoing.
  - Updated JEMSO-related commander's guidance.
- The JEMSOC gathers requirements from component EMSOCs and other EMS users, including:
  - EMS capabilities expected to be used in time, location, and EMS operating parameters.
  - Spectrum access needed in time, location, and EMS operating parameters.
- Components and agencies leverage the EMOE prediction, the EMOE data repository, and the JEMSO appendix to build their EMSO plans that:
  - Identify the units/platforms executing their CONOPS.
  - Identify the EMS activities to be executed, the desired EMS parameters, and the planned times and locations of execution.
  - Identify gaps between EMS allotments given and those required.

  - Prepare EMS support requests for non-organic EMS capabilities and resources.
  - Identify excess EMS allotments and EMS capabilities not planned for use.
- Components submit EMSO plans to the JEMSOC for deconfliction and integration into a coherent JEMSO plan.
- JEMSOC personnel develop an EMS requirements summary to quantify the EMS necessary to support the future operations.
  - Analyze the component EMSO plans and EMS use requests from other users.
  - Determine the necessity of using frequency sharing, spectrum reuse plans, and help in the development of allotment or channeling plans.
- JEMSOC personnel obtain EMS resources through coordination with the components and other users.
  - Re-apportion EMS-use allotments between components as needed to meet JFC objectives.
  - Request additional EMS allotments or EMS use permissions from the HN.
  - Resolve EMS capability support requests between components.

Stage 3: Integration, Deconfliction, and Synchronization. The JEMSOC, in coordination with component EMSO planners, develops an integrated JEMSO plan.

- The JEMSO plan identifies all component and agency EMS-related requirements, activities, and capabilities planned for execution along with their EMS parameters, time, and location of execution.
  - Fuse components' EMSO plans.
  - Ensure JEMSO plans align with all other planning activities.
- The JEMSOC performs the following:
  - Reviews EMS use requirements from the cross-functional team and component EMSO plans.
  - Reviews component EMSO plans for compliance with JFC guidance.
  - Identifies conflicts (i.e., EW and unintentional EMI) in the EMS during planning, and coordinates with components and other users to mitigate the impacts. This includes:
    - Adversary EW impacts to friendly force EMS-dependent systems.
    - Friendly force EW impacts to friendly, adversary, and neutral actor EMS-dependent systems.
    - Adversary and neutral actor EMS-use causing EMI that impacts friendly force EMS-dependent systems.
    - Friendly force EMS-use causing EMI that impacts friendly, adversary, and neutral actor EMS-dependent systems.
  - Coordinates EMS support requests and reallocation of EMS allotments between components.
  - Nominates and deconflicts frequencies to enable component planning.
  - Processes frequency nominations and assigns frequencies for all deconflicted EMS activities.
  - Develops mitigating options for unresolved conflicts and gaps.

  - Presents risk assessments and mitigation options to the J-3 for JFC decision on any issues.
  - Builds strategy for rapidly reassigning EMS allotments and capabilities to deal with contingencies.
  - Develops (or updates) the JRFL based on component inputs and EMOE changes.
  - Drafts the JEMSO plan.
- The JEMSO plan format is command- and situation-dependent, but contains information that could require adjustments to the JEMSO appendix from the OPORD. The JEMSO plan and adjustments are promulgated as a JEMSO addendum to a tasking order (TASKORD) or FRAGORD, i.e., via the orders format/process that the command uses for daily guidance and tasking). The format for an OPORD JEMSO appendix is shown in Figure 11. Subsequent JEMSO addenda could use the same general format as in Figure 11, with sections and content necessary to address adjustments as planning and operations progress through the coordination cycle.

Stage 4: JFC's JEMSO Decision. The JEMSOC prepares the JEMSO plan for approval and promulgates direction via JEMSO addendum to a TASKORD/FRAGORD (or other dissemination method) that directs components to execute their EMSO plans.

- Build JEMSO plan briefing for approval.
  - Present risk assessments and mitigation options to the J-3 for JFC decision on any unresolved JEMSO issues (e.g., gaps, conflicts, EMSO support requests).
- Update the JEMSO plan to include JFC's decisions for unresolved conflicts.
- Update the prediction of the EMOE and the JEMSO plan and promulgate this (via addendum to TASKORD/FRAGORD) to components/services and other EMS users, directing them to execute EMS activities IAW the JEMSO plan. EMS managers:
  - Assign frequencies for joint force capabilities and other EMS users.
  - Generate (or update) the JCEOI for joint networks.
  - Promulgate JRFL updates.
  - Approve components' EMS allocations.
  - Promulgate updates to the EMS management plan.

Stage 5: Execution Planning and Force Execution

(a) Execution Planning. Upon receipt of directives/orders from their chain of command, military units conduct detailed planning for all mission requirements, including the EMS activities needed to support their physical and temporal scheme of maneuver.

- Component units conduct the detailed EMSO planning for their assigned missions and execute their EMSO as directed in the JEMSO appendix and any JEMSO addendums to TASKORDs/FRAGORDs.
  - Component commanders and mission commanders have authority to maneuver in the EMOE and to adjust their EMSO plan within the scope of their EMSO tasking.
  - EMSOC EMS managers:
    - Assign frequencies to subordinate and supporting forces.
    - Report RF assignments back to the JEMSOC.
  - Component EMSOCs coordinate changes to their tasking with the JEMSOC.

- The JEMSOC coordinates the components' EMSO execution planning.
  - Analyze the impact of ongoing EMSO on the EMOE and planned operations.
  - Identify and resolve any conflicts or gaps in EMS-use or capability employment driven by changes to the plan.
  - Identify excess capabilities and EMS allotments available to satisfy new requests for EMS-use or EMS operations.
  - Gather requirements on need for EMSO plan changes.
  - Coordinate EMS support requests between components.
  - Coordinate spectrum assignment/allotment changes.
  - Obtain additional spectrum resources if required.
  - Perform EMI resolution and EW deconfliction during planning.
  - Update the JRFL and JCEOI.

(b) Force Execution. At the start of the execution period, the JEMSO watch officer (JWO) supporting the joint operations center (JOC) becomes the focal point for all EMSO duties for that period. Due to the dynamic nature of joint operations, the JEMSOC will monitor the EMOE and act as the focal point for coordinating changes to planned component EMSO.

- EMSO plan changes can be driven by changes to the EOB, changes in friendly force plans, support requests for EMS capabilities, discovery of time-sensitive targets, unexpected congestion in the EMOE, and unpredicted environmental conditions.
- The JWO coordinates adjustments component EMSO that impact other components.
  - Gather requirements on need for EMSO plan changes.
  - Coordinate spectrum assignment/allotment changes.
  - Obtain additional spectrum resources.
  - Coordinate EMS support requests between components.
  - Perform EMI resolution and EW deconfliction for immediate and impending operations.
  - Update JRFL and JCEOI.
  - Update the EMOE prediction for CUOPS to reflect changes to the physical environment, assessment results, and EMOE measurements and observations.
  - Evaluate the impact of changes to the EMOE CUOPS prediction.
  - Coordinate with other JOC duty officers to predict mission impacts from potential EMI.
- The JFC will issue FRAGORDs with JEMSO addenda (as required) to address changes in EMSO.
- The JWO will advise the JOC director or J-3 on options to improve friendly maneuver in the EMOE, mitigation of negative EMOE impacts, EMOE exploitation, degradation of adversary operations in the EMOE, and attacking the enemy through the EMOE.
  - Recommend changes to force maneuver (spatial, temporal, and spectral) to mitigate impact of EMI or to comply with EMS restrictions.
  - Recommend EMS parameters and assets for EMSO support to emerging high priority, time-critical, unplanned missions.
  - Issue cease transmission directions as required.
  - Facilitate resolution of EMS support requests between components and agencies

- The JWO must maintain EMOE SA to assess changes to the EMOE current operations prediction to support immediate and impending operations.
  - Analyze measurements and observations of the EMOE.
  - Track key force movements and operations, associated EMS-use, and the status of friendly, adversary, and neutral actors.
  - Oversee friendly force compliance with the JEMSO appendix and any JEMSO addenda in TASKORDs/FRAGORDs and check progress of friendly force EMSO plan execution.
  - Resolve Interference—determine possible sources of interference based on unresolved JSIRs submitted by EMSOCs or other users of the spectrum.
  - Coordinate JEMSO support throughout the targeting cycle and in support of time sensitive targeting with affected component commanders and the Joint Fires Element to ensure the EMS activities and capabilities required are deconflicted with other ongoing operations.
  - Coordinate with other component EMSOCs.
  - Request support from staff elements (i.e., J-2, J-6) and reach-back organizations.
- Report JEMSO. The JWO should examine any reports (e.g., SITREPS, TACELINT, AARS, MISREPs) reaching the JOC for EMS-related information or events. Reports with EMS implications should be summarized and compiled for assessments.
- Build Daily JEMSO Summary. At the end of each shift, the JWO should generate a current operations log (or similar report) that summarizes JEMSO activities during the most recent current operations period. The summary should capture changes to the EMOE current operations prediction and potential impacts to impending operations.
- Update the EMOE. Compile updated EMOE data from the components and other EMS users to provide current and emerging relevant EMOE data across the JOA/AOI. Disseminate the updated data to components and to the common operational picture (COP) management watch officer.
- Targeting and Fires Support. The JWO will coordinate with the Chief of Operations, the joint fires element watch officer, and the affected component EMSOC to integrate EMSO during dynamic targeting and to ensure EMSO activities and capabilities are deconflicted throughout operations.

Stage 6: JEMSO Assessment. Assessments are used to determine the effectiveness of JEMSO in support of operations and achieving JFC objectives and, if necessary, to recommend changes to JFC strategy and guidance. Enclosure D of this manual broadly discusses JEMSO assessment. JEMSO assessment tasks during execution include the following:

- The JEMSOC updates the JEMSO assessment plan developed during FUPLANS and refined during FUOPS with actual data observed during mission execution.
- The JEMSOC compiles component EMSO assessments into a JEMSO assessment and integrates the JEMSO assessment into the JFC's overall assessment process.
- JEMSOC personnel will also analyze EMOE reports, measurements, and observations from component EMSOCs, joint elements, and other EMS users to:
  - Refine the information defining the EMOE.
  - Resolve EMI—conduct interference analysis (IA).

- Review EMOE survey information and the EMOE prediction.
- Conduct IA to estimate the source of EMI.

- Conduct EMI resolution reporting—document results of information analysis and EMI resolution.

Figure 10. JEMSO Coordination Cycle Stages and Activities

3. JEMSO Coordination Cycle Products

a. JEMSO Appendix

(1) The JEMSO appendix to an OPORD (either derived and updated/ refined from an OPLAN/CONPLAN, produced in FUPLANS, or developed in crisis planning for which there was no pre-existing OPLAN/CONPLAN) is the fundamental JEMSO directive in mission execution (i.e., FUOPS/CUOPS). The JEMSO appendix reflects JFC guidance and data current at the time the order was approved. If derived from a pre-existing OPLAN/CONPLAN, the data (facts, assumptions, ROE, component specifics, etc.) and JFC guidance will likely need to be updated and tailored based on the current realities of the crisis. The JEMSO appendix can cover the operation's entire duration, or just a portion of the operation (e.g., Phase 2), or can change to reflect EMOE changes as the conflict unfolds. Changes requiring a new or updated OPORD would, in turn, require a new or updated JEMSO appendix to address changes.

(2) Figure 11 is a template of the JEMSO appendix to an OPORD. It is nearly identical to the OPLAN/CONPLAN JEMSO appendix templates in references (e) and (j), but can contain granular detail informed by knowledge of the current situation versus generalities and assumptions in OPLANS/ CONPLANS. Some products and information mentioned in the JEMSO appendix may contain large amounts of data, so links and references to information can be used to manage the length and volume of the appendix itself.

JEMSO APPENDIX TO OPORD (TEMPLATE)

Issuing Headquarters

Place of Issue

Effective Period of the Order

Date/Time Group of Signature

1. SITUATION

a. JFC guidance (verbatim).

(1) JFC's intent statement.

(2) Execution guidance (if issued).

(3) Supported and supporting command relationships.

b. General—See Annex B and related updates.

c. Area of Concern—JOAs for the current OPORD and the corresponding EMOE.

d. Adversary EOB—This subparagraph contains updates to the essential information concerning the enemy's composition, disposition, and strength based on its size, activity, location, unit, time, and equipment.

(1) Major EMS capabilities active in the AOI.

(2) How they are using the EMS to support their operations.

(3) Critical EMS vulnerabilities that friendly forces can exploit.

e. Friendly Force EOB—This subparagraph contains updates to the essential information concerning ongoing missions in the EMOE.

(1) Major EMS capabilities available in the AOI (e.g., sensing, communications, EA).

(2) Approved plans for how friendly forces use the EMS to support their operations.

(3) Critical EMS dependencies that friendly forces must address.

(4) Approved EMS support requests (i.e., SIGINT/electromagnetic support [ES]), EA, communications).

f. Neutral Actor EOB—Updates to the major neutral actor EMS activities expected over the EM AOI.

g. Summary of State of EMOE—This subparagraph contains essential information concerning the state of the EMOE and the subsequent risk to operations.

(1) Assumptions: See JEMSO Appendix to the order.

(2) EMS activities and EMS parameter assignments already approved.

(3) EMS boundaries:

- Total joint force spectrum allotments available
- EMS allotments already distributed.

(4) Existing Constraints:

- Approved JRFL covering the JOA.
- Approved (Regional) restricted frequency lists covering distinct AOs.
- Legal considerations concerning EMS activities.
    - Rules of engagement.
    - Local laws and Treaties.
    - Host and adjacent nation policies.
- Physical and environmental

(5) Predicted congested EMOE at specific locations, times, and frequencies.

- Adverse impacts to friendly force operations (risk to mission).

(6) Potential contested EMOE at specific locations, times, and frequencies.

- Adverse impacts to friendly force operations (risk to mission).

(7) Potential constrained EMOE at specific locations, times, and frequencies.

- Adverse environmental effects, ROE, host/adjacent nation agreements.

2. MISSION. The JEMSO mission is to gain and maintain EMS superiority in the JOA. Describe mission phases and the time period covered by this appendix.

3. EXECUTION—JOINT EMS OPERATIONS. The execution paragraph contains the information concerning how the components will conduct JEMSO. The paragraph includes the following subparagraphs:

a. Concept of Operations—This subparagraph explains the major operations and EMS-related tasks being conducted in the JOA as linked to JFC objectives. It includes:

(1) Priorities for EMS activities and EMS use (e.g., what JEMSO objectives and effects have priority) with respect to JFC guidance and as directed in the OPORD for main and supporting efforts. Include flexible deterrent options/flexible response options and preparation of the battlespace as required.

(2) Brief scheme of maneuver of each component, general locations of operations, and type of EMS activities that may be executed.

(3) Planned activities to protect friendly vulnerabilities.

(4) Discuss risks identified in Paragraph 1.

- Anticipated impact of EMOE on operations.
- Congested EMOE at specific times, locations, and bands.
- Adverse impacts on friendly force operations (risks to mission, force, or timing).

b. Tasks—This subparagraph contains specific instructions and tasks to cross functions staff elements, components, other CCMDs and supporting government agencies.

(1) JEMSO Assessment support.

(2) Emission control guidance.

(3) EMS activities to be executed by a supporting commander.

- Assured PNT in specific locations.
- Assured communications (SATCOM/Terrestrial).
- EA and ES support.
- Sensing.

c. Coordinating Instructions—Detail the JEMSO information exchange requirements applying to two or more elements. This also covers tasks that involve two or more components executing EMS activities in proximity. This includes coordinating the execution of EMS activities in a supporting and supported role as defined by mission priorities and the physical schemes of maneuver. This paragraph also contains information or instructions pertaining to information exchange locations, formats, content and suspenses. Includes locations within the JFC structure for information sharing.

(1) EMS Coordination Measures—Time-designated physical areas in which all EMS activities that create effects upon the adversary or undesired effects within that area must be coordinated with the supported mission commander. This includes inter-component EMS deconfliction (frequencies, Space, Cyber, STO etc.).

(2) Fire Support Coordinating Measures—Time-dependent physical areas employed by designated commanders that place coordinating requirements and employment restrictions on all fires, including EA, creating effects in that area.

(3) Assessment information requirements and reporting procedures.

(4) Location of existing SPECTRUM XXI RF assignments.

(5) Location of the EMOE data repository to support planning.

(6) Location of the approved JRFL and ROE.

(7) Location, date, and time EMSO plans and JRFL requirements are due.

(8) Location, date, and time that JEMSO appendix adjustments will be delivered (via FRAGORD or other order).

(9) Location to post JSIRs.

(10) Location of joint integrated prioritized target list (JIPTL) and joint integrated prioritized collection list (JIPCL).

(11) Cross-functional staff information requirements with suspense.

(12) Status of intelligence EMSO-related information requirements.

4. ADMINISTRATION AND LOGISTICS. This paragraph should cover procedures and status of forces or support anticipated to enter theater during specified time periods. Examples of paragraph content include logistics considerations affecting operations, such as the status of RFFs, joint urgent operational needs (JUONS), or TPFDD flow.

5. COMMAND AND CONTROL. Outline JFC command structure for JEMSO and include details of JEMSO relationships, authorities, and delegation.

a. JFC EMS-related authorities retained or delegated to subordinates (i.e., DIRLAUTH, EA control authority).

b. Physical boundaries of designated component operational areas.

c. JEMSOC and EMSO Cell points of contact.

6. ANNEXES. Use as required. One typical annex is noted in 6.a. below.

a. CCIRs and essential elements of information (EEI) applicable for specified time periods that the OPORD covers.

Figure 11. Template of JEMSO Appendix to an OPORD

b. JEMSO Plan. The JEMSO plan has no strict doctrinal or dictated format. It is essentially the working or draft version of what will become the JEMSO concept of operations in the JEMSO appendix (see Figure 10). To provide some definition of JEMSO plan content and sourcing, consider where the JEMSO plan is situated in the JEMSO coordination cycle (see Figure 9, coordination cycle stages 2 through 4). Initially, the JEMSOC consolidates and synchronizes component EMSO plans (described below) into a joint (JEMSO) plan, and gains approval for the plan, most likely from the J-3. The JEMSOC articulates the JEMSO plan as the concept of operations in the JEMSO appendix. Updates to the JEMSO plan can take effect during JEMSOWG meetings or via JEMSO addendums to respective FRAGORDs, depending on the extent of the updates, command battle rhythm, and procedural requirements.

c. Component EMSO Plans. The JEMSOC requires and incorporates component EMSO input in developing the JEMSO appendix to plans and orders. Based on JFC, JEMSOC, and component commander guidance, component EMSO planners build EMSO plans detailing EMS requirements and planned EMS activities in their respective AOs and submit their plans to the JEMSOC. The JEMSOC then prioritizes, synchronizes, and deconflicts proposed component EMS activities, and incorporates component EMSO plans into the JEMSO plan and JEMSO appendix. Updates to component EMSO plans and tasking changes can be communicated in JEMSOWG meetings or via JEMSO addendums in FRAGORD/TASKORDs, depending on the magnitude of the changes. Figure 12 is a list of information that should be included in EMSO plans.

- Describe component scheme of maneuver.
  - Include component objectives and planned activities by mission type and task.
  - Identify the major platforms/systems/units being planned to execute each mission task.
  - Identify physical scheme of maneuver and time window of execution.
  - Identify the priority of each planned mission as linked to JFC priorities.
- Identify the EMS-related requirements and priorities for EMS activities required for the mission "packages" or forces being utilized to the level of detail available, anticipated for the execution period.
  - Electromagnetic attack—Include adversary systems (if known) that will be nominated or system types that will be a priority for targeting with EA capabilities. Note: If specific fires are known, include EMS parameters and anticipated location of the target and engaging asset.
  - Electromagnetic support—Include collection priorities and anticipated ISR.
    - ➢ Include system type to be nominated in the joint collections process.
    - ➢ If specific adversary systems are known at this time, include EMS parameters and known activity (operating times, locations, and parameters).
  - PNT—Locations/times where assured PNT is required and expected source of PNT
  - Satellite and terrestrial communications (e.g., data links and locations/times) where assured communications are required and expected systems to be used.
  - STO/Cyber Integration requirements.
  - EMS sensing—Locations where priority EMS sensors will be required to analyze the EMOE. Identify EMS parameters expected to be used.
- Identify EMOE shaping requirements:
  - Those feeding into the target development working group (TDWG) and joint targeting working group (JTWG).
  - Component's nominated targets within their respected OAs.
- Identify how the EMS-related requirements will be satisfied organically for each mission task:
  - EMS allotments to be used, in time and space.
  - EMS parameters to be employed.
  - EMS capabilities/assets to be utilized (e.g., EA, ES, communications, sensing).
- Identify non-organic support requirements (EMS support requests) for each mission task. Include known or anticipated requests for communications, EW, or ISR assets provided by other components.
  - For EA support—Identify the target, the EMS parameters of the target element, the effects required (deny, degrade, disrupt), the location of the target, the time frame and location of the required support, and the mission the requested EA supports.
  - For ES and sensor support—Identify the targets to be monitored and associated EMS parameters, the support functions required (e.g., BDA, SIGINT, geolocation), the location of the target, the time frame and location of the required support, and the missions the requested ES supports.

- For communications (e.g., SATCOM, terrestrial LOS, tactical data links)—Identify the nodal connectivity requirements, the recommended EMS parameters, the times and locations that capabilities are needed, and the missions supported.
- For temporary EMS allotments—Identify the times, locations, and EMS parameters needed, the time windows of operations, and the missions supported.

- Identify projected excess EMS-related resources:
  - EMS capabilities/assets (EA and ES) not planned for use.
  - EMS allotments not planned for use.
- Identify EMS support being provided to other components:
  - Allotments.
  - Capabilities/assets.
  - Missions (EA, ES, communications, sensing).
- Identify contingency plans for satisfying EMS requirements or conducting EMS maneuver during mission execution under the following types of circumstances:
  - Primary EMS capabilities, assets, and resources not available.
  - EMOE is congested, contested, or constrained to the point of impacting operations.
- Identify impact and risk to mission.
- Identify anticipated or requested EMSCM based on EMSO, fires, and collections priorities.
  - Updates to JRFL or regional restricted frequency lists.
  - Component EMSOC POC information.
  - Describe C2 for each planned EA mission—Identify EACA position for each EA mission.

Figure 12. Typical EMSO Plan Content

d. JEMSO Addendum to FRAGORD. As operations progress through execution cycles, it will likely be necessary to promulgate new/updated guidance, information, and tasking. These changes to the OPORD are promulgated in a FRAGORD. For JEMSO and the JEMSO coordination cycle, adjustments can be driven by updates to the EMOE, changes to friendly or enemy forces/capabilities/situations, EMS usage guidance, results (i.e., effects) of previous cycles' missions, and other variables that could necessitate adjustments to the JEMSO appendix (to the OPORD). JEMSO changes in a FRAGORD should refer to the section of the JEMSO appendix (Figure 10) to which the change applies and articulate the change.

e. JEMSO Coordination Cycle Product Sequencing. Figure 13 depicts the sequencing of JEMSO coordination cycle products and the process interactions that require or provide product content. The Figure generally summarizes one iteration of the cycle, so it would recur for subsequent iterations, each one informed by the previous cycle.

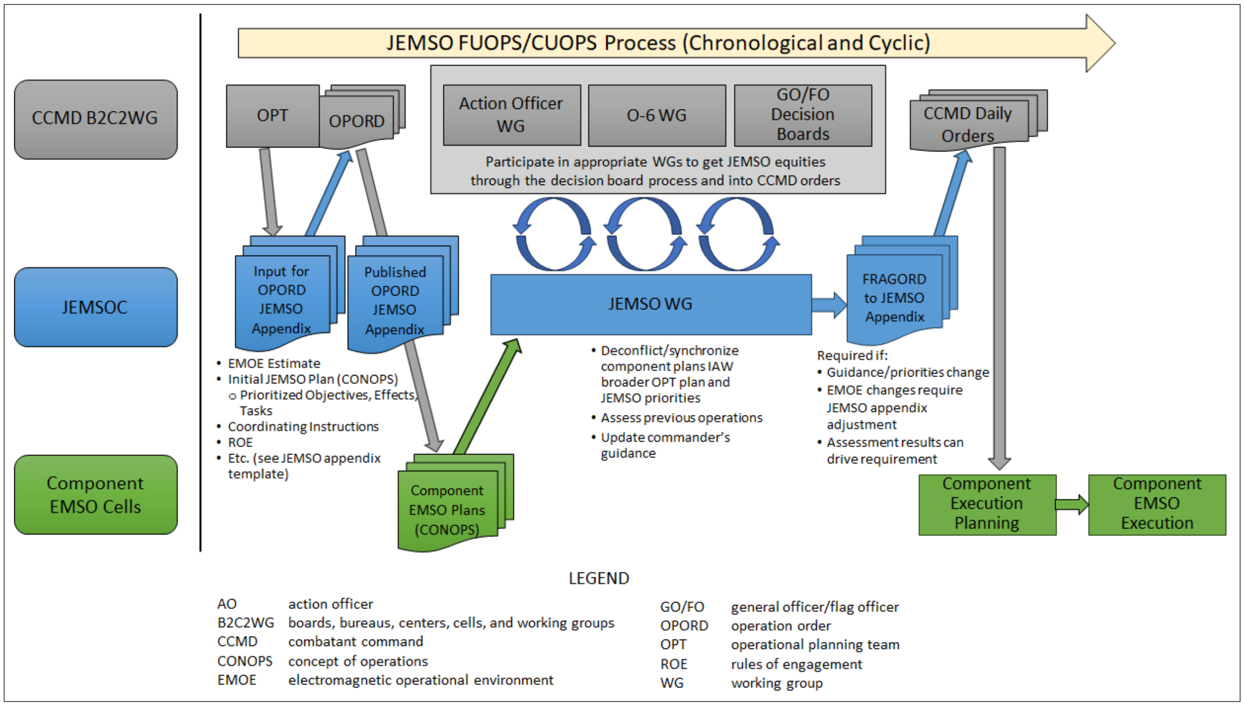

Figure 13. JEMSO FUOPS/CUOPS Process, Products, Interactions

4. <u>Integration/Deconfliction/Synchronization</u>

a. <u>JEMSO Working Group</u>. The JEMSOWG provides the primary mechanism for the JEMSOC to disseminate and receive information to synchronize and deconflict planning efforts. In a pre-crisis environment, the working group serves to refine JEMSO plans and prepare for plan execution. In a crisis, the frequency of JEMSOWG meetings must match the JFC's battle rhythm so that the JEMSOC is integrated into the commander's decision cycle, other boards, bureaus, centers, cells, and working groups (B2C2WG), and can provide appropriate guidance to component EMSO planners. Table 13 and the descriptive paragraphs that follow are JEMSOWG agenda items that will facilitate the discussion and information exchange.

JEMSO Working Group Agenda Items

• CUOPS.
  o Guidance update/hot items.
  o Intelligence update.
  o EMOE update.
  o Assessment of JEMSO objectives (previous 24 hours).
• FUOPS.
  o Prioritized JEMSO objectives (72 hours out).
  o Component EMSO plan updates.
  o Space/Cyber/STO updates/issues.
  o Other CCMD updates/issues.
  o Potential JEMSO appendix changes via FRAGORD
• FUPLANS (as applicable).
• Outstanding issues/Due Outs.

Table 13. Typical JEMSO Working Group Agenda Items

(1) Guidance Update/Hot Items. Initial commander's guidance was captured in the OPORD (and associated JEMSO Appendix) and will be updated via the OPT and/or via FRAGORD (as required). As guidance is updated, the JEMSOC must disseminate this guidance via the working group and, as required, in adjustments to the JEMSO appendix in FRAGORDs. Changes to ROE and EMSCMs impacting component EMSO planning and operations should be addressed here.

(2) Intelligence Update. JEMSO planners can use intelligence updates to ensure planning reflects the best estimates of adversary capabilities and actions. Intelligence updates should focus on adversary most likely and most dangerous COAs, which informs/validates priorities in the JEMSO plan and appendix.

(3) EMOE Update. Updating and characterizing the EMOE is fundamental to informing operations to achieve JEMSO objectives and EMS superiority. A daily update on observed activity in the EMOE will validate planning priorities and highlight potential areas for components to focus their efforts. EMI events should also be addressed in the EMOE update.

(4) Assessment of JEMSO Objectives (previous 24 hours). Based on operations of the past 24 hours, the JEMSOC should provide an update on progress towards achieving JEMSO objectives. During execution, the JEMSOC should monitor operations and collect necessary data to make this assessment based on the JEMSO assessment plan (discussed in Enclosure D). The necessary information to assess indicators, MOPs, and MOEs should be

reported to the JEMSOC as directed in the JEMSO appendix to the OPORD, and includes:

(a) Intelligence updates (see above).

(b) EMOE updates (see above).

(c) Situation reports (SITREPs).

(d) Mission reports (MISREPs).

(e) BDA reports.

(5) Prioritized JEMSO Objectives and Effects (72 hours out). Based on OPT priorities and the JEMSOCs assessment of progress towards achieving JEMSO objectives, the JEMSOWG lead will provide working group members a prioritized list of desired effects for the current planning cycle. These priorities provide the basis for allocating resources if conflict or shortfalls exist.

(6) Component EMSO Plan Updates. Each component should provide an update for the working group, primarily focused on desired CONOPS for 72 hours out.

(a) Previous 24 hours (by exception). Brief any events from the previous day impacting FUOPS.

(b) 0–24 hours (by exception). Brief any events/issues impacting other component operations.

(c) 24–72 hours (status of planning/issues). Brief the status of previously approved CONOPS if changes are required/in work.

(d) 72 hours out (EMSO Plan CONOPS). Brief an overview of desired operations based on the previously discussed EMSO plan worksheet. EMSO plans and worksheets should link to JEMSO objectives and effects, along with helping the JEMSOC and components synchronize and deconflict operations.

(7) Space/Cyber/STO Updates/Issues. The EMSO plans and worksheets also apply here in helping the JEMSOC and component EMSOCs to integrate, synchronize, and deconflict space, cyberspace and STO.

(8) <u>Other CCMD Updates/Issues</u>. Identify, deconflict, and synchronize other joint force EMS-related operations (if applicable) occurring in the JOA.

(9) <u>Potential JEMSO Appendix Changes via FRAGORD</u>. Summary or roll-up of all component EMSO plans, as well as space, cyber, and other CCMD CONOPS as submitted via worksheets prior to the meeting. JEMSOWG discussion and recommendations for changes requiring FRAGORD promulgation.

(10) <u>Outstanding Issues/Due Outs</u>. Capture outstanding issues introduced in the JEMSOWG group and clearly identify the point of contact (POC) and suspense for resolution. At this point the JEMSOC has action officer concurrence for the 72 hours out JEMSO plan, finalizes adjustments to be promulgated via FRAGORD or other directive/order, and components can conduct detailed planning.

b. <u>EMSO Planning Worksheet</u>. The EMSO worksheet shown in Figure 14 is essentially the same one discussed in Enclosure B, but when used during FUOPS/CUOPS it will contain more time-specific detail applicable to compressed execution timelines, and more granular component platform and EMS use specificity. Compiling worksheet information prior to daily JEMSOWG meetings allows the JEMSOC to address issues during the meetings.

<table>
<tr><td>PHASE:
2</td><td colspan="5">Flexible Deterrent Option (FDO) or Flexible Response Option (FRO) # From JPG/OPT</td><td>COMPONENT:
JFACC</td></tr>
<tr><td>CONOPS</td><td colspan="6">Narrative description of overall operation</td></tr>
<tr><td rowspan="2">Prioritized Tasks</td><td colspan="2">TASK 1</td><td colspan="2">TASK 2</td><td colspan="2">TASK 3</td></tr>
<tr><td colspan="2">Brief Task Description</td><td colspan="2">Conduct EA</td><td colspan="2">Conduct DCA</td></tr>
<tr><td>JEMSO Effects</td><td colspan="2">List JEMSO effects to be generated per OPORD (JEMSO appendix) guidance</td><td colspan="2">1.3 xxxxx
1.4 xxxxx
2.1 xxxxx</td><td colspan="2">1.1 xxxxx
1.4 xxxxx
2.2 xxxxx</td></tr>
<tr><td>Planned AO</td><td colspan="2">Location</td><td colspan="2">AO: Alpha</td><td colspan="2">AO: Bravo</td></tr>
<tr><td>Friendly Forces Planned</td><td colspan="2">Forces to accomplish task</td><td>EC-130
EA-18G</td><td></td><td>AWACS
F-15</td><td>EA-18G</td></tr>
<tr><td>EMS Requirements</td><td colspan="2">EMS requirements to accomplish task</td><td colspan="2">GPS
LOS COMMs</td><td colspan="2">Radar
LOS COMMs</td></tr>
<tr><td>Threats</td><td colspan="2">Specific threats to EMS requirements</td><td colspan="2">List GPS and Comms Jammers in the AO that can impact operations</td><td colspan="2"></td></tr>
<tr><td>Risk</td><td colspan="2">Articulate how the threats can cause risk to mission or risk to force.</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Collection Requirements</td><td>PIR</td><td>NAI</td><td>PIR</td><td>NAI</td><td>PIR</td><td>NAI</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fires</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Dependencies/Needs: Include EMS requirements/risks for Cyber, Space, STO, ISR and integration into plans. Examples include: Supporting effects required for success. Changes to ROE/Authorities. Requests for forces/support. Timing and tempo concerns.

Figure 14. EMSO Planning Worksheet

5. JEMSO Execution Summary. This enclosure addresses JEMSO execution through FUOPS and CUOPS, driven by the JEMSO coordination cycle. The JEMSOC's focus rests on producing the JEMSO appendix to the OPORD, integrating component EMSO plans/CONOPS into the JEMSO plan and interaction with B2C2WGs to execute coordinated, effective JEMSO in support of JFC objectives.

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ENCLOSURE D

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS ASSESSMENT

1. Introduction

a. Assessment is the determination of progress toward achieving the commander's objectives, or attaining an end state, and focuses on informing the JFC's decision-making. Assessment is the phase of the commander's decision cycle that facilitates determining the results of actions supporting overall mission objectives, and it can provide recommendations for future operations. The decision to adapt plans or shift resources in pursuit of the desired end state is based on the integration of intelligence updates, operational reporting, staff estimates, and input from other mission partners. Assessments provide:

(1) Data and analysis on the achievement of objectives and effects.

(2) Opportunities to improve planning and execution of operational capabilities.

(3) Identification of shortfalls or changes in conditions in the OE, which may cause unintended effects.

b. Assessment of JEMSO evaluates the effectiveness of joint force activities conducted in the EMOE. JEMSO assessors integrate with the commander's assessment cell and are primarily concerned with assessing:

(1) Progress towards gaining and maintaining EMS superiority across the JOA.

(2) Effectiveness of EMSO capabilities in support of operations across all domains.

(3) Ability of the EMS to support or impede component operations.

(4) Gaps between the actual EMOE and the predicted EMOE.

c. This enclosure focuses on integrating the assessment of JEMSO into the JFC's assessment plan and processes. For more information on overall operation assessment, see reference (u).

2. Background

a. Assessment Planning and Steps. Assessment planning and analysis integrates into all seven steps of the JPP (covered in Enclosure B) and into the commander's decision cycle during execution (JEMSO execution is covered in Enclosure C). The assessment process steps are as follows:

(1) Step 1: Develop Assessment Approach.

(2) Step 2: Develop Assessment Plan.

(3) Step 3: Collect Information and Intelligence.

(4) Step 4: Analyze Information and Intelligence.

(5) Step 5: Communicate Feedback and Recommendations.

(6) Step 6: Adapt Plans or Operations.

b. As shown in Figure 15, the first two assessment steps occur during the JPP. They include all the tasks necessary to form a plan, develop assessment measures and data sources, and task collection and analysis of information to conduct assessment for the planned operation. The remaining four steps consist of activities performed during execution of the operation, aligning with and informing the commander's decision cycle.

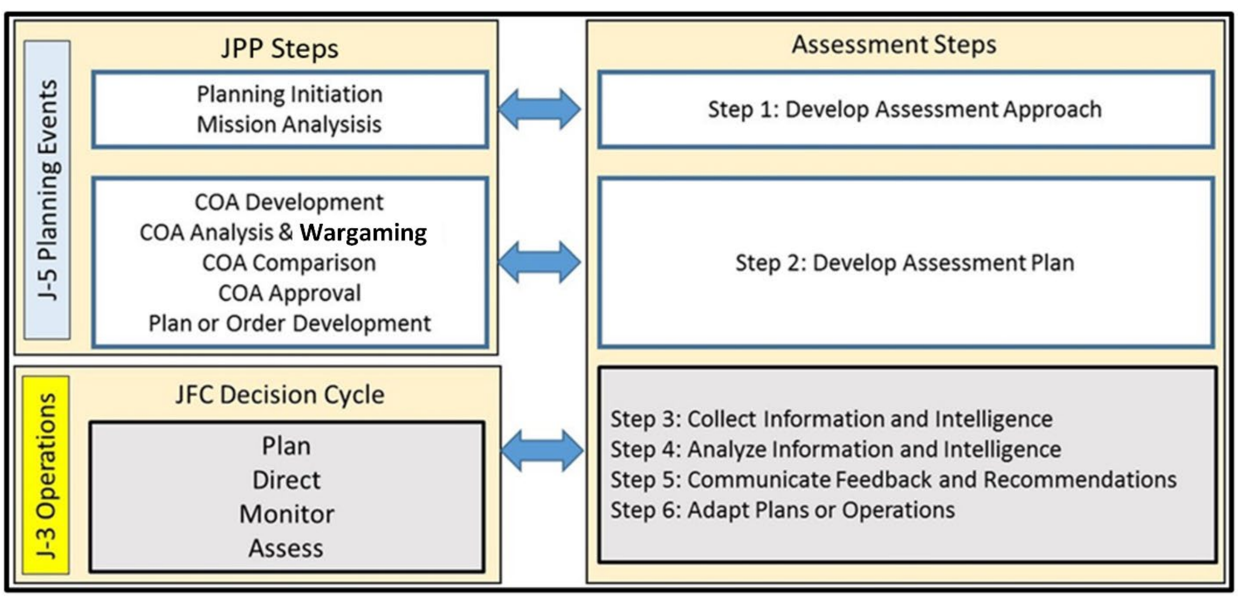

Figure 15. Integrating Assessments into Planning and Operations

3. JEMSO Assessment Planning. The major assessment planning tasks that occur during the JPP are listed below under the respective JPP steps (refer to Figure 15).

a. Assessment Step 1 is accomplished during JPP planning initiation and MA, and involves the following assessment tasks:

(1) Gather tools and identify sources of assessment data.

(2) Understand current and desired conditions.

(3) Identify assessment partners/stakeholders and their roles/ responsibilities.

b. Assessment Step 2 is accomplished across the remaining JPP steps and involves the following assessment tasks:

(1) Develop assessment measures and potential indicators.

(2) Develop the collection plan to support assessments.

(3) Assign responsibilities for conducting analysis and generating recommendations.

(4) Identify assessment feedback mechanisms.

c. Assessment Step 1 – Develop JEMSO Assessment Approach

(1) Assessment approach development begins during JPP step 1 (planning initiation), when the JEMSOC identifies desired outcomes (e.g., end states and associated tasks, effects, conditions, and objectives), and it continues through JPP step 2 (MA). The JEMSOC develops an assessment approach by identifying sources of data and integrating the appropriate framework, measures, and indicators for assessing JEMSO. This approach involves analyzing conditions associated with achieving EMS superiority and ultimately reaching the end state. The JEMSO assessment design will mature along with JPP progression towards plan development and into execution. JEMSO assessment step 1 inputs, activities, and outputs are depicted in Table 14.

Inputs	JEMSOC Actions	Outputs
• Commander's guidance. • Description of the OE. • Problem to be solved. • Operational approach. • Commander's intent. • Commander's desired end state.	• Define the EMOE and baseline the adversary EMOB. • Develop JEMSO assessment approach. • Develop and refine JEMSO plan elements (e.g., end states, objectives, and tasks). • Conduct joint planning. • Determine how to assess JEMSO plan element progress of COAs. • Identify JEMSO indicators.	• JEMSO assessment approach and framework. • Points-of-contact who will report measures of effectiveness and performance (MOEs/MOPs). • Specific JEMSO outcomes to be assessed. • Commander's estimate and CONOPS (from JPP).

Table 14. Developing the JEMSO Assessment Approach—Inputs, Actions, Outputs

(2) As the J-5's planning moves into MA, assessors will gain a better understanding of the OE, including adversary, friendly-force, and neutral-actor systems and associated EMOE data involved in the anticipated operations. The assessment framework identified during Planning Initiation will continue refinement during MA, based on commander's guidance and refinement of conditions required to meet the commander's desired end state. Developing the JEMSO staff estimate (discussed in Enclosure B in a planning/JPP context) during MA involves refinement of assessment indicators and identification of feedback mechanisms used to inform assessment measures. Table 15 lists the inputs, considerations, and potential indicators for developing the JEMSO assessment approach during MA.

JEMSO Assessment Approach (Mission Analysis)		
Inputs	**JEMSOC Considerations**	**Potential End State Indicators**
• Initial planning guidance. • Operational approach. • JIPOE. • Initial EMOE characterization.	• Impact (i.e., significance) of the EMS on the purpose of the received mission. • Impact of EMS limitations on friendly-force actions. • Impact of adversary and neutral actor operations and capabilities in the EMOE, including the potential to contest friendly-force EMS activities. • Impact of friendly-force EMSO on adversary and neutral-actor operations. • Adversary and friendly-force CCs, CRs, and CVs (identified via COG analysis), focused on the EMS aspects. • The operational, especially EMSO-related impact of physical and environmental factors in the JOA.	• Adversary ability to use the EMS to support their operations. • Adversary ability to contest friendly-force EMSO. • Friendly-force ability to use the EMS to support operations. • Friendly-force ability to contest adversary EMS operations.

Table 15. JEMSO Assessment Approach Development During Mission Analysis

(3) It is essential that JEMSO assessors fully participate in the planning process from the outset and that EMOE considerations are integrated into planning and executing operations. A crucial part of this integration is ensuring JEMSO assessment planning aligns with the commander's intent, end state, guidance, and battle rhythm.

(4) Developing the assessment approach consists of gathering existing assessment plans and identifying sources of assessment data, then analyzing them through the lens of the commander's intent and end state for the current operation. This groundwork will guide JEMSO assessors in determining how they will measure the progress and effectiveness in achieving the intent and end state. JEMSO assessment should indicate the effectiveness of friendly-force actions in the EMOE during the operation and should be integrated with the assessment cell's overall assessment effort. The following tasks will help JEMSO assessors develop their assessment approach:

(a) Develop an understanding of the commander's intent and the conditions required to meet the desired end state by reviewing HHQ's plans for objectives, guidance, and desired end state.

(b) Gather and research existing theater-level assessments and relevant assessment products (e.g., best practices, lessons learned) from military, civilian, and academic sources that can inform MOEs/MOPs and help determine indicators for assessing operations.

(c) Identify potential data sources to aid in developing and providing validity to assessments (see Table 16)—inform cross-functional staff and component EMSO cells of data requirements.

Commander's Intent & End State	Existing Assessments	Potential Data Sources for JEMSO Assessment
• OPLAN • CONPLAN • PLANORD	• OPLAN assessment plan. • J-2 and other IC assessments. • Academic studies, industry reports & assessments (e.g., manufacturing, energy). • Interagency assessments (e.g., Departments of State, Treasury, Energy).	• EMOE data repository • BDA/Battle Damage Indicator • MISREPs • SITREPs • After Action Reports (AARs)

Table 16. Potential Sources of Assessment Data

(5) Performing the following tasks will help JEMSO assessors understand the current situation and how to achieve the desired conditions:

(a) Identify potential JEMSO objectives to assess.

(b) Acknowledge and verify underlying assumptions.

(c) Identify specific conditions and, if possible, associated metrics required to meet the desired end state.

(d) Identify indicators of conditions and, if possible, associated metrics required to meet desired end state.

(e) Draft top-level MOEs and MOPs linking data to be collected to assessment of progress toward objectives.

(6) JEMSO assessors must identify the data required to assess progress toward achieving desired outcomes (i.e., end-state conditions, objectives, or effects). During assessment planning (i.e., prior to execution), assessors will not have the actual assessment data; rather, they identify the type of data and

data sources required during execution. Once data is identified and collection requirements are established, JEMSO assessors must coordinate with cross-functional staff and components regarding content and reporting of collected data. Required assessment data includes:

(a) Qualitative assessment data, e.g., multi-source intelligence reporting that confirms disruption of adversary communications or other EMS activities.

(b) Quantitative assessment data, e.g., numbers of completed EMSO missions and the number/type of adversary EMS-dependent/-enabled systems that the EMSO missions rendered ineffective.

(7) <u>JIPOE and Assessment Baseline</u>

(a) JIPOE is a J-2–led effort that supports the JFC's decision-making and planning by identifying or estimating the adversary's COGs, capabilities, limitations, intentions, and COAs pertinent to the friendly operation. JIPOE should be done as early as possible, so it is available to support timely decision-making. It occurs in tandem with and underpins MA because it enables awareness and understanding of the OE and friendly force/adversary interaction with the OE and with one another. The JEMSOC must work closely with the J-2 to ensure adversary and neutral-actor EMS capabilities, use of the EMS to support operations, and the EMS aspects of COGs are properly identified and included in JIPOE.

(b) The J-2 produces the intelligence estimate that serves as the baseline assessment of the OE. This baseline is a condition or set of conditions in the OE as measured before applying some effect (e.g., by performing a JEMSO task) to change the condition, and then measuring the change. Baselines serve as reference points enabling assessment of the effectiveness of JEMSO actions, and allowing for:

<u>1</u>. The JFC and JEMSOC to set goals for desired rates of change to aspects of the EMOE.

<u>2</u>. Establishing thresholds for assessing JEMSO success and failure.

<u>3</u>. Focusing intelligence collection on answering specific questions about desired outcomes of planned actions.

d. Assessment Step 2 – Develop JEMSO Assessment Plan. With MA completion and a defined JEMSO assessment approach, JEMSO assessment plan development begins. As depicted in Table 14, the assessment plan is developed as the JPP progresses into COA Development (JPP step 3) and is refined through the remainder of the JPP.

(1) Assessment Plan Development During COA Development. COA development generates options for the commander to meet the desired end state for the operation. COA development is a key enabler of JEMSO assessment plan development because the specific objectives, effects, and tasks that constitute JEMSO's intended support to the COAs are precisely what the assessment process must measure to determine the effectiveness of their support. Assessment tasks conducted during planning initiation and MA that resulted in an assessment approach are refined as required during COA development. The JEMSO assessment plan should include feedback mechanisms that instruct the components to assess their operations and report that to the JEMSOC so that the JEMSOC can compile a consolidated JEMSO assessment, integrate it with the JFC assessment cell's overall assessment effort, and apprise the commander on EMSO's effectiveness in supporting the operation. Table 17 lists additional considerations for developing the JEMSO assessment plan during COA development.

COA Development Assessment Plan Preparation		
Inputs	**JEMSOC Considerations/MOPs**	**Potential MOE Indicators**
• Refined planning guidance. • Refined operational approach. • EMOE characterization. • JIPOE. • A/F/N systems. • JEMSO staff estimate.	• Friendly forces/systems required for COA. • Limitations on friendly-force operations. • Friendly-force EMS requirements.	• Changes in adversary EMS operations. • Migration to other communication means. • Changes in tactics/force movement. • Ability to impact friendly-force operations.

Table 17. JEMSO Assessment Plan Preparation During COA Development

(a) JEMSO Assessment Plan Development Process. Table 18 shows the inputs, activities, and outputs associated with developing the JEMSO assessment plan. JEMSO objectives supporting the COA(s) should be clear and measurable. Measuring objectives' effectiveness should be based on the assessment baseline, which enables measuring the degree of achieving the desired effect and progressing toward the desired end state.

Inputs	Staff activity	Outputs
• JEMSO assessment approach which includes: ○ JEMSO assessment framework and construct. ○ Specific JEMSO outcomes. ○ Commander's estimate and CONOPS (from JPP).	• Document JEMSO assessment framework and construct. • Define measures and indicators. • Finalize EMS data collection plan. • Assign responsibilities for monitoring, collection, and analysis. • Identify how JEMSO assessment is integrated into the battle rhythm/feedback mechanism. • Vet and staff the draft JEMSO Assessment Plan.	• Approved JEMSO Assessment Plan integrated into the plan. Assessment plan includes: ○ Phased JEMSO objective, or end state measures (MOPs/MOEs), or other indicators. ○ JEMSO vetting process and timelines for integration into staff organizations. ○ EMS data collection plan.

Table 18. Assessment Step 2 – Develop JEMSO Assessment Plan

(b) Responsibilities for JEMSO Assessment. JEMSO assessors should identify and assign the responsibilities for monitoring, collecting, and analyzing assessment-related information. These responsibilities and requirements necessitate staff coordination and, via the JFC's assessment cell, should be included in plans, the commander's decision cycle, and the overall battle rhythm.

(c) Measures and Indicators. Properly formed plan elements (e.g., objectives, effects, MOEs, and MOPs) are the foundation for successful assessment. During initial JEMSO planning, it is imperative that the plan contains a well-crafted end state complemented with objectives and effects that are clear, understandable, and measurable.

1. Alignment. JEMSO tasks must be clearly written and aligned to the commander's objectives to justify resources for measuring their effects. The effects in JEMSO tasks and objectives are at the forefront of what must be observed, collected, and measured. If JEMSO effects and supporting tasks are not linked to the commander's objectives, or are not clearly written, measuring their effectiveness will be difficult. Figure 16 depicts the top-down (planning) and bottom-up (assessment) flows and relationships between end-state ↔ objective ↔ effect ↔ task.

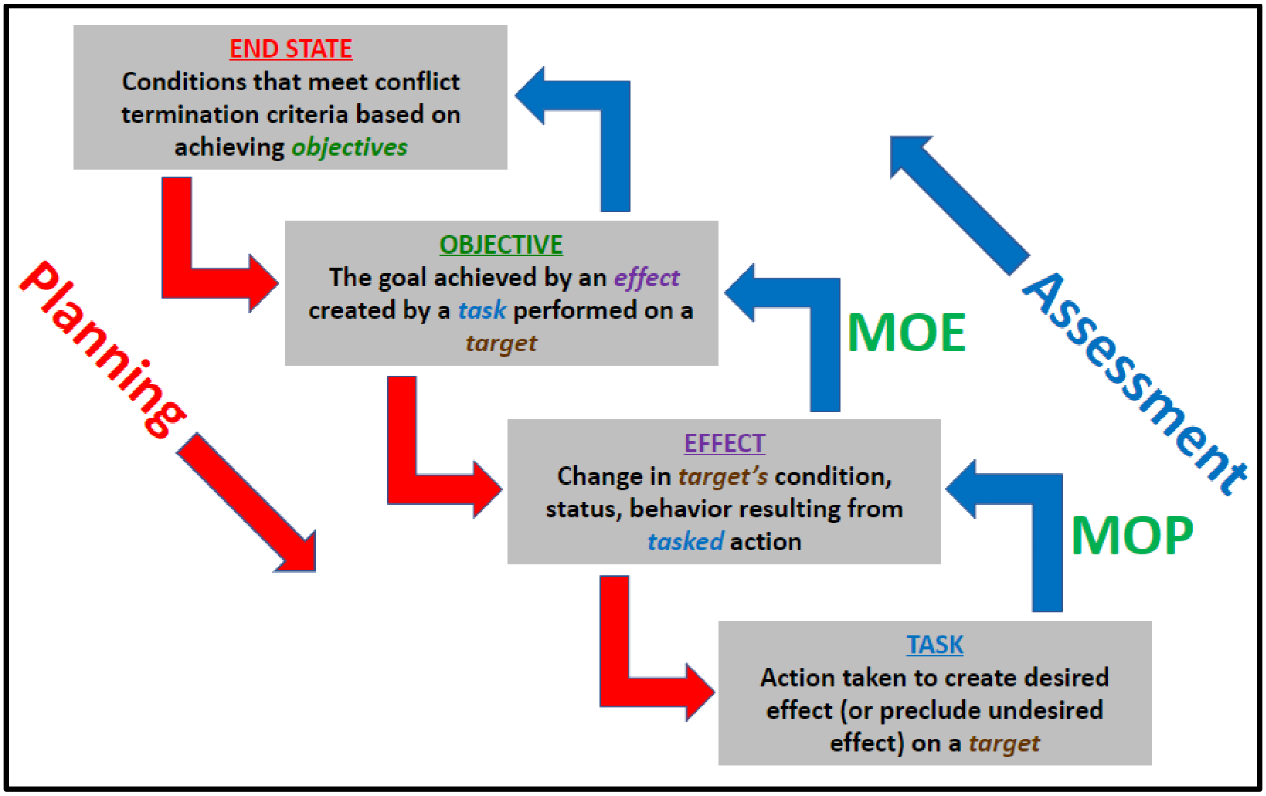

Figure 16. Hierarchy, Flow, and Interrelationship of Assessment Elements

2. Attributes. MOEs, MOPs, and indicators are the assessment measurement elements qualifying or quantifying the OE attributes needing to be affected. These elements enable assessing the effectiveness of activities conducted in the OE by establishing a direct cause-effect linkage between the activities and the desired effects. Each JEMSO effect can have multiple MOEs and MOPs since there are usually multiple ways to pursue and measure an effect. Thorough JEMSO assessment measures contain assessment criteria with supporting intelligence requirements, RFIs, and the requirements' office of primary responsibility (OPR) and reporting frequency.

3. MOPs. During COA development, EMSO mission tasks become definitive enough for developing corresponding MOPs. MOPs evaluate task accomplishment of EMSO-related actions, activities, or operations. MOPs do not directly measure achievement of the effect in a JEMSO objective (i.e., effectiveness), but will have criteria for evaluating the degree of task accomplishment. Tasks are assigned via various tasking orders or other mechanisms, which might include accomplishment criteria. Tasks involving EMSO capability employment are normally performed by components, so task assignment, completion, and feedback mechanisms must be in place so that

the JEMSOC can measure performance and incorporate it into the assessment process.

4. MOEs. MOEs are a criterion used to assess changes in behavior, capability, or, in the case of JEMSO, changes with a cause-effect linkage with activities within the EMOE. MOEs must be specific, clear, and observable with direct links between the objectives, effects, and targets (or friendly-force capabilities in the case of defensive objectives that do not have "targets"). MOEs should have the following qualities:

a. Ends-related—Directly associated with the target or object of the effect.

b. Measurable—The ability to quantitatively or qualitatively discern change attributed to the action/inaction intended to cause the change; requires a baseline measurement before execution.

c. Timely—The effect and measuring it should fall within temporal parameters that are reasonable and effective; includes specifying timeliness in feedback/reporting mechanisms.

d. Properly resourced—Measurement analysis and coordination requirements are built into the plan.

5. Indicators. Indicators are specific pieces of information that infer the condition, state, or existence of something, and provide reliable means to ascertain performance (MOP) or effectiveness (MOE). Indicators answer information requirements, so they are indelibly linked. However, when developing indicators, planners normally articulate the indicator (i.e., the desired condition or state of something, based on the desired effect) prior to its associated information requirement. The information and intelligence requirements for indicators are resolved via multiple sources, not just intelligence, including components' (and/or other external entities') systems, processes, and personnel. Assessment indicators should have the following characteristics:

a. Relevant—They directly relate to the desired effect in the objective and to the task intended to create the effect.

b. Observable—Can be measured or evaluated to tell if a change has occurred.

c. Responsive—Should detect changes in the EMOE with timeliness and reporting/feedback mechanisms to enable effective responses.

d. Resourced—Human and technical aspects of obtaining and analyzing required indicator data are adequately resourced.

(d) Managing Assessment Elements. During JEMSO assessment plan development, planners and assessors should be conscious of the quantity of plan and assessment elements (i.e., objectives, effects, MOEs, MOPs, indicators) created. Having a feasible quantity of plan elements makes the plan more actionable in execution. Two additional noteworthy points on the quantity of assessment plan elements are as follows:

1. Too few assessment elements might cause an inadequate assessment and subsequent recommendations based on insufficient evidence.

2. Too many assessment elements can cause data collection and analysis to be unwieldy, which can undermine assessment quality and the ability to keep pace with the commander's decision cycle.

(e) Intelligence and Information Integration

1. J-2 Support to JEMSO Assessment. JEMSO-related MOEs require measuring the baseline of and changes to adversary operations in the EMOE. JEMSO assessment therefore requires J-2 support for acquiring and maintaining adversary EOBs, and for the EMOE data repository and EMOE characterization. J-2 support is also essential to collecting and informing JEMSO assessors of EMOE-related indicator data and what sensors/ capabilities are providing it.

2. Information and Intelligence Requirements. The J-2 is the focal point for adversary-related requirements and can assist JEMSO assessors with developing them. Information to resolve the requirements associated with friendly forces comes from various sources. An indicator can have more than one associated information and intelligence requirement, depending on how many approaches are available for gathering the information to support the indicator and the analytical detail required. As previously stated regarding the number of proposed assessment elements, the number of assessment indicators and supporting information should be limited to those which are most relevant and conducive to required measurements.

a. Indicator information to answer intelligence requirements may come from many sources. For example, MISREPs may provide several indicators as they contain multiple types of specific reporting (e.g., targets, weapons delivered, assessed weapons effects, electromagnetic interference). The information requirement for each JEMSO effect and its associated assessment criteria should specify the sources of compiled indicator data.

b. Indicators should identify an associated OPR responsible for providing the requested information. During assessment plan development, it is important to establish OPRs and verify they can gather and analyze the required information. Since most of the data to answer indicators are associated with component actions, the JEMSOC should codify the communication conduits and data requirements with component EMSOCs to ensure they will gather, analyze, and report the required information at specified times as required.

(f) JEMSO Assessment Measure Example. Figure 17 provides an example of a JEMSO assessment measurement addressing GPS satellite jammers. An effect is distilled out of the JEMSO objective, with a corresponding MOE articulating a way of measuring the effect. MOPs are not included in this example due to the defensive nature of the objective/effect, but MOPs and associated tasks could be annotated for more overt friendly-forces offensive actions supporting this objective. In the example, the assessment measurement criteria are in parentheses under the MOE, shown as mission abort/ineffective rates. Many indicators are intelligence requests submitted to the respective J-2, while others are compiled from component-level reports. The component EMSOC is designated as the OPR to provide the JEMSOC a single POC within the component for reporting, and the frequency of reporting is stated as daily.

JEMSO OBJECTIVE 1: Mitigate adversary ability to contest friendly force operations in the EMOE.

Effect 1.1: Global Positioning Satellite Jammers unable to deny U.S., allied, and partner use of GPS for Precision Navigation and Timing

MOE 1.1: Coalition ineffective/abort rate due to adversary PNT jamming (Green < 5% mission ineffective/aborted during execution day; Yellow - 5-10% mission ineffective/aborted during execution day).

Indicator: # of coalition missions aborted/ineffective due to adversary PNT jamming activity during the execution period.

Indicator: # of GPS interference reported

Indicator: #of GPS jamming signals collected

Indicator: # of missions flown

Indicator: # of mission ineffective abort rate due to non-mechanical issues

(OPR: Component EMSO Cells. Reporting Frequency: Daily.)

Figure 17. Example JEMSO Assessment Measure

(g) Assessment Plan Development Tasks During COA Development. During COA development, JEMSO planners articulate mission tasks supporting JEMSO objectives for each prospective COA. These JEMSO tasks allow for generating MOPs, and refinement of all prior assessment measures (such as the example in Figure 17) with more specificity. JEMSO assessors apply COA development planning and analysis to the assessment approach framework (done during step 1 of the assessment process) and perform the following planning and coordination tasks in developing the JEMSO assessment plan (step 2 of the assessment process):

1. Develop Assessment Measures and Potential Indicators. MOEs designed to assess EMSO support to the progress of operations toward the desired end state can be challenging because EMS-related effectiveness metrics are typically lacking and because of the historical reliance on quantitative over qualitative indicators. The required effectiveness measurements are available only when the targeting and collections processes are closely integrated. Assessors should develop qualitative as well as quantitative indicators when measurements help assess progress toward mission accomplishment.

2. Develop assessment criteria for EMSO objectives and effects as part of determining mission success for each COA.

3. Characterize the EMOE end state that supports each COA.

4. Build MOPs to measure tasks performed by EMSO capabilities supporting each COA.

5. Develop indicators to inform MOEs.

6. Define information and intelligence requests for each JEMSO assessment indicator.

7. Determine process and exchange mechanisms to collect, integrate and disseminate data enabling MOE/MOP calculations.

8. Provide MOEs and MOPs to the JFC assessment cell/working group.

9. Coordinate with the appropriate cross-functional staff entities and components to collect MOE/MOP data and identify corresponding OPRs tasking/reporting mechanisms.

(2) JEMSO Assessment Plan Development During COA Comparison and Approval. During JPP step 5, the commander continues to provide refined guidance and then selects and approves a COA in JPP step 6. JEMSO assessment planners use the COA refinements and decision to finalize assessment measures and finish the JEMSO assessment collection plan as an attachment to the assessment plan. The assessment collection plan defines assessment information/data requirements and the corresponding OPRs for collecting, analyzing, and disseminating the data. JEMSO assessment-related tasks during COA comparison and approval include:

(a) Develop and finalize the assessment collection plan.

1. Identify the sources of information for each indicator.

2. Identify the staff position or other entity responsible for collecting and reporting information.

3. Coordinate pertinent information requirements with the J-2 and the components.

(b) Assign responsibilities for conducting analysis and generating recommendations.

(3) JEMSO Assessment Plan Completion and Documentation. As J-5 planning progresses into JPP step 7, Plan or Order Development, the JEMSO assessment plan should be incorporated in Annex N (Assessments) and in the JEMSO Appendix to Annex C (Operations) of the final plan or order. Assessment planners must socialize assessment information and intelligence requirements throughout the planning process and while developing the assessment and data collection plans. Socializing JEMSO assessment via the Assessment Cell, the JPG/OPT, and the components will likely result in references to the JEMSO Appendix in other sections of the plan/order to highlight JEMSO coordination requirements.

4. JEMSO Assessment for Execution. The remaining cyclical steps (3 through 6) of joint assessment occur after contingency planning (i.e., FUPLANS) is complete and the order is published. The JEMSOC should ensure the OPORD or execute order references the JEMSO assessment plan in support of the JFC's overall assessment. This reinforces and codifies JEMSO requirements for collecting, analyzing, and reporting information and intelligence. Figure 18 depicts the overall flow of information and responsible entities during operational execution (i.e., FUOPS and CUOPS, discussed in Enclosure C) occurring in conjunction with steps 3–6 of the assessment process.

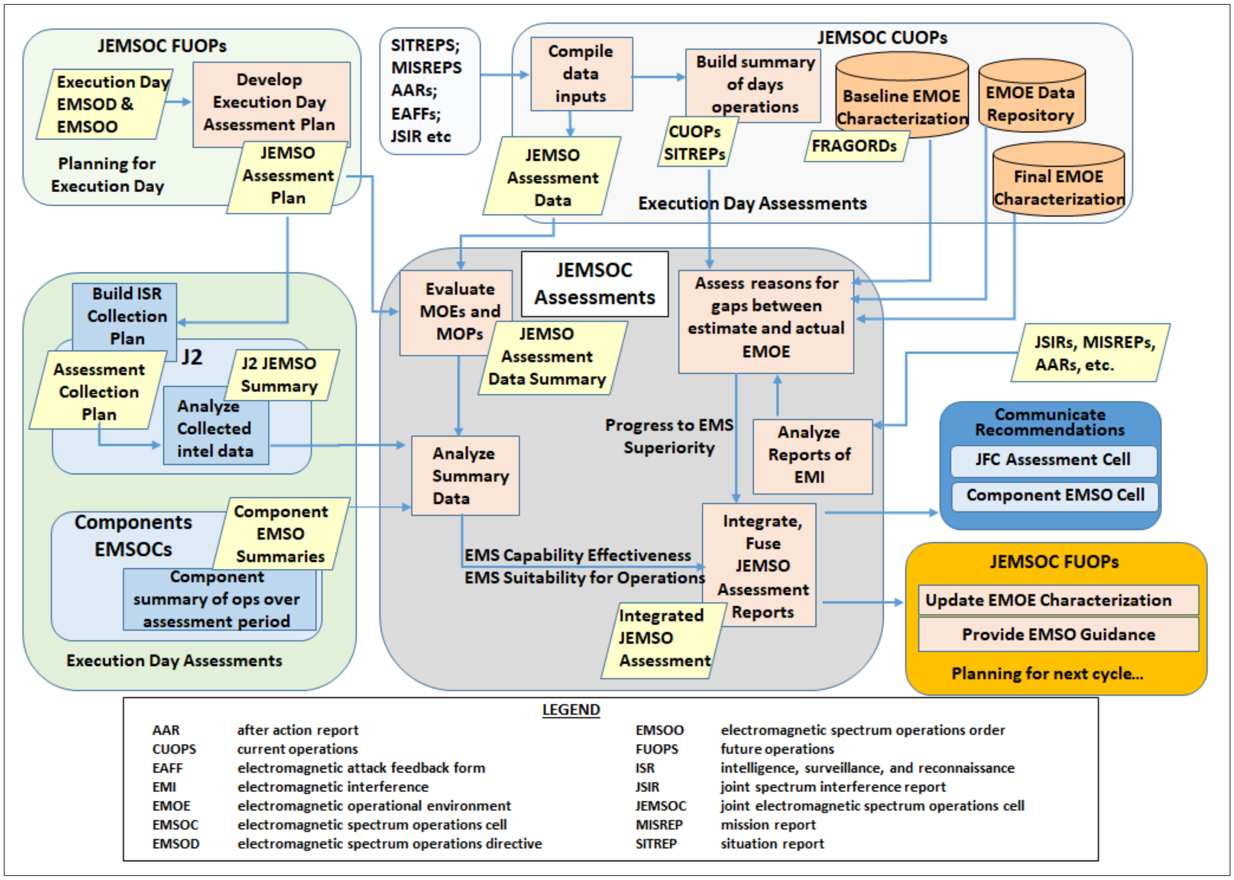

Figure 18. JEMSO Assessments During Execution

a. Assessment Step 3—Collect Information and Intelligence. Well-developed MOEs drive the development of information and intelligence requests. To operationalize assessments, collection management plans ensure collection efforts are focused on relevant information required through planning and execution. A collection plan integrates information requirements for servicing by assigned tactical, theater, and national intelligence collection assets. In addition to intelligence resources, MOEs should consider operational indicators derived from trend analysis of operational data. Table 19 identifies the inputs, activities, and outputs of this step.

Inputs	Staff activity	Outputs
• Approved JEMSO assessment plan. • EMOE data collection plan. • Approved OPLAN/OPORD (from JPP). • JIPOE	• Develop JEMSO staff estimate. • Intelligence and information requirement management. • Intelligence planning and optimization. • Monitor EMSO.	• EMSO-relevant data collected and organized.

Table 19. Assessment Step 3—Inputs, Activities, and Outputs

(1) JIPOE Considerations. JEMSO assessors should use the JIPOE, as well as specific information and intelligence requests, while developing the assessment approach and until the collection plan is approved. Information and data from the initial baseline support overall EMOE characterization and provides a reference point to enable the assessment of activities intended to create desired effects.

(a) Preparation. During preparation, JEMSO assessors should collect information on the EMOE IAW the EMS data collection plan, or as directed. Operational data feeds should be aligned to enable meaningful analysis. For example, correlating Joint Spectrum Interference Resolutions Online (JSIROs) with MISREPs will aid the evaluation of friendly aspects of the EMOE. Analysis of new information could change the approach, desired outcomes, or planned tasks within the current JEMSO plan.

(b) Collection. During execution, assessors use the collection plan to gather data about the EMOE. IAW the assessment plan, other considerations may assist planning, determine decision point triggers, and mission impacts. Assessors must consider other sources of information with potential to support assessments, such as open-source information and resources that provide survey, poll, and research data.

1. Variables. There are other factors that complicate EMSO assessment. For example, contingencies and operations in uncertain or hostile environments present unique challenges to operational tempo and necessary access to conduct assessments. Rapidly changing conditions might also affect the accuracy and volume of collected data.

2. Resourcing. As discussed in MOE development, information and intelligence requirements should be properly resourced. EMSO-related assessment indicators are supported by ES and ISR assets and capabilities

that are limited in number and in high demand. Tasking to support competing collection requirements must be prioritized. If the EMSO-related intelligence and information requirements are lower than others in priority, or other factors in the OE preclude servicing EMSO-related requirements, assessors should consider tailoring MOEs to conditions or indicators that can more realistically be measured.

3. Operating Tempo. Operations in non-permissive environments, or operations that proceed at an unusually fast pace, present unique challenges in terms of operations tempo (OPTEMPO) and conducting assessments. The ability to access areas of the JOA may limit the types and employment of assessment tools, and a rapid OPTEMPO may impact the amount of time available for collectors and analysts to conduct thorough assessments.

b. Assessment Step 4—Analyze Information and Intelligence. For assessors, monitoring trends and changes between the planned and observed EMOE is necessary. Observing EMOE changes requires comparison to a baseline, and comparison of the relevant aspects of the EMOE before and after EMSO. This enables assessors to attribute changes to EMSO actions rather than simply “noise” or normal variation of collected indicators. Based on analysis of attribution to EMSO effectiveness, assessors can estimate the effects of force employment, determine achievement of objectives, or determine if a decision point is reached. The staff may also identify risks to mission accomplishment or opportunities to accelerate mission accomplishment (see Table 20).

Inputs	**Staff activity**	**Outputs**
• Collected/organized data (relevant to JEMSO actions and current and desired conditions).	• Assessment working group integration and participation. • Staff estimates. • Vet and validate recommendations. • Evaluate progress towards JEMSO objectives.	• Drafted assessment products. • Vetted and validated recommendations.

Table 20. Assessment Step 4—Inputs, Activities, and Outputs

(1) Staffing and Vetting. Staffing and vetting enable the development of coherent, holistic assessment products. JEMSO assessors naturally focus on analysis and assessment of the EMOE, but should conjoin broader, cross-

functional staff analyses of EMSO assessments. This interaction cultivates more coherent, holistic assessment products.

(2) EMOE-Related Intelligence and Information Requirements. EMOE-related information gaps hamper analysis, so JEMSO assessors should draft and submit intelligence and information requirements, requests for forces and/or augmentation, and requests for support from external agencies. Technological changes, regardless of their source or cause, can impact information that underlies EMSO assessments and should be reviewed for:

(a) After initial analysis, periodic analyses must be conducted to detect changes.

(b) Analytical updates that need to be provided to the commander and staff.

(c) As operations occur, assessment data should be retrieved and analyzed.

(d) Effects on the assessment information collected.

(e) Information and updates to the analysis of the EMOE are captured.

(3) Assessment Analysis and Change Recommendations. JEMSO assessors should ensure subject matter experts (SMEs) validate assessment data for a sound, statistical approach, and expert interpretation for meaningful analysis. Assessment conclusions by the SMEs—e.g., achievement of the desired end state, force employment, resource allocation, validity of planning assumptions, and decision points—lead to recommendations. JEMSO assessments, when incorporated with Component assessments may led to the following recommendations to the JFC during Battle Rhythm events:

(a) Updates, changes, additions, or removal of critical assumptions.

(b) Transitions between phases and execution branches and sequels.

(c) Reallocation of resources.

(d) Adjustments to operations, orders, objectives, and end states.

(e) Adjustments of priorities that change priorities of effort.

(f) Adjustments of decision points, adaptations to changed conditions, or modifications to the assessment plan.

e. Assessment Step 5—Communicate Feedback and Recommendations. JEMSO assessors may be required to assist the assessment cell/working group in developing assessment products (e.g., summary reports and briefings) containing recommendations for the commander based on guidelines in the assessment plan. The commander's guidance is the most critical driver in designing assessment products.

(1) Assessment documents. The published JEMSO assessment plan, staff standard operating procedures, battle rhythm, and orders are documents in which commanders dictate how often, and in what format, assessment results are reported.

(2) Assessment results. Assessment results enable the staff to identify capability shortfalls and resource issues possibly impeding joint EMS effectiveness (see Table 21).

Inputs	Staff activity	Outputs
• Draft assessment products. • Vetted and validated recommendations.	• Provide timely recommendations to appropriate decision-makers through Decision Boards.	• Approved assessment products, decisions, and recommendations to higher headquarters.

Table 21. Assessment Step 5—Inputs, Activities, and Outputs

f. Assessment Step 6—Adapt Plans or Operations. Once feedback and recommendations are provided, commanders will direct or provide guidance to update or modify the plan or order, as required. The guidance may also induce modifications to the assessment plan. Even without significant changes to the plan or order, changes to the assessment plan may be necessary to reflect changes in the OE (including the EMOE), or adjustments/additions to information and intelligence requests (see Table 22).

Inputs	Staff activity	Outputs
• Approved recommendations from the assessment process.	• Develop branches and sequels. • Modify operational approach. • Modify plan elements. • Modify collection plan.	• Revised plans or FRAGOs.

Table 22. Assessment Step 6—Inputs, Activities, and Outputs

(1) Course Corrections. As operations transition between phases, the assessment plan may be updated to adjust to changes in objectives, effects, and tasks associated with the new phase. While some changes can be anticipated during assessment plan development, adaptations may be necessary to reflect new conditions in the EMOE.

(2) Obtaining and Enacting Assessment-Based Modifications. The JEMSOC Future Operations Element will update the JEMSO plan/CONOPS and assessment plan, as required, with the current commander's guidance along with any changes to desired end state, objectives, and/or priorities. Many mechanisms exist for capturing and acting upon updated commander's guidance, including:

(a) FRAGOs.

(b) Policy/authority changes.

(c) Resourcing requirements, including RFFs and RFSs.

(d) Key leader engagements and HN coordination.

(e) Coordination with, and assistance from, other U.S. Government (USG) entities (i.e., reachback and interagency support).

(f) ROE modifications.

5. JEMSO Assessment Summary. Operation assessment is the process the JFC and staff use during planning and execution to determine the progress toward accomplishing a task, creating a condition, or achieving an objective. JEMSO assessment planning begins at the outset of the JPP to develop the assessment approach, which provides the framework for assessing JEMSO as operational planning progresses into execution.

a. Assessing JEMSO requires close coordination with the J-2 and components for assessment baseline information, then for measures and indicators to assess the achievement of effects. Information must also be obtained via friendly channels to measure accomplishment of the tasks (i.e., MOPs) intended to provide desired effects.

b. JEMSO assessments are integrated with the JFC assessment cell's overall assessment effort. They can illuminate issues such as capability shortfalls that may be impeding JEMSO effectiveness in supporting the JFC's mission and end state. Of course, EMOE complexity and other operational dynamics can complicate the assessment effort, but familiarity with the process discussed in this enclosure can help alleviate challenges in conducting JEMSO assessments.

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ENCLOSURE E

ELECTROMAGNETIC OPERATIONAL ENVIRONMENT CHARACTERIZATION

1. Introduction. Characterizing the EMOE involves describing the distinctive aspects and dynamics of the EMOE having the potential to impact operations. Development and maintenance of an EMOE characterization data repository assists the commander and their staff in assessing threat and risk to operations in a time sensitive matter conducive to the pace of operations. The JEMSOC characterizes the EMOE for planned operations based on information and analysis derived from the EMOE data repository. EMOE-relevant data is aggregated from across the DoD and from across the Services in support of the JFC and their staffs. During MA, planners use the data repository for facts, deriving assumptions, and subsequent development of objectives. In COA development and analysis, planners use the data repository to assess EMOE impact on a COA, determine associated risk, and assess overall JEMSO supportability.

a. EMOE Impact. EMOE impact indicates the importance of the EMOE to the COA or mission. EMOE importance refers to the degree of EMS dependency of systems/forces central to COAs or mission accomplishment. Adversary and friendly JEMSO-related COG analyses are a primary source for determining the EMOE's impact on COAs.

b. JEMSO Risk. Examples of JEMSO risks include shortfalls in EMS capabilities or a heavily contested, congested, or constrained EMOE.

c. JEMSO COA Supportability. JEMSO supportability is assessed based on the EMOE impact and JEMSO risks affecting JEMSO's ability to support the mission or COA.

2. EMOE Data Repository. The EMOE data repository is a compilation, from many sources, of EMS-related information used by the joint force to plan and execute JEMSO. See Figure 2 and 19. It enables EMOE characterization, fosters EMOE SA and understanding, and underpins JEMSO planning and execution. The JEMSOC and component EMSOC(s) will use shared repository systems to describe and characterize the EMOE and predict the EMOE's potential impact on operations. "Characterizing" the EMOE requires possessing the relevant EMOE data and describing the distinctive nature or features of the EMOE having the potential to impact military operations. The JEMSOC establishes, updates, and manages the EMOE data repository.

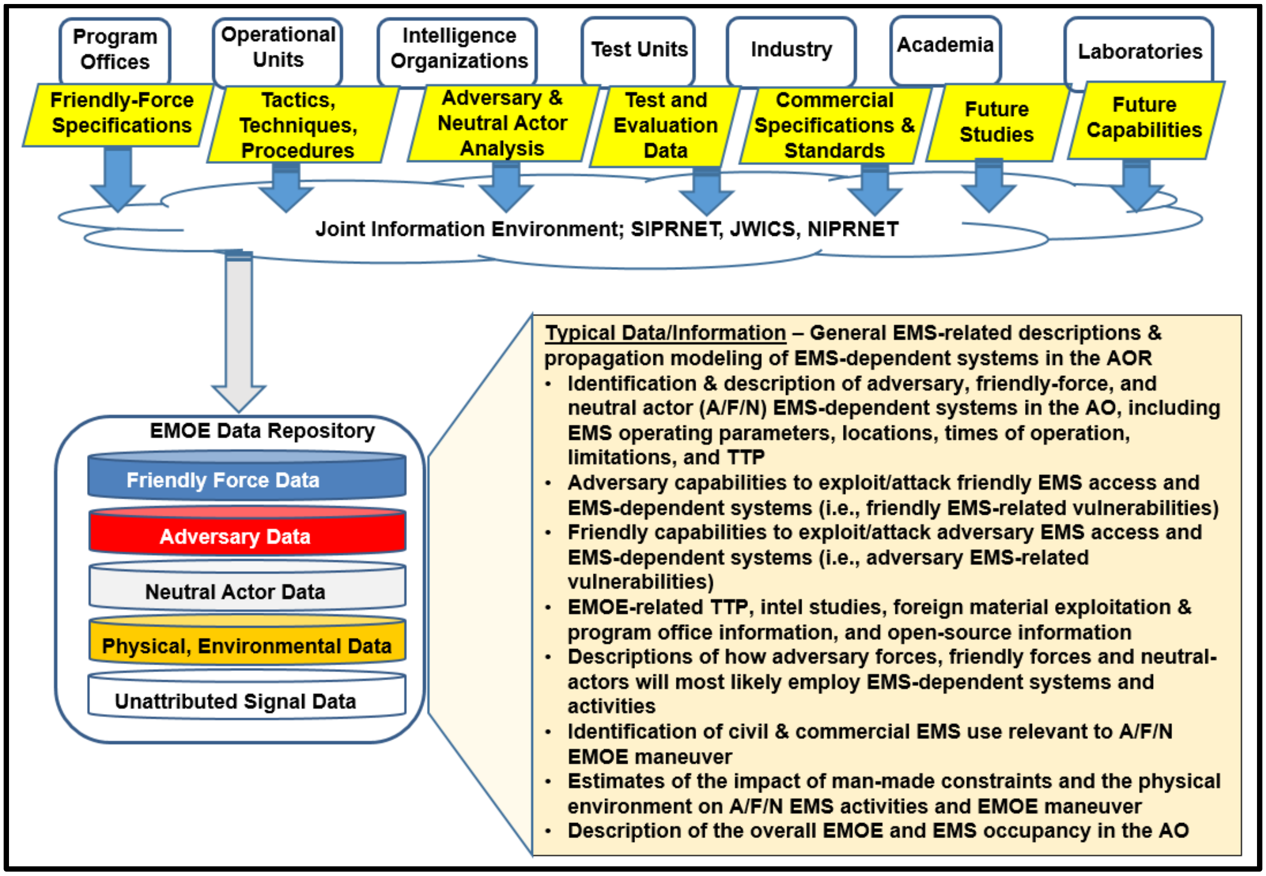
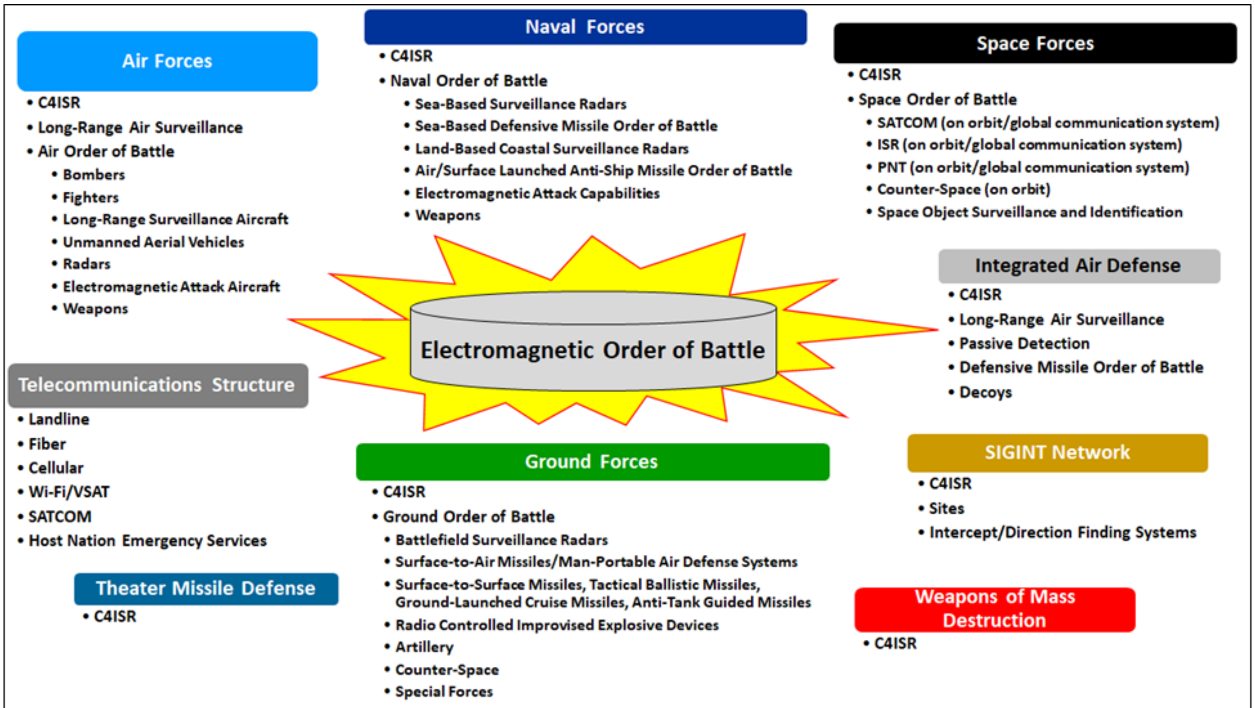


Figure 19. Sources and Types of Data in an EMOE Data Repository

a. As shown in Figure 19, the EMOE data repository will contain, by means of either manual data input or linkage to a common-source database, a wide range of information pertaining to the EMS-dependent systems known or assessed to be in the AO. The "Typical Data/Information" list in the figure refers not only to numerical or parametric EMOE data, but also to qualitative and inter-relational information characterizing the EMOE. Building the repository requires an iterative approach. The JEMSOC should reference the baseline EMOE data repository for the CCMD campaign, which can be tailored for contingency planning and operations.

b. The EMOE data repository should be organized into categories or bins (by domain or function, as depicted in Figure 20 below) to organize data collection and compilation, and to streamline access to portions of data in the repository. For example, a preponderantly land-based operation would require more land-associated EMOE/EOB data than air- or maritime-associated data, so data compilers and users can insert and extract data via the "land" filter. Data categorization also helps manage the volume and technical detail inherent in EMOE data.



LEGEND

C4ISR	command, control, communications, computers intelligence, surveillance and reconnaissance
ISR	intelligence, surveillance, and reconnaissance
PNT	positioning, navigation, and timing
SIGINT	signals intelligence
VSAT	very small aperture terminal
Wi-Fi	wireless fidelity

Figure 20. Categories of Data in an EOB

c. The level of EMOE data detail required to support JEMSO planning and operations differs according to the echelon of the data consumer. For example, JEMSOC EMOE data requirements are broader in scope but less detailed than those of component EMSOCs.

d. Table 23 contains EMS-related data guidelines that a JEMSOC could use in requesting and compiling EMOE data. It includes details such as transmitter and receiver parameters with corresponding standard frequency action format (SFAF) fields for reference. The SFAF provides a standardized mechanism for RF proposals, assignments, modifications, renewals, reviews, and deletions in spectrum management tools.

Intelligence-/Analysis-Derived Data	**EMS Management Assignment Data** *(SFAF Data Field Codes for Reference)*

• Electronic notations (ELNOT)/ communications emitter notations (CENOT)/foreign instrumentation signals intelligence notations (FISNOT)
• "System name"
• Location
• Frequency (upper/lower range)
• Bandwidth
• Channelization
• Power (Effective Isotropic Radiated Power [EIRP])
• Antenna type
  ○ Gain
  ○ Polarization
  ○ Sensitivity
• Modulation
• EP features
• Geospatial ranges
  ○ Search/Detection
  ○ Acquisition
  ○ Tracking
• Associated weapon engagement range
• Environmental factors
  ○ Terrain
  ○ METOC
  ○ Space environment
• Vulnerability info & data
	• Agency serial number (for data searching) *(102)*
	• Frequency/Band *(110)*
	• Station Class *(113)*
	• Emission Designator *(114)*
	• Transmitter (TX) Equipment Nomenclature *(340)*
	• Receiver (RX) Equipment Nomenclature *(440)*
	• Location
	  ○ TX geographic location name *(301)*
	  ○ TX latitude/longitude *(303)*
	  ○ TX area of mobility *(306)*
	  ○ RX geographic location name *(401)*
	  ○ RX latitude/longitude *(403)*
	  ○ RX area of mobility *(406)*
	• TX power (EIRP) *(115)*
	• TX/RX antenna data
	  ○ TX/RX antenna type *(354/454)*
	  ○ TX/RX antenna gain *(357/406)*
	  ○ TX/RX antenna polarization *(363/463)*
	• Functional Identifiers, Major, Intermediate and Detailed *(511, 512, 513)*

Table 23. Example Required Data for EMS-Dependent and EMS-Enabled Systems

3. Adversary Force, Friendly-Force, and Neutral Actor EMOE Data and Data Sources. The EMOE data repository starts with applicable A/F/N EOBs. The quantity and quality of EMOE information must be sufficient to support JEMSO planning activities such as evaluating EMOE impact and JEMSO-related risks.

a. Adversary EMOE Data

(1) JEMSO planners focus on compiling analyses of the adversary EMS -dependent/-enabled systems and capabilities. This includes systems that can contest friendly operations in the EMS (JEMSOC Objective 1) and critical capabilities for adversary use of the EMS (JEMSO Objective 2). For example, the EMS aspects of adversary C2, their overarching C2, and the C2 of subsystems of individual weapons and capabilities are nearly always significant from a JEMSO perspective. This point is reflected in Figure 20 by the recurrence of C2 and C4I across the categories.

(2) Sources of Adversary EMOE Data. The J-2 regional joint intelligence operations center is the primary touchpoint within the JFC staff to gather adversary EMS-relevant intelligence and information. The JEMSOC should request that the J-2 provides an EMOE-focused JIPOE with information on adversary and neutral actor EMS use, capabilities, vulnerabilities, and intentions. Many existing intelligence products containing EMSO-related information might already be published in some form, so the JEMSOC should inform J-2 personnel as to the types of information required and assist them in providing it. The JEMSOC should also coordinate with external organizations, either via the J-2 or directly, if authorized, to obtain relevant adversary EMOE data. Prevalent sources of EMSO-related data include:

(a) IC JIPOE.

(b) JEWC JEMSIAF.

(c) National Production Workshop (EOB data).

(d) Military Electronic Parametric and Engineering Database (MEPED).

(e) Service TTP Publications and threat databases (e.g., AFTTP 3-1 Threat Guides, Joint Threat Analysis Tool, Army Reprogramming Analysis Team threat libraries).

(f) Joint Navigation Warfare Center Armory (for PNT-related data).

(g) Joint Spectrum Data Repository.

(h) National and Service production centers' web pages and products (e.g., Defense Intelligence Agency, Office of Naval Intelligence, National Air and Space Intelligence Center, Missile and Space Intelligence Center, National Reconnaissance Office, Central intelligence Agency (CIA)).

(i) Intelligence "Spaces" (I-Space, R-Space, Q-Space).

(j) Target Systems Analyses.

(k) Internally generated and other organizations' information and intelligence requirements/RFIs.

(l) National Security Agency Pulse.

b. Friendly-Force EMOE Data

(1) JEMSO planners should focus on the information in Table 23 for identifying friendly EMS-related systems and capabilities available for employment by the JFC. Analyses of friendly EMOE data include system vulnerability to adversary attack (JEMSO objective 1), capabilities to contest adversary use of the EMS (JEMSO objective 2), and information for optimizing friendly force integration (JEMSO objective 3).

(2) Sources of Friendly-Force EMOE Data

(a) To understand friendly EMS access and ability to impact the EMOE, the JEMSOC should:

1. Collaborate with J-3 and J-6 to identify friendly-force EMS -dependent/-enabled systems, HN capabilities, and infrastructure vulnerabilities.

2. Coordinate with appropriate entities on the JFC staff, and/or submit requests to external information providers, to obtain required information for the EMOE data repository.

(b) Friendly information sources include:

1. Component EMSOC EMOE Characterization.

2. Forces in theater (includes components' and other supporting forces' EMOE data that can be obtained via EMS requirements data call message).

3. TPFDD/TPFDL.

4. Baseline Architecture views.

5. Service TTP publications (e.g., AFTTP 3-1 General Planning).

6. Force Management System Web (Army).

7. Real Time Spectrum Operations (Navy).

8. Joint SATCOM Mission Planning System/Mission Assurance Decision Support System/Beam and Transponder Assessment Report/Tactical Exploitation of National Capabilities.

9. Joint Spectrum Data Repository.

10. SPECTRUM XXI.

11. U.S. Electromagnetic System (USELMS) database.

12. DISA Area Studies.

13. Intelligence and information requirements/RFIs.

14. Evaluation Requisition Message—for EMOE-related data associated with cyberspace operations.

c. Neutral Actor EMOE Data

(1) JEMSO analysis should focus on compiling of neutral EMS -dependent/-enabled systems and capabilities and vulnerabilities that may be impacted by friendly operations (JEMSO objective 3).

(2) Sources of Neutral Actor EMOE Data. No single staff directorate or other specific entity is responsible for providing neutral actor EMOE data. Rather, information is obtained by compiling information from some of the same sources as for adversary and friendly data. Also, a primary information source can be the neutral countries/actors themselves but, if this is not forthcoming, the J-2 may be able to assist. Sources of neutral actor EMOE data include:

(a) The CCMD J-6 JFMO.

(b) J-2 Intelligence.

(c) DISA.

(d) Foreign-nation communications agencies, particularly those of the neutral actor(s) themselves.

(e) The ITU, including relevant ITU agreements and sub-associations.

(f) Open-source information.

(g) JEWC JEMSIAF products and portals (see Enclosure G for a description of JEMSIAF's EMS data and information functions and sources).

(h) CIA country studies.

(i) The Joint Spectrum Data Repository.

4. Format Data and Information to Enable Information Exchange. EMOE data is extracted from multiple repositories, databases, and reports, and in many disparate formats. Until the formatting and architecture of EMOE data sources are standardized, which is a codified but not yet implemented DoD requirement for EMSO-related data, JEMSO planners will have to tailor or format data as required for planning and products. While specific data requirements will vary from operation to operation, a fundamental JEMSOC task is to extract the pertinent data, develop baseline methods for interpreting the data, and establish a common format for describing the EMOE. Future EMBM systems and supporting databases will assist in providing EMOE data, analysis, and assessment.

5. EMS Modeling Data. JEMSO planners should recognize the utility of modeling in planning, establish reach-back connections with agencies that perform modeling, and be aware of what information is required by modelers for them to run the models and provide products. Two types of JEMSO-relevant "models" are discussed in the following two paragraphs. For additional information on JEMSO modeling and simulation, see reference (e).

a. Model Objects. Using Figure 21 as an example, information on individual component EMS-dependent systems of a parent system or weapon, such as the EA-18G in the figure, can be aggregated together to form a "model object." Computation using model object simulation software can depict the operational performance of model object transmitter-receiver chains and their parent platforms or weapon systems. This type of modeling supports analysis for describing EMS interactions and operational impact.

Figure 21. EA-18G as a "Model Object" with Component EMS-Dependent Systems

b. RF Propagation Modeling. RF propagation modeling provides computer-generated graphical depictions of EM signal emission propagation. This has value in highlighting the effectiveness of, or threat posed by, EMS-dependent systems and their host weapon systems or platforms. Examples of propagation models applications that can be important for JEMSO supportability and impact assessments include EMS-based media broadcast coverage ranges/ areas, jammer effectiveness ranges, and radar or communication system ranges.

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APPENDIX A TO ENCLOSURE E

CONTESTED EMOE CHARACTERIZATION TOOL

1. Overview. The EMOE Characterization Framework is a U.S. Strategic Command (USSTRATCOM)-developed tool that applies a methodology for deriving a numerical value to represent an adversary's ability to contest use of the EMS. The tool numerically evaluates adversary systems' threat severity levels and the probability of encountering them in the battlespace to calculate a risk level they pose in the EMOE. The tool is Microsoft Excel-based and uses the features of this software to elicit scenario-specific user inputs and perform its calculations. A newer tool—called the Contested EMOE Characterization and Analysis Tool (CECAT)—is in development, which will provide an improved user interface but will follow similar rules and have similar outputs as the spreadsheet-based tool.

2. Determining EMOE Threat Severity. The EMOE Characterization tool's processing begins with user inputs that rate adversary EA and ES system capabilities on a numerical scale, and the enterprise infrastructure that supports employment of the systems. System capability categories are referred to as "attributes," and include specifications such as frequency range, jammer power, and receiver sensitivity. The numerical attribute rating is referred to as a "condition" that indicates how capable (or severe) the threat could be. For example, a jammer with a higher output power (the attribute) than a lower-powered jammer would receive a higher rating score and would pose a more severe threat (the "condition" level) than its lower-powered counterpart. Most of the system information comes from commonly available intelligence sources such as the MEPED or System Parametric Information Relational Intelligence Tool. The more information that is available to enable rating system attributes for condition levels, the better the assessment. USSTRATCOM's initial approach to operationalize the tool includes completing severity calculations on all known systems for an adversary, along with corresponding adversary enterprise ratings, for an overall "baseline" EMOE characterization for that adversary. These baselines are provided to respective JFC JEMSOCs and can be adjusted for tailored use in specific areas, operations, and exercises.

3. Process to Characterize the EMOE Threat Level. The EMOE Characterization Framework and the CECAT (in development) point the user to providing scenario-specific data in fields required to perform its calculations. With baseline information already populated and user inputs, the tool calculates quantitative values that indicate the degree to which the EMOE is contested for the area/operation/phase in question. The tool also provides other analytical results such as those described in the following paragraphs.

The user's first entry is the overall purpose for the characterization along with facts and assumptions. This information is important for understanding the operational context to which the characterization applies and can be obtained from the respective Base Plan or other relevant documents.

4. Determining Probability. After entering the basic characterization information discussed above, the next main user input is to assign a "battlefield presence" rating value (the far-right column in Table 24) for each system expected to be encountered. The JEMSOC leads the effort, on behalf of the JFC, of determining and rating the presence of EA and ES systems in the EMOE for each situation. System presence is based on the EOB applicable to the operation (or portion/phase thereof) for which the EMOE is characterized. Information required to make accurate inputs will likely require coordination with and assistance from the J-2.

EA Systems Table

Rank	EA System	Elnot	Terrestrial mms	SATCOM	PNT	Radar	EO/IR	Land	Sea	Air	Space	Cyber	Attributes Percentag	System Score	Risk to Force	Link	Battlefield Presence
1	EA SYSTEM 7		X	X	X	X	X	X	X	X	X	X	100%	4.5	2.7	Go to	3.0
2	EA SYSTEM 5					X		X	X	X	X		50%	4.1	2.5	Go to	3.0
3	EA SYSTEM 6		X	X						X	X		60%	4.0	1.6	Go to	2.0
4	EA SYSTEM 3					X		X	X	X			50%	3.2	1.9	Go to	3.0
5	EA SYSTEM 4		X							X			50%	2.5	2.1	Go to	4.3
6	EA SYSTEM 1					X							40%	2.1	0.8	Go to	2.0
7	EA SYSTEM 2		X		X			X	X	X			60%	2.0	1.1	Go to	2.9

Table 24. Notional EA Systems Table

5. Calculating Risk and Overall Score

a. For each system rated, its basic system score (already scored in the baseline, based on system attributes) and its battlefield presence score are combined to calculate a "risk to force" score (see Table 24). These calculations are repeated for each scored system. If a battlefield presence score is not entered, that system does not get a risk to force score. All systems with a risk to force score are combined into one score for each functional category (i.e., EA Systems, ES Systems, and Enterprise will each have a resultant combined score). The next level roll-up is one overall contested EMOE score combining EA Systems, ES Systems, and Enterprise. The overall score is weighted across the three categories, with EA contributing the highest (50 percent) weight due to its direct ability to contest the EMS, ES contributing 10 percent for their ability to cue a response, and Enterprise contributing 40 percent since EA and ES systems are dependent on the intelligence, maintenance, training, organization, doctrine, etc., supporting them. The singular overall score for whatever portion of the operation was assessed is useful for comparing contested EMOE levels between portions/phases of operations, but tool users can refer to the more granular feeder scores if required. Table 25 shows some notional EA, ES, and Enterprise roll-up scores and their combined overall contested score.

Overall Scores	
Contested	2.9
Contested Breakdown	
Contested EA Systems	2.9
Contested ES Systems	2.6
Contested Enterprise	3.1

- 1) Score 0 - .9. Forces are unlikely to suffer any EMS dependent system degradation that will impact mission accomplishment.
- 2) Score 1 - 1.9. Most forces equipped with EMS dependent systems that have some EP features will be able to accomplish the mission.
- 3) Score 2 - 2.9. Forces with some EP TTP training and equipped with EMS dependent systems that have some EP features will likely be able to accomplish the mission.
- 4) Score 3 - 3.9. Forces with good EP TTP training equipped with EMS dependent systems that have good EP features will likely be able to accomplish the mission.
- 5) Score 4 - 5. Even forces with extensive EP TTP training and equipped with EMS dependent systems that have extensive EP features will be challenged to accomplish the mission.

Table 25. Notional EA Systems Evaluations

b. The tool also constructs EA and ES charts showing threat levels broken out by frequency band (the frequency coverage “heat maps” in Table 26). By cross-referencing EA/ES system tables and the EA/ES coverage heat maps, the analyst or planner can determine which systems and frequency ranges present the highest threat, and which blue systems or mission areas are most vulnerable.

IEEE Bands		HF	VHF		UHF		L	S		C		X	Ku	K V Ka	W
		3-30 MHz	30 - 300 MHz		300 - 1,000 MHz		1 - 2 GHz	2 - 4 GHz		4 - 8 GHz		8 - 12 GHz	12 - 18 GHz	18-26 26-40 40-75 GHz	75 - 111 GHz
	EA Coverage Heat Map														
Frequency Band	Below HF	HF	VHF	Upper A Band	B Band	C Band	D Band	E Band	F Band	G Band	H Band	I Band	J Band	K L M Bands	Above M Band
	< 3 MHz	3 to 30 MHz	30 to 100 MHz	100 to 250 MHz	250 to 500 MHz	500 MHz to 1 GHz	1 to 2 GHz	2 to 3 GHz	3 to 4 GHz	4 to 6 GHz	6 to 8 GHz	8 to 10 GHz	10 to 20 GHz	20 to 100 GHz	> 100 GHz
	1.6	1.6	1.6	2.1	2.1	2.1	2.1	1.6	1.6	2.5	2.5	2.5	2.5	2.7	0.0
	ES Coverage Heat Map														
Frequency Band	Below HF	HF	VHF	Upper A Band	B Band	C Band	D Band	E Band	F Band	G Band	H Band	I Band	J Band	K L M Bands	Above M Band
	< 3 MHz	3 to 30 MHz	30 to 100 MHz	100 to 250 MHz	250 to 500 MHz	500 MHz to 1 GHz	1 to 2 GHz	2 to 3 GHz	3 to 4 GHz	4 to 6 GHz	6 to 8 GHz	8 to 10 GHz	10 to 20 GHz	20 to 100 GHz	> 100 GHz
	0.6	0.6	3.6	3.6	3.6	3.6	3.6	1.3	1.2	1.2	1.2	1.2	2.0	2.0	0.0

Table 26. EA Coverage Heat Map

6. Exercise Planning. Exercise planners can use the EMOE Characterization Framework to emulate and assess the EMOE pertinent to the exercise scenario. During exercise design, planners can input EA and ES systems, and battlefield presence values, in the same manner as adversary systems that are included for assessing OPLANs or OPORDs. Employing the EMOE characterization tool in exercises not only provides an EMOE characterization for the exercise scenario itself, but will also inform the EMOE characterization for the real-world OPLAN and adversary on which the exercise is based.

APPENDIX B TO ENCLOSURE E

EMS MANAGEMENT CONTRIBUTION TO EMOE CHARACTERIZATION

1. Spectrum Management Activities for Characterizing the EMOE

a. Joint operations require a common, single, authoritative, interactive database to track and deconflict blue RF assignment use information. This blue force RF utilization database is hosted within the DISA's cloud Ecosystem. SPECTRUM XXI is the desktop client software required across the DoD for interacting with this master server database (see references (o) and (n)). SPECTRUM XXI enables a user-defined local data repository to continue planning, management, and operations during periods of interrupted network connectivity. Effectively fulfilling the role of an EMS manager ("spectrum manager") for this activity requires at least a SECRET security clearance and SIPRNET access. A TOP SECRET clearance is required to perform this activity at the joint level and at the Service level when collaborating with the joint force, EW, special operations forces (SOF), the IC, the space community, and other governmental entities.

b. The JEMSOC and component EMSOC(s) will use shared repository systems to describe and characterize the EMOE and predict the EMOE's potential impact on operations. The JFC is responsible for building and managing this common source of spectrum information in the JOA. The CCDR is responsible for ensuring common standards and processes across their AORs. The CCMDs, Services, and agencies collaborate with the Joint Staff; the Military Command, Control, Communications, and Computers Executive Board (MC4EB); and Command, Control, Communications Leadership Board (C3LB) in establishing and executing overarching spectrum management standards, collaboration, and the compilation of blue EMS data across the DoD. When working with allied, United Nations (UN), or coalition forces, the JEMSOC should obtain similar information from those forces to produce the SA necessary for effective use and control of the EMS across the JOA. See Appendix L to this enclosure for considerations in a joint, interagency, international, and multinational environment.

c. In support of joint planning, JEMSOCs should establish notional spectrum use plans and summaries aligned with the GFMIG. The Forces for Unified Commands Memorandum ("Forces For") is approved annually and establishes authority relationships between the CCDR and the units assigned to the CCMD to accomplish its mission. The TPFDD outlines apportioned forces for planning. Directed Readiness Tables periodically inform the supply and demand of forces throughout the planning process. The GFMAP aligns with deployment orders of forces allocated to operational plans. Emergent GFMIG products may also include Dynamic Force Employment Strategic Opportunities (DFE SOs), which address rapid changes in the OE requiring action. DFE SOs may include the deployment of forces not initially identified within the GFMIG or GFMAP. As part of their participation in JEMSO spectrum management activities in planning, component EMSOCs are responsible for building their contribution to EMOE characterization. This includes establishing and maintaining databases and sources that tie emitters to platforms and formations. These efforts in compiling EMOE data contribute to the development and delivery of the EMOE prediction.

d. EMOE characterization development for exercises and joint planning is built in the same manner as planning for emergent or crisis operations with the additional step of building EMS requirements against the specified exercise plan force structure and/or "Forces For" and the TPFDD.

e. EMOE characterization in exercises and joint planning may require establishing a SPECTRUM XXI database server separate from the live operations database. This may entail establishing a dedicated server for planning/exercise data or a non-data-exchanging SPECTRUM XXI client.

f. When a deployment order (DEPORD) is promulgated, a validation request will be generated to update all relevant plans with the EMS information required to engineer, deconflict, and assign EMS usage within the JOA. The validation request may occur in any manner, IAW JFC staff processes, that fulfills the purpose of obtaining and validating deployment forces' EMS requirements.

(1) Spectrum Management Actions

(a) Spectrum managers' assistance in defining and characterizing the EMOE involves not only creating a database of RF assignments but also identifying factors affecting signal propagation, such as environmental characteristics and terrain. Accomplishing this starts with defining the AOI within SPECTRUM XXI and its environmental characteristics, locating necessary terrain data, and then locating the data and creating a database of known spectrum-use information. This process also includes updating and maintaining this spectrum-use information and adding all JFC required RF assignments and is ongoing until operations cease.

(b) The information produced in support of characterizing the EMOE will constitute a database that can be used to depict the blue force EOB and will be the basis for all JFC spectrum-interaction analyses.

(c) Identifying the Area of Interest

1. To assist in defining the EMOE, the spectrum manager must identify the pertinent AOI. The area of influence is inclusive of and extending beyond an operational area wherein a commander is capable of direct influence by maneuver, fire support, and information normally under the commander's command or control. The AOI is the area of concern to commander, including the area of influence and areas adjacent to it, and extending into enemy territory. In an EMS context, the AOI is always greater than the geographical JOA because radio waves do not stop at borders or lines on a map. There are two approaches in determining the extent to which the area of influence exceeds the JOA.

2. One approach, the "more is better" approach, is to include all spectrum-use data for a geographical area extending well beyond the AOR. The advantage of this approach is that it is a simplistic method for RF assignment records. The disadvantage is that the RF assignment database becomes saturated with records, many of which do not affect JFC operations. For example, if the AOI was described within 1609.34 km (1,000 miles), then every low-powered emitter in a band reserved for land mobile radio (LMR) service within that radius would be included, even though those emitters would never be close enough to have any effect on joint force operations. An excess of records would add to the size of the database and increase the processing time just to rule them out of any analysis.

3. Another approach is to discriminate spectrum-use data to only those affecting operations. It focuses on frequency bands and radio services in which forces will operate. An example of this in Figure 22 shows specific RF assignments for specific known systems. The aeronautical assignments are more likely to propagate beyond the geographical limits of the JOA than the land-based system assignments, so the air-based assignments probably dictate the geographical expanse limits of the AOI. The advantage to this approach is that the number of excess records would be greatly reduced, thereby reducing the analysis time. The disadvantages are the increased complexity in having to sift through all systems and assignments—and discriminate between them based on what domain they operate in, their propagation distances, and their likelihood of being used—just to define the AOI.

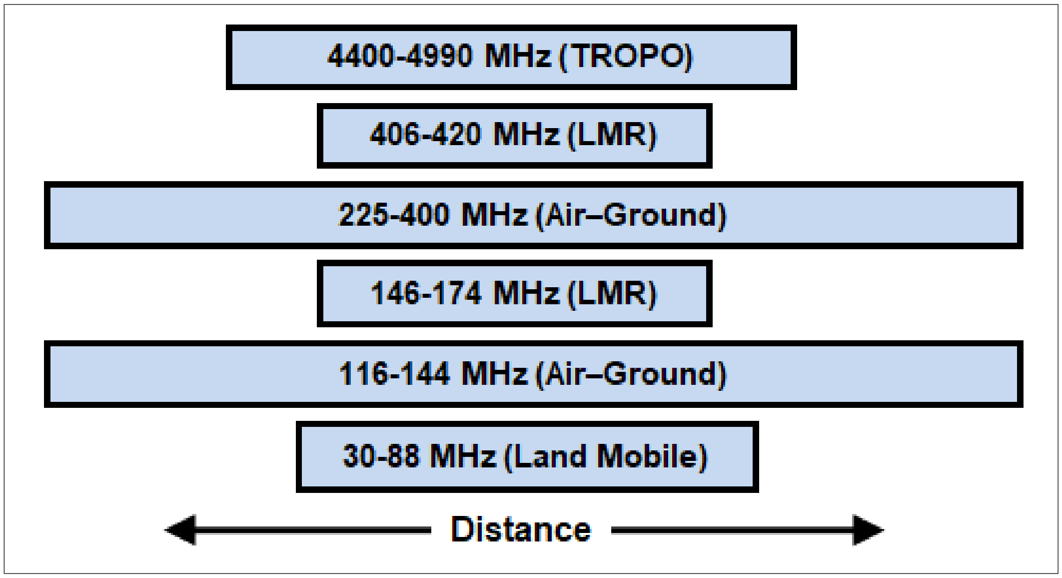

Figure 22. AOR Distance versus Frequency Bands

4. Another point to consider when capturing spectrum-use data is SPECTRUM XXI analysis capabilities, specifically for frequencies below 30 MHz. SPECTRUM XXI analysis capabilities are used to calculate path loss between proposed transmitters/receivers against transmitters and receivers in the RF assignment database. For records below 30 MHz, SPECTRUM XXI only analyzes ground wave propagation, so sky wave propagation is not analyzed. The spectrum manager should decide whether to capture spectrum-use information, other than the joint force's assignments, for frequencies below 30 MHz, to balance the need to analyze this spectrum use versus the potential for slower computer performance.

5. Whichever approach is taken to import and export AOI definitions, the concept and parameters of the AOI should be determined before creating the AOI in any software tool. The parameters of the AOI should be applied both to capturing the initial RF assignment database from available sources and to updating the database via SPECTRUM XXI data exchanges. AOI queries are interchangeable between SPECTRUM XXI and the Frequency Assignment Retrieval System (FARS). These AOI queries can be imported and exported between the two software tools with the following considerations:

a. The number of queried SFAF fields is fewer in FARS than SPECTRUM XXI. Therefore, the AOI built with SPECTRUM XXI may contain conditions on fields that are not allowed in FARS. When opening such an AOI, FARS will automatically delete conditions on fields not queried in FARS.

b. SPECTRUM XXI performs geographic queries as circular radius selects, while FARS geographic selects are always rectangular. However, the user may specify the rectangular area using a center point and radius. When opening a SPECTRUM XXI AOI in FARS, radius selects are automatically converted to geographic rectangular selects. Inversely, when importing a FARS query into SPECTRUM XXI, geographic rectangular selects are automatically converted into radius selects. Therefore, SPECTRUM XXI selects a "smaller" portion of the Earth than does FARS, given the same center point and radius (the "corners" of the rectangle outside the circle are not selected). Figure 23 illustrates the difference between FARS and SPECTRUM XXI radius selects.

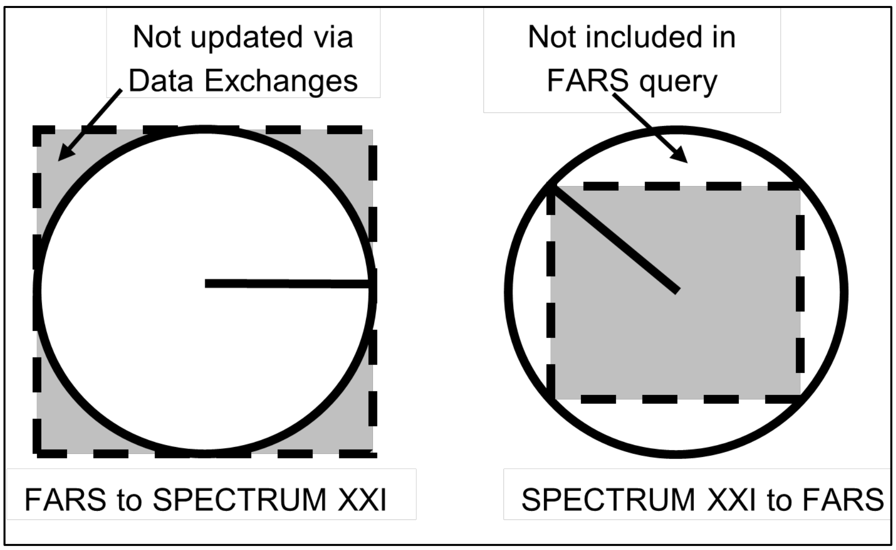

Figure 23. FARS versus SPECTRUM XXI Radius Selects

c. The geographic area of a FARS-created AOI would include records outside the SPECTRUM XXI radius, and it should be noted that these records would not be updated via a SPECTRUM XXI data exchange. However, for a SPECTRUM XXI-created AOI used in FARS, all records would be queried.

d. Geographic selects in SPECTRUM XXI support Authorized Radius (SFAF items 306 and 406). In FARS, these fields are not supported. When opening a SPECTRUM XXI AOI in FARS, any options concerning Authorized Radius are ignored. When importing a FARS query into SPECTRUM XXI, these options take their default values.

6. Blue EMOE Data Sources. Spectrum-use information, environmental parameters, and terrain elevation data characterize the EMOE. Joint operations require the most current, accurate, complete, and authoritative spectrum-use information available. If information on a S-D

system, transmitter, or receiver is not in the RF assignment database, there is no way of ensuring it will not interfere with other systems or that its capabilities would not be degraded by other emitters. Decisions must be made based on the best information available; therefore, spectrum managers should not expect to have information on every spectrum-dependent system within the EMOE, identified in the RF assignment database. There are various sources for obtaining and updating EMOE spectrum-use information. Enclosure E and Enclosure F contain additional information on spectrum-use information sources.

7. Background Frequency Assignment Data Sources. The following paragraphs contain brief descriptions of sources that may be used to capture initial background environment information within the EMOE.

a. FARS. FARS is a Windows-based program that enables the user to query and retrieve RF assignment records by area, organization, or other SFAF items and then output those records in SFAF format. FARS is provided with RF assignment data from the following sources: Frequency Resource Record System (FRRS), ITU, and FCC. FARS is used to provide spectrum managers with initial background EMOE data that is not available on the SPECTRUM XXI regional server.

b. DISA Area Studies. DISA area studies contain information on a country's physical and cultural characteristics and their civil telecommunications sector, including RF management; broadcasting; telephone, telegraph, and telex; data communications; aeronautical information; and transmission systems. RF assignment data is provided in both SFAF and spreadsheet formats. Additional SFAF records are provided on broadcast transmitters, along with navigational aids (NAVAIDS) not registered with the ITU. Since 1995, these area studies have included SFAF records on international search and rescue frequency assignments, which should be TABOO frequencies on the JRFL (see Appendix H to Enclosure F).

8. Update Spectrum-Use Information. RF assignment information from the data sources discussed above are a fundamental part of the EMOE data repository. However, these sources do not always contain the most up-to-date spectrum-use information available. Other sources are available (discussed in the following paragraphs) that can provide more current spectrum-use data and a more accurate EMOE data repository.

a. SPECTRUM XXI Data Exchanging Capability. The SPECTRUM XXI Data Exchange module is used to electronically exchange RF assignment data between regional servers and client computers. It is used to create AOIs as well as to establish and manage SPECTRUM XXI accounts (e.g., Oracle server accounts and Job Accounts) that are necessary for exchanging data between a networked client and a server. Data exchanging is the method that the JEMSOC, component EMSOCs, and other spectrum management organizations use to stay abreast of new assignments or proposals that could affect their EMOE.

b. Joint Automated Communications-Electronic Operating Instructions System. The Joint Automated Communications Electronic Operating Instruction System (JACS) is used to create the JCEOI, a directory of C2 radio nets consisting of radio call signs (CSs) and RF for use by the warfighter. The JCEOI also includes challenge and password, as well as instructions for conducting visual communication. JACS imports and exports data in SFAF and provides JCEOI information for input into either an OPTASK COMM or air tasking order message.

c. Real-Time Spectrum Operations. The Real Time Spectrum Operations (RTSO) software, incorporating Afloat Electromagnetic Spectrum Operations Program (AESOP), is a spectrum planning, optimization, and monitoring tool. It is used to coordinate radar and communications spectrum usage in a manner that mitigates EMI and maximizes system performance. RTSO calculates optimal RF use considering all strike group emitters, including radar, combat systems, communications, NAVAIDS, and EW equipment. It also includes the ability to predict EMI based on geographical separation and terrain data. Foreign and domestic military and commercial systems are addressed in these calculations, and RTSO provides operational recommendations to resolve and minimize identified issues. Additionally, if a compatible shipboard spectrum analyzer and antenna are available, RTSO can interface with them to provide own-ship emission control (EMCON) awareness.

d. System Planning Engineering and Evaluation Device. The Systems Planning Engineering and Evaluation Device is a planning system that provides radio propagation tools required for rapid communications engineering in changing tactical environments. The analysis tools include HF analysis, satellite analysis, point-to-point analysis, enhanced position location reporting system analysis, Worldwide Interoperability for Microwave Access analysis, Radio Guard Chart, Force Structure Manager, and tools for spectrum management. The mapping engine supports digital terrain elevation data (DTED), ARC Digitized Raster Graphics, Compressed ARC Digitized Raster Graphics, Controlled Image Base, and Shuttle Radar Topography Mission data.

e. Intelligence Sources. The IC is a source of spectrum-use information on adversary and neutral forces. Information on adversary emitters and receivers should be provided to the spectrum manager. JIPOE analysts must work closely with spectrum managers to ensure EMOE data is based on current adversary and neutral forces information. The JEMSOC will have to establish procedures to enable the protection of intelligence systems that exceed the classification level of SPECTRUM XXI.

f. Understand the Operational Environment. As stated earlier, the RF assignment database needs to be current, accurate, and complete, and each analysis will be based on the information gathered to characterize the EMOE. In the AOI (defined as discussed earlier), the spectrum manager should be aware of the issues in the following paragraphs that could adversely affect analysis results and performance time.

9. Missing SFAF Items. It is common for some RF assignment records within the database to be missing necessary SFAF items for performing an analysis. These items include: emission (item 114), transmitter power (item 115), antenna gain (items 357/457), and antenna feed point height (items 359/459). For analysis purposes, if a record is missing any of these items, SPECTRUM XXI will use the default values specified by the user's preferences based on the record's RF. These default values may not accurately depict the emitter with the missing SFAF items. For example, a record for an air-ground assignment operating between 225–400 MHz missing the antenna gain would, for analysis purposes, use the initial default value of 8 dBi for the antenna, which is more than 4 times the actual radiated power leaving the antenna. Another example is that many FCC RF assignment records for television (TV) stations are missing the emission designator (item 113) and the antenna gain (item 357). For analysis purposes, default values are used for these missing items. The initial default values can significantly misrepresent the actual values. For example, for a very high frequency (VHF) TV station with an actual bandwidth of 6 MHz wide, SPECTRUM XXI would apply an initial default value of only 16 kHz to perform its analysis; similarly, the UHF TV station initial default bandwidth is only 6 kHz. The default values result in exaggerated antenna gain values for these TV stations. Knowing the database shortcomings and adjusting default preference values will minimize the analytical errors and increase accuracy of results.

10. Deleted History. When SPECTRUM XXI performs a data exchange, expired and deleted records are added to the RF assignment database. Unless otherwise specified, expired and deleted records residing on the regional server conforming to the user's selected AOI definition are downloaded and identified as deleted history. These deleted history records are

required to update the initial FRRS and Government Master File (GMF) database and, after the first data exchange, will be unnecessary bulk in the RF assignment database, which will slow down every analysis. To preclude these records from being included in a data exchange, the following expressions should be included in the SPECTRUM XXI AOI definition:

========(START GROUP========

[Deleted History] == F

=========END GROUP)=========

11. FRRS vs. GMF vs. ITU. There are usually several RF assignment records on the same emitter contained in the FRRS, GMF, and ITU databases. As repeatedly mentioned, the greater the number of records in the RF assignment database, the longer it will take SPECTRUM XXI to perform each analysis.

a. Many permanent DoD RF assignments are in both the FRRS and GMF databases, with the FRRS records containing more information. Accordingly, all DoD records with a records source equaling GMF should be purged from the RF assignment database and, to preclude them from being downloaded via a data exchange, the SPECTRUM XXI AOI definition should contain the following expressions:

========(START GROUP========

[Record Source] == FRRS

==============OR============

========(START GROUP========

[Record Source] == GMF

=============AND============

[102-Agency Serial Number] Not in Set 'N ','AR ','AF ','NS '

=========END GROUP)=========

b. In addition to the FRRS versus GMF issue, there is the probability of duplicate RF assignments between the GMF and ITU databases. This probability is based on the theory that the RF the United States registers with the ITU are assignments outlined in the GMF database. These duplicate records should be removed from the RF assignment database by querying and purging records with a record source equaling ITU and where the transmitter or receiver state country code is either United States or one of the codes used for U.S. possessions, such as PR for Puerto Rico and VI for the U.S. Virgin Islands.

12. Protect Spectrum-Use Information. Since the information collected while defining the EMOE is invaluable and used in every analysis, spectrum managers must safeguard it. The SPECTRUM XXI archive manager should be used to back up and restore the database files should they become corrupt or lost. Using the archive manager, the spectrum manager can create and name archive files and save them to a user-defined folder. These archive files are created by compressing (zipping) all the files in the \SPECTRUM XXI\DBFS folder and saving them to a single file. The archive files serve only as backups for the databases not for the software. An archive should be performed immediately after establishing the initial databases and then periodically to back up the databases when significant changes are made. In most cases, it should be two or three times per week. This procedure takes only a few minutes to complete and could save hours if the databases become corrupted. It is recommended that the archive files be stored on a different computer or even at a different location as a safeguard in the event the computer itself is lost or corrupted.

13. Environmental Parameters. The environmental parameters of the AOR affect the way in which RF propagate within the EMS. These parameters impact the path-loss calculation made by the SPECTRUM XXI IA and path-loss modules and will have a significant impact on the analysis results. The values selected under SPECTRUM XXI preferences should be changed to reflect the geography of the area for which the analysis is performed. Although there are four categories of environmental parameters—ground, atmospheric, oceanic, and space—SPECTRUM XXI can only process ground and atmosphere.

a. Ground Parameters. The ground parameters affect the path-loss calculation and should be changed each time an IA or path-loss calculation is made for a different geographical area. Table 27 contains the seven possible ground types and their associated conductivity and permittivity values. Set the parameter that best applies to the AOI.

Ground Type	Conductivity in siemens per meter (S/m)	Permittivity
Fresh Water (20 C)	0.00600	80.0
Ice (Fresh Water-1 C)	0.00002	3.0
Medium Dry Ground	0.02780	15.0
Pure Water (20 C)	0.00500	80.0
Sea Water (20 C)	5.00000	70.0
Very Dry Ground	0.00100	3.0
Wet Ground	0.01200	30.0

Table 27. Electrical Earth Properties of Various Ground Types

b. Atmospheric Parameters. Atmospheric parameters differ throughout the world and affect radio wave propagation. These parameters should be changed to reflect the conditions at the location for which an IA will be performed. These atmospheric parameters are refractivity, humidity, and man-made noise levels.

(1) Refractivity. Radio waves propagating in free space follow a straight-line path. However, in passing through the Earth's atmosphere, the waves tend to bend along a curved path. This phenomenon is termed TROPO or atmospheric refraction. This affect is influenced by changes in atmospheric pressure, temperature, and humidity at different altitudes. The variation of refractivity with altitude is referred to as the refractivity gradient. The refractivity gradient causes the curved path of the EM wave. Propagation models, such as the Terrain-Integrated Rough Earth Model (TIREM) and the Spherical Earth Model (SEM) used in SPECTRUM XXI, calculate the appropriate refractivity gradient, and use it to calculate the Earth radius factor for the entire propagation path. Based on the climate of the operational environment, select the appropriate refractivity values as listed in Table 28.

Climate	Refractivity
Equatorial	360
Continental Subtropical (Sudan)	320
Maritime Subtropical	370
Desert	280
Continental Temperate	301
Maritime Temperate, over land	320
Maritime Temperate, over sea	350

Table 28. Refractivity Values in Various Climates

(2) Humidity. Humidity is the amount of water vapor in the air, expressed as a percentage or ratio per unit volume of air. Water vapor causes absorption of EM energy, especially at high frequencies/low wavelengths. Absorption is considered a propagation loss factor, typically for frequencies above 10 GHz. Table 29 lists humidity levels, expressed as grams per cubic meter, for various climate types; from these, select the appropriate value within SPECTRUM XXI that best characterizes the climate type in the operational environment.

Climate	g/m³ Setting
Very Dry	0.0
Dry	2.5
Average	5.0
Humid	10.0
Very Humid	50.0

Table 29. Absorption Factors in Various Climates

(3) Man-Made Noise. Man-made noise has an impact on the interference calculation and should be set based on the local conditions below for which the IA is performed.

(a) Rural—Quiet: Used for rural, relatively unpopulated areas.

(b) Residential—Average: Used for suburban areas outside (but near) cities.

(c) Urban—Noisy: Used for urban areas (inside a city or town).

(4) Terrain Elevation Data. Terrain elevation has a significant impact on the distance signals can propagate. The TIREM propagation model in SPECTRUM XXI uses elevation data to calculate transmission loss over irregular terrain. However, it should be noted that terrain elevation is not considered whenever either the transmitter or receiver is afforded some radius of operation listed in SFAF items 306 or 406. In other words, a mountain range separating a mobile system from a fixed system would not exist for analysis purposes.

(a) TIREM uses the terrain elevation information processed by the Topographic Manager (TOPOMAN) module in SPECTRUM XXI. TOPOMAN converts and stores Level-1 DTED from the National Geospatial

Intelligence Agency (NGA) in compatibly formatted files. Much of Level-1 DTED from NGA is derived from maps portraying the Earth as being smoother than it is, softening and omitting many features and terrain irregularities. It should be noted that DTED does not reflect the presence of trees or other obstacles such as buildings, and may contain blank areas that reflect missing elevation data. DISA has processed the NGA DTED on most of the world at 15-second latitude/longitude spacing. This data is available on their Topographic Data System.

(b) NGA terrain elevation information can be processed by TOPOMAN at a spacing of every 3, 6, 12, 15, or 30 seconds. These processed files can become very large and, if available hard disk space is an issue, note that each increase in spacing significantly decreases the data storage requirements. For example, the size of a file containing terrain data at 3-second spacing is 25 times larger than a file for the same area at 15-second spacing. Studies have shown that using 15-second versus 3-second spacing data reduces input/output processing times of the application program by as much as five times with a negligible loss in prediction accuracy.

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ENCLOSURE F

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS
SPECTRUM MANAGEMENT ACTIVITIES

1. Overview. The JEMSO spectrum management activities discussed in this manual evolved from the JTF spectrum management lifecycle. The lifecycle was developed as a guide for joint spectrum managers in establishing a functional and efficient JTF Joint Spectrum Management Element (JSME). Today, JSME functions are subsumed by the JTF JEMSOC IAW reference (e). However, these functions are performed in part or in whole by spectrum managers across the DoD. Over the past 30 years, the lifecycle evolved to become the disciplined unified standard for synchronizing efforts not only across the joint force but for military service spectrum management and their components. JEMSO spectrum management activities are an element of operational art and design. JEMSO spectrum management activities involve both independent and collaborative spectrum management support to the JFC and are integral to JEMSO planning (Enclosure B), execution (Enclosure C), and assessments (Enclosure D). As such, every reference to EMS requirements, EMS synchronization, and EMS deconfliction throughout this document denotes a cross-reference to spectrum management activities discussed in this enclosure. These activities involve joint planning deliverable products (e.g., Tab A to Appendix 23, the JCEOI, and the JRFL) and developing information that is integral to effective JEMSO (e.g., EMOE characterization). Most lifecycle activities are initiated during competition below armed conflict (the competition continuum is defined at the beginning of Enclosure B), continue through armed conflict, and endure upon transition back into the competition.

a. The role of spectrum management in support of military operations is to enable warfighting capability. Outside of military channels, the EMS is treated as a sovereign commodity to enable our Nation's, or a respective HN's, economic objectives. Military spectrum management navigate this national and international framework through policy, agreements, collaboration with respective administrations, and engineering in executing JEMSO spectrum management activities to enable warfighting capability and power projection. See chapters 1 and 2 of reference (s) for additional information.

b. JEMSO spectrum management activities and corresponding appendices to this enclosure consist of the following (graphically depicted in Figure 24):

(1) Define command specific policy and guidance (Appendix A).

(2) Gather requirements (Appendix B).

(3) Develop EMS requirements summary (Appendix C).

(4) Characterize the EMOE (Appendix A to Enclosure E).

(5) Obtain EMS resources (Appendix D).

(6) Develop spectrum management plan (Appendix E).

(7) Nominate and assign frequencies (Appendix F).

(8) Generate the JCEOI (Appendix G).

(9) Develop the JRFL (Appendix H).

(10) Perform EW deconfliction (Appendix I).

(11) Resolve EMI (Appendix J).

(12) Report EMI (Appendix K).

(13) Considerations in a joint, interagency, international, and multinational environment (Appendix L).

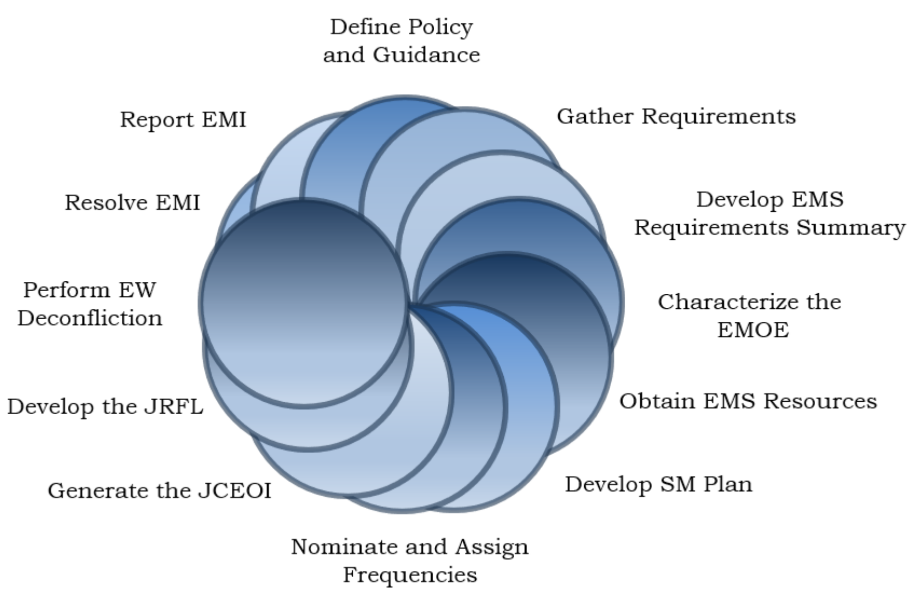

Figure 24. JEMSO Spectrum Management Activities

2. Spectrum Management Roles and Authorities. Spectrum Management activities are performed and coordinated from the national-strategic level to the tactical level across the entire spectrum of conflict. RF assignment authority and generation authority are defined in Enclosure A. Reference (e) contains additional discussion on EMS management roles responsibilities.

a. In joint planning, the JEMSOCs will establish notional spectrum use plans and summaries in support of the respective OPLAN TPFDD and the "Forces For." Component EMSOCs build their respective portions of spectrum use plans and summaries and integrate them into joint plans and orders via the JEMSOC. This includes contribution to EMOE characterization and establishing and maintaining databases and sources tying emitters to platforms and formations. When deployment orders are promulgated, spectrum use plans and summaries are updated to engineer, deconflict, and assign EMS usage within the JOA. This validation may occur in any manner that accords with the staffing processes and procedures of the respective JFC for the purpose of obtaining and validating the EMS requirements of deploying forces. The EMS requirements data call message is one example of such a validation request. The data call format can be tailored to fit the JFC's requirements, e.g., it can be a standalone directive request for information, published as part of theater entry requirements, or published as an order or FRAGO. The EMS management tab (Tab A) to the JEMSO appendix (Appendix 23 to Annex C) in plans and orders is developed in conjunction with JEMSO planning, IAW the JFC's overall planning and execution processes. The spectrum management plan is derived from, and developed along with, the spectrum management tab. During execution, the spectrum management plan changes as operations progress; spectrum management activities are carried out IAW the JEMSO coordination cycle, including provision of spectrum management content in the JEMSO appendix to the JFC OPORD and EMSCMs, as discussed in Enclosure C.

b. Spectrum managers will establish or contribute to orders, policy, and standard operating procedures that align EMS management activities with higher level guidance but will also provide guidance to organizations they support. IAW the data call message, plans and orders, or standing JFC polices, coordination for EMS resources generally begins through technical support channels that align with C2 relationships. In some cases, coordination will require DIRLAUTH to collaborate activities that fall outside of the JFC's direct C2 relationship, e.g., Service retained forces, regionally aligned forces, and other governmental entities.

c. The CCDR is responsible for all EMSO in their AOR, including JEMSO EMS management activities. 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. At the JTF level, the JEMSOC subsumes all responsibilities and personnel previously held by the JSME and EM warfare cell. See reference (e) for a complete listing of EMS management responsibilities.

d. When a specified subordinate unified command or JTF is established, the CCDR may delegate all or elements of JEMSO spectrum management activities, or split responsibilities among the respective commands and components. Component EMSOCs coordinate all EMS activity within their geographic areas. Further delegation may occur if required (e.g., on order, spectrum management assignments below 10,000 feet above ground level (AGL) are the responsibility of the JTF JEMSOC while RF assignment authority above 10,000 feet AGL is the responsibility of the Joint Force Air Component Commander (JFACC)). This framework is generally established within existing CCMD policy and then delegated on order. Depending on current or emergent support agreements, the JTF JEMSOC may also be the coordination spectrum management authority for Department of State (DOS) and respective other governmental entities within the JOA. Upon standup, the JTF JEMSOC may receive surge manpower augmentation direct from the CCMD JEMSOC, the JFMO and from joint force enablers such as the JEWC.

e. When established, the JTF JEMSOC is the lead for spectrum management activities within the JOA. The CCMD retains authority and oversight of the JOA and across the AOR. The JEMSOC also plans, directs, monitors, and assesses EW activities employed from the theater-strategic through tactical levels. Spectrum management traditionally addresses the manageable portion of the EMS; however, the JEMSOC's scope of activities is broadened to include all operational EMS interactions such as electro-optical, infrared (IR), and directed energy. The JTF will either coordinate RF assignments and EW deconfliction with the CCMD JFMO for approval or the CCMD will delegate spectrum coordination and assignment authority to the JTF. This authority may also include HN coordination where the JTF may be better situated to coordinate approvals.

f. From the tactical level up through the JTF echelon, Service units and other JTF subordinates will submit EMS assignment requests through their respective technical support channels for the requests to be reviewed and approved by the respective RF assignment authority. During the competition phase, the respective CCMD will outline the framework and guidance for spectrum management activities. Additionally, tactical-level spectrum managers must provide their spectrum use and other EMS-relevant information (i.e., their EMOE data) to up-echelon spectrum managers for compilation and EMOE characterization.

g. Service retained forces preparing for deployment will receive guidance for spectrum management coordination through their service component in line with established CCMD policy, a respective order, theater entry requirement, or data call. Generally, forces will coordinate through their respective components, through the CCMD, or, if established, the JTF JEMSOC. Once in theater, forces will coordinate through their respective C2 technical support channels up though the RF assignment authority for all activities. This guidance is clarified through respective channels with orders nested in CCMD guidance.

h. New and experimental spectrum dependent systems will be introduced during competition and as operations progress. These new requirements must be identified and coordinated before they arrive and are employed in the AOR. Situational awareness of new systems, additional forces, incidents of interference, and the movement or relocation of existing forces must be maintained by attending operational meetings, briefings, and planning sessions.

i. During planning, spectrum managers perform an analysis of blue EMS-enabled C4ISR capabilities against other blue systems and assist the JEMSOC to discern impact of adversary systems on blue EMS systems. This analysis includes identifying impact on blue force C4ISR capabilities. This supports EMOE characterization and assessing the degree to which the EMOE is congested, contested, and constrained. Analyses also support risk assessment and mitigation. Preemptive or reactive risk mitigation could be as simple as changing RF usage, or more involved mitigation actions such as engaging institutional processes or initiating CCMD integrated priority lists and urgent/emergent operational needs statements.

j. Jamming is an EMS management activity during the competition continuum. This coordination includes minimizing unintentional effects while ensuring compliance with international law, treaties, HN and coalition agreements, DoD policies, and JFC authority. Within the US&P, there are two primary jamming authorities controlled (but delegated) by the NTIA. One authority supports tests, training, and exercises through the DoD (NTIA Manual 7.14) as the federal agency lead. The other authority is coordinated through the Department of Justice in support of homeland security missions (NTIA Manual 7.25) (see references (b), (k), and (l)). Outside of the US&P

during competition, CCMDs coordinate with HNs to obtain jamming training clearances. During conflict, EA, and respectively EACA, is authorized and enabled in response to an attack and in self-defense and IAW references (z)–(bb). CCMDs evaluate the above international framework and agreements in the establishment of formal ROE to employ EA and EACA. Jamming in support of test, training, and exercises does not require formally establishing ROE. CCMDs should establish pre-coordinated EA authorities and ROE (both standing and event oriented operation-specific authorities/ROE) with allied, coalition, and partner nations. Appropriate authorities should be clearly outlined by the CCMD for implementation across the entire spectrum of conflict—competition, crisis, and conflict.

k. Unit spectrum managers assist users who report EMI by guiding them through the EMI trouble-shooting process. EMI that is not resolved at the unit level may require an investigative site visit from their higher echelon spectrum manager and their spectrum monitor/analyzer. EMI identification and resolution may require on-site emitter surveys and investigation analysis by unit or higher-level headquarters spectrum management personnel. For this effort, spectrum managers use Service or unit-procured spectrum monitors/analyzers to perform the required analysis. An emitter survey is an on-site validation of all emitters within a given area against SPECTRUM XXI records. On-site investigations effectively compare and contrast the emitter survey results against anomalous radio signals to identify the source of harmful EMI. Emitter surveys may be proactively performed to map and validate radio assignments. SIGINT, ES, and respective space databases are evaluated in the investigation process to validate or exclude adversary and other considerations. Persistent and unresolved efforts may be elevated for additional effort. Unresolved EMI that elevates to the attention of the CCMDs may elect to request and deploy joint enabler EMI resolution teams.

l. The quality or accuracy of JEMSO spectrum management activities can be affected by the rigor and reliability of preceding activities and products. Omission or failure of preceding activities does not necessarily cause mission failure, nor does it necessarily indicate that the overall spectrum management plan is ineffective; rather, it probably portends operating without complete information, which raises the risk level attributable to spectrum use and JEMSO. In some operations, not all spectrum management activities are required. For example, a JTF established to conduct a noncombatant evacuation operation (NEO) operation might not require a JRFL if no EA activity is planned. Spectrum management activities initially deemed unnecessary, or performed with incomplete or inaccurate information, might have to be revised or added when new or unforeseen information arises. Figure 25 is a spectrum management plan development and execution flow chart.

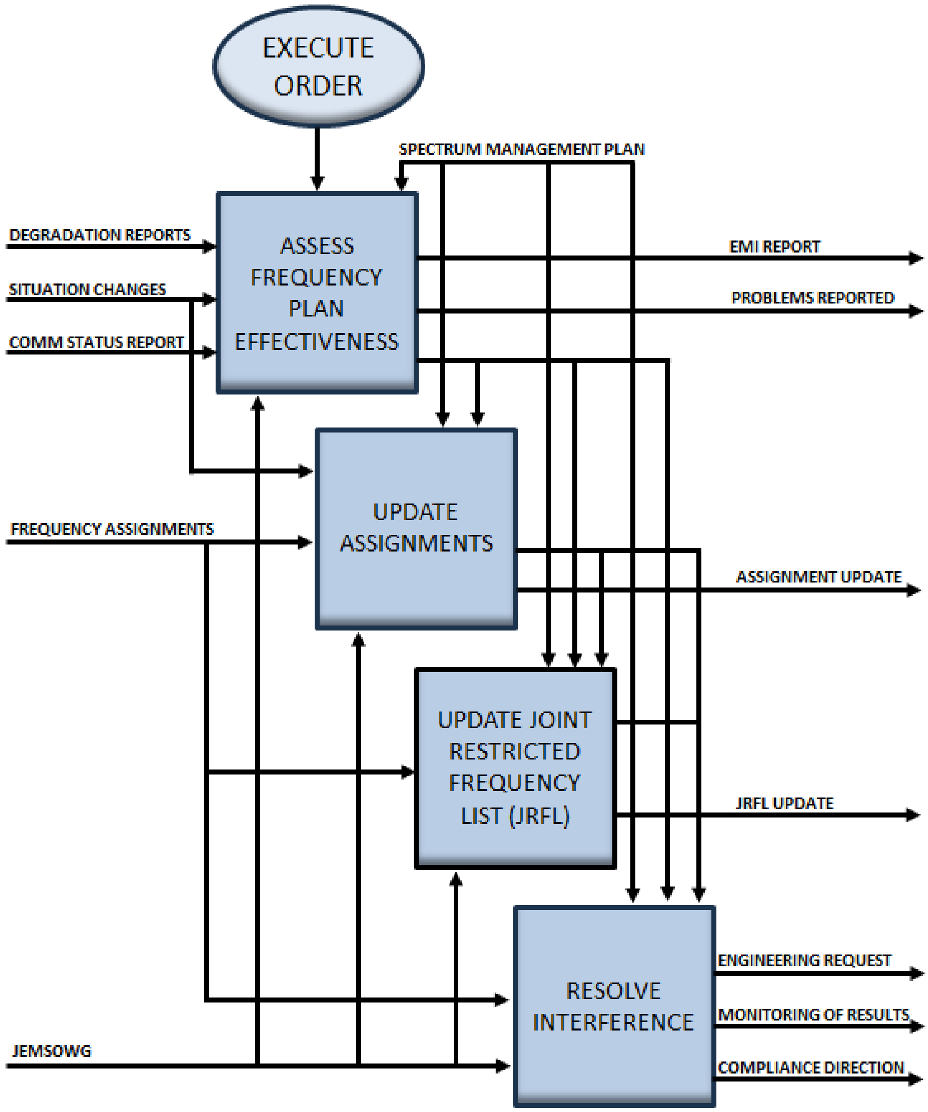

Figure 25. Executing the Spectrum Management Plan

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APPENDIX A TO ENCLOSURE F

DEFINE POLICY AND GUIDANCE

1. Overview

a. The JFC or JTF JEMSOC establishes guidance for performing many spectrum management activities—to include managing, requesting, coordinating, and assigning EMS-use, the JRFL process, the JCEOI, and other processes—IAW policy. Therefore, the necessary first JEMSO spectrum management activity is to establish and define policy. Defining spectrum management policy requires refining existing policy and guidance for EMS use within the CCDR's AOR to meet the mission requirements for the JOA. Sources of CCDR's EMS policy and guidance may include a Spectrum Management Manual (SMM), CCMD regulations or instructions, and existing OPLANs and CONPLANs. See also Appendix E to this enclosure.

b. The JEMSOC should compile, read, and understand existing command spectrum management policy and guidance. If necessary, modify command policy and guidance for emerging JFC or JTF mission requirements. Radically changing the CCMD policy should be avoided, if possible, to reduce the impact of change on JTF forces.

c. If a JTF is established, the CCMD-level JFMO should be the resource center for the JTF JEMSOC since the JFMO has extensive institutional knowledge concerning the AOR EMS issues. The JFMO should have prepared the basic spectrum management resources needed to support of operations anywhere within the CCDR's AOR. Such resources should include digitized terrain data, background electromagnetic environment (EME) records, country area studies, copies of agreements for EMS use or sharing with host or adjacent nations, and historical EMS use records pertinent to the JTF JOA.

d. The CCMD JEMSOC/JFMO and JTF JEMSOC must work closely together during contingency and crisis planning. The JFMO will provide direct support to operations as the JTF JEMSOC stands up to assume responsibilities. The JTF JEMSOC may be augmented with surge personnel to assume its role. This augmentation may come from the CCMD JEMSOC, the JFMO, or the JEWC. Once the JEMSOC operational assumes delegated responsibilities, the JFMO takes on an advisory role while performing oversight of EMS issues.

e. There are two main spectrum management deliverables generated from the define policy and guidance activity: the spectrum management concept and the EMS requirements data call message.

2. Spectrum Management Concept. The spectrum management concept supports EMS deconfliction and use. If directed, the JEMSOC should be prepared to provide direct support to the DOS and other governmental entities for their EMS requirements. Support of other governmental entities will be driven by established or emerging support agreements or orders. The spectrum management concept contains assumptions, considerations, and restrictions that, when analyzed together, can illustrate the best approach to managing the allied EMOE. To develop this concept, the JEMSOC must assess the mission requirements, AOR and JOA considerations, forces involved, potential radio services, threat EOB, and other factors that affect EMS use. The initial mission briefing and/or mission CONOPS should contain much of this required information and the CCMD/JTF J-2 can provide further information on the current operational environment. An overall guideline for developing the spectrum management concept is to consider everything, seek input from many sources, consult facts, and consider assumptions.

a. Assumptions. Assumptions may be required concerning resources and the availability of personnel, equipment, connectivity, and information. To continue planning and to make decisions, the spectrum manager might have to make educated assumptions regarding the most likely scenario, on things such as the participation of allied or coalition forces, the necessity and likelihood of HN coordination, the type of entry (forced or peaceful), and the availability or accessibility of EMS resources. Planning, and the inevitability of unknown but required information, requires making assumptions, but planners should realize and act on using available information resources to turn assumptions into facts as planning progresses. Accordingly, it is important to document assumptions made during planning so that they can be tracked for resolution, documented in plans and orders, and, if unresolved, assessed for their contribution to risk.

b. Considerations. Spectrum management-related considerations are based on the JFC's mission, the friendly and adversary forces involved, and other factors, as listed in the subparagraphs below. The depth and detail of considerations in developing the spectrum management concept depends on the expanse of operations, the EMS-centricity of the mission, and planning time constraints. The detail and depth of analysis for considerations affects the fidelity and accuracy of the spectrum management concept and related JEMSO planning products, so spectrum managers should expend as much time as constraints permit to identify and resolve considerations.

Considerations are also likely to generate RFIs and assumptions, which has planning ramifications as discussed in the paragraph above. See Appendix L to this enclosure for additional allied, coalition, and partner considerations.

(1) Allied or Coalition Operations

(a) Types and numbers of spectrum-dependent equipment.

(b) Foreign Information releasability.

(c) Integrated operations with other forces.

(d) Does the allied or coalition force have a trained spectrum manager?

(e) What automated spectrum management software, tool, or automated system does the allied or coalition force utilize?

(f) How will I deliver RF assignment information to them?

(g) How will allied or coalition partners submit RF requests?

(h) What format will be used for data exchange with the JEMSOC?

(2) EMS Use Considerations

(a) Type of operations.

(b) Force complement.

(c) Type of entry.

(d) Area of responsibility.

(e) Type(s) of radiocommunication services.

(f) Centralized or decentralized RF assignment authority.

(g) EMS coordination/availability.

(h) Radiocommunication service RF band occupancy and sharing.

(3) Automation and Other

(a) Do all required organizations have SPECTRUM XXI and job accounts?

(b) Will all components be able to perform SPECTRUM XXI data exchange?

(c) Is there reliable SIPRNET connectivity to the components? Is the preponderance of coordination traffic on a coalition network?

(d) How will the JEMSOC handle area/mobile assignments.

(e) Do all required offices have JACS.

(f) A plan must be made by the CCMD or JTF on the creation and management of SPECTRUM XXI job accounts and the centralized planning and management of seeding blocks of agency serial numbers to subordinate commands. This positive control will assist in maintaining discipline to ensure good data within the SPECTRUM XXI data repository.

(g) The JFC or JTF JEMSOC must remain aware of software updates to SPECTRUM XXI and other spectrum management systems and the JEMSOC must proactively plan to ensure the updates do not create backward compatibility issues across the JOA. Some software updates are not backwards compatible and may create issues when the JEMSOC distributes JACS-developed JCEOI hopsets and loadsets.

(h) Unlike the EMS management systems and processes for which the spectrum manager has input/output decision-making latitude, some spectrum restrictions might not be within the spectrum manager's power to change, so they must either accept the restrictions or continue to coordinate to obtain the proper authority to operate. Coordinating and resolving on restrictions may create extra work for the JEMSOC, such as obtaining and maintaining EMS resources and planned EW operations. Operations by organizations outside the JFC/JTF may compete for the spectrum manager's use of frequencies or frequency bands. Restrictions come from many sources, including command guidance, JFC/JTF policy, HN constraints, and political or legal restraints imposed by laws or treaties. Information restrictions may prohibit the spectrum manager from sharing data with certain allied or coalition forces. Many restrictions, like ROE, will be identified in the JFC/JTF mission briefing, plan, or order. As operations progress, new and different restrictions will arise and need to be considered.

c. Spectrum Management Concept Summary

(1) The spectrum management concept is the initial plan on how to best use the EMS to support operations. It is based on JFC/JTF force complements and locations, the type of operation and type of entry, radio services used, EMS availability, and HN restrictions.

(2) The concept will include delegation of (or not to delegate) CCMD authority for RF assignment to the Service and functional components. The spectrum manager may consider further delegating the management of specific frequency bands or functions to one of the JTF Service components. In some JTF operations, the management of the LOS radio relay EMS is totally delegated to the Army force (ARFOR) component because it has an automated spectrum management software that manages the radio relay bands (e.g., 224-500 and 1350-1850 megahertz (MHz)) better than SPECTRUM XXI. The AESOP is a surface Navy spectrum management software for managing radar and communication frequencies of shipboard equipment. This automated spectrum management system can manage radar frequency assignments. The JEMSOC provides these Service components with a frequency resource to use and then lets the component manage the individual assignments. The concept will outline the spectrum manager's plan to use allotment plans, restrictions for delegated assignment authority, and radiocommunication service sharing of frequency bands. The spectrum management concept will also contain conclusions.

(3) In campaign planning, the content of the spectrum management concept should be covered in the JEMSO appendix to plans and orders. The spectrum management concept addresses known assumptions and political and planning restrictions pertinent to the plan or order. Plans are developed based on future (i.e., not yet executed) operations, so challenges may not present themselves until encountered in execution. Future planning and planning in execution are likely subject to time constraints, so spectrum managers must anticipate restrictions, and assumptions as early as possible and include them in the spectrum management concept. The spectrum management concept essentially constitutes a first draft of the spectrum management plan.

2. Concept to Policy

a. Policies and procedures will need to be developed once a determination has been made on how best to manage the EMS.

b. The JEMSOC should review and understand the existing command spectrum management policy and guidance. The best source of this information is the CCMD's SMM, instruction, or publication. Once the spectrum manager fully understands the existing command spectrum management policy and guidance, they can determine what specific areas need to be clarified, expanded, and modified. Experience has shown that modifying or changing existing policy and guidance may contribute to errors, as the staff and components learn and comply with the new guidance. In the context of time-sensitive planning, adopting these modifications and navigating the associated learning curve often turn out to be less efficient than adhering to the existing policy. Ideally, policy and guidance for establishing a JEMSOC is incorporated into the CCMD's SMM, publication, or instruction. The JEMSOC policy and guidance should also be included in all CCMD planning products (i.e., OPLANs, CONPLANS, and functional plans). Appendix E to Enclosure F and reference (j) discuss JEMSO and EMS management sections in plans and orders.

c. Second, the spectrum manager should establish contact with each of the components and identify the office and person responsible for spectrum management, intelligence, space, and electromagnetic warfare. The spectrum manager should also acquire complete contact information for each component representative: name, message address, e-mail address for NIPRNET, SIPRNET, JWICS, and telephone numbers for secure and nonsecure devices. This information should be included in the EMS requirements data call message.

d. Finally, once the spectrum manager has decided how to manage the EMS in support of JTF operations and has determined what, if any, policy changes should be made to existing command spectrum management policy and guidance, he should document and publish this guidance in an EMS requirements data call message.

3. <u>EMS Requirements Data Call Message</u>

a. In support of joint planning, JEMSOCs should establish notional spectrum use plans and summaries in support of the respective OPLAN TPFDD and the "Forces For." When a DEPORD is promulgated that will introduce forces and materiel, and corresponding spectrum use requirements into the JOA, plans will be updated with relevant EMS information required to engineer, deconflict, and assign EMS usage in the JOA. Component EMSOCs support this process with planning and validation requests for executing their spectrum use activities. The requests may occur in any manner according to JFC/JTF policies and procedures. Mechanisms for documenting validation requests include published orders and FRAGOs, JFC theater entry requirements documents, traditional Automated Message Handling System (AMHS), or a spectrum requirements data call message.

b. The EMS requirements data call message provides guidance to staff elements, components, and supporting agencies on how to request EMS support for spectrum-dependent systems that operate under their control within the JOA. This multipart message covers the following subjects: spectrum management policy and guidance, security classification guidance, RF and JCEOI Master Net List (MNL) request procedures, and guidance for identifying nets and frequencies to be included on the JRFL.

c. If data call messages are solicited and compiled by an established JTF JEMSOC, they should distribute the message to relevant JTF staff elements and JTF components, and a consolidated data call should be submitted to the CCMD JEMSOC or JFMO, supporting JFMOs, JTF supporting agencies, military satellite control facilities, and other organizations tasked with providing forces or equipment to the JTF. The message should call out all relevant related publications. This may include the CCMD's policies, joint publications, allied regulations, and any warning orders, OPLANs or CONPLANs for the operation.

d. The subject line of the message should be as follows: "RF and JCEOI Requirements Request." This subject line will identify the message as an RF management and JCEOI function and should ensure that it is routed to the appropriate personnel for action.

e. The EMS requirements data call message has several parts. Part One should provide JFC/JTF specific spectrum management policy and guidance to participants in the operation being planned. Part Two should direct JFC/JTF staff, components, and other associated agencies to submit their EMS requirements, through their respective chains of command to the JFC. Part Three should request the JFC/JTF staff, components, and other associated agencies to submit their initial JCEOI MNL, and Part Four should request that the JFC/JTF staff, components, and other associated agencies submit proposed JRFL entries to the JFC/JTF.

4. <u>Part One – Policy and Procedures</u>. The purpose of part one of the data call is to provide specific guidance on how to request EMS resources.

a. Part One of the message should designate the automated spectrum management systems to be used by the JFC and JTF. It should also specify spectrum request formats and should direct components to use designated agency serial number (SFAF item 102) conventions and for spectrum managers to consolidate and validate proposals before sending them on to the JFC/JTF JEMSOC. Part One should identify JFC/JTF JEMSOC and component points of contact, including phone numbers, email addresses, and SPECTRUM XXI job account names. The exercise or operation name (SFAF item 910) will be designated by the JEMSOC/JFMO. All SFAF item 910 entries will be filled in using the precise manner directed by the JEMSOC/JFMO with no deviation. Separate instructions for other governmental entities, allied, and/or coalition forces will be included if necessary.

b. The agency serial number (SFAF Item 102) of every new RF proposal must be unique. Permanent RF proposals are required to use specific prefixes which are dictated by the agency responsible for their RF proposals and assignments. Temporary proposals and assignments have no automated method to manage agency serial numbers, so they are reliant on spectrum managers to manage them manually. It is up to the JFMO or JEMSOC to develop an agency serial numbering scheme that provides an adequate number of unique agency serial numbers for the JTF JEMSOC and components.

c. A determination must be made on whether an agency serial number prefix is unique. First, select a prefix scheme that is suitable for the operation or exercise. For example, an operation named TANDEM THRUST could use a prefix of “TT” for RF assignments made by the JTF JEMSOC as shown in the example below.

TT = JEMSOC	TTMC = JTF Joint Force Marine Corps Component Command
TTAC = JTF JFACC	TTAR = JTF Joint Force Air Component Command
TTLC = JTF JFLCC	TTAF = JTF Joint Force Land Component Command
TTSO = JTF JFSOCC	TTNV = JTF Joint Force Special Operations Component Command

d. The next part one action is to create a SPECTRUM XXI AOI that queries all temporary RF proposals and assignments having (as in the examples above) an agency serial number starting with the prefix “TT.” If no records are found, the spectrum manager has a unique agency serial number prefix and can use the numbering system shown above. If the spectrum manager finds records with a TT prefix, a combination of letters not in use must be found.

e. Security classification, including special handling codes, must be included in the initial EMS requirements data call message. This guidance will identify what information needs to be protected (i.e., classified) and at what level. Special handling codes will determine if the Foreign Disclosure Office (FDO) has determined the RF request and assignment relative to the equipment can be shared and/or coordinated with coalition allies and partners, including the HN. Overall classification guidance is normally determined and prepared by the JFC J-2 with input from the JFC staff. However, careful attention to classification and release authority of the equipment specified in the DD-1494 in the Host Nation Supportability for Windows Online (HNSWDO) must also be observed. When a DD-1494 is coordinated with a CCMD, it may receive a new designation as a PC (USINDOPACOM), EC (USEUCOM), CC (USCENTCOM) coordination paper, etc., and retains the original DD-1494 (or J/F-12) designation. It will also have specific FDO restrictions and instructions concerning which attributes of the equipment is classified and with whom it can be shared. Classification guidance identifies information requiring protection, the level of protection, release authority, and the time span for which protection is required (i.e., declassification instructions). See Appendix E to Enclosure F for more information regarding security classification.

5. Part Two – EMS Request Procedures. Part Two of the message includes defining the required data items to be included in all RF requests. The specific data items, any standardization of these items, and any special instructions should be included in this part. Instructions on how data should be entered into the SFAF (e.g., emission groups starting from largest bandwidth to smallest, standard SFAF 200 series items). Required lead-time for requests and unique coordination requirements for special systems should also be addressed. Non-data exchanging SPECTRUM XXI client procedures should be addressed here along with specific requirements for when a data-exchanging client must perform data exchange.

a. Part Two should address the actual EMS requirements data call. This request should task components to submit all EMS requirements for deploying units, including instructions to identify EMS use by units as they operate deployed and fully functional.

b. EMS request format and content instructions provided in part two should cover required data items for all EMS requests and any specifics regarding the way data should be entered. Specific data entry requirements include the following (see Appendix B to this enclosure for a complete list of recommended engineering SFAF items):

(1) SFAF for all U.S. forces.

(2) The JFC standard for allied or coalition units.

(3) Items not required.

(4) Situations unique to this JTFs operation.

(5) Agency serial number (SFAF item 102) prefix and numbering.

(6) Control request number (SFAF item 702) prefix and numbering.

(7) Use of the operation and/or exercise name (SFAF item 910).

6. <u>Part Three – JCEOI MNL</u>. Part three solicits inputs for the JCEOI MNL. The JFC/JTF staff, whose inputs are usually collected by the JEMSOC and component EMSOCs, should compile their MNL as if they were in mission execution. The normal requirements for call signs, call words, frequencies, and net IDs should be identified, and any applicable sharing plan anticipated for use should also be included. The reuse class and zone information are required in case the JEMSOC spectrum manager is not from the same service as the requester and is not familiar with constructing a JCEOI. The requirement to submit JCEOI inputs does not exclude the user from submitting SFAF requests for EMS support. Instructions to Service components should specify only communications-electronics operation instructions (CEOI)/Signal Operations Instructions (SOI) nets unique to their units should be included.

7. <u>Part Four – JRFL Data Call</u>. Part Four is a request for all participants of the operation to submit initial JRFL inputs, which will be compiled into an initial JRFL by the JFMO. See Appendix H to Enclosure F for additional information.

ANNEX A TO APPENDIX A TO ENCLOSURE F

SAMPLE DATA CALL

This annex contains a sample EMS data call message template in the AMHS, Allied Communications Publication (ACP)-128, and Standard Agreement (STANAG) 5500 standard 16-line message format. The template may be modified as required to meet specific mission requirements and the staffing procedures of the JFC employing it. It is directive in nature, and can be promulgated as a standalone message, published as part of theater entry requirements, or in the spectrum management tab to the JEMSO appendix in a plan or order.

FM JTF XRAY//JEMSOC//

TO AIG #####

BT

UNCLAS

OPERATION/IRAQI FREEDOM//

MSGID/GENADMIN//

SUBJ: FREQUENCY REQUEST AND JOINT COMMUNICATIONS-/ELECTRONICS OPERATION INSTRUCTIONS (JCEOI) REQUIREMENTS /DATA CALL//

REF/A/MSG/OCEAN VENTURE WARNING ORDER//

REF/B/DOC/COMBATANT COMMAND SPECTRUM MANAGEMENT MANUAL//

NARR/REF A IS OCEAN VENTURE WARNING ORDER. REF B IS COMBATANT COMMAND SPECTRUM MANAGEMENT MANUAL//

1. THE PURPOSE OF THIS MESSAGE IS TO PROVIDE GUIDANCE TO JOINT TASK FORCE (JTF) COMPONENTS AND SUPPORTING ORGANIZATIONS AND COMMANDS FOR REQUESTING FREQUENCIES, SUBMITTING JCEOI MASTER NET LIST (MNL) INPUTS, AND JOINT RESTRICTED FREQUENCY LIST (JRFL) INPUTS ISO EXERCISE OCEAN VENTURE. THIS MESSAGE CONTAINS FOUR PARTS: POLICY AND GUIDANCE, REQUESTING FREQUENCIES, JCEOI MNL REQUIREMENTS, AND JRFL INPUTS.

2. PART ONE – POLICY AND GUIDANCE

A. UPON PUBLICATION OF THIS MESSAGE, THE CCMD DELEGATES FREQUENCY ASSIGNMENT AUTHORITY, JCEOI, AND JRFL PRODUCTION TO THE JTF CDR. DIRLAUTH IS AUTHORIZED TO ENABLE COORDINATION OF REQUIREMENTS AS DESCRIBED WITHIN THIS MESSAGE.

B. THE COMPONENTS WILL ENFORCE THAT UNITS DEPLOY WITH THEIR SPECTRUM MANAGERS TO FULFILL JEMSO REQUIREMENTS.

C. SPECTRUM XXI IS THE DESIGNATED JOINT SPECTRUM AUTOMATION SYSTEM AND WILL BE USED TO COORDINATE, NOMINATE, AND ASSIGN SPECTRUM RESOURCES. SPECTRUM XXI WILL BE USED TO SUBMIT COMPONENT FREQUENCY REQUEST TO THE JTF J-3 JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS CELL (JEMSOC) AS WELL AS NOTIFICATION OF ASSIGNMENTS FROM THE JEMSOC BACK TO THE COMPONENTS. THE JOINT AUTOMATED COMMUNICATIONS-ELECTRONICS OPERATION INSTRUCTIONS SYSTEM IS THE DESIGNATED AUTOMATED JCEOI SOFTWARE AND WILL BE USED TO CREATE, UPDATE, AND MANAGE JCEOI PRODUCTS.

D. COMPONENTS WILL ESTABLISH SPECTRUM XXI JOB ACCOUNTS USING THE FOLLOWING NAMING CONVENTIONS FOR THIS EXERCISE.

ORGANIZATION	JOB ACCOUNT	POC	DSN PHONE
JEMSOC	OVJEMSOC	SGM REYES	222-1210
ARFOR	OVARFOR	MSG MCNAMARA	222-1211
AFFOR	OVAFFOR	MSGT CERVJAKOVS	222-1213
NAVFOR	OVNAVFOR	ITC MCNEAL	222-1214
MARFOR	OVMARFOR	MSGT COURTENAY	222-1215
JFACC	OVJFACC	SMSGT GLICA	222-1216
JFLCC	OVJFLCC	MSG FERNANDEZ	222-1217
JFMCC	OVJFMCC	ITC(SW) BAEZ	222-1218
JFSCC	OVJFSCC	SFC DECKINGA	222-1210

JFSOCC	OVJFSOCC	SMSGT CHOSIN	222-1220
STATE DEPT	OVSTATE	GYSGT FERGUSON	222-1221

E. SATELLITE ACCESS REQUEST (SAR) AND SATELLITE ACCESS AUTHORIZATIONS (SAA) WILL INCLUDE THE CCMD AND JTF JEMSOC AS AN INFORMATION ADDRESSEE. COMPONENTS SHOULD IDENTIFY ALL RECEIVE ONLY STATIONS TO THE JEMSOC FOR PROTECTION FROM UNINTENDED INTERFERENCE. NOTE: JOINT RADIO NETS USING DOD/COMMERCIAL SATCOM WILL BE IDENTIFIED BY THEIR SATCOM DATABASE (SDB) RECORD IDENTIFIER.

3. PART TWO – R REQUEST

A. REQUEST FOR FREQUENCY WILL BE SUBMITTED IN THE STANDARD FREQUENCY ACTION FORMAT (SFAF) FROM THE COMPONENTS TO THE JEMSOC. THE JEMSOC WILL RESPOND TO THE COMPONENTS USING SFAF. FREQUENCY REQUESTS WILL BE SUBMITTED BY THE COMPONENTS AND WILL INCLUDE THE JCEOI MNL REQUIREMENTS. SPECTRUM XXI DATA EXCHANGE IS THE PREFERRED METHOD OF EXCHANGING PROPOSAL AND ASSIGNMENT INFORMATION. FREQUENCY REQUESTS WILL BE SUBMITTED THROUGH NORMAL SERVICE COORDINATION CHANNELS UP TO THE COMPONENT LEVEL OF THE JTF. COMPONENTS WILL VALIDATE REQUIREMENT AND QUANTITY OF SPECTRUM NEEDED ALONG WITH FORMAT AND NECESSARY INFORMATION. ALL SFAF REQUEST WILL INCLUDE, AT A MINIMUM, THE FOLLOWING ITEMS; 005, 010, 102, 110, 113, 114, 115, 140, 141, 144, 200, 201, 202, 204, 205, 207, 300, 301, 303, 306, 340, 354, 357, 358, 359, 362, 363, 400, 401, 403, 406, 440, 454, 457, 459, 462, 463, 467, 502, 513, 702, 801, 803, 804, 806, 910. ITEMS 306 AND 406 WILL BE USED FOR MOBILE ASSIGNMENTS BUT SHOULD NOT EXCEED 500KM. ALL PROPOSALS MUST HAVE EITHER A FIXED LOCATION OR A GEOGRAPHIC POINT OF REFERENCE AND A RADIUS. THIS LIST SHOULD BE USED AS A MINIMUM STANDARD.

B. THE FOLLOWING AGENCY SERIAL (SFAF 102) NUMBERING CONVENTIONS AND STANDARD 200 SERIES ENTRIES WILL BE USED.

ORGANIZATION	SERIAL NUMBER
JEMSOC	OV000000
AFFOR	OVAF000000

ARFOR	OVAR000000
NAVFOR	OVNV000000
MARFOR	OVMC000000
JFACC	OVAC000000
JFLCC	OVLC000000
JFMCC	OVNC000000
JFSCC	OVSC000000
JFSOCC	OVSO000000
STATE DEPT	OVST000000

C. THE FOLLOWING AGENCY STANDARD 200 SERIES ENTRIES WILL BE USED. SELECT THE APPROPRIATE ENTRY.

200. JNTSVC/USA/USMC/USN/USAF/USSF (SELECT ONE)

201. CDRSOUTHCOM

202. JTF OV

204. AFFOR/ARFOR/NAVFOR/MARFOR/JFACC/JFLCC /JFMCC/JFSCC/JFSOCC/ (SELECT ONE)

205. IDENTIFY USING UNIT'S HIGHER HQ

207. IDENTIFY USING UNIT

D. FOR MOBILE EMITTERS THE FOLLOWING STATION CLASS CONVENTION WILL BE USED:

(1) ML FOR LAND MOBILE STATIONS

(2) MS FOR MARITIME MOBILE

(3) MO FOR MOBILE STATIONS OPERATING BETWEEN 45 FT TO 10,000 FT (I.E., HELICOPTERS)

(4) MA FOR MOBILE STATIONS OPERATING ABOVE 10,000 FEET.

E. EMISSION DATA (SFAF ITEM 114) WILL BE ENTERED WITH THE LARGEST BANDWIDTH AS THE FIRST OCCURRENCE AND SHOULD ONLY INCLUDE THE EMISSIONS THAT WILL ACTUALLY BE USED BY THE STATION, NOT ALL POSSIBLE EMISSIONS.

F. LOCATION DATA SHOULD BE STANDARDIZED BY THE COMPONENTS FOR MOBILE STATIONS AND LIMIT THE OPERATING RADIUS (SFAF ITEM 306/406) TO LESS THAN 500KM. REFERENCE AREAS WITH AN OPERATING RADIUS HAVE BEEN ESTABLISHED AS FOLLOWS:

REF	AREA COORDINATES	RADIUS
OV–AOR	181500N0662000W	200 KM
OV–EAST	180700N0652500W	50 KM
OV–WEST	182923N0670737W	30 KM
OV-NORTH	200000N0660000W	100 KM

4. PART THREE – JCEOI MASTER NET LIST (MNL) SUBMISSIONS. THE JCEOI WILL BE GENERATED AT THE JEMSOC. COMPONENTS WILL SUBMIT THEIR MNL VIA ELECTRONIC MEANS OR MESSENGER TO THE JEMSOC. THE MNL WILL REFLECT CURRENT SERVICE DOCTRINE CONCERNING FORCE DEPLOYMENT, FREQUENCY SEPARATION, SHARING, AND REUSE CLASS AND ZONES. COMPONENT MNL WILL INCLUDE ALL SINGLE CHANNEL RADIO NETS, CALL SIGN, CALL WORD, COLOR WORD, CHALLENGE/PASSWORD, AND RUNNING CALL WORDS NEEDED TO SUPPORT THE UNIT. SERVICE COMPONENTS SHOULD DECONFLICT THEIR MNL WITH THE FUNCTIONAL COMPONENTS AS MANY NETS THAT A SERVICE USES BECOME JOINT NETS IN A JTF.

5. PART FOUR – JRFL SUBMISSIONS. UNITS CAN SUBMIT JRFL NOMINATIONS ALONG WITH SFAF AND MNL INPUTS. COMPONENTS WILL IDENTIFY NETS REQUIRING PROTECTION IN THE MNL ENTRY OR IN SFAF ITEM 985 FOR NON-JCEOI REQUIREMENTS. JRFL NOMINATIONS REQUIRE JUSTIFICATION. JRFL WILL BE SUBMITTED USING SPECTRUM XXI FORMAT AND SENT VIA SECURE EMAIL TO THE JEMSOC. INTERNATIONAL TABOO FREQUENCIES WILL BE INCORPORATED AT THE JEMSOC AND THE COMPONENTS NEED NOT SUBMIT THEM.

6. POC THIS ACTION IS THE JTF J-3 JEMSOC

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APPENDIX B TO ENCLOSURE F

GATHER REQUIREMENTS

1. Overview. Gathering requirements is a continual task across the competition continuum. Personnel performing this task require at least a SECRET security clearance and access to required classified networks. During FUPLANS, EMS assessments are conducted against TPFDD projections. This process can be refined and done with more specificity after promulgation of a DEPORD when more detail on forces is available. In mission execution and as forces are in place, requirements validation progresses to coordinating deconfliction and spectrum assignments for all deployed EMS-dependent systems. The process continues and requirements are refined through operations as new systems are acquired in support of urgent needs requirements or through the fielding or replacement of equipment. The JEMSOC must obtain the requirements of all EMS-dependent systems from all echelons and users. This coordination begins within the JFC staff by compiling all EMS-dependent systems, then extends to all components and other participants and their spectrum-dependent systems.

2. How Requirements are Gathered. Ideally, all JTF EMS requirements would be submitted to the JEMSOC through the components in SFAF via SPECTRUM XXI data exchange. This coordination may be directed through the example data call message. However, many service retained forces do not have access to SIPRNET to submit requirements via SPECTRUM XXI. Submission may occur IAW directed guidance from the CCMD or JTF through nonstandard channels, and some not even in electronic format. Some example requirement sources are phone calls, e-mails, messages, spreadsheets, bubble diagrams, and illustrations. Format guidance is obtained from the CCMD or outlined within the Data Call. Many joint enablers and other governmental entity assets are not directly tied to a component command and, in most circumstances, do not have organic spectrum managers. Thus, the JTF JEMSOC will perform respective engineering and radio assignments.

a. Receive-only spectrum-dependent systems only require identification to ensure protection. These systems are identified by the JFC staff sections using them, and this information is provided to the JEMSOC, which can create SFAF records for the receive-only systems and afford them protection by nominating their required frequencies and performing IA. While receive-only systems can be located anywhere in the JOA, documenting known operating locations by creating an SFAF record within the SPECTRUM XXI database is the best way to protect the receiver and the frequencies pertinent to its function. Making a single assignment record with an operating radius encompassing the JOA provides less interference protection than making multiple assignments using a smaller radius (less than 500 kilometer (km)).

b. SATCOM systems require an assignment within SPECTRUM XXI, although most single and multi-channel SATCOM systems receive authorization for use of the satellite through a separate process managed by the satellites' controlling authority. SATCOM users are issued a SAA that contains a disclaimer stating, "Local RF clearance is the responsibility of the user." The JEMSOC may not be aware these satellite systems are present in the JOA until the systems either cause or suffer interference. It is recommended that components include the JEMSOC on all satellite access request and authorizations as well as create and submit SFAF records for these authorizations even though day-to-day management of these systems occurs in a separate process. JEMSOC points of contact are in Appendix A to Enclosure G. Additionally, the JEMSOC may want to make separate specific RF assignment records for known single channel satellite systems located at the major HQ to aid in reducing and identifying interference.

c. Attending meetings, briefings, and participating on cross-functional working groups is another way of gathering information and having awareness of EMS issues and concerns. Spectrum managers are attuned to hearing and identifying potential EMS issues or new EMS requirements not readily obvious to others, even other J-6 personnel. Meetings concerning the planning of future operations, incoming units, or new systems being deployed into the JTF should all have JEMSOC representation.

d. Making the JEMSOC known and available to incoming units and organizations informs them about the existence of an entity overseeing their communications and spectrum management interests and requirements. A proactive approach is beneficial, not only regarding interference reduction, but in all EMS matters supporting operations and functions.

e. The JFC JFMO manages RF assignments across the AOR. These records will be included in the JEMSOC database, not as requirements but as assignments, which streamlines the effort of gathering requirements.

f. Navy forces (NAVFOR) EMS requirements may also be documented as an operational tasking for communications (OPTASKCOM). The Navy develops their OPTASKCOMs from approved SFAFs documented within SPECTRUM XXI. A combined task force (CTF) may not have a billet for a trained spectrum manager. As a result, the Navy communications officer or chief may be tasked to provide the NAVFOR EMS requirements. The numbered fleet is the lowest echelon at which the Navy has an assigned spectrum manager. Since the CTF will already be deployed and operating to arrive at its tasked operational location, it must have an operational RF plan. This document will list all communications links (frequency, emission, and type of use) operating in the CTF. There is also an OPTASKLINK providing the same information for Navy data links. Many of the JTF JCEOI nets will match some operational nets used by a CTF. The Navy maintains Navy-Marine Corps Spectrum Offices regionally around the world and is in place to assist the Fleet and any disadvantaged users with overall spectrum management processes, including producing OPTASKCOMs if required.

2. Documenting the Process (Tracking Action Items). Knowledge management and information flow become critical as proposals flow in. Incoming proposals require tracking to ensure all requirements are addressed. It is best to create a team-shared event log or some form of process workflow tracker. The event log should include every occurrence. Any event causing a change to JEMSOC tasking should be entered into the log (e.g., new tasks, modification of tasking, elimination of tasking). Meeting minutes, interference reports, reprioritization of existing tasks, and all incoming message traffic should be recorded in the event log. Some JEMSOCs create a separate log just for incoming and outgoing message traffic. Spectrum managers may choose to create a frequency proposal log to track incoming proposals and outgoing assignments. This type of log is best kept in an automated spreadsheet or database so it can be searched and sorted for case numbers, agency serial numbers, or other data, making it readily accessible when searching. The event log should be periodically reviewed to create an action item list. The action item list is used to prioritize tasks for the JEMSOC, track document arrival, processing, and task completion. The logs, along with the action item list, assist the spectrum manager in ensuring nothing is left unfinished.

3. Spectrum Manager to the JTF Staff. The JEMSOC becomes the spectrum management element for the JFC/JTF staff and gathers as much information in this role as required to identify EMS use in the JOA. JEMSOC personnel should establish contact with each JFC/JTF staff section and discuss, in working groups or more informal discussions, the importance of documenting all known EMS use, so those systems are available and protected in the mix of all competing spectrum requirements supporting JFC/JTF operations. Spectrum managers are required to document these requirements, make RF assignments, and manage collective use of the EMS across the joint force.

a. Many intelligence and weather information systems are receive-only. It is important to identify these systems and document the locations of the receivers to protect them from unintentional interference. The JEMSOC must create processes to track and deconflict systems exceeding the classification level of the SPECTRUM XXI database.

b. Spectrum managers must continuously remain engaged with all elements of the JFC/JTF staff. Remaining engaged within the JTF staff increases situational and operational awareness, and fosters identification of previously unidentified EMS resource requirements.

4. Reviewing the Requirements. Components' EMS requirements should be reviewed and validated by the component staff prior to submission to the JEMSOC. Validation includes an accurate (not inflated or embellished) reflection and justification of spectrum requirements, correct formatting, and completeness of requests.

a. Service components should also coordinate with functional components prior to submitting requests for EMS use to reduce or eliminate the possibility of duplicate requirements being identified to support radios nets used by both the Services and JFC-/JTF-directed nets. The JEMSOC will perform the validation for EMS requests from within the JFC/JTF staff and from organizations other than the components. The JEMSOC should review requests for anomalies, ambiguities, or errors that may adversely affect the request process.

b. The JEMSOC should be judicious in validating EMS requests and only assign frequencies required. Inflated requirements result from requesters overestimating (i.e., "padding") their actual spectrum needs for the sake of precluding potential interference by fending-off competing spectrum users. The JEMSOC and spectrum managers should work with requesters to ensure both parties understand the requirement and provide a quick response to a request for another frequency if interference is encountered. The JEMSOC and spectrum managers must be willing to work with requesters for shared understanding of EMS requirements and limitations.

APPENDIX C TO ENCLOSURE F

DEVELOP THE ELECTROMAGNETIC SPECTRUM
REQUIREMENTS SUMMARY

1. Spectrum Requirements Summary. The EMS Requirements Summary provides the JEMSOC spectrum manager with the information and data sources required to analyze the totality of the JFC's EMS requirements. The requirements summary quantifies necessary EMS access through analyzing mission requirements, determining the necessity of using frequency sharing and reuse plans, and helping develop allotment or channeling plans. The spectrum requirements summary is solely used by the spectrum manager and provides input into EMS automated systems and software for defining initial requirements and making future spectrum-use decisions. This product may assist the spectrum manager in requesting spectrum from a HN or provide insight into effectively allocating EMS to support emitters utilizing varying radio bandwidths, which are processes requiring compiling and analyzing previously generated data. The spectrum manager analyzes the summary to determine the EMS requirements to support the JFC.

a. The spectrum requirements summary also determines the number of different radio services competing for EMS resources within the same frequency band, different emissions utilizing a particular band, and supports development of a plan for frequency sharing. Historically, the summary was referred to as a "spectrum-use plan," a term used to describe many products generated by the JEMSOC (see the glossary definition of "spectrum-use plan").

b. To create this plan, the spectrum manager compiles the EMS requirements documented in the Gather Requirements activity and reformats this data using a spreadsheet and export options in SPECTRUM XXI. The spectrum manager can import the resulting file into a commercial spreadsheet application and then manipulate, sort, or record data to help gain a better understanding of the JTF EMS requirements. The information to compile the EMS requirements summary is found in the SFAF items required by the EMS requirements data call message.

2. How to Create the Spectrum Requirements Summary

a. Exporting the Requirements from SPECTRUM XXI. The Spectrum Requirements Summary is created using the "Spreadsheet Output" feature in SPECTRUM XXI, which enables the user to select specific SFAF items to include in a spreadsheet report that can be exported as a .txt file. The resulting file is opened using a spreadsheet application.

(1) Once the spectrum manager receives a preponderance of JTF spectrum requirements data, SPECTRUM XXI is used to query the requirements from the database. The spectrum manager then tags all records in the query results, selects the "Output" option, and then selects "Spreadsheet." When creating the spreadsheet, the following SFAF items should be included to provide the necessary information for properly evaluating the requirements: 005, 110, 113, 114, 115, 300, 301, 303, 306, 401, 403, 406, 467, 513, and 804. These SFAF items were identified as mandatory items in the data call message and should be present in all SFAF records. The spectrum manager should save the requirements summary as a template in the SPECTRUM XXI spreadsheet menu.

(2) While not specifically a requirements summary issue, a standardized file-naming convention should be used to preclude losing or misplacing files. Provide guidance to everyone within the JEMSOC on how files are to be named and where they are to be stored.

b. Sorting the Requirements (Spreadsheet Application). Once the summary file is exported from SPECTRUM XXI and opened in a commercial spreadsheet application, the JEMSOC spectrum manager re-sorts the spreadsheet by frequency and divides the requirements by frequency band: 200-500 kilohertz (kHz), 2000-29999 kHz, 30-88 MHz, 88-136 MHz, 136-225 MHz, 225-400 MHz, 400-1000 MHz, 1-3 gigahertz (GHz), 3-6 GHz, 6-10 GHz, and 10-20 GHz. After reviewing the number of requirements in each frequency band, the spectrum manager may choose to further subdivide these bands based upon the number of proposals, radio services, or emissions. In the process of dividing these requirements, the spectrum manager should recognize many of the potential conflicts, issues, and concerns that must be considered in the analysis.

3. Analyzing the Requirements. Once the requirements are sorted by frequency band, the JEMSOC spectrum manager can analyze the data and determine the amount of spectrum needed to support each band. There is no automated method for this process. Geographical separation between users must be considered, along with the number of frequencies requested, radio services used, and density of users in a given area. Each of these considerations help the spectrum manager formulate an educated guess as to the number of needed frequencies to support requirements. Records from past exercises, personal experience, and unit institutional knowledge are information sources to assist in determining the spectrum requirement.

a. In the requirements analysis, the spectrum manager must consider HN restrictions and band sharing plans. When requesting a spectrum resource from a HN authority, the spectrum manager may find restrictions imposed on the requested frequency bands. Less industrialized nations may grant a JTF spectrum manager more latitude regarding spectrum use. However, these nations are more likely to have undocumented spectrum-dependent systems operating, potentially causing harmful interference.

b. Additionally, the concern over frequency sharing plans have become less important as most industrialized countries have defined spectrum-use plans addressing possible sharing. An example of frequency bands being shared by different radio services is found within the North Atlantic Treaty Organization (NATO), which shares the single-channel satellite allocation with the fixed and mobile service provided to radio relay systems. Since radio relay systems are terrestrial based, leverage very directional antennas, and are usually easily identified, they can share the same frequencies as the space based, skyward directed antennas used by single-channel satellites. This sharing periodically results in interference but is easily resolved through a basic site survey and local interference investigation.

c. The spectrum manager should document the results once spectrum requirements are analyzed, then determine the quantity of spectrum needed, the possible need of sharing plans, recommendations for sharing plans, and systems requiring operational deconfliction. By documenting these findings, the spectrum manager creates a decision baseline for follow-on spectrum managers to use in understanding why and how the spectrum is being allocated and assigned. As with the spectrum management concept, this document becomes important for future decisions and provides the JEMSOC spectrum manager a form of institutional knowledge management. File names should begin with the highest classification of data within the document.

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APPENDIX D TO ENCLOSURE F

OBTAIN EMS RESOURCES

1. Overview. This activity addresses the fundamental processes of planning, requesting, and obtaining spectrum resources to support operations within the JTF's JOA. EMS requirements generated in previous activities can help in determining EMS requirements needed to support the JTF mission. The EMS requirements summary quantifies EMS requirements and identifies the different radio services and emissions operating within each frequency band. Once spectrum requirements are defined, spectrum management must decide how to acquire the spectrum necessary for meeting these requirements. This appendix outlines the processes of requesting spectrum resources, determining spectrum resources, and managing acquired spectrum resources. This section discusses HN considerations, spectrum supportability determinations, and dynamic spectrum access considerations. Additional coalition, allied, and other governmental entity issues are discussed in Appendix L to this enclosure.

2. Obtaining Spectrum Resources

a. The EMS is considered a national resource for all HNs. To obtain EMS resources, the spectrum manager has two options:

(1) Request support from the appropriate HN during competition below armed conflict.

(2) Determine an EMS resource based on the defined EMOE during armed conflict.

b. The method will be situation-dependent (i.e., IAW command and staff processes and procedures) and where the operation lies along the competition continuum in that situation. For operations other than joint forcible entry operations (below armed conflict), the situation may allow for direct coordination with the HN for EMS resource. Portions of joint forcible entry operations involve armed conflict and would call for the second option. The second option requires more time and effort unilaterally on the spectrum manager's part (i.e., without direct HN permission and assistance for spectrum resources) to characterize the EMOE and determine spectrum availability.

3. Requesting EMS Resources. HN coordination is enabled through security cooperation and other related agreements. To request EMS support, the spectrum manager should use HN coordination channels established by the CCDR and the U.S. Mission. Most CCMDs will have published guidance on HN

coordination for spectrum management nested within CCMD J-5 guidance, regional partner agreements, and HN agreements. Initial contact should be made in coordination with the CCMD, as they have the resources (e.g., translators, POC information). When HN agreements are established or renegotiated, consideration should be made to establish complementary HN and DoD Table of Allocations beyond the competition continuum to meet the demands of crisis and conflict. The complementary table of allocations would align with OPLANS for emergent crisis and conflict operations. An example of policy in support of this concept with Humanitarian Assistance/Disaster Relief operations exists with Resolution 647, World Radio Conference-19, Emergency and disaster relief radiocommunication. All correspondence, both written and verbal, should be formal. HN coordination may differ from country to country. In some cases, the JTF may be delegated HN coordination responsibility by the US Mission, through the CCDR, to the JFC. In other countries, the CCMD will submit requests through the Security Cooperation Organization (SCO) located with the U.S. Mission. The SCO may be known by different titles that vary depending on the location, scope of work, and operational agreement signed with the HN. Prior to meeting with HN representatives, the spectrum manager should review the JTF EMS request for information that may not be released to the HN. Coordination with the JTF J-2 for foreign disclosure guidance is imperative. Classified equipment characteristics, exercise/operation objectives, the involvement of certain types of forces, and how some systems are employed are examples of unreleasable information.

a. What to Provide to the HN. The spectrum manager should coordinate details of all the information the host nation requires to obtain an approval. Details should include forms to be used; method to coordinate; POC information, including names, phone numbers and e-mail; expected lead time; and anticipated length of time to receive a response. Some HNs may prefer to use nominated candidate RF for evaluation. If the HN asks for proposed RF, it is highly recommended at least a two-to-one ratio for each requirement. Alternate RF should be requested as feasible. For additional information, see Annex A to Appendix D to Enclosure F on spectrum supportability determinations.

(1) The spectrum manager should expect to be asked to provide follow-up information explaining how certain systems operate and why the number of RF resources are requested. Questions from the HN should be treated with importance and answered promptly within the confines of security classification releasability. There will be questions regarding how the spectrum manager's RF assignment system handles specific situations. Language barriers should be considered whenever there is an information exchange; clarifying questions and answers are a part of good coordination.

(2) The JFMO/JEMSOC must develop a system to track pending RF awaiting final approval from the respective administration. There are several methods to use. One method is to create RF assignment records for the delegated allotment plan, identifiable by a unique SFAF entry, and load them into the assignment database. These records would be temporarily assigned and not data exchanged. Another method is to create a separate job account and place all pending assignments on-hold within this account. When querying these records or performing an IA including one of these records, the result will include the allotment plan records. If performing an IA, notification will be made that a RF provided as a RF resource to subordinate elements is a possible source of interference. At this point, the spectrum manager should research and determine if the units provided with that spectrum resource were performing data exchanges as required and are the cause of the interference. Ideally, there will be two records; one from the allotment plan and one indicating an actual temporary assignment made by the subordinate unit.

b. What to Expect Back From the HN

(1) HN responses to request for spectrum vary from country to country and depend upon the HN's internal priorities and political views. Responses will most likely be written and formal. The disadvantage to this method is trying to manually enter information into the allotment plans. Some nations are slow to respond. For example, in cases of humanitarian assistance, circumstances may require the spectrum manager to make noninterference basis (NIB) RF assignments to support the operations before receiving authorization to transmit. Less-developed countries are often least responsive and not accustomed to providing rapid responses to RF requests.

(2) DoD does not pay for RF assignment access and use with a HN. DoD provides bilateral security cooperation assistance and, as such, are guests of the HN. DoD has published mandates dating back through 1998 (and updated in 2020) prohibiting the practice of DoD paying for RF assignments. The SCO, as the primary interface with the HN on all security assistance functions, shall handle issues related to spectrum fees. All received invoices are submitted to the Joint Staff through the CCMD. This issue is distinct and separate from leasing commercial satellite services or Mobile Satellite Services (MSS) through DISA. Contact the respective CCMD JFMO for additional details on this topic.

4. Seizing Spectrum Resources

a. Joint forceable entry operations, any operation that is not conducted with the expressed approval of the HN, or operations conducted in countries without a functional government require the JTF manager to determine the available spectrum resource. CCDRs leverage their COCOM within bounds of international law to enable this activity. Determining the spectrum resource without the aid of the HN requires much more research and analysis than just requesting it from a HN. Begin by considering how the HN uses the EMS in the frequency bands needed by the JTF. A copy of the HN spectrum allocation table would be ideal, but may not be available, leaving JTF managers with only the appropriate ITU region allocation tables. The JTF JEMSOC will collaborate across the community of interest to characterize the EMOE. This includes J-2 contributions with information to assist in protecting collections and their JIPOE contribution to adversary order of battle and EOB. Collaboration and deconfliction must also occur with SOF in joint forceable entry operations.

b. The SPECTRUM XXI spectrum occupancy plot capability can identify where, within the EMS, the spectrum manager has areas to nominate. The spectrum occupancy plot provides the spectrum manager with a visual representation of spectrum use at a given location based upon the information in the assignment database. This plot is only as accurate as the information contained in the assignment database. Additionally, the plot does not consider area assignments, as they are not definable by location.

c. Once the spectrum manager determines what spectrum is available, a comparison of what is available can be made against the specific requirement. The spectrum manager should realize coordination is almost always required with neighboring countries and should devise and present a plan for efficiently using the spectrum resource.

d. Interference reporting is critical in a joint forceable entry operation, as the interference may be from indigenous spectrum-dependent systems the JEMSOC is not aware of and may be susceptible to interference as well. Unintentional disruption of indigenous systems may create danger-to-life situations.

e. Determining the spectrum resource should be performed at the JTF JEMSOC spectrum management division under close coordination with the JFMO. Any resources obtained using this method should be placed in allotment plans and utilized or provided to subordinate units in an allotment plan format. This process controls the parameters used in determining the spectrum resource and reduces the probability of error. The JTF assignment authority is the JTF commander and, since the JEMSOC acts as the designated representative for that function, all frequency resources should be managed and validated by the JEMSOC.

f. The idea of using known enemy frequencies as a resource can be considered, because it may be a resource that the enemy would be reluctant to jam for fear of causing interference to their own operations. While enemy operations may cause interference to the JTF operations, they will also be accepting the same. Such use of enemy spectrum must be coordinated with the JEMSOC.

g. See Appendix L to this enclosure for additional information on intergovernmental cooperation and joint stabilization activities.

5. Managing Spectrum Resources (Allotment Plans and Internal Assignments). Documenting and tracking the available frequency resource is an ongoing task. Regardless of how the spectrum manager obtains frequency resources, a record of what is authorized must be maintained. This record is kept by identifying the resource in allotment plans. However, allotment plans are not the only method to keep records of allocations. SPECTRUM XXI enables the spectrum manager to access a resource for use in the nomination process and by the frequency scheduler.

a. Centralized spectrum management is where the JEMSOC does not delegate assignment authority and makes all RF assignments. Using this method of spectrum management, tracking the spectrum resource is easier as a single user of the resource. However, SPECTRUM XXI does not have a method for querying the allotment plans. The only way to locate a particular frequency is through manual searching of each allotment plan.

b. Decentralized spectrum management is performed by delegating RF assignment authority to subordinate unit spectrum managers under specific conditions. One of these conditions is that a data exchange must be performed prior to making any RF assignments. Another condition is that a data exchange be performed upon making a RF assignment, or group of assignments. In this event, the spectrum manager should contact other spectrum managers and let them know that the JTF is making a large number of assignments, and they should refrain from making assignments in a specific band until a data exchange is performed. The units delegated assignment authority must also be given a frequency source from which to make assignments.

c. Allocation (of a frequency band) is an entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. An allotment (of an RF or RF the JEMSOC establishes, updates, and manages the EMOE data repositor channel) is an entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions. In the DoD's terms, an allotment plan is a list of approved radio bands or sub-bands that are pre-coordinated and pre-approved by the HN solely to support U.S. operations in the HN. An allocation table is a list of all possible bands in the manageable EMS, divided to support U.S. and HN radio services. Pre-approved allotment plans and frequencies enable delegation of frequency nomination, management, and assignment authority to the JTF JEMSOC without the need to independently coordinate frequency resources for approval with the HN. Allocation tables identify bands that may support specific equipment and modes of use. The CCMD JFMO normally coordinates frequency resources with the HN and delegates management of those resources to the JTF JEMSOC. See Annex B to Appendix D to this enclosure for additional discussion on allotment plans. For example, a strategic approach to working with the HN may enable cognitive radio systems (CRS) (see Annex C to Appendix D to Enclosure F for additional information on CRS). Therefore, independent frequencies are coordinated for approval with these HNs. The ease or difficultly in the establishment of an allotment plan or allocation table depends on the HN.

6. How to Allocate the Resource. All RF resources must be identified, requested, and coordinated through the respective administration. This may include HN coordination for approval. RF is approved by a respective administration based on operating location and operating conditions. Respectively, all authorized RF must be registered in SPECTRUM XXI database. The JEMSOC and EMS managers would have visibility on all authorized assignments. If an approved allotment plan exists with a respective administration, the CCMD would determine the best way to optimize the use of such plans to ensure RF resources are available and sufficient to satisfy all RF requirements.

7. Single Channel Ground and Airborne Radio System Hopset Generation. Single channel ground and airborne radio system (SINCGARS) is a VHF frequency modulation (FM) radio that can be operated in a single channel or a frequency-hopping (FH) mode (100 hops per second). The FH mode is dependent on the electronic fill information provided by JACS-generated load sets. Electronic fill information, coupled with time, determines SINCGARS FH parameters. The JACS workstation supports the generation of SINCGARS hopsets to be used in the SINCGARS radio. A SINCGARS hopset is a set of frequencies available for FH operations. The maximum number of frequencies SINCGARS can hop between is 2,320 (30.000 to 87.975 MHz, with 25 kHz

separation). Hopsets are electronically loaded into the radio with a data transfer device (AN/CYZ-10 fill device) using the Common Tier 3 (CT3) application software. SINCGARS can store a different hopset in each one of the six FH channels.

a. Normally, the size of a hopset depends on the frequencies available in a geographical region. The larger the number of frequencies and the wider the distribution across the SINCGARS frequency range (30.000 to 87.975 MHz), the better SINCGARS performs when frequency hopping. The minimum size for an effective hopset is situation dependent. Hopset performance is a function of many factors, including interference from friendly emitters, other EMI, and enemy EA. Typically, hopsets of 700 or more frequencies, spread across the SINCGARS frequency range, will adequately support both voice and data FH operations. As the hopset size decreases, FH performance rapidly degrades, and data over FH nets may receive too many errors to be successfully communicated. Spectrum managers need to understand the importance of maintaining an adequate number of frequencies and "why" and "how" lockouts are created, and must be able to request a spectrum resource that better accommodates SINCGARS hopset creation.

b. The hopset frequencies are usually used as part of the frequency resource to generate the JCEOI cue and manual frequencies. If the hopset is not created first, it is required to have a separate frequency resource in the 30–88 MHz band for the JCEOI cue and manual RF assignments.

c. To create the SINCGARS hopset, JACS and the SINCGARS assume the radio has access to the entire frequency range between 30–87.975 MHz and all 25 kHz tunable frequencies to hop on. To reduce this frequency range to a narrower authorized range, JACS must create lockouts to prohibit the use of certain channels. These procedures may be required to deconflict with EW operations. Lockouts are computer language lists that identify frequencies out of the 2,320 in the radio that are not selected or are not available for FH. If a hopset is overly complex, the memory required to process the FH data may exceed the radio's basic channel memory capacity. The SINCGARS radio has additional memory storage space available in the form of lockout sets. Lockout sets come in two types, common and assignable, and are used to define frequency restriction imposed on one or all the hopsets in the radio. SINCGARS can store up to eight lockout sets.

d. A hopset must be created to support SINCGARS frequency hopping nets. This task involves requesting, receiving, and processing the available frequency resource provided for SINCGARS hopping. When requesting frequency resources for tactical radios, spectrum managers must identify a need for a frequency hopping resource as well as a frequency resource for the MNL cue and manual requirement. While both requirements are met in most circumstances by the frequency hopping resource, there are many possible reasons why the cue and manual requirement may require sourcing separately from the frequency hopping resource.

e. When delegated, the JTF JEMSOC creates the frequency hopping compatible loadset for the JTF. The hopset and loadset are distributed, on order, along with the JCEOI and required communications security (COMSEC) resource through the appropriate COMSEC controlling authority. Frequency resources need to be considered prior to making any assignments. A plan of how to best utilize the available EMS resource cannot be created after making the preponderance of RF assignments in a band. It is imperative that SINCGARS frequency allocations be considered in the early planning stages and equally imperative that dedicated SINCGARS resources be maintained in the JACS resource manager.

f. For additional information on the creation of a hopset and the management of hopset lockouts, see reference (cc).

ANNEX A TO APPENDIX D TO ENCLOSURE F

SPECTRUM SUPPORTABILITY DETERMINATION

1. Spectrum Supportability Determination. A Spectrum Supportability Determination (SSD) is required when any emitter intended for operation within the AOR does not have an approved J/F 12 number obtained through the spectrum supportability risk assessment (SSRA) process.

2. Acquisition Responsibility. Materiel developer program managers are responsible for ensuring compliance of their programs with U.S. and HN EMS regulations (see references (dd) and (ee)). New spectrum-dependent capabilities may not be procured without an SSD from the CCMD IAW DoD guidelines. An Application for Equipment Frequency Allocation (DD Form 1494) must be initiated by the DoD program manager in coordination with the respective military department spectrum management office. J/F 12 numbers are issued by the MC4EB upon final approval of a DD 1494.

3. Actions. The SSD supports the formal SSRA process. The SSRA determines and documents emitter parametric data and emitter supportability for use by the DoD within the US&P and abroad. The SSRA documents are an assessment of EMS supportability, risks imposed by E3, and risk mitigation. The materiel developer coordinates the SSRA with the CCMDs and submits it to the respective military department spectrum management office. Final coordination remarks are forwarded with recommendations to the service CIO for approval.

a. The CCMD or JTF supports the formal SSRA process by processing an SSD. The following are the two most common scenarios requiring the CCMD/JTF to initiate or process an SSD.

(1) An SSD is created in support of a routine SSRA coordination action initiated by the acquisition authority. The action is initiated and then routed from the Service Spectrum Management Offices to the CCMD through end-to end supportability system (E2ESS) via HNSWDO for HN supportability comments and, subsequently if required, for RF assignment through the HN coordination process.

(2) The CCMD or JTF becomes aware of the procurement or employment of a system that not previously coordinated through the SSRA process. This tends to occur with rapid procurement activities, experimental systems, or new uncleared systems procured by commands within the JOA.

b. The immediacy of an SSD in support of urgent operational needs requires rapidly evaluating interoperability and risk to currently employed systems within the AOR/JOA. The SSD assists the abridged formal acquisition process and ensures required action into the formal SSRA accreditation process.

(1) The SSD is not an endorsement or recommendation to procure or to bypass the formal acquisition process, legal review, or obligation of funds. Additionally, an SSD does not constitute an approval to deploy nor an approval authority to operate. Rather, the SSD is an assessment intended to inform commanders and program managers of risk and system compatibility within the AOR/JOA.

(2) Prior to the obligation of funds, an SSD should be completed to predetermine the system is supportable within its intended area of employment. An SSD from a single CCMD is not a blanket assessment applying to different geographic areas in other CCMDs—thus, SSDs must be completed individually by each CCMD.

c. SSD processing actions include, but are not limited to,:

(1) Determine and validate number of systems and locations for intended deployment.

(2) Determine and validate emitter parametric data.

(3) Validate security classification of emitter(s) data and discern releasability for HN coordination. See Appendix A to Enclosure F for additional information.

(4) Obtain and review concept of operations for system.

(5) Coordinate with Service or Component for formal SSRA coordination input.

(6) Perform IA and, if required, supplementary engineering analysis of system(s) against currently employed emitters within the intended AO.

(7) Perform an analysis of emitter operating requirements with ITU, regional, and HN allocation tables and allotment plans.

(8) Coordinate with HN for comment on supportability and any restrictions on employment within the country.

(9) Document risks of employment.

(10) Document terms and limitations of system employment.

(11) Capture findings within HNSWDO.

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ANNEX B TO APPENDIX D TO ENCLOSURE F

ALLOTMENT PLAN

1. An allotment plan identifies small bands or groups of frequencies within a spectrum use plan for use by a specific organization or for a particular function. An allotment plan enables the JFC to maintain overall control of spectrum use in the AOR while decentralizing authority to a lower level.

2. Allotment plans are normally developed for, but not limited to, the HF (2–30 MHz), VHF (30–88 MHz and 118–174 MHz), and UHF (225–400 MHz) bands. The frequency allotments in each of these band-specific plans is based on the ratio of air, land, and sea forces for a particular operation or mission, and an assessment of their spectrum requirements. Planners should consider spectrum-use restrictions when developing an allotment plan.

3. Planners obtain the spectrum use requirements on which the allotment plan is based from J-2, J-3, and J-6 staff elements and components; the JCEOI net list; and any UN, allied, or coalition forces. The allotment plan developer must consider joint and/or multinational force equipment capabilities, HN allocations and restrictions, RF requirements for wide area assignments, jam-resistant equipment, NAVAIDS, wide-band versus narrow-band, SATCOM, wartime reserve modes, and equipment that requires specified frequencies such as unmanned aircraft systems/UAV, and Airborne Warning and Control Systems (AWACS).

4. JFMO/JEMSOC planners must evaluate all requirements in the allotment plan for electromagnetic compatibility and eliminate potential conflicts. If the JFMO/JEMSOC cannot meet all RF requirements due to physics limitations or lack of approvals by an administration, the JFMO/JEMSOC must attempt to resolve conflicts based on operational priorities within a given set of EMS resources. Conflicts unresolvable at the JEMSOC level will be referred to the J-3 for adjudication and resolution.

5. The below items serve as a guide for creating an allotment plan.

a. Is there an existing channeling plan for the frequency band?

(1) Yes. Begin development of allotment plan at paragraph (4).

(2) No. Begin development of allotment plan at paragraph (2).

b. Divide band into individual channels (uniform bandwidths or mixed).

c. Begin with all channels in the band as candidates.

d. Block known denied RF assignments, including:

(1) Allocated for other or special use, e.g., NAVAIDS (instrument landing system glide slope).

(2) U.S. permanent RF assignments in the AOR.

(3) ITU international RF listings within the AOR and those in interference range distance of the AOR.

(4) HN and/or neutral nation frequency use.

(5) U.S., UN, and coalition forces' specific frequency requirements.

(a) Satellite frequencies.

(b) Fixed-frequency equipment.

(c) Special frequency complements (e.g., spread-spectrum, wideband network, hopsets).

(d) Frequencies for JTF HQs and/or JCS-controlled assets.

(e) Other frequencies as required.

e. Identify U.S. and coalition forces' spectrum-use requirements. These requirements should be presented in numbers of nets, circuits, etc., for translation into the number of frequencies required.

f. Analyze requirements for minimum and maximum separation distances, channel sizes, and bandwidth requirements.

g. Determine coalition and component force spectrum requirements as percentages of total force spectrum requirements.

h. Prioritize links and systems to be supported in the event of insufficient spectrum resources.

i. Allot remaining available channels to participating forces based on their respective percentages of total requirements.

j. An allotment plan should be conveyed to users in a simple format containing a listing of the frequencies derived from the process described above. It should also contain introductory information specifying all restrictions applying to the allotted frequencies (e.g., transmitter power, authorized emission and bandwidth, geographical location, maximum transmitter altitude, function).

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ANNEX C TO APPENDIX D TO ENCLOSURE F

DYNAMIC SPECTRUM ACCESS

1. Dynamic spectrum access (DSA) refers to the presence of systems having CRS capabilities. CRS capabilities provide systems the ability to operate on temporarily unused or unoccupied portions of the EMS and can flexibly adapt to, or cease use of, those portions of the EMS in response to other users of the radio band.

2. CRS capabilities generally consist of those discussed in the following paragraphs.

a. The capability to obtain and factor-in the knowledge of its radios' operational and geographical environment, its internal state, established software administration policies, and the ability to monitor usage patterns and users' preferences. This could be accomplished by EMS sensing, using a database, and/or a CRS's ability to accept and function with control and management information. As discussed in this annex, sensing refers to the capability for the CRS to detect other signals within its reception range to determine temporary unused/unoccupied EMS.

b. The capability to adjust its operational parameters and protocols dynamically and autonomously according to the defined software ruleset to achieve predefined objectives (e.g., more efficient utilization of spectrum).

c. The capability to dynamically learn from the results of its previous actions to adjust subsequent performance.

3. The deployment of CRSs is relatively new, so formal regulatory and employment guidance are still evolving as of the date of this publication.

4. <u>Some CRSs Leverage Software Defined Radios</u>. A software defined radio (SDR) employs technology allowing the RF operating parameters of its transmitter and/or receiver to be set or altered by the SDR's software. The software-controlled parameters include, but are not limited to, frequency range, modulation type, and output power. SDR-controlled parameters exclude those that are preinstalled or predetermined as part of the radio's baseline system specifications or standards.

5. CRS capabilities may offer improved efficiency and additional flexibility to EMS use. A CRS is not a radiocommunication service but rather a system that

employs technology that can be implemented in a wide range of applications across the land mobile radiocommunication service. It should also be noted that any system within a radiocommunication service employing CRS technology will operate IAW the provisions governing use of the frequency band in which it operates. Reference (b) discusses the various classes of radiocommunication services.

6. The amount of spectrum available for CRSs depends on factors such as the level of radio assignment priority (e.g., NTIA Manual 12.16, JRFL) and protection (e.g., Article 5, Section II ITU RR) given to the emitters' services and related applications, as well as the CRSs' technical and operational characteristics. Spectrum availability can depend on systems' operating locations and can vary over time. For example, spectrum availability is significantly reduced for higher-powered CRSs, particularly in populated areas, due to a higher level of spectral competition and EMI potential.

7. Considerations for the Implementation of CRS

a. Although CRS are engineered to transmit on non-utilized EMS white space, a CRS may cause unintended harmful interference to various radiocommunication services if programmed incorrectly. Thus, JSIR procedures apply to CRS.

b. HNs may restrict the use of CRSs. During competition, a HN might restrict a CRS even if it will not interfere with the primary or secondary radiocommunication service. Conversely, they may also enable its use. From both a JFC and an HN authorities and permissions perspective, CRS employment may become more permissive as operations transition into conflict.

c. The RF assignment authority must develop an approach for the use and management of CRSs. This approach may be as simple as building a channel plan nested into an allocation table or allotment plan to support deconfliction with critical radio services and to make informed RF assignments that avoid interference. Several considerations apply when employing this approach, as discussed in the following paragraphs.

(1) Great consideration must be made to identify and protect critical passive military systems.

(2) RF assignment authorities must deconflict dynamic spectrum access devices with bands allocated to safety-of-life radiocommunications,

radionavigation, and aeronautical mobile and aeronautical mobile-satellite services. Device assignments conflicting with frequency allocations for safety-of-life applications would impose risk to the safe and efficient use of aviation and maritime services that might not be easily corrected after the devices are in operational use. Protecting aeronautical radiocommunication services is critical to aviation safety, and even minimal interference can pose an operational hazard. Several aeronautical navigational aids only transmit information for reception by the passive receivers of that navigational system. Most of these receivers are on aircraft and are therefore highly mobile, at widely ranging altitudes, and potentially long lines-of-sight.

(3) Using a database with locational data for bands allocated to MSS and radiodetermination-satellite service (RDSS) downlinks is also impractical due to the mobile nature of MSS and RDSS receivers. Sensing is unlikely to be a solution due the difficulty of detecting transmissions from the satellite. Moreover, in bands allocated for signals oriented in the Earth-to-space direction, the permissible interference to ensure the protection of MSS or RDSS links are both the single-entry and aggregate interference produced by all such devices seen by the satellite receiver. Moreover, satellite systems cover wide geographic areas where sensing receivers may not be located. Therefore, such a system would lead to a permanent unavailability of any application employing DSA in the satellite downlink bands. An illustrative example of this issue is a radionavigation-satellite service (RNSS) providing global coverage and a device employing dynamic spectrum access equipped with a sensor that can detect the RNSS signal. The sensing device would conclude the RNSS signals can be received globally, which would give indications the signal is not in local proximity of the CRS, and the CRS could shift frequencies and potentially interfere with the RNSS.

(4) Allowing emissions in bands allocated to the Earth exploration-satellite service (passive), space research service (passive), and radioastronomy service where provision No. 5.340 of the RR applies, would violate this provision. Moreover, because No. 5.340 prohibits all emissions in the aforementioned bands, special considerations apply to unwanted emissions from operations in other bands if they might affect use of the bands that are restricted by the provision. Passive service use that cannot be detected by spectrum sensing because no signal characteristic of the use is present: In such cases, only geolocation seems a possible means of preventing unwarranted dynamic access to spectrum. Use of geolocation must also be extended to recognize radio quiet and coordination zones protecting passive service operations on a regional or national level, including spectrum bands where passive services are not allocated but are locally protected.

(5) Regarding bands allocated to the Earth exploration-satellite service (EESS) (active), sensing of EESS (active) by systems with DSA features may occur too late for the DSA system to cease emissions and avoid interference to the EESS (active) sensor. Consequently, the database approach for employing CRSs is technically feasible but has potential pitfalls in practice.

(6) Certain space radiocommunication applications having time, safety or mission-critical links are only detectable by highly sensitive equipment or do not have continuous transmission. For example, communications between space research service (deep space) spacecraft and ultra-sensitive Earth receivers with very large antennas (greater than 34 meters in diameter), would be undetectable to sensors of a DSA-based application network. Therefore, such low probability of detection signals can cause sensors on DSA systems to mistakenly identify those portions of the spectrum as temporarily unused/ unoccupied, which can lead to interference on the links and potential loss of critical mission support and reception of science data.

(7) During the critical launch and ascent phases of spacecraft missions, communication links must be available and uninterrupted to ensure the safety and protection of the crew, spacecraft, and the mission.

(a) Sensing strategies to deconflict CRS and space launch/ascent.

(b) Combination with geo-database.

(c) Spectrum sharing mechanisms among different DSA systems.

(8) In the Earth-to-space direction, fixed satellite service (FSS) transmitting earth stations are blanket-licensed and ubiquitously deployed in some frequency bands, hence there is no central database in which the location of these stations is recorded, so compiling an allocation table/ allotment plan/database is not possible. Moreover, sensing will not help a DSA device determine if it can transmit because, in bands allocated in the Earth-to-space direction, the permissible interference to ensure the protection of FSS links and broadcasting satellite service (BSS) feeder links from such devices would be specified both as single-entry and aggregate interference. Since there would be no way to control the aggregate number of DSA devices seen by the satellite receiver, there would be no way to control the aggregate interference level. Consequently, use of the sensing technology also seems impractical in FSS uplink bands (including FSS bands used for BSS feeder uplinks).

(9) In the space-to-Earth direction, again the ubiquitous nature of FSS and BSS in some frequency bands precludes the practical implementation of solutions based on databases. The low power of satellite transmissions also makes sensing an unlikely solution due to a requirement to detect low power transmissions from the satellite. Even if employed, sensing systems would be of little value because many satellites cover wide geographic areas, many devoid of receivers. Therefore, even if a satellite transmission could be detected by a DSA emitter it would provide no real information as to the possibility of interfering with a satellite receiver.

(10) For bands allocated to a broadcasting service, spectrum sensing of broadcast station signals may be challenging due to the so-called “hidden node” problem and non-continuous operation of some local broadcast stations. The hidden node problem arises when the receiver of the service to be protected (i.e., the intended receiver) is better able to receive the licensed transmissions than a DSA emitter located in a different position, where reception is affected by factors particular to the different spatial location (e.g., low height/altitude, shielding by buildings or other terrestrial features, terrain masking). Sensing thresholds accounting for a wide range of potential digital terrestrial TV (DTT) receiver configurations are very challenging to implement under the current state of technology. In some scenarios, even low detection threshold values do not guarantee a reliable detection of the broadcasting signals at a distance corresponding to the interference potential of a DSA emitter. This leads to concluding the sensing technique investigated, if employed by a stand-alone DSA emitter (autonomous operation), is probably not reliable enough to guarantee protection of DTT reception.

(11) Use of a geolocation database for DSA systems to avoid possible interference to DTT receivers is normally more reliable than near-real-time sensing, but consideration must be given to how a geo-location-based solution would be implemented along with its implications to DTT planning. First, this technique would require a database of DTT service areas that a national administration determines will be protected for reception at any location. This could be based on the franchised area for commercial broadcasters or the predicted service area in other cases. Second, the determination would have to ensure extensive deployment of DSA emitters would not restrict access to DTT services. Third, an organization would have to be assigned responsibility for setting up and maintaining the geo-location database. The locational database approach will need to be operated, managed, data verified, and maintained.

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APPENDIX E TO ENCLOSURE F

DEVELOP THE SPECTRUM MANAGEMENT PLAN

1. Spectrum Management in Plans and Orders. The JFC/JTF JEMSOC will promulgate guidance for managing, requesting, coordinating, and assigning EMS use, the JRFL process, the JCEOI process, and other processes. The JEMSOC is the focal point for inclusion of EMS-use instructions and overall spectrum management, and these instructions become directive as part of the JEMSO appendix in the plan or order. As operational transition from planning to execution, subsequent spectrum management guidance and direction is included in the JEMSO appendix to the OPORD (EMS Management Tab), in EMSCMs, and in FRAGORDs. Spectrum management guidance in these directive documents is derived from the spectrum management concept (discussed in Appendix A to this enclosure) and the spectrum management plan discussed in this appendix. Inclusion of spectrum management content in JEMSO plans and orders requires close integration of the JFMO and spectrum managers in all JEMSOC planning and execution activities. Of note, a preponderance of planning processes and access to the information underpinning the processes requires that planners, including spectrum managers, possess at least a TOP SECRET security clearance and have access to required classified networks. The annex, appendix, tab, and exhibit hierarchical structure for JEMSO and EMS management in plans and orders is depicted in Figure 26 and is discussed in reference (j).

- *ANNEX C – OPERATIONS*
  - *Appendix 23 – Joint Electromagnetic Spectrum Operations*
    - *Tab A – Electromagnetic Spectrum Management*
      - *Exhibit 1 – Electromagnetic Interference Reporting*
      - *Exhibit 2 – JTF Joint Communications-Electronics Operating Instructions and Compromise Procedures*

Figure 26. Hierarchy of JEMSO/EMS Management Sections in Plans/Orders

2. Spectrum Management Plan. The spectrum management plan essentially becomes the EMS management tab (Tab A and supporting Exhibits), to Appendix 23 (JEMSO), to Annex C (Operations) in plans and orders. The spectrum management plan provides policy guidance and direction to the JFC/JTF Service and functional components, staff elements, supporting CCMDs, and adjacent JTFs. Guidance will evolve and change as operations transition from planning to execution. The spectrum management plan provides guidance for all JFC/JTF spectrum management functions, including

information exchange, expected coordination channels, format for deliverable products, interference and reporting resolution procedures, and suggested resolution steps.

3. Spectrum Management Plan Content. The following paragraphs describe content for inclusion in the spectrum management plan. Most or all this content is also included in the spectrum management tab to the JEMSO appendix of plans and orders, tailored specifically to the operation for which the plan or order is written.

a. References. The spectrum management plan should identify documented references, including messages, OPLANS, CONPLANs, directives, manuals, instructions, and joint doctrine. At a minimum, these references should include the CCMD policy and directives concerning spectrum management, the JTF spectrum requirements data call message, directives to initiate planning for the JTF, and CJCS 3320 series of instructions and manuals.

b. Concept of EMS Management. The concept of support should be clear and concise. It describes how spectrum management will support the commander's concept of operations. The purpose statement should focus on the main spectrum management tasks and their importance to the JFC's mission.

c. Responsibilities. Lists responsibilities of elements within and external to the JFC staff. It articulates the scope and expected performance of Service and functional components, supporting organizations, agencies, supporting unified commands, and other JTFs. Clear guidance will be provided on which command is performing various aspects of the JEMSO spectrum management activities, including JFMO responsibilities.

d. Frequency Assignment Authority and Generation Authority. Clear guidance will be provided to the joint force on which commands have RF assignment authority and JCEOI generation authority. See Enclosure A. Additionally, see references (m) and (s) for more detail on authorities.

e. Frequency Request Procedures. Guidance will be promulgated on theater entry requirements for units and EMS-dependent systems entering the JFC/JTF JOA. Guidance includes the RF assignment process, routing chains, required spectrum request formats, and required data items. This guidance may initially be published in the spectrum requirements data call message; including it in the spectrum management plan and in the spectrum management tab makes it directive in mandating that spectrum users provide the necessary information. Changes, updates, and subsequent data calls as operations progress will be promulgated as required and in conjunction with other JEMSO planning and execution products. See Enclosure B and Enclosure C for more information on where these activities are integrated into JEMSO planning and execution, and Appendices A through E of this enclosure for more detail on frequency requirements, requests, and the data call message.

f. Spectrum Management Automation Systems. The spectrum management plan provides guidance on the use and operation of SPECTRUM XXI and other automated spectrum management tools. SPECTRUM XXI is the designated joint spectrum management system for use in a JFC/JTF. JACS is required to generate operational hopsets and loadsets. Use of SPECTRUM XXI should be mandated in the spectrum management requirements message, and Tab A to Appendix 23 to Annex C should expand on system settings, minimum times between data exchanges, radius of mobility settings, engineering parameter defaults, etc. Also noted should be guidance on the controlled implementation to spectrum management tool software updates. Some software updates create backwards compatibility issues thus the JEMSOC is required to monitor and implement guidance on when a software patch is applied to systems such as JACS.

g. Administrative Guidance. The spectrum management plan outlines responsibilities across and external to the staff for those elements and personnel who have spectrum management responsibilities. External commands and organizations include components, supporting organizations and agencies, supporting unified commands, and other JTFs (if established). JFMO responsibilities also need to be thoroughly covered. Administrative items can be as detailed as necessary for covering things like file naming conventions, control-numbering conventions, reporting periodicity, etc.

h. Security Classification

(1) Security classification is addressed in two different ways in the spectrum management plan. First, it provides general classification guidance. Second, it provides guidance on which SFAF line items need to be classified and how to properly mark them. Spectrum managers are not a classifying authority and must derive classification authority from existing sources (e.g., communications cards inherit the highest security classification from the source RF records). Classification of RF assignment records is a historical and recurring concern. Consequently, all spectrum managers should receive derivative classification training. Consult and refer to applicable CCMD

security classification guides (SCGs), reference (r), respective material developer SCGs, and Joint Knowledge Online course number HQJ0-0000-0015-ONL.

(2) RF requests and assignments are typically classified when they associate the request with an operation, purpose, operating unit, location, or time frame. It is common for compilers of frequency lists to omit classifying the frequencies themselves and only classify associated detail such as time, location, units involved, and the purpose of the frequency or net. Because most joint operations are conducted outside the United States, foreign disclosure becomes an issue. RF requests requiring coordination with non-U.S. entities are effectively useless until foreign disclosure approval is obtained, and special handling codes are assigned.

4. Spectrum Management Exhibits. The two below topics are discussed in the context of their spectrum management exhibits in a plan or order. Prior to plan/order completion, they are addressed in the spectrum management plan, which becomes feeder content to the plan/order exhibits.

a. Exhibit 1—EMI Reporting. This exhibit provides guidance to JFC/JTF forces for the investigation and reporting procedures related to harmful EMI. It provides additional instructions unique to applicable CCMD/JFC/JTF interference reporting policy and includes references to those policies. This guidance should align with procedures in Appendix I and Appendix J of this enclosure, and in reference (g).

b. Exhibit 2—JCEOI. This exhibit should provide guidance to JTF forces for JCEOI development, updating, distribution, and how to handle potential information compromise. This guidance should include what was published in the spectrum requirements data call message, updated with the most current information. See references (j) and (m) and Appendix G of this enclosure for additional details.

5. Considerations for Additional Amplifying Guidance or Exhibits. Additional guidance and considerations may be published into the plan or order as additional exhibit(s), incorporated into the existing tab or exhibits, or covered under JTF polices and standard operating procedures (SOPs) referenced in the order. Examples of topics that might require additional guidance are discussed in the following paragraphs.

a. Cognitive Radio Systems. This guidance outlines the JFC/JTF approach to supporting these systems in the JOA. See reference (a) and Annex C to Appendix D of this enclosure for additional information.

b. Frequency-Hopping Radios. Service components may have established SOPs for planning and operating SINCGARS, HAVEQUICK or other frequency-hopping tactical radio systems. This section is separate from JCEOI or hopset/loadset development, and can contain CCMD-, JFC-, or JTF-level guidance on authorized timing sources for these radios to ensure effective communications across the joint force.

c. JRFL. JRFL guidance, whether in its own exhibit or included in another exhibit, should include when and how units across the joint force submit JRFL inputs. It should also specify when and by what format/mechanism the JRFL is published and promulgated. Appendix H to this enclosure contains additional information on the JRFL.

d. Land Mobile Radio. LMRs are handheld-sized radios that operate in either a trunked or simplex mode. LMRs are often used by the USAF to support aircraft maintenance efforts, airfield control, and for military police. The other Services, to include SOF, also use LMRs to perform a variety of mission-essential tasks. Coordinating frequencies for these radios is an ongoing task that needs to have defined policy and procedures to prevent interference.

e. Mobile Satellite Services and Commercial Cellular Services. These spectrum-dependent devices support a variety of joint functions and require spectrum deconfliction protection from other joint force systems. The J-6 usually manages these devices, with visibility by the JEMSOC.

f. Spectrum Supportability Determination. A variety of military EMS-dependent systems, such as wireless microphones or ones enabling physical perimeter security, are used to support missions. Documented policies are required addressing how to handle new systems, requesting use of existing systems, and preventing or mitigating the potential interference they cause. Additional information on spectrum supportability is contained in Annex A to Appendix D to this enclosure.

g. Unlicensed Radios and Wireless Systems. Unlicensed wireless radio systems operate within, and must not exceed, the authorized parameters specified in documents such as NTIA Annex K or HN Allocation Table. HNs or CCMDs can authorize additional unlicensed systems in designated radio bands, along with applicable guidance and restrictions. While formal management of unlicensed radio systems in the civil or commercial sectors might not be implemented, the DoD and some HNs require registration of these systems with the respective RF assignment authority. U.S. forces should not rely on unlicensed wireless systems to support critical joint functions due to the systems' potential to cause or be vulnerable to harmful EMI, which could increase mission risk. Because of the potential pitfalls and lack of control over these systems, most CCMDs do not support harmful EMI reporting or resolution to unlicensed wireless systems.

APPENDIX F TO ENCLOSURE F

NOMINATE AND ASSIGN FREQUENCIES

1. Overview. The activities and considerations presented in this appendix enable making RF assignment decisions. They apply both within the JEMSOC and to subordinate units to whom RF assignment authority is delegated.

2. Spectrum Management

a. Nominating and assigning frequencies is pursuant to actual implementation of the spectrum management plan. Authority may be delegated to components to issue RF assignments or allotments, so they have the requisite latitude and flexibility to support of their combat operations. The JFC/JTF spectrum manager may make the initial RF assignments or may delegate (decentralize) assignment authority to components along with frequency pools (allotment plans) from which to assign their required frequencies. Decentralized assignment authority requires that all temporary RF assignments be data exchanged with the SPECTRUM XXI regional server, so they are visible to, and included in, other spectrum managers' nominations or IA calculations. This activity, nominate and assign frequencies, contributes to defining the EMOE. This activity depends on actions previously determined availability of EMS resources and complies with restrictions in the spectrum management plan. The following information applies to SPECTRUM XXI unless otherwise stated.

b. The RF assignment database conforms to, and is created IAW, regional table of frequency allocations, ITU RR, and channel plans. The database is the spectrum manager's most important resource and is the basis for nominating interference-free assignments, providing impact analyses of EW operations, and identifying and resolving interference issues.

c. Because the EMS is a finite resource, its effective use requires management to provide users with effective service. EMS-dependent systems support all joint functions and enable the elements of power projection (e.g., ballistic missile defense, air defense, fires, intelligence, aviation, ground maneuver). Three general parameters underpin the management of EMS resources—frequency, time, and distance—and must be deconflicted (i.e., spectrum users cannot occupy the same frequency, at the same time, at the same location). Frequency plans are the instrument for deconflicting users competing for EMS use in the three parameters. Physical location (e.g., a JOA, training range, military post, or within the borders of a HN) is an overarching bin in which the three parameters can be managed. Separating frequency use by time is a method of managing EMS use; it can be planned manually (e.g., allowing one user at a time to use a frequency to be shared by multiple users). Frequency hopping is an automated, technology-enabled example of time-sharing EMS resources. Separating users by distance is another sharing option but offers limited deconfliction potential for operations that dictate multiple users in close geospatial proximity to one another.

d. Automation has evolved the ability to instill separation across frequency, time, and distance. Despite the benefits of automation, interference can never be completely eliminated. One reason for this is that automated spectrum management processes depend on modeled interactions in the EMS, and these models have inherent inaccuracies, information gaps, and processing limitations. Other sources of errors are caused by inaccurate frequency records, environmental variables, variations on system use, and modifications to existing SPECTRUM XXI systems without updating the assignment. Notwithstanding the limitations of automation, modern spectrum management has developed a measured but beneficial reliance on its ability to process an inherently voluminous amount of technical data, and substantial improvements in timeliness, efficiency, and accuracy to support operations.

3. Nomination/IA Deconfliction. Spectrum management involves planning the use of the EMS. To this end, RF assignments must be made so they do not conflict or cause interference with one another. Automated tools, as described in the following paragraphs, are available to assist spectrum managers with SPECTRUM XXI frequency nomination and assignment.

a. Culling Environmental Records from Analysis. The environmental records obtained from the RF assignment database are culled to exclude environmental factors from the IA whose frequencies or geographical locations are too far removed from the proposed system's frequency and location as to present an interference concern. The three culling methods are: frequency cull, region or distance cull, and path loss cull.

b. Frequency Cull. When conducting an IA, the user enters the geophysical and technical characteristics of the proposed system, which include the transmitter and receiver tuned frequencies. A frequency cull is then conducted, which eliminates any system operating on a tuned frequency different from the proposed frequency by more than 10 MHz (if the frequency range is between 37 MHz to 10 GHz). For frequencies above and below this range, the calculation is a percentage of the proposed frequency.

(1) For example, a receiver for which the fPROPOSED is 934.4 MHz (934,400,000 Hz) would exclude from the analysis any systems with a transmit

frequency below 934.4 – 10 = 924.4 MHz (924,400,000 Hz) as well as those with a transmit frequency above 934.4 + 10 = 944.4 MHz (944,400,000 Hz). Systems above and below the +/- 10 MHz exclusion are considered not to cause interference to the proposed receiver.

(2) When environmental band assignment records are included in an analysis, an additional frequency culling criteria is applied. If the edge of the band assignment is greater than one-half (i.e., 0.5) of the sum of proposed radio-frequency bandwidth (BWPROPOSED) + radio-frequency bandwidth environmental (BWENVMT) the band assignment is not analyzed.

c. Region or Distance Cull. The standard 4/3 earth radio horizon formula is used to compute the culling distance (dCULL), in km, as follows:

(1) dCULL = 1.609 [(2hTRANS)0.5 +(2hCULL)0.5], where hTRANS = height (in feet) of proposed station antenna, hCULL = cull height of environmental station antenna = 30,000 feet.

(2) Any system separated by more than dCULL km from the proposed system is excluded from the analysis and is not considered as an interference concern. In one common example, a 30-foot (10-meter) antenna height equates to a 410 km distance cull.

d. Path Loss Cull. This discriminator applies a free-space path loss cull. The free-space path loss equation is a function of frequency and distance and, for this culling feature, serves to minimize the number of interactions that must be analyzed by computing a more time intensive path loss (e.g., TIREM) and the frequency-dependent rejection. The rationale applied here is that any interaction meeting the interference threshold at this point will most certainly meet the threshold requirement using the more time-intensive analysis.

e. Interference Conflict Margin. The interference conflict margin (ICM) is a measure of the interference protection existing between a potential interfering transmitter and a victim receiver. For each environmental interaction, an ICM is computed, which is defined as 10 times the logarithm of the ratio of the interference power to the receiver interference threshold. Essentially, the computed ICM equates to the signal strength of the interference that is greater than the receiver threshold value.

f. TIREM. TIREM is supported by a terrain database and is employed for all path loss calculations in the 1-MHz to 20-GHz frequency range, if terrain data is available. SPECTRUM XXI automatically replaces TIREM with SEM in an analysis where the radius of operation is associated with the transmitter and/or receiver station, if the required terrain data is absent, or if there are less than three elevation points in the transmitter-receiver path profile. The free-space propagation formula is used for analyses of frequencies outside the 1 MHz to 20 GHz range.

4. Co-Site Analysis (the Interference Power-Level Model). This and the following paragraphs describe common types of analyses performed within the software program and the co-site algorithm. The interference power-level model is the primary model used by SPECTRUM XXI when determining interference potential for the capabilities being nominated, for EW deconfliction, and for IA. The model considers the spectral interaction factors of intermodulation and harmonics, described in the paragraphs below.

a. Intermodulation occurs when signals from two or more transmitters mix in a nonlinear device. A nonlinear device could be an amplifier, a power supply, or even the junction of two dissimilar metals behaving as a diode. When signals mix, they produce additional signals (i.e., intermodulation products) on new frequencies mathematically related to the original frequencies. Fortunately, intermodulation products' signal strength tends to get weaker as the order gets higher. Interference caused by up to fifth order intermod hits is fairly common, but it is common to experience interference caused by 13th-, 15th-, or even higher-order products. In analog FM receivers, intermodulation is often recognized by loud, distorted audio, and can often manifest as multiple voice audios superimposed on one another. A spectrum analyzer depiction of this phenomenon often shows twice (or more) than the normal FM deviation.

b. Harmonics. SPECTRUM XXI only considers second-order harmonic frequencies and fundamental frequencies (e.g., a fundamental frequency of 30 MHz will generate a second-order harmonic frequency at 60 MHz). At the third-order level, only second- and third-order harmonic frequencies and fundamental frequencies will be considered (e.g., a fundamental frequency of 30 MHz will generate a second-order harmonic frequency at 60 MHz and a third-order harmonic frequency at 90 MHz). When harmonic frequencies are analyzed, the analysis will take longer than when the harmonic emission analysis default (OFF) is used. The increase in run-time depends on several variables, including the number of records loaded, the band chosen, the harmonic selected, and computer processing speed.

5. Calculating Interference (Spectrum Overlap Model). A major distinction exists between the SPECTRUM XXI Spectral Overlap and the Interference Power-Level Models. As previously stated, spectral overlap relies solely on frequency and bandwidth data to declare conflicts in a region, whereas the

interference power level model accounts for many other technical and geophysical parameters that determine the potential coexistence of systems sharing an environment, from an EMI standpoint. Additionally, the interference threshold settings are user-selectable (or automatic if enabled in the engineering preferences settings) when using the Interference Power-Level Model, which ultimately governs whether a conflict is declared; whereas, no user control in the conflict decision is possible when using the Spectral Overlap Model.

a. The Spectral Overlap Model, which declares conflicts only when there is spectral overlap between the interfering transmitter emission and the victim receiver band pass. The overlap is determined from the assigned RF and necessary bandwidth data, assuming that the emission spectrum and receiver selectivity are band-limited to the necessary bandwidth. Note that the Spectral Overlap Model is not executed if a single frequency is being analyzed for the proposed system. Furthermore, with the Spectral Overlap Model, conflicts will always be declared when there are co-channel assignments, but never when there are adjacent-channel assignments. Conversely, when using the interference Power-Level Model, co-channel assignments do not necessarily result in conflicts (e.g., low-power interference or wideband interference truncated by the receiver selectivity); whereas harmful adjacent-channel interference caused by realistic emission spectrum/receiver selectivity characteristics will be identified.

b. In summary, the Spectral Overlap Model can only be used to identify potential co-channel conflicts; alternatively, the Interference Power-Level Model can be used to quantify potential co-channel and adjacent-channel interference. In general, there is no way to predict if more or fewer conflicts will be declared using the Spectrum Overlap Model versus using the Interference Power-Level Model; therefore, if results obtained by using one model are suspect or unexpected, the spectrum manager should adjust settings such as limiting the radius around the proposed system to improve results.

6. RF Assignments. A RF assignment is an authorization to operate on a frequency at a specified location (or area), during a designated time frame, and at specified parameters. The following paragraphs discuss types of frequency assignments and some associated terms.

a. Permanent assignments are those RF assignments that never automatically expire and are reviewed every five years for currency and accuracy. It is not recommended to use permanent assignments when establishing a JTF or for an operation occurring over a limited time span.

b. Temporary assignments are frequencies assigned for a short time duration, which, IAW reference (p), is less than 5 years. It is generally recommended to make all JFC/JTF RF assignments temporary. In a real-world historical example, most of the temporary assignments made for the 2003 forced entry operations in Iraq were created as 5-year records. A loss of positive control evolved with the rotations of units over the course of several years, with debates evolving over who owned what records. In some cases, multiple units were leveraging a single record, causing harmful interference with each other. Respective SPECTRUM XXI job accounts associated with those records were no longer accessible. Thus, the following procedures evolved: temporary assignment dates are made based off the projected entry date and exiting rotation date of the unit within the Iraq JOA. The JTF promulgated policy noting that an exiting unit's temporary assignments would expire 60-days after a unit leaves the JOA—regardless of the expiration date on the record. This enables a forcing action for incoming units, directly replacing exiting units, to take ownership of expiring assignments. This effort contributes to the continuity, rather than the abandonment, of SPECTRUM XXI job accounts. The incoming unit modifies existing temporary assignments with current points of contact, and the respective assignment records are updated to reflect current emitter locations along with validating the record assignment and requirement.

c. NIB assignments are those radio assignments for which noninterference is a particular priority (i.e., the assignment shall not cause harmful interference to, or require protection from, an existing authorized radio assignment). Although not formally defined by the ITU, section 4.4 of the RR provides the framework for authorized regulators to define and assign NIB. The CCMDs and respective partner agreements (e.g., CCEB, NATO) may define NIB exercised under a partner agreement and/or CCMD authority.

(1) <u>Area Assignments</u>

(a) Area assignments made within SPECTRUM XXI are frequencies assigned for use within an area of interest not defined using a fixed geographical coordinate. Examples include safety of flight, combat search and rescue, and other like frequencies. Area assignments may be the spectrum users' first choice as they provide maximum flexibility to the user, but they should not be the assignment type of choice for use in joint operations. The lack of automated engineering tools to nominate or consider area assignments make them time consuming and difficult to manage. Users should be required to define an area of some type that is tied to a geographic coordinate with a radius of operation and then allow the assignment authority to determine if and when area assignments best fit the situation. These assignments may contain comments describing an area in text. Such assignments are normally authorized for operation within the boundaries of a country or state. SPECTRUM XXI considers an assignment to be an area assignment if it has duplicate entries in SFAF items 300/301 and 400/401. To make an area assignment, the spectrum manager must manually coordinate the use of these frequencies, unless previous authorization has been made with the requisite HN authority. The assignment applies everywhere within the area designated in the assignment as well as beyond the area for the distance over which use of frequency might cause interference beyond the authorized boundary. Normally, an area assignment is made on a NIB.

(b) SPECTRUM XXI does not include area assignments in nomination or interference calculations. The nomination results process flags proposed frequencies having a corresponding area assignment somewhere in the RF assignment database and enables the user to view that record before accepting or rejecting the nominated frequency. This process of reviewing each nominated frequency with an area assignment somewhere in the database, and manually evaluating its impact, is time consuming. Time constraints might hinder performing this amount of manual engineering in the assignment process.

(c) Mobile assignments are ones that operate within a given area, and include a geographic reference and operating radius, but have the potential for operating across a wider area than assignments associated with geographically fixed systems. Spectrum managers must consider how they intend to manage mobile assignments, what parameters automated spectrum management systems use to make mobile assignments, and what limitations should be placed on mobile assignments before making RF assignments. Mobile assignments with a record source of FRRS or GMF are evaluated using a modeling process named fixed and mobile logic. This logic modifies records to replicate the spectral interactions associated with the record being evaluated.

(2) Mobile assignments are for portable or transportable systems but are still given a radius around a defined geographic point. They are usually for omnidirectional antennas with a relatively low transmit power. Mobile assignments are common in joint operations and much preferred over area assignments. Mobile assignments use fixed radiocommunication services and have a radius of mobility as listed in SFAF item 306/406. A mobile assignment does not actually reflect how the station is intended to be operated and can skew the nomination and IA results by placing fixed directional antenna gain values in an omnidirectional manner. While the use of mobile assignments is preferred over area assignments, they too can invalidate nomination and IA

results. Mobile assignments commonly present unique problems in the nomination process, as the mobility of stations is hard to accommodate using the existing frequency assignment algorithms in SPECTRUM XXI.

(3) SPECTRUM XXI provides options for how to handle mobile assignments. These options enable the spectrum manager to determine how to best accommodate the forces involved and optimize the nomination of interference-free frequencies. To better understand the impact of choosing mobile assignments, it is necessary to review how SPECTRUM XXI deals with mobile assignments, what options the spectrum manager can modify, and what setting options/levels to choose. Two mobile assignment options are the radius of mobility multiplier and the mobile logic model, discussed below.

(a) Radius of Mobility Multiplier. Earlier automated spectrum management tools calculated nominations and interference for mobile assignments as if the mobile assignments could be located anywhere within the authorized radius listed in SFAF item 306/406. This approach created a situation where the mobile station could be collocated directly with other fixed and mobile stations. This method was very conservative and greatly reduced the available EMS resource. A review of actual mobile and fixed station interactions found that most stations were seldom collocated and that, by placing the mobile stations, EMS availability was increased. To accommodate this concern, a capability was created—the radius of mobility multiplier—to separate mobile and fixed stations from each other to better replicate the actual interactions of mobile and fixed stations. With this capability, mobile stations are separated from the mobile assignment (SFAF item 306/406) by a distance of between 1 and 25 percent of the radius of the mobile assignment (the SPECTRUM XXI default is 10 percent of the radius). While the 10 percent default is reasonable in many circumstances, in others it is not. For example, a mobile assignment with a radius of 1,000 km would have a default radius of mobility multiplier of 100 km (approximately 60 miles). This distance might preclude two mobile stations from being considered in a nomination or IA and would stand off mobile stations from fixed transmitters within their AO. Therefore, the spectrum manager should consider the size of the operating radius along with the size of the standoff distance that will be caused by the radius and multiplier. Policy and guidance should be provided to JFC/JTF spectrum managers regarding the radius size for mobile assignments and for the radius of mobility multiplier. These considerations also apply to JCEOI RF proposals and their radius values.

(b) Fixed and Mobile Logic. The NTIA developed the fixed and mobile logic model for fixed and mobile station interactions. This model causes changes to be made to RF assignment analysis records and better replicates their interactional effects in the EME. The fixed and mobile logic feature is available in SPECTRUM XXI; however, before choosing to use this capability, spectrum managers need to understand how it evaluates both background assignments and proposals. This model interprets fixed and mobile RF assignment records and builds analysis records that more accurately reflect how the system is deployed. For instance, when the record contains both a fixed station class and a mobile station class, and a radius of operation is specified, that radius is applied to the mobile station not the fixed station. Propagation loss calculations between the fixed and mobile stations use smooth earth terrain data, not digitized terrain data, for calculations. Also, two or more receiver analysis records are created, one for the fixed site (without a radius) and one for the mobile site (with a radius). Modified values for antenna height, gain, polarization, and azimuth are used in the calculations. For example, mobile stations (station classes beginning with MO) are given an antenna height of at least 10,000 feet, mobile aeronautical stations (station classes beginning with MA) are given an antenna height of at least 30,000 feet, and mobile land stations (station classes beginning with ML) are given an antenna height of 2 meters. While use of the NTIA fixed and mobile logic model for mobile records is recommended, the authorization for its actual use must be documented in JFC/JTF policy or guidance. Not selecting the fixed and mobile logic model, as is the case for all non-FRRS and GMF assignments, causes SPECTRUM XXI to analyze the assignment records using the values stated in the record and using previously stated defaults for missing data. When the fixed and mobile logic model is not used, the following recommendations are made for mobile class designations: use station class MA only for aircraft operating above 10,000 feet; use station class MO for aircraft operating up to 10,000 feet; and use station class ML for land-based emitters.

d. Space assignments are assignments where either the transmitter or receiver is located in space. Space assignments may be placed in SPECTRUM XXI to protect the service. However, satellite access and usage are controlled through U.S. Space Force and respective space command's systems and processes.

e. Band assignments are assignments for which the transmitting frequency changes within a given band of frequencies and/or does not remain constant. Examples of band assignments for Joint Tactical Information Distribution System and certain radars. Current spectrum management automation tools cannot be used to engineer, nominate, or deconflict band assignments. Once made, band assignments are considered by SPECTRUM XXI IA as background emitters and are provided protection, provided that band assignments were selected in the user preferences during the nomination process.

7. Before Nominating. Prior to nominating any frequencies, a data exchange should always be performed, thus ensuring nominations are based on the most current information. Having a checklist covering the nomination steps and options is highly recommended. Knowledge of which records will be included for analysis and nomination, and how SPECTRUM XXI handles the different types of records, is also necessary.

a. Permanent assignments and proposals are always considered unless specifically user excluded.

b. Temporary assignments and proposals both have a user option in preferences allowing them to be included or ignored.

c. Band assignments have a user option in preferences allowing them to be included or simply flagged by the nomination or IA process.

d. Space assignments have a user option in preferences allowing the terrestrial interference potential to be included IA process or to simply flag the frequencies that have corresponding results.

e. Delete history has a user option in preferences allowing them to be included or totally excluded from analysis (excluded by default setting).

f. User excluded records are user controlled (records can be queried once excluded).

g. Only nominate what is needed. If using a decentralized RF assignment method, nominating more than what is needed could deprive others of spectrum resources needed to support their functions and missions.

8. Nominating. Nominating requires the user to make specific decisions and choices. The first of these is to specify a number of assignments (nominations) to be performed. If SPECTRUM XXI cannot provide the required results or resources, the SPECTRUM XXI fall-back spectral overlap model can be used. Not specifying a number results in SPECTRUM XXI nominating the maximum possible number of proposed frequencies, which is probably far more than required. Another useful tip to apply when the number of nominations is relatively small is to use the maximum frequency separation capability, which will spread frequency nominations over the frequency band.

9. Interference Flags. Records containing certain Interdepartment Radio Advisory Committee (IRAC) record notes (SNOTES), or space assignments, or area assignments, or that contain no coordinates at all, are represented by a

set of dashed lines (_ _ _ _). Records containing certain SNOTES will be annotated with X in place of the first dash. If the record is a space assignment, the second dash is replaced with an X. If the record is an area assignment, the third dash is replaced by an X. If the record does not contain any coordinates at all, an X replaces the fourth dash. A record could contain more than one X. An explanation of each of these conditions follows.

a. SNOTES. For assignments containing SNOTES S159, S352, or S353, the IA is bypassed, and these records are noted for the user in the output report.

b. SPACE. For SPACE station assignments, those records containing a transmitter or at least one receiver state country code equal to SPCE, SPA, SPCW, or SPCU, the IA is bypassed, and the records are flagged as potential conflicts on the output report. In the frequency nomination mode, any nominated frequency overlapping these assignments is also noted for the user. This flag can be overridden, and space records will be analyzed if the option to include space records in the analysis is selected on the Engineering Preferences screen.

c. Area Assignments. Records are marked as AREA assignments if all the following conditions are true:

(1) The transmitter state/country field (SFAF item 300 or GMF item XSC) contains the same data as the transmitter antenna location (SFAF item 301 or GMF item XAL) or the antenna location is empty.

(2) The receiver state/country field (SFAF item 400 or GMF item RSC) contains the same data as the receiver antenna location (SFAF item 401 or GMF item RAL), or the antenna location is empty.

(3) The transmitter latitude/longitude (SFAF item 303 or GMF item XLA/XLG) and the receiver latitude/longitude (SFAF item 403 or GMF item RLA/RLG) are blank.

d. Missing Coordinates. There are environmental records with blank entries for the station coordinates. These include nationwide assignments (e.g., USA state code), non-state assignments (e.g., Guam or Puerto Rico code), or state area-assignments with a text description for their respective operating region (e.g., west-southwest of Colorado). Such records cannot be processed in the region cull due to the lack of station coordinates, but these records are noted for the user as potential conflicts in the output report. The user is given the option, via the query, to exclude records from the IA. Records designated as potentially creating interference problems are noted for the user in the output report (USER). This option is available for SFAF mode only.

e. Band Assignments. For assignments occupying a frequency band or range, the IA is bypassed but these records are noted in the output report if the band assignment could create a potential interference problem (BAND). Band assignments can be included in the analysis if the correct option is selected on the Engineering Preferences screen.

f. Experimental. For assignments designated as experimental, i.e., station class begins with an "X," the IA is bypassed but the existence of experimental assignments possibly creating a potential interference problem are noted in the output report (experimental records (EXP)).

10. Interference Flags—Order of Priority. Since background assignments could fall into multiple categories, the following order of priority was developed for flagged records. The ERROR flag is checked first. If it exists, then that will be what is listed on the output. If it does not exist, the SNOTES, SPACE, AREA, and COORDINATES flags are checked. If any exist, they are listed on the output. The next check is the USER flag, then the BAND flag and finally the EXP flag.

11. Nomination Ranking. Nomination ranking scheme is listed below:

a. Reuse Number. The primary ranking criterion is the reuse number, which is the number of times the nominated frequency is "reused." As assignments within the software program RF assignment database are analyzed to determine a potentially adverse interaction with the proposed system, the maximum limits of authorized bandwidth for noninterfering assignments within set geographic limits are recorded. Each nominated discrete frequency is checked against these limits. The total number of these limits (inside of which a nominated frequency falls) is that nominated frequency's reuse number. Nominated frequencies are ranked first by reuse number, in descending order highest to lowest.

b. Edge Number. The secondary ranking criterion, the edge number, is used in cases when the reuse numbers for nominated frequencies are equal. Each nominated frequency is given an edge number corresponding to the number of times (zero, one, or two) the maximum limits of its authorized bandwidth are such that no additional adjacent nominations may be made. Nominated frequencies with equivalent reuse numbers are ranked using the edge number. This is done to ensure nominated frequencies near the edges of largely unused frequency bands are assigned before those at the centers of these unused frequency bands.

c. Relative Signal Level. The third criterion, the relative signal level, is used in cases where both the reuse number and the edge number are equal. Nominated frequencies are ranked in order of how far the signal level of each frequency is below the interference threshold.

d. Frequency Order. The fourth criterion is used in cases where all the above criteria are equal; thus, nominated frequencies are ranked by frequency in ascending order.

12. RF Assignment Strategies. Identify difficult to fill requirements first by identifying the proposals having the following unique and potentially challenging characteristics: large separation criteria, large bandwidths, located in congested geographical areas, operation over a long time period (duration), and those with the large numbers of needed frequencies. It is prudent to handle these difficult nominations first, before more routine, simplistic nominations.

13. Assignment (Nomination) Processing. A systematic approach to organizing and managing EMS requirements from the proposal through the assignment process must be adopted to ensure requirements are met.

14. Limitations of SPECTRUM XXI

a. HF. HF proposals (2–30 MHz) are normally requested for systems utilizing skywave propagation. SPECTRUM XXI nomination and IA algorithms are based upon groundwave propagation and only evaluate those environmental emitters that could interfere when operating in a groundwave configuration. Additionally, there is no consideration of the ionosphere and its effect upon propagation. Since most HF assignments are not groundwave or direct LOS, the nomination process only considers the collocated near-field transmitters and receivers in determining interference potential. If the user did not already limit the frequency bands to be requested, the spectrum manager usually tries to identify the intended use of the system and performs an HF radio wave propagation prediction prior to nominating frequencies. SPECTRUM XXI, for HF assignments, is an analysis software that deconflicts local interference sources only and acts as a record-keeping device.

b. Band Assignments. Proposals requesting band RF assignments cannot be nominated from SPECTRUM XXI. Background assignments having a frequency band in SFAF item 110 can be considered against proposed single

RF nomination analysis. The SPECTRUM XXI user can choose to include environmental band assignments in the interference/nomination analysis; this will exclude nominations either within the band assignment or that could cause co-channel interference. There is an in-depth explanation of this process in both the SPECTRUM XXI training manual and SPECTRUM XXI online help.

c. Space Assignments. Proposed space assignments cannot be made using SPECTRUM XXI. SPECTRUM XXI does provide the capability to protect existing space assignments, for the ground-based emitter, from future nominations. There is an in-depth explanation of this process in both the SPECTRUM XXI training manual and SPECTRUM XXI online help.

d. SPECTRUM XXI does not enable hourly management of JRFL entries. Nor does SPECTRUM XXI contain the ability to manage geographic JRFL entries in a more precise manner.

15. RF Assignment Authority

a. Each country has authority over its spectrum resources and assigns frequencies IAW international and domestic law. The U.S. military operating as guest forces must coordinate with the HN to secure spectrum resources for operational and training exercise requirements. Those spectrum resources provided to the JTF JEMSOC from the HN should be considered a measure of the HN trust and treated as a valuable resource, to include compliance with restrictions defined in applicable agreements with the HN. Misuse of the spectrum resources provided may result in the HN rescinding use and/or, authority to manage spectrum resources. There may be legal implications in the case of injury or damage to HN personnel and property. It is incumbent upon the JTF JEMSOC to comply with any agreements made with the HN. For additional information see Enclosure A.

b. RF assignment authority coordinates and deconflicts all RF assignments within the commander's geographic AOR, JOA, or OA and not simply for the delegated commander's services functions. For example, a JFLCC with delegated RF assignment authority coordinates all EMS activities for blue forces within, and moving in and out of, their respective footprint. The JFC may further clarify roles and responsibilities on order.

c. Forcible entry operations are those military actions that, based on their very nature, cannot be coordinated with the HN. These operations do not preclude the protection of safety-of-life frequencies. Additionally, forced entry operations do not preclude the responsibility of managing the spectrum efficiently for the forces involved in the operation or coordinating with neighboring counties.

16. Centralized Spectrum Management. Centralization occurs when, for example, the JFC/JTF JEMSOC retains all RF assignment authority. Centralization can be beneficial for some processes and products, such as developing the spectrum management plan, but can be inefficient and too top-heavy for other products. Centralized spectrum management is best suited for small operations (i.e., NEO or hostage rescue where a limited number of forces are involved, in a limited geographical area, and/or for a limited operation time span).

17. Decentralized Spectrum Management. This type of spectrum management allows spectrum managers at the CCMD, subordinate unified commands, JTF, and subordinate levels to these commands to make assignments and determine how to best use the available spectrum resource optimally suited for large operations. This type of spectrum management requires knowledgeable personnel at all levels and monitoring from the JEMSOC to be effective.

18. JEMSOC. The JEMSOC should try to incorporate the capabilities of the Service unique RF assignment tools into the spectrum management process as much as possible. The Services have developed some automated spectrum management tools. The JEMSOC should consider allowing components with automated spectrum management tools to manage the spectrum for like type systems.

19. U.S. Army. See Enclosure G.

20. U.S. Navy. The Navy's RTSO could be used to manage radars both on the water and on land. Additional procedures must be in place to facilitate proper coordination. The JEMSOC should place restrictions on how and when the components can make RF assignments.

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APPENDIX G TO ENCLOSURE F

GENERATE THE JCEOI

1. JCEOI Generation

a. The JCEOI is the JFC's master JTF communications "telephone book" enabling the joint force to communicate with each other across the components, allies, coalition, and partners. The JCEOI includes:

(1) Directory of all units and elements assigned frequencies.

(2) Daily changing and non-changing RF assignments.

(3) SINCGARS cue, manual and net identification assignments.

(4) Call sign, suffix, and expander assignments.

(5) Call word assignments.

(6) Daily sign and counter sign change.

(7) Pyrotechnics and smoke.

(8) Software distributable SINCGARS compatible hopset and loadset; AMPS extract for HAVEQUICK compatible radios.

b. The effective management of the JCEOI components enables the successful communications of military units during planned and contingency operations. It is imperative that proper coordination and preparation take place as soon as the force structure, architecture, and communications requirements are identified for a given deployment. Accurate and timely inputs from the supported force structure are essential to generate an effective JCEOI product. The JEMSOC must:

(1) Establish command-specific policy and guidance for development and use of the JCEOI that uniquely applies to their area and command structure. This includes who has generation authority.

(2) Function as the generating authority for their JCEOIs.

(3) Establish a JCEOI management function to control the JCEOI process, structure, and procedures to support planned and ongoing operations.

(4) Establish procedures for deconfliction of call signs and call words within their AOR.

(5) Establish procedures for the loss and compromise of the JCEOI and derivative elements (e.g., commo cards).

(6) Ensure liaison is made with appropriate foreign military and multilateral forces (e.g., UN forces, NATO) operating as part of combined operations to ensure unique requirements are met as part of a combined JCEOI. See also Appendix A of this enclosure for additional information on coalition operations.

c. The JTF commander, acting as the CCDRs representative, assumes the duties of the CCMD concerning the JCEOI for the JTF JOA. The JCEOI is a two-part document. Part One is a directory of radio nets or units and their associated frequencies, call signs, call words, and net IDs listed by time period. Part Two contains supplemental procedures for electronic, visual, and verbal interactions, such as sign/countersigns, smoke/pyrotechnics, and suffix/expanders. JCEOI development and distribution at the JTF is a J-3 responsibility normally delegated to the JEMSOC.

d. Inputs submitted by the components during the Gather Requirements activity should have included JCEOI MNLs. Having just nominated and assigned frequencies, the spectrum manager can now use some of those assignments in generating the JCEOI. This product should be constructed and completed prior to the deployment of forces in support of JTF operations. On average, it may take around 40 labor hours to produce a JCOEI for a single Army Infantry Division once all the data is collected.

e. Development of a JCEOI does not restrict component commands from developing their respective internal “telephone book” and derivative products (see Figure 27). Commanders can use the full range of available communications planning resources in any way that meets their needs. Ideally, a communications plan must be followed with confidence or should be subject to revision based on mission needs. Accordingly, the mission, scene, or theater commander should be granted all necessary authority to modify the guidance provided throughout this document to meet mission needs, unless counter to specific policy.

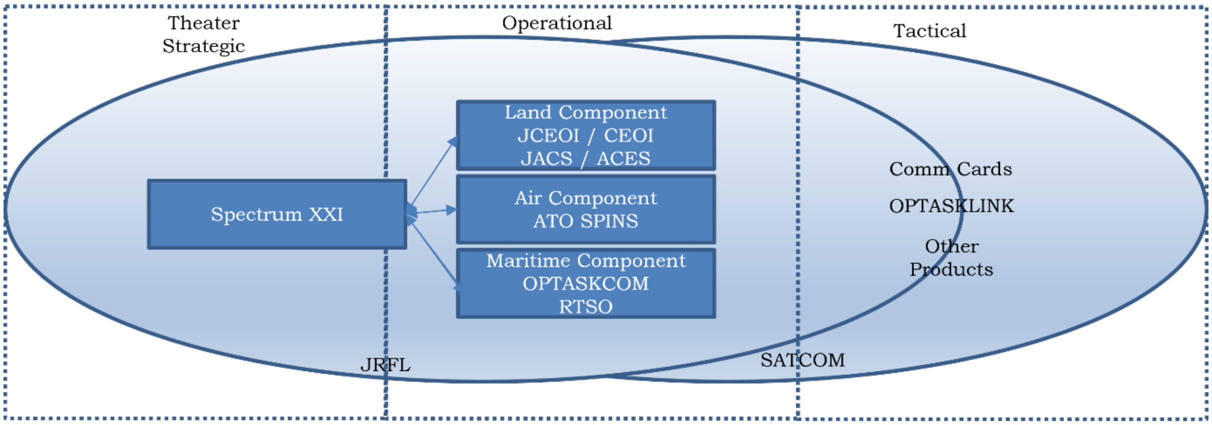

Figure 27. JCEOI and Component Command "Telephone Books"

d. Effective communication of elements rapidly deploying to the CCMD AOR or JTF OA relies on standardized means of creation, dissemination, and implementation. JTF instructions must exist in a prepositioned state and receive only minor periodic changes to accommodate changes in mission and force structure. JACS software is widely recognized as the joint standard for JCEOI development.

(1) JCEOI generation also creates a software distributable hopset and loadset required for SINCGARS and HAVEQUICK to function. This generation enables a degree of COMSEC protection by using unique call words, network identification (NET ID) channels, and transmission secure keys (TSK) for SINCGARS, HAVEQUICK, and other compatible FH capable systems. JCEOI generation also creates an extract to enable HAVEQUICK FH operations.

(2) The creation of the JCEOI can take on many variations. Variations come from several different external as well as JEMSOC internal factors. The intent of this section is to examine the complexity of the JCEOI process and provide some of the questions that should be asked. Skill at creating a JCEOI and using JACS are perishable, if not used on a daily basis. The JCEOI development process is shown in Table 30.

(a) Pre-design. The product determines how the organizational structure and requirements are entered into JACS. This pre-design phase should be accomplished at all echelons at one time or another; the JCEOI is just piecing together several subordinate MNLs to create the JCEOI. However, each echelon needs to consider the following during this initial process:

1. A concept of the organization's unit structure.

2. An idea of the organization's communications net requirements.

3. Available types of radio equipment.

4. Interoperability requirements (within the unit and for joint/coalition operations).

5. Frequency requirements and restrictions.

6. Frequency band allocations and restrictions.

7. Special requirements the organization needs for the operation.

(b) Design. Most of the work for component JCEOI are performed well in advance of any operation; however, during the merging process there are several steps JEMSOC must take to ensure there are no mistakes caused by lack of planning. Providing guidance to the JTF components and sub-component levels as soon as possible on JCEOI MNL design is essential. Another way to accomplish this is to establish a pre-planned design in advance of the requirements (deliberate planning). Maintain constant contact with the J-6 communications planners because they will be in design mode as well. Knowing the proposed force structure prior to collecting MNLs, spectrum requirements, and designing the policy and procedures message will help prevent potential problem areas.

Step	Action
1	Create Mission
2	Create Plan (Coordinate)
3	Create Folders (MNL, RM, SOI)
4	Create (import as needed into) JACS MNL, or SFAF with line item 983.
5a	Create Reuse Scheme (Class/Zones) (Coordinated)

Step	Action
5b	Create Frequency Separation Plans (as needed)
5c	Establish Share Plan(s) (Coordinated)
6a	Conduct SOI-Frequency Analysis (done at the CCMD, JTF, and Component levels).
6b	Create SFAF Proposals
7	Complete SFAF Proposals
7a	Import to SPECTRUM XXI
7b	Validate Proposals
7c	Follow Procedures for RF Proposal Requests
8*	Create/populate appropriate dictionaries
8*	Create Call Sign Share Groups/annotate MNL
8*	Create Call Word Share Groups/annotate MNL
8*	Create extract groups
8*	Create quick reference pages for extract and Master Call Sign Book
9a	Transfer/Import RF assignments
9b	Replicate MNL from default net lines

Step	Action
9c	Change resource type from RAW to SOI in RM
10	Create short titles and editions—Always generate spare edition for compromise recovery
11	Select MNL lines, generate components as required
12	Create Extract Packets
13	Validate generated components by displaying JCEOI
14*	Export JACS database, print JCEOI packets (¼ – ½ - full page formats), export OPTASKCOM circuits (as needed), export to CT3 devices
14*	Export SFAF modification records for each time period (JEMSOC only) update SPECTRUM XXI database as required.
As needed	Add new nets/circuits to MNL, create new extract groups, selectively generate those nets, update edition, and distribute as necessary
As needed	If component of JTF is compromised, generate short-term procedure by regenerating just the compromised portion and distribute as necessary.
As needed	Those components requiring change from daily changing to fixed frequency, defined as generated fixed, generate and distribute as necessary.
* Can be accomplished in any order.	

Table 30. JCEOI Order of Completion

(c) Classification. Classification should always be at the top of the list of concerns, because of the sensitivity of the information spectrum managers handle. Since there are many combinations of classifications, it was decided to take a general approach to the classification of individual nets. When the user initially enters a classified net by placing a two-letter classification and special handling code into the SEC CLASS, JACS prompts the user for the declassification instructions. Most, if not all, classifications will be derivative (i.e., the spectrum manager or JEMSOC will not be the original classification authority and will classify information IAW the source from which it was derived); retain a repository of those sources as references and for properly marking the JCEOI. Releasability and special handling codes could require some lead time to obtain or determine, so plan the task of obtaining them as early as possible.

(d) Mission and Plan. The user must create a mission; this name can be anything identifying its use for the operator. The plan name entails two concerns. The first concern is the name of the plan. The first four characters of the plan name are used for the agency abbreviation (identifier) portion of the agency serial number of the SFAF proposals; SPECTRUM XXI will require they be actual characters (not numbers or spaces). The second concern is the effective date (which will be SFAF item 140) and duration (which, when the duration in days is added to the effective date, becomes SFAF item 141). Ensure the time period extends out far enough to cover the planned or anticipated duration of the exercise or operation so they do not get inadvertently sent to the delete history of the EMOE database in SPECTRUM XXI.

(e) The MNL. The MNL is the foundation of the JCEOI. The MNL is where the net, call sign, call word, and frequency requirements are identified; therefore, it also captures a portion of the frequency requirements for the JTF. Keeping the MNL organized is essential so the JEMSOC, as well as components, can quickly and easily identify the locations of sections containing the information to extract. One method for organizing the MNL is into sections. Once again, this is based on personal or command preference; however, the recommended method is to design it into a hierarchical structure based on the JTF organization (e.g., CCMD, JTF, JFACC, coalition, Air Force forces (AFFOR), ARFOR, joint force special operations component commander (JFSOCC), NAVFOR, Marine forces (MARFOR) layers). The recommended way to create a JCEOI for a JTF is having the JEMSOC be the generation authority for the entire JCEOI, thereby alleviating many possible mistakes. JACS allows the ability to transfer all net associated data from one terminal to another.

(f) Net Unique Identifiers. The Net Unique Identifiers (NUI) is the basic characteristic for any net or circuit placed on the MNL. It is essential to understand the NUI is of utmost importance because it; lays the foundation for the SFAF proposal; the SFAF assignment import and replication; establishing a relationship between the requirement (the MNL) and the fulfillment of that requirement (the frequency in the resource manager); generation; and finally, the modification record SFAF sent back to the SPECTRUM XXI database. Nowhere along this entire process can an NUI be changed without informing the next higher echelon in the spectrum management chain of command. If this does happen, the JEMSOC will be unable to generate those nets because of a failure between the NUIs of the MNL and the resource manager. JACS has certain edit checks that will identify for the user items needed for different net types, as follows: net name, net type, classification, frequency or frequency band, transmitter state/country, transmitter antenna location, station class, emission, power, and channel spacing.

(g) Additional Fields. Although the data fields above can be considered most important in terms of minimum required in the process toward completing the JCEOI, additional fields are required. Completing the MNL requires additional considerations. However, at this juncture, the spectrum manager should be primarily concerned with those that will provide SFAF proposals and allow JACS to validate the MNL—the remainder can be completed later.

(3) Net ID. Choosing SINCGARS as a net type requires two types of frequencies, a CUE and a MAN channel. JACS will not allow the operator to validate the MNL until a NET ID is added. The NET ID is a three-digit number (000-999) used as an identifier for the SINCGARS nets in frequency hopping mode. Each net is operated using a different ID number. It designates the frequency within the hopset on which to start hopping. For a random number assignment, an X can be placed in the first digit location to identify a random number in that 100s series (9xx) or in all three fields to allow JACS to generate a random number from 000-999. This information should be a part of the initial spectrum management process message. Each command can have these organized for ease of use for subordinate units. For example:

Net Number	Element Assigned
000-099	Theatre/Joint Level
100-299	Service Component Level/Corps
300-599	Service Level Units

(4) It is important to remember this is a coordinated effort and units sharing the same TSK must have separate NET IDs. For units with different TSKs, it does not matter if two units are assigned the same NET ID.

(5) Call Word and Call Sign. International call sign and call word management is governed under ITU RR polices, with governance provided by the appropriate nation’s Administration. The FCC and NTIA control the use and issuance of call words and call signs within the US&P for commercial and

general federal use. The ITU and NTIA provide military forces the ability to independently manage call signs and call words for internal use.

(a) Call Sign. A call sign is a unique alphanumeric or phonetic letter-number-letter combination used to identify a unit or element on a given radio net. A suffix is a two-digit number used in conjunction with a call sign to indicate a specific position, mission, or function (e.g., 06 for Commander). An expander is a single letter code used in conjunction with a suffix and call sign to identify a sub-element or position, mission, or function (e.g., 06T for Commander's radio operator). The only option allowed in this field is "Y" or "N" for yes or no. This tells JACS to randomly assign a call sign for this net or, if the unit desires a letter-number-letter combination, can be entered giving the unit a nonchanging call sign. Units sharing the same nets can later be grouped using the call sign-sharing plan. The maximum number of unique call signs available for any JCEOI is 6,760 (due to available letter number combinations). See subparagraph (7) below for additional guidance if more than 6,760 calls signs are required within a JCEOI. A net is required to have a call sign, even when operating in secure mode, in case of a malfunction in secure equipment, to prevent the enemy from gathering intelligence on that affected station. If the JCEOI contains more than the maximum number, the operator must choose those nets where it would be acceptable if they shared a call sign with another unit, because they are not in the same net, or they will never operate within the same command structure. When this occurs, the units must be placed into two different organization codes (OCs). JACS automatically assigns an OC code of 1 to all new nets.

(b) Call Words. A call word is a pronounceable word, unique to the specific net used, to identify units when communicating in a secured communications net. Call words serve the same function as a Call Sign. Reference (q), published by the MC4EB, is the source document for assigning joint call words for communicating among JTF elements. See references (g), (q), and (s). In lieu of JANAP 119, coalition, allied, or partner operations may have an alternate master call word reference based on the respective regional partner agreements (e.g., ACP-119 for NATO operations). See Appendix L to this enclosure. The JFC retains sole authority to assign and deconflict JTF call words.

(6) Organizational Codes

(a) OCs are used for two purposes: for call sign requirements greater than 6,760 (discussed above), and for a JCEOI that contains more than 1000 SINCGARS NET. When a net is first entered into the MNL, JACS defaults the value in this field to a number 1. OC identification is primarily used to allow assignment of identical SINCGARS net IDs in developing the JCEOI (since there is a limit imposed of 999) and in merging, printing, and exporting data, when there will commonly be duplicates between two units utilizing SINCGARS. OCs need to be published as part of the SINCGARS or JCEOI Exhibit within Tab A, to Appendix 23, to Annex C; one example can be seen below in Table 31. Notice in Table 31 that the JTF, NAVFOR, JFSOCC, and AFFOR are utilizing the same OC. This is because the sum of the SINCGARS nets is not above 1000. However, looking at the 2 ARFOR DIVs and the MARFOR, each have a separate net ID. This could mean each of these entities want to utilize the 300 series NET IDs for their command elements or that each contain over 1000 SINCGARS nets when combined with one another.

Net Description	Net ID
JTF nets	1
ARFOR 55th INF DIV	2
ARFOR 56th INF DIV	3
MARFOR 31st MEU	4
NAVFOR nets	1
JFSOCC nets	1
AFFOR nets	1

Table 31. Representative Organization Codes

(b) OCs are also used in a situation where more than 6,760 call signs are required. A separate OC must be created in this case. However, the challenge with the 6,760 unique call sign limit means the same call sign will be shared by separate units/elements operating on a different OC. Great care must be taken by planners and operators to identify and alleviate potential confusion between the two or more elements sharing the same call sign on joint nets during pre-mission planning. These units would probably be a part of a lower echelon, so that confusion would be averted. No matter what the OC code is, JACS will attempt to provide all nets a unique call sign during generation before it begins to look to the OC code to start reusing call signs.

(7) <u>Reuse Class and Zone (Reuse CL and Reuse ZN)</u>. Utilizing a frequency reuse plan should be a part of every unit's operating procedure, especially in the 30-88 MHz range. Typically reuse is broken up into two areas: classes and zones. A good reuse plan should be developed by first placing the lowest echelon (platoon/squad) into the reuse plan, then evaluating the need to add other higher echelon nets. The designers must realize this is a step-by-step process and can take time to complete. If the plan is haphazardly put

together, there is a high probability for interference. Selecting which nets can be put into a reuse plan is difficult unless the designer is knowledgeable of the specifics regarding the unit(s) and how they communicate. Sometimes it is easier to identify which nets should not be in the reuse plan.

(a) The following is a list of nets that would not normally be put into a reuse plan because of mission requirements:

1. Command nets.

2. Retransmission/relay nets.

3. Fire control/direction nets.

4. Aviation nets (30-88 MHz).

5. Emergency/medical evacuation (MEDEVAC) nets.

6. Fixed frequency nets.

7. Anti-jam nets (non-frequency hopping).

(b) Reuse Class. In the reuse class column, enter the class number the net is assigned to. Each class will make assignments to its nets from a different set of frequencies (from the correct NUI group); therefore, class 01 uses a group of frequencies and class 02 uses another set of frequencies. There can be up to 99 classes assigned for any one JCEOI. All nets within a class must have the same NUIs. The designer must enter a zone number if a class number is assigned. The total frequency requirement for any class is equal to the number of nets in the largest zone in that same class.

(c) Reuse Zone. In the reuse zone column, enter the zone number the net is assigned to. A zone is a group of nets in which an assigned frequency cannot be repeated within that group for the same time period. Zones contain elements that will not share common frequencies within the same zone but will share common frequencies with elements of other zones within the same class. The reuse planning process may be changed several times during the course of building the JCEOI and requires constant attention to ensure the frequency requirements and assets are in synchronization with one another. The ideal frequency plan would have a 1:1 ratio or nets to frequencies; however, this is hardly ever the case on the modern battlefield. The designer must be familiar with the operation being conducted, the geographic regions, the unit structures, and how they fight and use the frequencies. This information is critical to the designer. Knowing the geographic region and the operation, it may be possible to share radio frequency resources between two units separated by a mountain range. If the designer is familiar with the unit's task organization, lower echelon units may be able to share radio frequency resources. Many units are experienced enough with SINCGARS operation to hardly ever use the cue or the manual channels (they utilize net cold start procedures)—entering the Julian date, GPS time, and loadset and then entering the net without requesting an electronic remote fill (ERF)—which makes these nets the best candidates for reuse plans. The reuse class separates the reuse plan into pools of available frequencies. A class will use an entirely different frequency resource than that of another. JACS allows 99 classes and 99 zones in each class with an unlimited number of nets in each zone. The amounts of nets placed into one zone should be very close to that of other zones because the number of nets required for the largest zone in a class is the number of frequencies required for the entire class. This will tell the JCEOI developer how to better improve the reuse plan, whether to add or subtract nets, and which zones to modify. This is based on the JEMSOCs guidance when making the initial determination for JCEOI production. The JEMSOC should coordinate with the spectrum assignment authority and attempt to determine an estimated number of frequencies that will be received by the JTF; especially in the 30–88 MHz band.

(d) Frequency Sharing Plan. A frequency share (FRQ Share) plan should be done in conjunction with the reuse plan since nets in a reuse plan cannot be in a share plan and vice versa. By placing one or more nets into a share plan during the generation of the JCEOI, JACS will assign the same frequency to all nets in that sharing group. In JACS, the sharing plan must be named first and the user would go to the CEOI/SOI groups display of the MNL utilizing the FRQ Share column to add nets to that share plan. Nets that are candidates for sharing are:

1. Nets that are separated geographically.

2. Nets where the duty cycle (the time of actual transmission versus non-transmit time) is very low.

3. Nets used for a similar purpose (such as survey nets).

(e) LOADSET Generation. On the JACS workstation, the loadset is defined as the package of COMSEC keys and FH data adequate to load all six channels of the SINCGARS integrated communications security radio. One loadset consists of COMSEC key tags, hopsets/lockouts, TSK, and net IDs. The JTF JCEOI requires a loadset that ties the JCEOI, the SINCGARS Hopset, and the cryptographic key together. This combination provides secure communications. The creation of the loadset is built using the procedures in Annex A to Appendix E (Joint Radio Nets) of this enclosure and reference (v).

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ANNEX A TO APPENDIX G TO ENCLOSURE F

JOINT RADIO NETS

This annex contains tabular listings of joint radio nets in three categories: Command Authority Nets, JTF Nets, and Air Coordination Nets.

Command Authority Nets	
Net Name	**Description**
CCMD 1	CCMD Command Net - Secure UHF SATCOM voice net connecting the supported Command Authority, Commander, Joint Task Force (CJTF), and selected subordinates.
CCMD 1A	CCMD Command Net – Secure HF-single side band (SSB) voice net connecting the CCMD, JTF, and selected subordinates.
CCMD 1B	CCMD Command Net – Secure super high frequency (SHF) SATCOM data net connecting the supported CCMD and selected subordinates.
CCMD 2	CCMD Mission Radio Net – Nonsecure HF-SSB voice net supporting security assistance administrative matters.
CCMD 3	Command Data Net – Secure HF data net between supported CCMD and JTF.
CCMD 3A	Command Data Net – Secure HF data net between supported CCMD and Commander, United States Forces (COUNTRY).
CCMD 3B	Command Data Net – Secure HF data net between supported and supporting CCMDs.
CCMD 4	CCMD Special Intelligence Net – Secure HF-SSB data net linking supported CCMD, JTF, and selected special intelligence elements.
CCMD 5	Tactical Missile Alerting Net – Secure UHF SATCOM voice alert broadcast net to JTF and in-theater forces. Established upon direction of JTF.

Table 32. Command Authority Net Listing

JTF Nets	
Net Name	**Description**
JTF 3	Embassy Emergency and Voice Command Net – Nonsecure HF-SSB voice net between military commanders and American Embassy within the area of the crisis.
JTF 3A	Embassy Emergency and Voice Command Net – Secure VHF-FM voice net between military commanders and American Embassy within the area of the crisis.
JTF 3B	Embassy Emergency and Data Command Net – Secure HF-SSB Data net between military commanders and American Embassy in area of crisis.
JTF 5	Out-Of-Country Net – Secure and Nonsecure UHF SATCOM voice net providing the JTF and component HQ with DSN access via a satellite ground entry station.
JTF 6	Noncombatant Evacuation Net – Nonsecure HF-SSB voice net to link selected evacuation points and elements being evacuated.
JTF 6A	Noncombatant Evacuation Net – Nonsecure HF-SSB voice net activated by JTF or senior objective area commander to link selected evacuation points and elements being evacuated.
JTF 7	Joint Medical Regulation Net – Nonsecure HF-SSB voice net linking JTF-designated medical authorities.
JTF 7A	Joint Medical Regulation Net – Nonsecure VHF-FM voice net linking JTF-designated medical authorities.
JTF 8	JTF Objective Area Special Intelligence Net – Secure HF-SSB data net linking supported CCDR, JTF, and selected special intelligence elements.
JTF 8A	JTF Objective Area Special Intelligence Voice Tactical Satellite net – Secure UHF SATCOM between JTF and subordinate and supporting commanders.
JTF 11	Joint Command Net – Secure UHF SATCOM net for JTF and components.
JTF 11A	Joint Command Net – Secure HF-SSB voice net (backup to JTF 11).
JTF 12	Joint Administrative and Logistics Net – Secure UHF SATCOM voice and FAX net connecting JTF and subordinate forces to coordinate routing administrative and logistic requirements.
JTF 12A	Joint Administrative and Logistics Net – Secure HF-SSB voice (backup to JTF 12).
JTF 17	Joint and Combined Search and Rescue (SAR) Net – Nonsecure HF-SSB voice net linking SAR elements.
JTF 17A	Joint and Combined SAR Net – Nonsecure UHF voice net linking the SAR elements.
JTF 17B	Joint and Combined SAR Net – Nonsecure VHF-FM voice net. Links SAR elements.
JTF 18	JTF Communications Engineering Net – Secure HF-SSB voice net for coordination relating to communications systems operation.

JTF 19	Joint Information Bureau Net – Nonsecure HF-SSB operated IAW special instructions promulgated by the supported CCMD Joint Information Bureau.
JTF 19A	Joint Information Bureau Net – Nonsecure VHF-FM operated IAW special instructions promulgated by the supported CCMD Joint Information Bureau.
JTF 23	JTF Objective Area Voice Command Net – Secure VHF-FM voice command net linking JTF forward-deployed element in the objective area with designated subordinates.
JTF 24	Medical Evacuation Net – Nonsecure VHF-FM voice net linking JTF units for purpose of medical evacuation.
JTF 24A	Medical Evacuation Net – Secure UHF SATCOM data net between JTF field hospital and area of operation medical center.
JTF 70	Commander Joint MISO Net – Configuration to be promulgated when activation is required.
JTF 75	Joint Counterintelligence Coordination Net – Configuration to be promulgated when activation is required.
JTF 81	Joint Supporting Arms Coordination Net – Secure HF-SSB voice nets for component forces to coordinate with JTF concerning supporting arms for fire that impact outside of the task force areas of operation.
JTF 81A	Joint Supporting Arms Coordination Net – Secure VHF-FM voice nets for component forces to coordinate with JTF concerning supporting arms for fire that impact outside of task force areas of operation.
JTF 82	Naval Fire Control – Secure or Nonsecure HF-SSB voice net used to pass mission status and relief reports from the firing ships to CTF____SACC.
JTF 83	Naval Fire Support Net – Secure HF-SSB voice net supporting requests for fire, ship assignments, and orders pertinent to execution of fires.
JTF 84	Naval Fire Ground Spot Net – Secure HF-SSB voice nets between shore fire control party (SFCP) and assigned direct support gunfire ships.
JTF 84A	Naval Fire Ground Spot Net – Secure VHF-FM voice nets between SFCP and assigned direct support gunfire ship.
JTF 85	Joint Link-up Net – Secure VHF-FM voice net to coordinate rendezvous of separate elements or the rejoining of detached elements to parent organizations (multiple discrete frequencies).
JTF 86	Naval Fire Ground Spot (Expansion Net) – Secure or nonsecure net to call for and adjust fire for units of TF ____. Assignments of SFCP Spot net to the firing ship and Support Fire Control Spot team will be made on JTF-82 by CTF _____SACC.
JTF 87	Naval Fire Ground Spot (Expansion Net) – Secure or nonsecure net to call for and adjust fire for units of TF____. Assignments of SFCP Spot net to the firing ship and SFCP Spot team will be made on JTF-82 by CTF____SACC.
JTF 88	Naval Fire Ground Spot (Expansion Net) – Secure or nonsecure net to call for and adjust fire for units of TF___. Assignment of SFCP Spot net to the firing ship and SFCP Spot team will be made on JTF-82 by CTF___SACC.

JTF 89	Naval Fire Ground Spot (Expansion Net) – Secure or nonsecure net to call for and adjust fire for units of TF___. Assignment of SFCP Spot net to the firing ship and SFCP Spot team will be made on JTF-82 by CTF___SACC.
JTF 90	Naval Fire Ground Spot (Expansion Net) – Secure or nonsecure net to call for and adjust fire for units of TF___. Assignment of SFCP Spot net to the firing ship and SFCP Spot team will be made on JTF-82 by CTF___SACC.
JTF 91	Combined Forces Link-up Net – Nonsecure VHF-FM voice net to coordinate rendezvous of separate elements or the rejoining of detached elements to parent organizations (multiple discrete frequencies).
JTF 93A	NF Airspot Control – Secure or nonsecure UHF voice net used by airborne spotter to call and adjust fire. Assignment of this net to an air spotter will be made over the Tactical Air Observation Net. Assignment of this net to the firing ships will be made on JTF 83, "Naval Fire Support." Only one fire mission at a time, per net, will be conducted.
JTF 93B	NF Airspot Control – Secure or nonsecure UHF voice net used by airborne spotter to call and adjust fire. Assignment of this net to an air spotter will be made over the Tactical Air Observation Net. Assignment of this net to the firing ships will be made on JTF 83, "Naval Fire Support." Only one fire mission at a time, per net, will be conducted.
JTF-XXX	JTF Net Expansion – JTF expansion capability for additional net designators as determined by the applicable CCMD or JTF.

Table 33. JTF Net Listing

Air Coordination Nets	
Net Name	**Description**
AC 1	Joint Air Coordination Net – Secure UHF voice net via tactical satellite linking military air control agencies for coordination of air operations within and adjacent to the objective area.
AC 1A	Joint Air Coordination Net – Secure HF-SSB voice net backup to UHF satellite net. Links military air control agencies for coordination of air operations within and adjacent to the objective area.
AC 2	Civil Air Control Common – Nonsecure VHF-AM voice net designated by the Federal Aviation Administration or Civil Air Route Traffic Control Center to be used by Air Force Air Traffic control functions at CTF ______ control and reporting centers (CRCs) and/or control and reporting posts (CRPs) for control of civil aircraft movement in and through tactical airspace.
AC 3	Tactical Air Traffic Control Net – Nonsecure UHF voice net guarded by air control agencies of Navy and Marine tactical air control system for initial report by tactical aircraft in support of CTF___ units. Also used by administrative and transient aircraft to establish contact with the applicable control agency. Circuit may also be used by AFFOR elements for Theater Air Control System (TACS) and COMMON initial reporting net.
AC 3A	Tactical Air Traffic Control Net – Nonsecure UHF voice net guarded by all Air Force radar facilities for initial reports by tactical aircraft in support of AFFOR CRCs and/or CRPs for control of civil aircraft movement in and through tactical airspace.
AC 4	Tactical Air Direction Net – Secure UHF voice net provides for direction of aircraft in the conduct of a close air support (CAS) mission (multiple discrete frequencies).
AC 5	Fighter Air Direction, Combat Air Patrol, and Air Defense Net – Nonsecure UHF voice net supporting aircraft mission briefs and control of combat air patrol aircraft performing air defense alert, fighter escort, and/or threat intercept missions.
AC 8	In-flight Report – Nonsecure UHF voice linking tactical air control systems and aircraft.
AC 9	UHF Airborne Relay – Secure or nonsecure UHF used to provide and extend point-to-point UHF voice communications between ground and surface elements.
AC 9A	UHF Airborne Relay – Secure or nonsecure UHF used to provide and extend point-to-point UHF datalink communications between ground and surface elements.

AC 10	Joint Air Support Coordination Net – Secure HF-SSB voice net used to coordinate immediate air support.
AC 10A	Joint Air Support Coordination Net – Secure VHF-FM voice net to coordinate immediate air support.
AC 11	Link 11/22 – Secure HF netted tactical digital information link (TADIL) A datalink.
AC 11A	Link 11/22 – Secure UHF netted TADIL A datalink.
AC 12	Link 14 – Secure HF-SSB receive-only broadcast providing air movement data.
AC 13	TADIL B – Normally, a secure or nonsecure full duplex, HF, point-to-point link that operates with continuous transmissions in both directions, utilizing serial transmission frame characteristics.
AC 14	Interface Coordination Net – Secure HF-SSB voice dual-function net (tactical weapon employment coordination and digital message and interface control).
AC 15	Track Supervision Net (TSN) – Secure or nonsecure HF-SSB voice primary, assisting units entering and exiting the interface.
AC 15A	TSN – Secure or nonsecure UHF voice backup, assisting units entering and exiting the interface.
AC 16	Datalink Coordination Net (DCN) – Secure or nonsecure HF-SSB voice primary used to coordinate equipment supporting TADIL operations.
AC 16A	DCN – Secure or nonsecure UHF voice backup used to coordinate equipment supporting TADIL operations.
AC 17	Voice Product Net (VPN) – Secure UHF voice net used to forward non-digital SIGINT information to other interface subscribers.
AC 17A	Special Information Systems/VPN – Secure UHF voice net used to forward non-digital special intelligence and SIGINT information to other interface subscribers.
AC 18	Tactical Air Request Net – Secure HF-SSB voice net used to request immediate air support from air control agencies.
AC 19	Fighter Check-In Net – Secure or nonsecure UHF voice net used to direct joint fighter type aircraft missions.
AC 19A	Fighter Air Direction Net – Nonsecure UHF voice net used to direct joint fighter type aircraft missions.
AC 20	Air Traffic Control – Nonsecure UHF voice used for air traffic control services.
AC 20A	Air Traffic Control – Nonsecure VHF-AM voice used for air traffic control services.

AC 23	Tanker, Refueling, and Rendezvous Operations – Nonsecure UHF or VHF-AM voice nets for control of rendezvous and tanker and/or tactical aircraft in-flight refueling operations (multiple discrete frequencies).
AC 24	HELO Direction Net – Nonsecure UHF voice net used to control HELO assets in the JTF operating area.
AC 25	HELO Command Net – Secure UHF voice net linking the tactical air control center with the Naval HELO support units.

Table 34. Air Coordination Net Listing

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APPENDIX H TO ENCLOSURE F

DEVELOP THE JRFL

1. Overview. 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. The JRFL does not provide protection from other authorized spectrum users. Frequency protection is provided by a valid frequency assignment, assigned under authority within SPECTRUM XXI. The JRFL is an EMSCM that operational, intelligence, and support elements use to identify the level of priority desired for various networks and frequencies. The JRFL is developed prior to initiating joint force operations and is continually updated during operations. This activity requires a TOP SECRET clearance to collaborate, coordinate, and manage.

2. JRFL. The CCMD is responsible for JRFL production across its AOR. The CCMD may delegate production to a subordinate command. Draft JRFLs are produced in support of FUPLANS and refined during emergent contingency and crisis planning. Draft JRFLs contain essential baseline capabilities required to support all operations (see Table 35, Worldwide-Restricted Frequency List). During operations, the JRFL is typically developed by the JTF JEMSOC. The JEMSOC should compile the JRFL based on the coordinated inputs from the operations, intelligence, and communications staffs. The JEMSOC should ensure that the RF assignments of nets and systems designated for inclusion as PROTECTED or TABOO on the JRFL before final approval and dissemination. For EW deconfliction measures in support of JRFL preparation see Appendix I of this enclosure. The restrictions imposed by the JRFL may only be removed at the direction of the J-3 if determined that the benefit of jamming a restricted frequency surpasses the immediate criticality to friendly forces. Operations and intelligence functions must be consulted before this decision.

a. GUARDED. A list of enemy frequencies that are, for a special time period, exploited for combat information and intelligence or jammed after the commander has weighed the potential operational gain against the loss of the technical information.

b. PROTECTED. 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. TABOO. 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.

3. JRFL Production Process. See Figure 28.

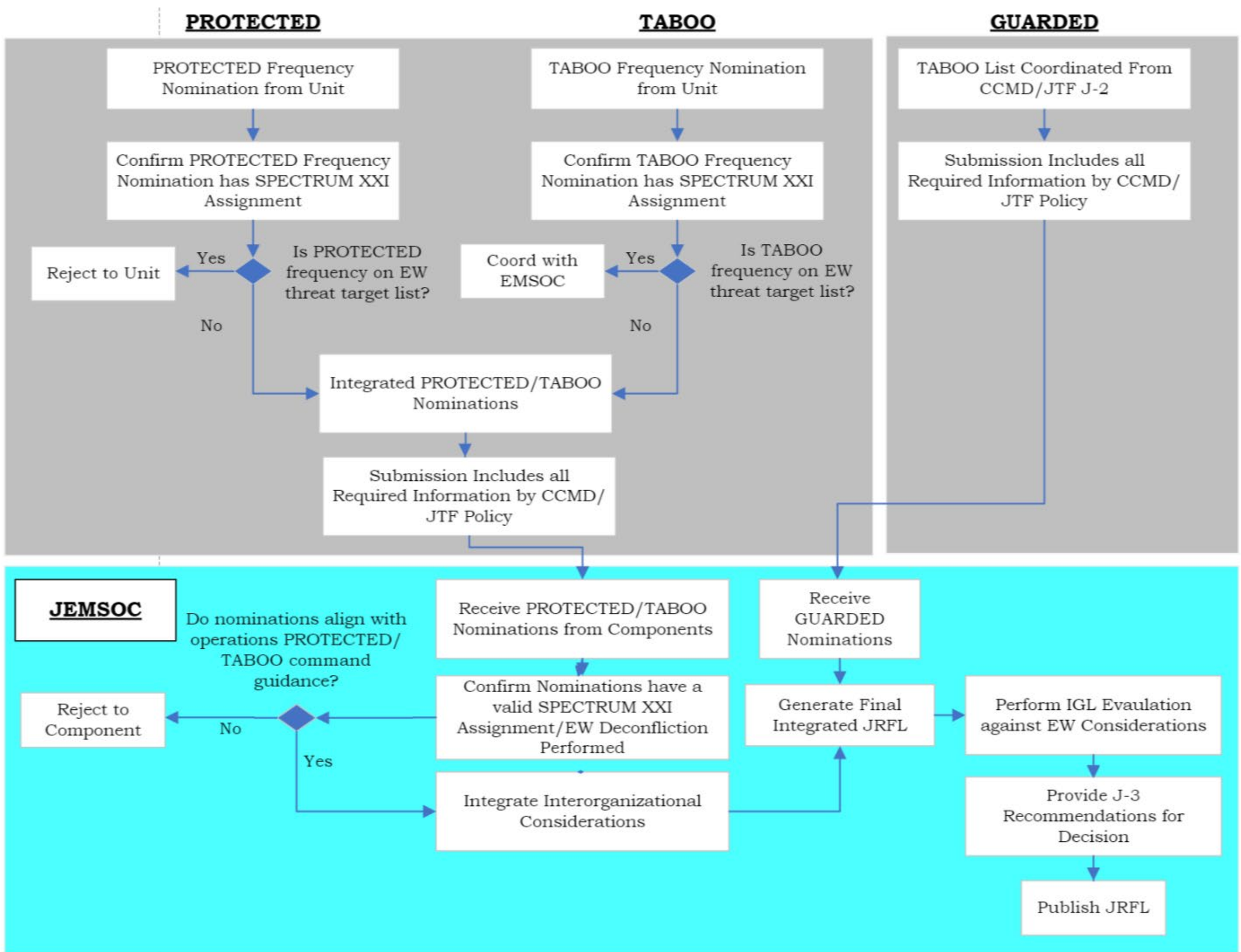

Figure 28. The JRFL Process

4. Policy. The CCMD and JTF will publish guidance in support of JRFL collaboration, production, management, and dissemination. Policy should outline clear assignment of EA authority, coordination channels for JRFL production, promulgation of the JRFL, responsibilities, coordination, and deconfliction procedures in support of ongoing operations.

a. Identification. The JRFL identification process begins at the unit level and works upward through component's chain-of-command. The JTF staff, along with other agencies, will identify to the JEMSOC those frequencies to be included in the JRFL. Units may submit JRFL nominations along with SFAF and MNL inputs. Components will identify nets requiring protection in the MNL entry or in SFAF item 985 for non-JCEOI requirements. JRFL nominations require justification. JRFL will be submitted using SPECTRUM XXI format and sent via secure email to the JEMSOC. International TABOO frequencies will be incorporated at the JEMSOC; the components need not submit them. In some cases, JFC's may find SPECTRUM XXI does not support more precise hourly and geolocation identification in support of mission requirements and may enable additional or outside systems and processes in support of their JRFL development. The following are the minimum fields for JRFL input consideration.

(1) Proposer. Contact information for the RF proposer (Name, Phone Numbers, User/Email Address—all three are submitted for the organization wanting the RF to be added to the JRFL).

(2) Frequency. All frequencies are documented in MHz. Frequency proposed for JRFL inclusion is validated as assigned within SPECTRUM XXI. Special consideration is made for the inclusion of GUARDED frequencies not assigned within SPECTRUM XXI.

(3) System. Nomenclature of emitter and nomenclature of system (e.g., name of radio and name of platform). Emission designator if known.

(4) Receive Location—Latitude/Longitude. These coordinates are the latitude and longitude of the receiver location. In future, the coordinates may mark a bounding box for an area within which the receiver will be operating (e.g., if the exact location of the adversary receiver is unknown).

(5) Time. If the JRFL nomination is for a limited duration, the beginning and end Date-Time-Group is required. Document the appropriate time zone designator in which the operation will occur. The Juliet time zone designator identifying the use of local time should not be used. The Lima time zone designator should not be used unless operations are occurring within the UTC +11 designated time zone.

(6) Radius of Receiver. This is the area of operation in kilometers using the receiver or transmitter latitude-longitude as the center point.

(7) JRFL Justification. This is the specific function or usage (i.e., net name) of the RF and justification for all JRFL entries. Requesters will provide a concise description.

(8) JRFL Code. Single-letter code to categorize the JRFL frequency entry type: P, G or T.

(9) EW Deconfliction. See Appendix I to this enclosure for additional information on EW deconfliction.

b. Consolidation. Input to the JEMSOC will be in the form of JCEOI nets, frequencies in the database, and frequencies identified by the various elements of the J-2, J-3, and J-6. These frequencies, along with any frequencies similarly identified by the components, are consolidated by the JEMSOC. All generated JCEOIs for the JTF will be provided to the JEMSOC. Included will be a listing of international TABOO frequencies.

c. Review and Dissemination. The draft JRFL is evaluated by the JEMSOC planners for review, coordination, and deconfliction. Once approved the JEMSOC will disseminate the JRFL.

5. SPECTRUM XXI Data Fields. The following is a list of data fields required to complete the JRFL report in SPECTRUM XXI.

a. Classification. One character indicates the security classification of the JRFL.

(1) U = UNCLASSIFIED.

(2) C = CONFIDENTIAL.

(3) S = SECRET.

b. Declassification. The declassification date for the JRFL frequency entries.

c. Unit. Name of the unit to which the frequency is assigned.

d. Status. Restricted classification status followed by a slash (/) and two characters to indicate the level of restriction, A–Z and 1–9, with A1 being the highest level (SFAF line 985).

(1) T = TABOO.

(2) G = GUARDED.

(3) P = PROTECTED.

e. Period. The time-period for which the restriction will be active. This refers to the JCEOI time-period.

(1) Start Date. The date on which the restriction will begin.

(2) End Date. The date on which the restriction will end.

(3) Start Hour. The hour on which the restriction will begin.

(4) End Hour. The hour on which the restriction will end.

(5) Agency Serial. A unique agency identifier for each frequency assignment (SFAF Item 102).

(6) Frequency. The frequency to be restricted.

(7) Emission. The bandwidth and emission designator of the equipment (SFAF Item 114).

(8) Power. The transmitter power proceeded by the unit indicator (SFAF Item 115). Unit indicators are as follows for data entry into SPECTRUM XXI:

(a) W = if power is less than 1000 watts.

(b) K = if power is at least 1 kilowatt (kW) but less than 1000 kW.

(c) M = if power is at least 1 megawatt (MW) but less than 1000 MW.

(d) G = if power is 1 gigawatt or greater.

(9) Transmitter Lat-Long. The latitude and longitude of the transmitter location in degrees, minutes, and seconds followed by N or S for the latitude and E or W for the longitude.

(10) Receiver Lat-Long. The latitude and longitude of the receiver location in degrees, minutes, and seconds, followed by N or S for the latitude and E or W for the longitude.

(11) Equipment. Enter the equipment name.

(12) Comments. Enter all remarks, limitations, and comments.

6. Frequency List. Table 35 contains the baseline worldwide TABOO frequency listing.

FREQUENCY	AUTHORIZED USAGE	EMISSION DESIGNATOR
K490	GMDSS/MET AND NAV WARNINGS	1K24F1B
K500	GMDSS/DISTRESS AND CALLING	20K00A2A
K518	GMDSS/NAVTEX/MET AND NAV WARNINGS	1K24F1B
K2174.5	INTL DISTRESS/SAFETY	3K00J3E
K2182	INTERNATIONAL DISTRESS	6K00A3E
K2187.5	INTL DISTRESS/SAFETY	3K00J3E
K3023	INTERNATIONAL SAR	6K00A3E
K4125	INTERNATIONAL DISTRESS AND SAFETY	6K00A3E
K4177.5	INTL DISTRESS/SAFETY	3K00J3E
K4207.5	INTL DISTRESS/SAFETY	3K00J3E
K4209.5	GMDSS/NAVTEX MET AND NAV WARNINGS	1K24F1B
K4210	INTL MARITIME NAV SAFETY	6K00A3A
K5680	INTERNATIONAL SAR	6K00A3E
K6215	INTERNATIONAL DISTRESS AND SAFETY	6K00A3E
K6268	INTL DISTRESS/SAFETY	6K00A3E

FREQUENCY	AUTHORIZED USAGE	EMISSION DESIGNATOR
K6312	INTL DISTRESS/SAFETY	6K00A3E
K6314	INTL MARITIME SAFETY/GMDSS	1K24F1B
K8291	INTL DISTRESS/SAFETY	6K00A3E
K8364	INTL SAR/SURVIVAL CRAFT	6K00A3E
K8376.5	INTL DISTRESS/SAFETY	3K00J3E
K8414.5	INTL DISTRESS/SAFETY	3K00J3E
K8416.5	GMDSS/INTL MARITIME SAFETY	1K24F1B
K12290	INTL DISTRESS/SAFETY	6K00A3E
K12520	INTL DISTRESS/SAFETY	6K00A3E
K12577	INTL DISTRESS/SAFETY	6K00A3E
K12579	GMDSS/INTL NAVIGATION SAFETY	1K24F1B
K16420	INTL DISTRESS/SAFETY	6K00A3E
K16695	INTL DISTRESS/SAFETY	6K00A3E
K16804.5	INTL DISTRESS/SAFETY	6K00A3E
K16806.5	GMDSS/INTL MARITIME SAFETY	1K24F1B
K19680.5	GMDSS/INTL MARITIME SAFETY	1K24F1B

FREQUENCY	AUTHORIZED USAGE	EMISSION DESIGNATOR
K22376	GMDSS/INTL MARITIME SAFETY	1K24F1B
K26100.5	GMDSS/INTL MARITIME SAFETY	1K24F1B
M121.5	INTL DISTRESS/AERONAUTICAL EMERGENCY	6K00A3E
M123.1	INTL EMERGENCY/SAR	6K00A3E
M156.3	INTL SHIP/AIRCRAFT SAR	25K00G3E
M156.525	INTL DISTRESS/SAFETY/GMDSS	25K00F3E
M156.65	INTL SAFETY OF NAVIGATION	25K00F3E
M156.8	INTL DISTRESS AND SAFETY	750K00F3E
M243	AERO EMERGENCY/INTL DISTRESS/SAR	6K00A3E
M406.05	SATELLITE EPIRB	100K00F3E
M1227.6	SATELLITE GPS DOWNLINK	24M00F1D
M1544.5	SATELLITE EPIRB FEEDER LINKS	1M00F1D
M1575.42	SATELLITE GPS DOWNLINK	24M00F1D
M1646	SATELLITE EPIRB	1M00F1D

Table 35. Worldwide-Restricted Frequency List

APPENDIX I TO ENCLOSURE F

PERFORM EW DECONFLICTION

1. EW Frequency Deconfliction. Friendly, adversary, and third-party operations that use or affect the EMS have the potential to interfere with joint force communications and other emitters. To counter this, the U.S. military established spectrum management and EW frequency deconfliction procedures. This task requires spectrum management personnel to possess TOP SECRET clearances to access threat information and coordinate with respective mission partners. Spectrum management involves a wide range of technical and nontechnical processes designed to quantify, plan, coordinate, and control the EMS to satisfy spectrum use requirements while minimizing unacceptable interference. EW frequency deconfliction is a subset of spectrum management and entails systematic management procedures to coordinate the use of the EMS for operations, communications, and intelligence functions. EW frequency deconfliction is an iterative process and the steps of the process, while listed here sequentially, may occur concurrently. The steps are as follows:

a. Define the Operations Concept and Critical Functions. For each phase, the J-3 (or designated representative) defines the critical mission functions requiring uninterrupted communications connectivity or noncommunications operations. For example, communications with long-range reconnaissance elements or close air support assets could be crucial to preparing for transition from defense to offense. At the same time, noncommunications equipment such as IFF systems and fire-control radars need protection. The J-3 provides this guidance to the joint force staff and subordinate commanders for planning. The JEMSOC identifies these channels for inclusion in the JRFL as either PROTECTED or TABOO.

b. Develop the Intelligence Assessment. Based on the CONOPS, the J-2 determines intelligence support requirements. The J-2 and JEMSOC identify adversary EMS-dependent systems for targeting or exploitation in each phase of the operation (including the critical adversary functions) and identify EMS-dependent system nodes and associated frequencies that must be guarded. For example, during the friendly attack, adversary communications and noncommunications associated with C2 of counterattack forces could be crucial to friendly forces in determining the timing and location of the counterattack. Therefore, those critical nodes should be protected from EA. To achieve that protection, the J-2 must identify to the JEMSOC the adversary channels to be included in the JRFL as GUARDED. An IGL analysis should identify the value of the data being exploited to enable a JFC decision to strike adversary C2 despite its value to intelligence. In a dynamic situation such as troops in contact, the J-2 should work closely with the J-3 to make IGL recommendations in real time.

c. Manage the Electromagnetic Spectrum. The JTF JEMSOC is responsible for the administrative and technical management of the EMS within the JOA. This includes maintaining, in conjunction with the JTF staff, the database containing information on all friendly, available adversary, and selected neutral or civil EMS-dependent systems. With the aid of the database, the JEMSOC assigns frequencies, analyzes and evaluates potential conflicts, resolves internal conflicts, recommends alternatives, and participates in EMS-use conflict resolution. The assignment of frequencies is based on the CONOPS, frequency availability, unit geographic dispersion, electromagnetic propagation, equipment technical parameters, and the criticality of unit functions.

d. Define and Prioritize Candidate Nodes and Nets. The JTF staff and subordinate commanders should define functions and identify specific nodes and equipment critical to friendly and adversary operations. Candidate nodes and nets are submitted for EA protection to the JEMSOC. Friendly and neutral EOB information is provided by the JEMSOC, and adversary EOB information is provided by the J-2. Standard operations security (OPSEC) measures should be taken when making JRFL inputs.

e. Analyze Friendly EW System Programming. The JEMSOC will review EW system programing, when required, for risk and assessment in support of the RF assignment process and in consideration for inclusion in the JRFL. An example of these inputs is the JEMSOC evaluating potential EA effects of self-protection systems such as counter radio-controlled improvised explosive device EW (CREW) systems and aircraft EA capabilities to build coordinated communications/self-protection EA load sets. In this example, the spectrum manager identifies target threat radio bands to avoid assigning frequencies within CREW, or other persistent EA systems, programmed target sets. When CREW threat load sets are subject to change, the JEMSOC reviews pending changes and coordinates with subordinate units to change authorized RF assignments outside of programmed target radio bands. In support of CUOPS, JEMSOC planners should be prepared to examine cases where EA missions conflict with the JRFL or where JRFL changes might affect planned EA operations. The extent of conflict analysis depends on the tools and time available to the JEMSOC staff. JEMSOC personnel should attempt to resolve the conflict by working within the staff and with subordinate units. If the deconfliction effort is successful, the operation is conducted as planned or modified. An emitter survey may assist in validating this approach. See Appendix J to Enclosure F for more information on emitter surveys. For unresolved conflicts, the J-3 remains the ultimate authority on EW and frequency deconfliction. For example, the JEMSOC and EMSOCs review upcoming EA missions to evaluate impact to critical C4ISR systems. Affected units are informed to plan and mitigate friendly EA impact to friendly forces by the development of a primary, alternate, contingency, and emergency (PACE) plan, understanding CEASE [activity] procedures, and proactive reassignment of RF for the mission.

(1) EA. As a form of nonlethal fires, the determination to conduct offensive EA is made according to the JFC's guidance and established ROE. The JTF JEMSOC is familiar with the process and principles of joint fire support and provide appropriate guidance and coordination necessary to deconflict offensive EA with other friendly uses of the spectrum. Close, continuous coordination with component, allied, and coalition planners (during both the planning and execution phase of joint operations) is necessary to ensure that the EA missions are conducted as planned and necessary while minimizing unintended disruption of the spectrum. OPLANs should include provisions for an on-station EACA that will provide real-time coordination and deconfliction of jamming efforts (see Enclosure A). The EACA does not need to be an EA asset but should be capable of monitoring the EMS and assessing effects on both friendly and adversary and third-party forces and be in contact with EA assets to provide direction and coordination of EA efforts.

(2) Disruption. When the operation is successful and friendly EA missions do not disrupt friendly communications networks or noncommunications equipment operations, no frequency conflict occurs. However, when any disruption on a friendly frequency occurs that is attributed to a friendly EA activity, a report of the disruption should be made as soon as possible to the JEMSOC and, if critical functions are interfered with, the JEMSOC will make a determination to issue a CEASE [activity]. Table 36 contains an extract example of various brevity code combinations. See reference (t) for a complete listing of DoD multi-Service brevity codes. Allied operations may have a separate reference to adopt for operations based on regional partnership agreements (e.g., NATO Allied Procedure Publication-07, Joint Brevity Words). See Appendix L to this enclosure for additional joint, interagency, international, and multinational considerations.

Brevity Code	Description
CEASE [activity]	Discontinue stated activity
BUZZER	EW communications jamming (same as NATO term CHATTER)
MUSIC	Radar electromagnetic deceptive jamming
SPARKLE	Mark or marking target by IR pointer
TORCH	Friendly high-energy laser weapon fire
TIMBER	Jamming Link 16 network

Table 36. Example Brevity Code Combinations

f. Analyze and Mitigate Adversary EW Capabilities. Across the continuum of conflict, analysts perform a compare and contrast of adversary order of battle, EOB, and EW capabilities in support of operational objectives. The electromagnetic spectrum manager assists the JEMSOC to evaluate adversary impact on blue force joint functions and C4ISR capabilities, contributes to risk analysis of these impacts, and assists in the development of courses of actions to mitigate impact to blue forces. This action contributes to the EMOE prediction.

g. Generate the JRFL. The JRFL is a time- and geographic-oriented listing of TABOO, PROTECTED, and GUARDED functions, nets, and frequencies. The JRFL should be limited to the minimum number of frequencies necessary for friendly forces to accomplish objectives. The JEMSOC compiles the JRFL based on the coordinated inputs from the operations, intelligence, and communications staffs within the command and subordinate commands. All JRFL inputs will have a final and approved RF assignment. No RF assignment will be made within a high-risk friendly EA systems threat load. The restrictions imposed by the JRFL may only be removed, by direction of the J-3, if the J-3 determines the benefit of EA on a restricted frequency surpasses the immediate criticality of exploited or required information to friendly forces. Operations and intelligence functions should be consulted before this decision. In any event, the self-protection of friendly forces has priority over all JRFL restrictions.

h. Report of Interference. Report interference IAW CCMD or JTF guidance. Operators should report interference through JSIRO. As the interference reports are passed through the chain-of-command, each component with the capability should attempt to resolve the interference under its purview. Each component may not have the capability or control over that portion of the spectrum to resolve the conflict, so the report should be forwarded as quickly as possible to a level of command with the capability. Ultimately, all interference reports reach the JEMSOC, at which time the spectrum manager should attempt to determine the cause of the interference and resolve the conflict if not previously resolved. Also see reference (g).

i. CEASE [activity] Notification. For critical functions (generally those on the JRFL TABOO list), an immediate CEASE [activity] notification should be promulgated by the EACA if the interference can be positively identified as friendly EA. The CEASE [activity] notification is issued for the specific frequency or range only on the EW control net of the offending jammer. No acknowledgment of interference is made on the signal being jammed.

2. Resolving Electromagnetic Interference. EMI resolution is performed IAW reference (g) and respective CCMD guidance. Also see Appendix J to Enclosure F. If the JEMSOC can determine the disruption is caused by a source other than friendly EA, the JEMSOC will assist the reporting unit in the resolution process. If the spectrum manager determines the interference was caused by friendly EA, the report should be collaborated with the JEMSOC and community of interest for resolution and possible modification of the JRFL.

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APPENDIX J TO ENCLOSURE F

RESOLVE EMI

1. Overview. Electromagnetic interference to EMS-dependent systems is a continuing problem in military operations. The very nature of military operations may force assignment of some frequencies on a non-interference basis. The military user may be forced to accept a certain amount of interference during duties. When this interference impedes operations and hinders mission accomplishment, it is considered unacceptable, and steps are taken to resolve and/or eliminate the source of the interference. Effective EMI management plays a crucial role in assuring timely and accurate critical information is exchanged across the spectrum of conflict. Timely and accurate identification, verification, characterization, reporting, geolocation of the source, analysis, and resolution of EMI during military operations is essential to command and control of U.S. forces and responding to adversary EA actions. Since EMI can be caused by enemy, neutral, friendly, or natural sources it must be resolved on a case-by-case basis. Users must report all EMI regardless of the severity. Reporting contributes to trend analysis of troublesome issues. It is essential that efficient, practical procedures be established to positively affect the reporting and resolution of EMI. EMI management is a process of investigative elimination. Guiding EMI reporting, investigation, and resolution is a primary task for electromagnetic spectrum management. As such, electromagnetic spectrum management personnel require TOP SECRET security clearances to investigate EMI with appropriate affected partners and then corroborate information on the appropriate network.

2. Causes of Interference. Electromagnetic noise is always present in a military environment. It may come from a single source or a combination of many sources including natural or manmade frequency interference, poor equipment condition, improper equipment usage, frequency interference, use of unauthorized frequencies, and frequency reuse. Intentional EMI is jamming and deception techniques used against EMS-enabled systems. Unintentional EMI is natural phenomena, co-channel interference, radio design flaws, etc. See Figure 29.

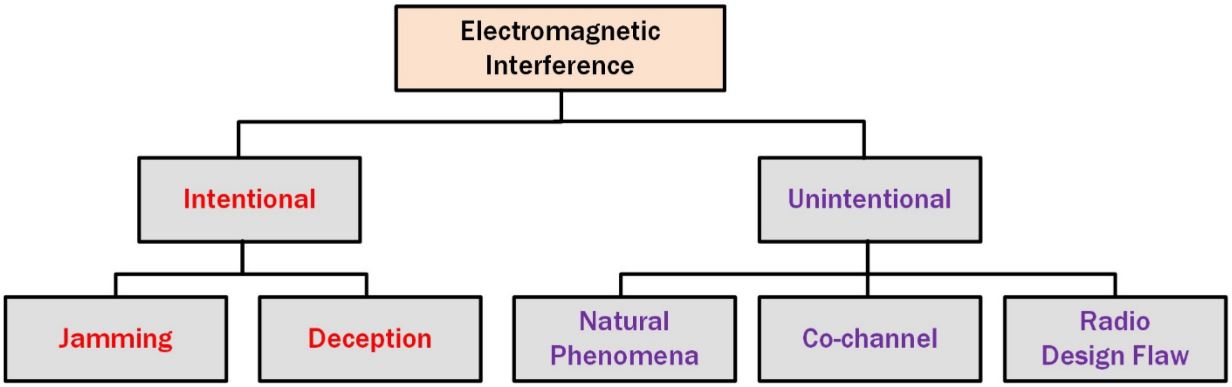

Figure 29. EMI—Intentional and Unintentional

a. Natural Interference. Natural electromagnetic noise has three principal sources: atmospheric (thunderstorms), the sun, and galactic (stars). At night, HF frequencies propagate farther than in the daytime so spurious signals from unintentional sources may find their way to a receiver of interest. At night the galactic radio background is more detectable in the absence of the radio cacophony of the sun. During the day, the sun is constantly emitting radio noise at all frequencies. One way to reduce this type of interference is to use directional antennas to prevent receiving interference from all directions. However, this will not eliminate the noise coming from the direction of the received signal or from the sun. Use of a higher frequency will also help, although, if a sky wave circuit is used, care must be exercised not to pick the highest frequency at which the signal will be refracted to Earth by the ionosphere (i.e., the critical frequency). A frequency chosen above the critical frequency will pass through the ionosphere and will not be refracted back toward the earth.

b. Manmade Interference. Most manmade interference comes from electrical sources such as power generators, alarm systems, power lines, auto ignition, fluorescent lighting, faulty electrical relay contacts, and electrified railroads. Manmade interference also includes enemy jammers. The key to combating this form of interference is to learn how to correctly differentiate and identify the type of interference and isolate communications equipment.

c. Frequency Interference and Intermodulation. This type of interference is caused primarily by two radio transmitters using the same frequency, or frequencies so close to each other that the emission bandwidths overlap, which is considered co-channel interference. Another condition that can occur is called adjacent-channel interference. This is where the emission bandwidths do not overlap but are aligned close beside each other and cause interference. Brute force penetration is a condition where the transmit power of the interferer is so strong that it desensitizes the receiver and causes the receiver to become operationally ineffective. This type of interference is particularly problematic because it can occur when the interferer and the affected receiver operate in different bands. One solution is to increase the geographic separation between the transmitters. Another solution is to change frequencies. Interference from known sources such as generators can be greatly reduced if an antenna is positioned so an obstacle (e.g., a hill) is between it and the source. This must be done so the same obstacle will not block the intended radio path. If the interference is not coming from the same direction as the intended signal, a directional antenna should be used.

d. Poor Equipment Condition, Improper Usage, or Improper Placement. The condition of radio equipment and how it is being used may result in interference. There are several steps that should be taken to lessen this possibility. One solution includes making certain shielded cables are used where required, ensuring connectors are properly connected to cables, and making sure antennas within a group are as far apart as possible to prevent co-site interference. Another solution is to change frequencies. All antenna leads (transmission lines), power lines, and telephone lines should be as short as possible when they are on the ground and should not cross. If lines do cross, they must cross at 90-degree angles to each other, and they must be separated from each other by standoffs. Lines threaded through the trees near an antenna serve as pipelines for interference to and from antennas. Finally, ensure all radio equipment is grounded.

e. Use of Unauthorized Frequencies. This practice is prohibited under law and CCMD and military Service policies. Use of unapproved frequencies has the potential to disrupt a carefully engineered frequency plan, introduce interference to other frequencies and circuits, and prevent other units from fulfilling their mission. Equipment operators should never use unauthorized frequencies.

f. Frequency Reuse. There are not enough RFs available for all radio operators to have their own channel. For example, when HF propagation conditions are favorable, operators may discover that their RF is being used by foreign or US military personnel in other countries. VHF FM frequencies often must be reused within the same operation by more than one unit. The exercise spectrum manager will try to make certain users of the same frequency are as far away as possible from each other, but some units (Marine Corps and Army in particular) will join at some stage in the operation. When this occurs, the first common, higher HQ should be informed to settle the problem.

3. SPECTRUM XXI IA Capability

a. The SPECTRUM XXI IA module can be used to analyze an existing RF assignment or user-specified operating parameter for potential interference from environmental transmitters and receivers. This analysis could incorporate interference resolution by identifying possible known emitters whose authorized operating parameters could be the source of the interference. IA can also be performed on the victim's RF assignment record by using the nomination process in the SPECTRUM XXI RF assignment module. The IA process is only as accurate as the currency of the RF assignment database.

b. Using the IA capability should cause the EMS manager to reevaluate the parameters used to determine interference. Unlike the nomination process that uses the same computer algorithm, when performing an IA, the EMS manager should look at considering harmonics and intermodulation products as well as the levels needed to be evaluated. The EMS manager may reduce the criteria set for the radius of mobility as well as using the actual location of the victim receiver.

4. Resolving Interference. Actions to take:

a. Electromagnetic Spectrum Managers assist affected unit operators through the EMI resolution process, guiding them through the troubleshooting process. This assistance may require on-site emitter surveys and on-site investigation analysis by unit or higher-level headquarters spectrum management personnel. Spectrum managers utilize service or unit procured portable handheld spectrum monitors/analyzers to perform the required analysis. An emitter survey is an on-site analysis to validate all emitters within a given area against SPECTRUM XXI records. On-site investigations effectively compare the emitter survey results against anomalous spectrum signals to identify the source of harmful EMI. Persistent and unresolved efforts may be elevated for resolution by joint enabler EMI teams.

b. Interference is always reported from a receiver perspective. Interference reports need to answer specific questions like: Who is the affected unit? What is the affected EMS-dependent system? What is the receiver frequency? Where is/are the affected location(s)? What is the impact to mission?

c. Is the report coming from a unit working for or supporting the JTF, a supporting unit, NGO, other governmental entity, etc.? If so, query the victim assignment (search on unit, frequency, location to assist in identifying the victim record within the database), if found and not a band assignment, tag the record and load it into the proposal editor. Modify the record to the exact parameters of receive station getting interference, to include exact location, remove mobility (306/406), exact antenna height, and power levels and then perform a nomination on this proposal. If the victim proposal is not found, initiate a new proposal (requirement) and go no further in the interference resolution process.

d. If the report is from an authorized spectrum user, where is the interference being experienced? Exactly what type of interference is it? How severe is the problem? Has the user attempted to resolve the interference locally using the local EMI resolution checklist? See Enclosure F of reference (g) for an example of a local EMI resolution checklist.

e. Evaluate the IA results and research identified conflicts starting with the records with the highest ICM values as they are the most likely interfere. As the higher value ICM are eliminated, proceed to records with lower ICM values and then to the flagged records until the emitter causing the interference is located.

f. If no interference source is identified, the forces deployed in the area where interference is occurring need to be identified. Bootleg frequency use or unknown users in the area will cause this problem; NGO and other governmental entity are also possibilities to consider.

5. Electromagnetic Interference Resolution Systems

a. SPECTRUM XXI Database. The SPECTRUM XXI assignment database is, by joint doctrine, the primary source of spectrum use information for all DoD operations. Near real-time maintenance of this database is critical to using it as an effective system for JTF interference resolution. Additionally, failure to maintain this database will also degrade the JEMSOC ability to make new interference-free RF assignments.

b. IC. Establish a partnership with the local IC representatives. They have access to information sources (i.e., intercept databases) not typically available to the spectrum manager. They also have analysts who can assist in interpreting potentially unfamiliar information. The IC can also task their in-theater assets, or interface with other national agencies to leverage deployed in-theater assets for local geolocation. Encourage spectrum managers at all echelons to establish a working relationship with their intelligence counterparts.

c. JEMSOC/JFMO. Maintain close coordination to help facilitate both interference and EW deconfliction. Continued coordination, periodic updating, and dissemination of the JRFL is the first step. Be an advocate for the education of staff and respective B2C2WG on JRFL and frequency deconfliction methods and procedures. Even strict adherence to the JRFL will not totally prevent EA disruption of sensitive friendly systems. Jammer out-of-band noise and harmonic effects can easily cause unintentional disruption to systems. Using SPECTRUM XXI's EW deconfliction analysis module (among other tools), these potential problems can be better identified by considering jammer parameters along with the JTF EMOE. Performing an EW deconfliction analysis as a part of the EW planning and/or targeting process could allow for advance notice to the warfighter of potential fratricide.

d. In-Theater Operators and Maintainers. Incorporate the user into the interference resolution process. Typically, the user will have the best knowledge of the local area and equipment. Providing mentorship to ask questions about changes in the area, adjustments to the equipment, and checking to see if other local systems are affected will greatly help in identifying and reducing EMI. The maintenance community possesses test equipment capable of validating if equipment is operating correctly and within authorized parameters. This type of assistance is invaluable when troubleshooting frequency problems with UHF SATCOM. Capturing this information in the reporting process to help identify future interference problems is important.

e. CCMD J-6 and J-2. Both organizations possess many available assets, along with a larger SA of operations that may be causing the interference problem.

f. 557th Weather Wing. The 557th Weather Wing's 2d Weather Squadron is designated by reference (ff) as the only DoD 24/7 Space Weather Operations Center (SpWOC) and, as such, has the on-demand capability to analyze and attribute, or rule out, EMI due to natural environmental parameters from the HF (3MHz) to the extremely high frequency (EHF) (300GHz) frequency bands. SpWOC can tailor EMI resolution assessments to the specific location, geometry, frequency, polarization, and date/time of an EMI occurrence. In addition, SpWOC can provide a forecast up to three days in advance of potential natural environmental impacts to a PACE communication plan (HF to EHF frequencies). This can assist planners and spectrum managers with understanding and adjusting their plans.

g. Direction Finding/Signal Characterization Equipment. Requesting higher level echelon assistance is considered after exhausting all local efforts. Historical JSIR records indicate most EMI reports are resolved through local operator troubleshooting. However, persistent problems require an emitter survey with a spectrum analyzer/monitor. Some, though not all, of the

Services have a program of record to supply spectrum managers with spectrum analyzers/monitors. These systems will be organic to a particular unit. It may be required for the JEMSOC to query all spectrum management and EW elements within the JOA to discern who possess organic systems. Certain force package builds may have the circumstance where no organic spectrum analyzers/monitors exist. In such cases, the JFC will procure portable handheld spectrum analyzers/monitors to resolve EMI issues within the JOA.

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ANNEX A TO APPENDIX J TO ENCLOSURE F

GENERAL JSIR PROCEDURES

1. EMI to EMS-dependent equipment is a persistent, pervasive problem in military operations. Routine continued use of EMS-dependent systems will inevitably encounter EMI that affects their systems.

2. Although EMI may affect mission accomplishment, unacceptable EMI impedes operations. It may be caused by friendly, enemy, neutral, or natural sources. Generally, EMI must be solved on a case-by-case basis. Most interference incidents are dealt with at the lowest possible level within the JTF structure. However, when the cause and recipient of the interference are not within the same component force or supporting element, resolution becomes more difficult. When reporting, it is important to emphasize reporting facts and staying away from suppositions without supporting facts. For example, reporting interference on a specified radiocommunication service is more accurate than reporting jamming without empirical attribution. For more information on the JSIR procedures, see reference (g).

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APPENDIX K TO ENCLOSURE F

EMI REPORTING

1. Overview. Interference reporting provides a means to help identify unauthorized spectrum users, lack of proper radio procedure training, adversary EA, or local enforcement issues. Interference can come from sources other than the JFC/JTF; adjusting or removing those sources to remedy interference may not be within the spectrum manager's control. Failure to identify the source of interference, or lack of control over its source, calls for reporting the interference to gain assistance in resolving it. Depending on knowledge of the source, interference reporting might require routing to both the JFC JFMO and the local HN. If equipment and spectrum availability permit changing RF assignments for the net or system, this can alleviate the impediment while, or in lieu of, waiting for completion of the potentially time-consuming resolution process.

2. CCMDs and Components. The CCMDs and their components are responsible for developing local procedures, training, and reporting requirements in their respective AOR for resolving interference matters. In cases of EMI to terrestrial systems used outside the continental United States (OCONUS), the command using the affected system is responsible for pursuing interference resolution. When interference originates from one component's AO and affects another component's AO, the component responsible for the AO where the interference source is located will support the other component. The supporting component (i.e., interference source AO) will request HN assistance to identify the interfering source and to resolve the EMI problem. The supporting component is not required to provide resources to resolve the interference. Unified commands, sub-unified commands, and combined commands can directly request DISA JSIR technical support.

3. JTF. The JTF is responsible for developing local procedures and reporting procedures for resolving interference matters. In cases of EMI to terrestrial systems used by a JTF OCONUS, the JTF using the affected system is responsible for resolving the interference. A JTF can request DISA JSIR technical support.

4. JEMSOC. The JEMSOC is responsible for management of the EMS and should be the focal point for EMI resolution within their JFC's/JTF's AOR. The JEMSOC is also responsible for requesting and coordinating interference resolution support from the DISA.

5. Reporting. EMI reports shall be submitted using JSIRO. The JSIRO portal facilitates proper distribution of the reports, based on alerts managed by responsible CCMDs, Services, and agencies.

6. JSIR Program. DoD established the JSIR program in October 1992 to address persistent and recurring EMI problems in joint operations, including those between civil and DoD systems and those involving space systems. The JSIR program was designed as a replacement for the EMI portion of the former DoD Meaconing, Intrusion, Jamming, and Interference program, disestablished 30 June 1992, which was administered by the JEWC. For more information on the JSIR Program, see reference (g).

APPENDIX L TO ENCLOSURE F

CONSIDERATIONS IN A JOINT, INTERAGENCY, INTERNATIONAL, AND MULTINATIONAL ENVIRONMENT

1. Introduction. JFCs integrate and synchronize joint operations, as much as possible, in time, space, and purpose with the actions of supporting or supported multinational forces and civilian partners. Our USG interagency partners frequently do not have the budget or the capacity of the military. The military is often tasked to fill roles it is not habitually accustomed to performing. In some cases, the CCMD or JTF may be required to support the U.S. mission with electromagnetic spectrum management activities.

2. HN Coordination. See Appendix D to Enclosure F for details regarding HN coordination.

3. Allied, Coalition, and Partner Interoperability. The DoD recognizes the critical importance of interoperability and shared capabilities in joint and coalition operations within the EMS.

a. DoD components shall develop systems architecture and software that facilitate the sharing of appropriate EMSO information, tools, and capabilities with allied, coalition, and PNs.

b. Shared EMSO tools must adhere to established interoperability standards, including but not limited to references (gg)–(jj), to ensure seamless integration in multinational operations.

c. Through this comprehensive approach to EMSO tool sharing, the DoD aims to strengthen allied, coalition, and partner EMS capabilities, enhance interoperability, and ultimately improve coalition effectiveness in joint electromagnetic spectrum operations.

4. Support of Other Governmental Agencies

a. Interorganizational Cooperation. The DoD may have a formal support agreement with the DOS to support the U.S. Chief of Mission (COM) and respective USG partners with EMS management support. In these cases, the JTF JEMSOC is providing direct engineering, deconfliction, and RF assignment support. The JTF JEMSOC will coordinate and collaborate with the respective USG partner to resolve harmful EMI. In the event of no formal support agreement, DIRLAUTH is the preferred method for resolution; however, the CCMD's or JTF's Joint Interagency Coordination Group will assist when required. For more information on interorganizational cooperation see reference (d).

b. Joint Stabilization Activities. Military operations may create conditions where the United States assists the legitimate HN to reestablish effective governance. The COM is responsible for USG efforts in the development of a U.S. strategy in support of the HN. The JTF may be tasked with supporting lines of effort. These efforts may create the following conditions for the JTF JEMSOC working in collaboration with the COM, the CCMD, and across the JTF staff. For additional information on joint stabilization activities see reference (c).

(1) The JTF is managing all EMS within the country and thus the DoD database of RF assignments becomes the coordination standard for deconfliction across the entire JOA.

(2) The JTF may be required to assist the new government in the management of essential HN EMS infrastructure until the DoD transitions formal spectrum management authority to the HN administration. Direct support for the HN may include, but may not be limited to, planning, engineering, and RF assignment in support of military, television, radio, civil aviation, telecommunications, and safety (e.g., fire, EMS, police) services.

(3) Transition of EMS RF assignment authority and spectrum management activities to the proper HN authority may require:

(a) Assisting the HN reestablish formal ties to the ITU.

(b) Establishing a national-strategic regulatory and policy framework and, in conjunction in the establishment of some form of status of forces agreement, the establishment of formal HN EMS coordination policy. The CCMD JFMO or JTF JEMSOC may be a direct participant in the above efforts. In addition, the JEMSOC will support the formal administrative and technical preparation and handoff of all HN releasable RF records when directed.

5. Regional Partnerships. There are several standing regional partnerships and alliances agreements that produce policy applying to certain CCMD C2 relationships. These regional partnerships may also develop supporting doctrine regarding how allied, coalition, and partner forces operate together.

a. NATO is an alliance of 32 member states, called NATO Allies, from North America and Europe committed to each other's common defense. NATO also cooperates with a wide range of international organizations and countries in different collaborative structures. The fundamental role of NATO is to safeguard the freedom and security of its member countries. The Alliance's first task is to deter and defend against any threat of aggression against any member country. NATO continually reorganizes and periodically restructures itself, enabling it to contribute more effectively to the development of cooperative security structures for the whole of Europe. NATO has transformed its political and military structures to adapt to peacekeeping and crisis management tasks undertaken in cooperation with non-member countries and with other international organizations. As one of the foundations on which the stability and security of the Euro-Atlantic area depends, NATO serves as an essential forum for transatlantic consultations on matters affecting the vital security interests of all its members.

b. The NATO Civil/Military Spectrum Capability Panel's (CaP3's) mission is to advise and support the NATO department equivalent to the U.S. Joint Staff J-6 on all matters related to availability and access to adequate RF resources. The CaP3 employs a dual-session structure, which allows for a military only session as well as a civil and military session. In the latter case, both national civil and military representatives together take part in the meetings, thus promoting the coordinated national positions. The main CaP3 activities are the development and regular review of the NATO Joint Civil and Military Frequency Agreement, which is the basic document of NATO spectrum management; development of NATO positions on the Agenda Items of Word Radiocommunication Conferences, to be approved by North Atlantic Council; development and management of NATO frequency pools; development of unified spectrum management data exchange formats and frequency management tools and databases; fulfilment of peacetime frequency management needs in military operations, exercises and training activities; and coordination of adequate and harmonized access to the radio-frequency spectrum for NATO purposes with national authorities to support operations in states of emergency, times of crisis and war.

(1) NATO publishes various Standard Agreements establishing interoperability standards between allied forces. STANAG 5641 covers NATO Spectrum Management in Military Operations and STANAG 5642 covers Spectrum Managed Allied Data Exchange Format. NATO accepts ACPs as policy.

(a) <u>Combined Communications Electronics Board</u>

<u>1</u>. The Combined Communications Electronics Board (CCEB) is a five-nation joint military communications-electronic (C-E) organization whose

mission is the coordination of any military C-E matter referred to it by a member nation. The member nations of the CCEB are Australia, Canada, New Zealand, the United Kingdom, and the United States. The CCEB consists of a senior command, control, communications, and computer (C4) representative from each of the member nations. The CCEB is committed to maximizing the effectiveness of combined operations by the definition of a Combined Information Environment. The Combined Information Environment enables users to share, creatively apply, and add value to collective information and knowledge, constrained solely by policies defined by originators and recipients. The CCEB's intent is to maximize the effectiveness of the warfighter in joint and combined operations by optimizing information and knowledge sharing. The CCEB's role is to examine military C-E issues and influence delivery of necessary capabilities to ensure allied interoperability. While the CCEB does not control national procurement initiatives, or mandate the use of established standards, equipment acquisition is strongly influenced by the standards, policies, and procedures the CCEB develops.

2. The CCEB publishes ACPs for interoperability of communications between the militaries of member countries. The Joint Staff J-6 principal chairs the MC4EB and the CCEB so, in some circumstances, an ACP will apply to U.S. forces within the US&P. ACP 190 provides guidance to allied spectrum management operations during peacetime, humanitarian operations, and in war. The US Supplement 1 to ACP-190 provides responsibilities, instructions, guidance, and technical information management for EMS management for all DoD activities within the US&P and for certain activities in support U.S. forces outside of the US&P. This publication also provides the DoD guidance on obtaining clearances for foreign forces conducting joint exercises with U.S. forces within the US&P. See MC4EB in Enclosure G.

(b) Australia, New Zealand, and United States Treaty. Australia, New Zealand, and the United States (ANZUS) is a defense agreement signed in 1951 by the respective countries. As a result of the reestablishment of peace between Japan and the United States in 1951, Australia and New Zealand asked for a treaty making it clear that an attack on any of the three signatory countries would be considered an attack upon all. The pact became effective in 1952. New Zealand's 1985 refusal to allow U.S. nuclear-powered or nuclear-armed ships to enter its ports caused the United States to nullify its ANZUS responsibilities toward New Zealand in 1986; however, New Zealand has not formally withdrawn from the alliance. ANZUS has no provision addressing spectrum management issues. Issues and concerns are addressed through the CCEB, of which both the United States and New Zealand are members.

(c) The Organization of American States. The Organization of American States (OAS) is an international organization developed to achieve an order of peace and justice, promote solidarity, strengthen collaboration, and defend sovereignty, territorial integrity, and independence of its member states. The nations of the Americas are working more closely together than ever before—strengthening democracy, advancing human rights, promoting peace and security, expanding trade, and tackling complex problems caused by poverty, drugs, and corruption. Within the UN, the OAS is a regional agency. The OAS contains no body coordinating spectrum use between the states, which is done on a country-by-country basis. There are existing agreements (treaties) on spectrum use between the United States, Mexico, and Canada.

c. Other Coalition and Allied Partner Considerations. Past operations have demonstrated the need for aligning DoD spectrum management policies and activities with those of U.S. allied and coalition partners. U.S. spectrum managers must be prepared to integrate U.S. spectrum requirements into a coalition spectrum-use plan to support the mission. To assist in some cases, foreign military spectrum management LNOs may be collocated within the JTF JEMSOC. However, the development of specific procedures to support this requirement is made more difficult because of concise security guidance, differences in the level of training, different automation tools, support communication networks, and some language and terminology barriers. Where a regional partnership agreement establishing standards does not exist, the CCMDs may host some form of one-on-one Command and Control Interoperability Boards (CCIB) with respective allied, partner, and coalition nations. Involvement from the spectrum manager may be required in CCIB efforts to bridge spectrum management collaboration across the community of interest. The following information is provided to highlight some areas of which the U.S. spectrum manager must be aware when operating in a multinational and/or coalition environment.

d. Security. The JTF intelligence officer must provide foreign disclosure guidelines early enough in the operational planning phases to facilitate the flow of information. The following are some specific items to consider.

(1) Frequency Assignment Databases. Ensure the appropriate special handling code is entered in SFAF item 005.

(2) JF-12s. Some equipment information may not be releasable to all countries involved in an operation. Each JF-12 should be scrutinized to determine which countries enjoy foreign disclosure authority. If the JF-12 data cannot be released to all the countries, that information should not be entered

into the proposal or assignment being coded into the releasable portion of the database.

(3) Communications Networks. Due to the different communication networks potentially used to support coalition and allied operations, network security and releasability issues need to be addressed with local security and intelligence officers at the earliest point possible to facilitate the flow of information between coalition and allied, and US spectrum management functions. If an unclassified network is used, OPSEC must be addressed to determine what information can or cannot be released.

(4) Waveform Releasability. Certain waveforms may not be releasable, all or in part, to all allied or coalition nations. CCMD policy must specify which waveforms are releasable to which countries and for which specific purpose.

(5) Waveform Transfer. Transfer of SDR waveforms may be accomplished by electronic transfer device or by manual means (paper transfer). Approved methods and procedures must be delineated before allowing transfer of waveforms.

e. Personnel. Allied and coalition spectrum managers may not be trained to the same standards as U.S. spectrum managers. They have different automation capabilities, responsibilities, and national requirements. U.S. spectrum managers could expect to find they are the most experienced (according to U.S. standards) and, at the same time, the lowest ranking person in the spectrum management cell. U.S. spectrum managers can be expected to lead the overall database management effort and provide training to their allied counterparts on using the U.S. automation tools.

f. Coordination, Automated Systems, and Software

(1) SPECTRUM XXI. This automated database and software ecosystem is the standard in the DoD for maintaining the tactical RF assignment database for contingency operations and, today, is readily accepted in most areas in which the United States maintains a presence. The DoD version of SPECTRUM XXI software is not releasable to non-DoD personnel. The Defense Security Cooperation Agency (DSCA) endorses a separate, but compatible, software release that is available to certain partner nations (PNs) through foreign military sales (FMS). Data standardization is very important when analyzing information contained in the database. U.S. spectrum managers should consult reference (p), partner agreements, CCMD publications, instructions, JTF, and applicable SCGs in written procedures for specific guidance on RF proposal formatting.

(2) JACS. This software system is the current joint standard within the DoD. It is used to develop and manage the JCEOI and build the frequency hopset and loadset. Most coalition countries do not have JACS; therefore, U.S. spectrum managers can expect to receive JCEOI inputs in various forms. JACS software is not releasable to non-DoD personnel. The JEMSOC will manually input the coalition requirements before generating the JCEOI. JACS is a common software that provides an interface between spectrum managers and communication planners, allowing for automated transfer of information that is easily understood by both parties.

(3) Due diligence must be taken within an allied and coalition environment to ensure the compatibility and releasability of the JCEOI, hopset, and loadset with PNs. FMS supplies a version of JACS to PNs who procure SINCGARS and HAVEQUICK compatible frequency hopping radios from the DSCA. If required, a separate partner releasable version of the JCEOI may be required alongside the build of a JACS coalition compatible hopset and loadset. The allied JCOEI with appropriate coalition COMSEC should be distributed together through the appropriate COMSEC controlling authority. The JEMSOC will be required to assist with developing control measures ensuring the proper development and distribution of these products through the appropriate COMSEC controlling authority.

(4) Other collaborative tools. PNs may not have access to SIPRNET, or the preponderance of spectrum management activities may be occurring on another all-partner network. In missions including coalition partners, CCMD and JTF JFMOs may need to establish a means for sharing unclassified spectrum management data. This may require the establishment of different spectrum management tools, processes and/or networks that both the United States and coalition partners can collaboratively access.

(5) Frequency Assignment Authority. Identification of the RF assignment authority must be made early in the planning process. This action initiates decisions enabling the development of essential processes. The resulting procedures are then incorporated into the specific OPLAN and corresponding annexes.

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ENCLOSURE G

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS SUPPORT AGENCIES, BOARDS, AUTOMATED SYSTEMS, AND INFORMATION SOURCES

1. Support Agencies

a. Joint Electromagnetic Spectrum Operations Center. The Secretary of Defense designated the Commander (CDR), USSTRATCOM as the electromagnetic spectrum enterprise (EMSE) operational lead for JEMSO. The Joint Electromagnetic Spectrum Operations Center (JEC) consists of a HQ element and two subordinate organizations, the JEWC and the Joint Center for Electromagnetic Readiness (JCER). As the designated EMSE operational lead for JEMSO, CDRUSSTRATCOM executes the functions listed in Table 37.

CDRUSSTRATCOM Operational Functions Regarding JEMSO
1. Establish, maintain, and assess deployment certification standards for Joint Force EMSO readiness.
2. Identify and report Joint Force JEMSO deficiencies, operational risk, and capability requirements to appropriate DoD entities.
3. Establish and standardize joint EMSO education curriculum and provide combatant command joint training support.

Table 37. CDRUSSTRATCOM Operational Functions Regarding JEMSO

(1) The CDRUSSTRATCOM establishes the JEC. In exercising JEMSO roles and responsibilities established in the *Unified Command Plan* and DoD issuances, CDRUSSTRATCOM has the responsibilities outlined in Table 38.

CDRUSSTRATCOM JEMSO Roles and Responsibilities
1. Identification and assessment of Joint Force EMSO deficiencies and opportunities to advance mission effectiveness, interoperability, speed, and survivability.
2. Evaluation and assessment of JEMSO readiness and operational risk and accrediting Joint Force EMSO readiness certification.
3. Development of operational concepts for future JEMSO capabilities and assessment of the performance of planned and programmed capabilities to support future operational concepts in coordination with DoD Components with responsibilities for the EMSE.
4. Providing operational risk assessments of Department JEMSO readiness to inform programmatic/budgetary guidance and decisions IAW DoD EMSE Components.
5. Providing operational perspective to inform and guide development of DoD EMSE policy, resource prioritization, and Joint Force training and education IAW DoD EMSE Components.
6. In conjunction with the DoD EMSE Components, briefing Congress regarding the state of Joint Force EMS readiness, JEMSO proficiency, and ability of the Joint Force to conduct effective operations in the EMS.
7. Establishing and maintaining Joint Force training and education standards for EMSO, establishing and standardizing JEMSO curriculum, and assessing Joint Force education, training, readiness, and interoperability IAW DoD EMSE Components.
8. Coordinating with the relevant DoD Components, appropriate U.S. Government departments and agencies, and PNs on doctrine, training, and interoperability, and providing support as directed.
9. Developing and providing recommendations on JEMSO strategy, policy, doctrine, training, tactics, techniques and procedures, and requirements in coordination with DoD EMSE Components.

Table 38. CDRUSSTRATCOM JEMSO Roles and Responsibilities

(2) The JEWC enables EMS superiority through joint training, planning, operations support, and assessment. JEWC personnel identify and assess current and emergent EW and EMS superiority requirements, technologies, and capabilities to enable global access and freedom of maneuver across all domains and joint functions throughout the competition continuum. The JEWC assists CCMDs and components to plan, execute, and assess EW and EMS superiority. The JEWC also provides joint training and training oversight to meet joint force requirements. Services the JEWC provides to support the joint force include:

(a) On request, provide CCMDs with joint force enabler manpower in support of emergent operations.

(b) Supports JEMSO-related joint force education training standards and certification and is responsible for and conducts the JEMSO Theater Operations Course.

(c) The JEWC Modeling and Simulation branch provides support to the DoD with predictive and reconstructive modeling, simulation, and analysis at the engineering, engagement, and mission levels. Products include RF propagation, electromagnetic trend, and 3D terrain modeling/analysis for airborne, ground-based, and surface/subsurface EMS-dependent systems (e.g., IADS analysis, LOS communications, SATCOM, commercial broadcast, cellular, EA optimization/effectiveness). Products support ongoing operations, mission planning, and operational contingency/crisis planning efforts. See Appendix J of reference (e) for additional information on this topic.

(d) Provides JEMSO exercise support to the CCMDs.

(e) JEMSIAF

1. JEMSIAF is a USSTRATCOM activity located within the JEWC. JEMSIAF provides comprehensive and fused EMS products, and data to support CCMD EMS superiority efforts. In support of these efforts, JEMSIAF executes the following activities: produces EMS products supporting EMSO at CCMDs; supporting JEMSOCs across the range of EMS activities; aggregating and normalizing information from multiple sources; conducting analysis in support of decision-making in pre-crisis, competition, and conflict; and collaborating with external agencies and organizations across the DoD and USG.

2. EMS data aggregation and normalization is an integral JEMSIAF activity supporting CCMD EMS data requirements for planning, operations, and assessment. Data aggregation refers to the compilation of EMS data. Normalization refers to structuring EMS data to make it ingestible into repositories so that it is searchable, retrievable, and can be manipulated and visualized. JEMSIAF aggregates and normalizes EMS data from a variety of authoritative databases, technical documents, operational test and evaluation reporting, and from other sources containing information and data on the operating characteristics, vulnerabilities, and EMS parameters of friendly, adversary, neutral, and commercial EMS-dependent/-enabled systems.

3. The JEMSIAF portal is located on SIPRNET at <https://intellipedia/intelink.sgov.gov/wiki/Joint_Electromagnetic_Spectrum_Information_Analysis_and_Fusion_(JEMSIAF)>.

(3) The JCER will participate, evaluate, and analyze to accredit the Services' readiness certifications in Joint Force exercises, rehearsals, and war games under realistic operational conditions. Evaluation results provide CCDRs with information related to JEMSO readiness of assigned forces and inform Services of gaps and limitations in readiness events while enabling data-driven decisions, informed DoD capability investments, and refinement of JEMSO readiness standards.

c. <u>DISA</u>

(1) Develop and maintain joint standard spectrum management information systems and databases.

(2) Develop spectrum architectures.

(3) Perform electromagnetic compatibility analyses.

(4) Develop integrated spectrum plan.

(5) Support DoD CIO on national and international spectrum issues, when requested.

(6) Provide technical and engineering support to the DoD E3 program.

(7) Develop and maintain EMS data capture and data sharing environments, serving as the Defense Spectrum Data Administrator.

(8) Manage the Joint Spectrum Interference Resolution program, assisting the DoD in resolving interference, and maintaining a database of interference events and tools to support interference resolution.

(9) Support tests, training, and exercises involving the global positioning systems and high-power microwave systems including the performance of quality assurance checks and analyses.

d. <u>NGA</u>

(1) The NGA is a DoD agency with the primary mission of collection, analysis, and distribution of geospatial intelligence in support of national security. Although the DoD is the NGA's parent organization, the NGA is a member of the broader IC supporting national intelligence activities. The NGA is responsible for DoD imagery and mapping with a goal of achieving the DoD vision of dominant battlespace awareness. The NGA was created to exploit the

tremendous potential of enhanced collection systems, digital processing technology, and the prospective expansion in commercial imagery beyond that of its separate predecessor organizations. The creation of the NGA brought together the Defense Mapping Agency, the Central Imagery Office, and the Defense Dissemination Program Office, as well as the mission and functions of the Central Intelligence Agency National Photographic Interpretation Center. Also included in the NGA mission set are imagery exploitation, dissemination, and processing elements of the Defense Intelligence Agency, National Reconnaissance Office, and the Defense Airborne Reconnaissance Office.

(2) The NGA provides DTED Level 1 for use with Joint automated spectrum management systems and Arc Digitized Raster Graphic formatted map data used for various engineering tools. The NGA also produces DoD Flight Information Publication (FLIP) En route Supplements by region, which provide a good source for worldwide communications at airport facilities. The FLIPs provide information about airfield locations by latitude and longitude, frequencies used at those airfields, types of air navigational aids and, if appropriate frequencies associated with them. The FLIPs also identify tower and coordination frequencies.

e. U.S. Space Command

(1) Regional SATCOM Support Center. The Regional SATCOM Support Centers (RSSCs) currently provide the joint warfighter with a single focal point for SATCOM use within a region. The RSSCs provide direct support to CCMDs and Service components with RSSC—Pacific Command (PAC), RSSC—Europe (EUR), and RSSC—CONUS. RSSC planning, management, and coordination ensures tactical forces obtain critical access to Defense Satellite Communications System and Wideband Global SATCOM (SHF); Military Strategic and Tactical Relay, Advanced EHF, and Evolved Strategic SATCOM (EHF); UHF Follow On (UFO) and Mobile User Objective System (UHF); and EHF payloads on UFO (UFO/EHF [UFO/E] and UFO/EHF Enhanced [UFO/EE]), and limited commercial satellite resources. These multi-service RSSCs provide tactical communications satellite network planning and management support for CCMDs, and DoD agencies by working closely with unit communications planners. The RSSCs perform engineering and planning for CCMD OPLAN development. They also serve as the regional CCDR's space advisor and liaison between the CCMDs. JEMSOC Spectrum Managers often coordinate with an RSSC if frequency clearance must be coordinated for the use of RSSC-supported terminals. Frequency clearance for satellite terminals is different in almost every country, so the spectrum manager's involvement with an RSSC will be dictated by the JTF operating location. An SAA only authorizes the user to use the satellite and may not include a frequency

clearance. It is always best to establish a relationship with the RSSC and determine what, if any, coordination may be required.

f. 557th Weather Wing. The 557th Weather Wing's (WW's) 2d Weather Squadron is designated by reference (ff) as the only DoD 24/7 SpWOC responsible for monitoring the space environment and characterizing its impact to DoD and IC operations. The SpWOC staffs an EMSO operations desk dedicated to analyzing and predicting space weather impacts to EMSO available at all security enclaves (UNCLASSIFIED, SECRET, and TOP SECRET/SCI) by telephone, e-mail, and Chat Surfer (SIPRNET only). Given operator parameters such as TX/RX location, SATCOM asset, frequency, polarization, system noise temperature, and antenna gain, the SpWOC can tailor natural environmental impact assessments and forecasts to specific EMS circuits. SpWOC is a source of space weather subject matter expertise regarding EMSO.

2. Boards. The following boards affect JEMSO related plans, policy, doctrine, and resourcing across the DoD. The CCMDs have direct interaction with several processes driven by the following working groups.

a. MC4EB. The MC4EB serves as the primary military advisory forum for assessing the IT aspects of C4 matters, to include the Warfighter Mission Area portfolio management. This forum leads and guides several JEMSO equities as described below.

(1) The MC4EB Frequency Panel supports the development of Joint Staff policies and procedures for implementing DoD EMS management guidance. IAW reference (i), the MC4EB is chaired by the Joint Staff J-6 and composed of appointed senior EMS Management and Electronics personnel from each of the services; all are voting members. MC4EB permanent and ad hoc working groups report to the MC4EB Frequency Panel on committee's referrals, tasking, and updates.

(2) Spectrum Operations Permanent Working Group. The Spectrum Operations Permanent Working Group (PWG) provides guidance and procedures for the management and system enhancements of the DoD spectrum management record keeping system and DoD joint standard spectrum management information systems and components, architectures, and operational procedural standard affecting joint and/or combined U.S. and allied interoperability. This panel also reviews DoD EMS management doctrinal issuances under review or rewrites and provides adjudicated doctrinal comments for final review and approval.

(3) Equipment Spectrum Guidance Permanent Working Group. The Equipment Spectrum Guidance (ESG) PWG provides and coordinates military guidance to DoD on spectrum-dependent systems per DoD directives and allied, U.S., and international rules, regulations, and standards on electromagnetic spectrum management. The working group conducts internal DoD technical review on preparing, disseminating, and voting on ESG S-D systems/equipment applications and Note-to-Holder to include requiring S-D systems/equipment applications submission to NTIA Spectrum Planning Subcommittee. This working group also endorses S-D systems/equipment applications for HN coordination for release through the CCMD JFMOs. See also Annex A to Appendix D to Enclosure F.

(4) Space System Permanent Working Group. The Space System (SS) PWG ensures proper and timely actions occur on the national and international RR procedures for waiver, advance publication, coordination, and notification of RF assignments for satellite networks to support DoD space systems. The SS PWG briefs the Frequency Panel on waivers, publications, coordination, and notification on technical and administrative comments which are forwarded directly to DoD commands/agencies and/or NTIA IRAC Space Systems Subcommittee.

(5) International Permanent Working Group. In preparation for international and federal government meetings, the International Permanent Working Group (I PWG) reviews agendas, documents, and proposals to identify potential impacts to military operations. The I PWG prepares and recommends U.S. positions, alternative, and negotiation strategies for the appointed U.S. representative attending national, international, regional, and other spectrum management related forums such as ITU, NATO, and the CCEB. See also Appendix L to Enclosure F.

(6) MC4EB Ad hoc Working Groups

(a) JCEOI. This working group serves as the focal point to coordinate CCEB, joint, and/or coalition JCEOI. The working group reviews and implements recommended material lifecycle management, capabilities, and changes to the software production of the JCEOI.

(b) Allied Communication Publication. As required, this working group manages updates, reviews, evaluates, and coordinates recommended changes, and serves as the Frequency Panel focal point to coordinate with DOS and coalition partners. See Appendix L to Enclosure F.

(c) Allotment Plan Management manages and updates various US&P allotment and channeling plans. This working group reconciles spectrum policy related to this topic with the NTIA Frequency Assignment and other NTIA subcommittee.

(d) Dynamic Spectrum Access. The US&P coordinator for electromagnetic spectrum management issues, policies, and procedural matters. This working group participates and coordinates with agencies, and committees at the DoD, national, and coalition levels that have responsibility for DSA spectrum policy, and for creating, visualizing, evaluating, verifying, certifying, managing, and distributing digital policies.

(e) Electromagnetic Spectrum Enterprise Architecture. The Electromagnetic Spectrum Enterprise Architecture (EMSEA) is the coordinator for spectrum issues, policies, and procedures. It supports development of the DoD EMSEA by ensuring EMS-related functions, processes, activities, and relevant information are accurate and consistent with approved doctrine and policy.

b. C3LB. The purpose of the C3LB is to accelerate and synchronize the fielding of modernized networking solutions across the joint force with the objective of establishing priorities and strategies, enabling implementation across the DoD C3 and EMS enterprises while identifying associated risks and opportunities. The scope of the C3LB is to provide effective oversight for: C3 transport (terrestrial, aerial, maritime, and satellite-based); EMS enterprise; commercial mobile devices and cellular technologies; and enterprise C3 services. COMSEC, C2 enabling capabilities, Senior Leader C3, and PNT have existing governance forums and are outside the scope of the C3LB. Where execution authority exists within the principal membership, or is delegated to them by cognizant authority, the C3LB is empowered as an executive-level body to make decisions. In instances where statutory responsibility exists outside of the principal membership, the C3LB provides recommendations to the appropriate decision authority (i.e., the MC4EB).

(1) EMS Senior Steering Group. The EMS Senior Steering Group (SSG) provides dedicated oversight of EMS-dependent capability and interoperability (e.g., communications, sensors, EW, EMS management) across the DoD and elevates EMS-related issues to the C3LB and other senior management bodies, such as the EW Executive Committee, as required, to ensure U.S. military EMS superiority. It also serves as the DoD's executive management and advisory body for statutory and regulatory matters for EMSO and advises the C3LB on planning and resourcing initiatives in pursuit of spectrum superiority goals

and objectives of the *National Defense Strategy* and the *Electromagnetic Spectrum Superiority Strategy*.

(2) Tactical Communications Senior Steering Group. The Tactical Communications SSG (TCSSG) serves as the subject matter expert body and advisor for all DoD tactical communications architectures, services, standards, interoperability, and waveform Lead Service and Sponsor management. Tactical networks include wireless communications networks and net-centric capabilities required to support deployed forces at the operational and tactical level of warfare. The TCSSG addresses enterprise level performance, resilience, interoperability, and security of tactical networks by addressing the gaps across the separate services, weapon systems, and data links.

3. Automated Systems, Software, and Databases. The following automated ecosystems, databases, and software are evolving or the predominant systems in use currently by the CCMD and the JTF. The list is not all inclusive.

a. Electromagnetic Battle Management-Joint. Currently in development, Electromagnetic Battle Management-Joint (EMBM-J) is a system capability to support JEMSO at the JFC level, including CCMD and JTF elements. EMBM-J will deliver planning and management capabilities, enhanced electromagnetic spectrum SA, decision support, command and control and improved interoperability with related service, joint and intelligence tools, and systems.

b. Global Electromagnetic Spectrum Information Systems. Global Electromagnetic Spectrum Information Systems (GEMSIS) is DISA's joint program of record supporting spectrum management tools across the CCMDs, Services, and Agencies.

c. Integrated Spectrum Desktop. The Integrated Spectrum Desktop (ISD) facilitates a web-based common desktop that integrates GEMSIS-managed spectrum tools. The ISD provides web links to various sites and capabilities used to support the spectrum community.

d. Joint Spectrum Data Repository. The Joint Spectrum Data Repository (JSDR) is a comprehensive repository of spectrum management data supporting sources/web services compliant with the MC4EB Standard Spectrum Resource Format data standard. It provides access to RF assignments, spectrum certifications, interference reports, and detailed engineering characteristics and platform employment information. The JSDR contains DoD, national, and international spectrum-related information up to the SECRET level. The JSDR service interface permits machine-to-machine data exchange with other programs requiring access to spectrum data.

e. E2ESS. E2ESS provides the DoD a worldwide collaboration platform for data collection and a database for spectrum supportability business processes. E2ESS integrates and evolves both Stepstone and HNSWDO capabilities to meet GEMSIS end-to-end supportability requirements.

f. SPECTRUM XXI. SPECTRUM XXI is a single authoritative system designated by the Joint Staff for the management and tracking of all RF in support of all DoD operations. This single database backbone enables blue EMS interoperability, collaboration, and visibility across the joint force. It provides spectrum managers with a single information system addressing spectrum management automation requirements. SPECTRUM XXI supports DoD planning and operations with frequency management workflow capabilities, RF engineering analyses, data validation, regulatory compliance checks and visualization tools. SPECTRUM XXI is available through FMS for use by allied and coalition partners.

g. HNSWDO. HNSWDO is a web application providing worldwide visibility of HN RF spectrum dependent equipment's supportability. It automates distribution of HN coordination requests and tracking from material developers through acquisition proponents through the CCMD in support of submitting HN approvals and capturing supportability comments.

h. Stepstone. Stepstone is an online resource for data capture of parametric information for spectrum dependent equipment supporting the spectrum certification and spectrum supportability processes. It provides a mechanism for the Services and industry to complete an “Application for Equipment Frequency Allocation” (DD Form 1494), enabling compliance checks within SPECTRUM XXI to assure data quality, collaboration and workflow capabilities and certification process metrics.

i. JSIRO. The JSIRO collaboration portal is a web-based, centralized application containing data and correspondence for reported interference, meaconing, intrusion, and jamming incidents. The portal is the repository for the results of analyses, collected data, and supporting documentation for electromagnetic interference resolution to support both trend and future interference resolution analysis.

j. JACS. JACS provides a common software system that interfaces between Spectrum Managers and communication planners, allowing for automated transfer of information that is easily understood by both parties. COMSEC managers leverage JACS for certain COMSEC functions. Spectrum managers leverage JACS to build the JTF JCEOI and build the blue, allied, and coalition frequency hopset and loadset resource for various radio sets.

k. Fusion Analysis Development Effort. Fusion Analysis Development Effort Multi-INT Spatial Temporal is software that detects patterns of life and anomalies within large volumes of geospatial data. When exposed, this tailored, time-sensitive information is an asset for mission planning and battlefield forensics.

l. Improved Many on Many. Improved Many on Many (IMOM) is an EW analysis software for air operations. IMOM models radar detection capabilities and threat engagements based on parametric data drawn from 57th Intelligence Squadron's Combat Support Database, aircraft radar cross-section, DTED, and electromagnetic countermeasures (ECM), which includes stand-off jamming and self-protective jamming. Using engineering-based algorithms, EW system capabilities are modeled, and the results aid the user in assessing and understanding the EW environment for mission planning. Current operational uses include prediction of platform vulnerability/route analysis to radar detection and weapons systems, near–real-time mission monitoring including EW analysis, and route vulnerability to optically guided weapons systems. IMOM also has acoustic, ISR, ES/passive detection, communication networks and comm jamming, satellite communications, and GPS jamming.

m. GPS Interference and Navigation Tool. The GPS Interference and Navigation Tool (GIANT) is a physics-based, constructive, and repeatable simulation model that computes PNT system performance and its impacts on mission effectiveness in a benign or electromagnetic contested environment. GIANT includes databases of satellites, receivers, antennas, inertial navigation systems, and emitters. GIANT is the only modeling tool accepted by the Federal Aviation Administration (FAA) for GPS jamming training submissions within the US&P. The spectrum manager is responsible for coordinating with the J-2 and outside agencies to identify and input known GPS denial capabilities.

n. Navy Research Labs Interactive Scenario Builder. The Navy Research Labs Interactive Scenario Builder is a three-dimensional, interactive RF tactical decision aid. As a mission planning tool, 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. 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 ECM. Builder can be used for pre-mission planning, near real-time SA, and after-action debriefing. Builder is the only model accepted by the FAA for coordination of jamming within the US&P.

o. Service Software Systems. The following JEMSO systems and software are developed by respective military departments and may offer utility to the JFC.

(1) Electronic Warfare Planning and Management Tool (EWPMT) is the U.S. Army tool to control, manage, and dominate the EMS. EWPMT provides the ability to conduct remote control and management of EW assets to execute offensive and defensive EA, EW targeting, and enable maneuver by synchronizing EW and spectrum management operations across intelligence, operations, and signals.

(2) Marine Air-Ground Task Force Spectrum Awareness System. In development, the Marine Air-Ground Task Force Spectrum Awareness System spectrum management software requirements will be condensed into a singular system utilized within the spectrum services framework and in conjunction with the EW and SIGINT community. This system will create a user defined operating picture in support of the spectrum manager with the ability to exchange information with adjacent, subordinate, and higher-level commands.

(3) RTSO is the U.S. Navy tool that optimizes EM spectrum usage and develops OPTASK COMM and OPTASK EW Annex C Appendix 23 Radar Frequency Plans. RTSO maximizes compatibility and ensures compliance with Treaties and Directives on spectrum allocations. Additionally, it provides real-time spectrum awareness and EMCON validation to support electromagnetic maneuver warfare and cyberspace operations concerns. RTSO enables SA of military, civilian, and HN spectrum use.

p. Area Studies. Area studies are available upon request from the DISA. Area studies are compiled from unclassified sources, are Controlled Unclassified Information (CUI) and are authorized for release to USG agencies only. Area studies cannot be released outside the DoD without permission from the DISA.

q. EOB data (collateral data only). EOB information consists of all known spectrum generating equipment within an area. The EOB is usually classified by the three sources of data. The EOB includes: the electromagnetic spectrum used by friendly users, the adversary, and neutrals. The EOB database contains information collected in peacetime, and only lists known permanent installations.

r. FCC Records. The FCC database contains non-government records within the US&P. These records are unclassified.

s. Force Management System (model) Web is an Army database containing authorized force structure to include Augmentation Tables of Distribution and Allowances. The database also provides basis of issue information regarding all issued equipment to include EMS dependent equipment.

t. Frequency Assignment Data derived from the Frequency/Environmental Database—Frequency usage data (also referred to as RF assignment data) is required for most RF management functions where the authorized RF usage is needed. This data class includes administrative and technical data describing the authorized use of radiating electromagnetic-dependent systems in the environment.

u. GMF. The GMF database contains government RF assignment records within the US&P assigned by the IRAC. This database is classified.

v. ITU Database. The ITU database contains records from the Master International Frequency List.

w. (Blue Space) EOB. The Monthly Blue Space Order of Battle is a classified USSPACECOM report providing information about the defense satellite network, including satellite position data, age, and status. This information is valuable for planning purposes and is an information source for JFC/JTF communications planners, including spectrum managers.

x. Master Radio Frequency List. The Master Radio Frequency List database contains NATO frequency assignment records converted from 14-point format to vertical SFAF records.

y. Platform Configuration Data derived from the Tactical Database. The Platform Configuration Data derived from the Tactical Database contains data on Tables of Organization and Equipment (TO&E) and platform configurations. TO&E data includes equipment inventory data describing C-E equipment assigned to real-world organizations.

z. SPECTRUM XXI and FRRS. The FRRS is a RF record-keeping system managed by the MC4EB and used by DoD spectrum managers requiring frequency data and background EME information. The FRRS is comprised of several worldwide computer network servers operating SPECTRUM XXI server software. DoD spectrum managers access the FRRS using the SPECTRUM XXI client software application, thus ensuring the effective and efficient use of the EMS. Area CCMDs can provide information on the requirements for establishing a user account on the FRRS within their AOR. SPECTRUM XXI client software application is the DoD standard spectrum management system and is used at all levels of spectrum management operations (i.e., from tactical to sustaining base operations).

aa. UHF SATCOM Channelization Database. This database provides JTF satellite planners, who may also be spectrum managers, with the frequency plans of DoD UHF satellites, along with the channelization plans of the different satellites, current authorized users, and status of the UHF SATCOM satellite. This product is provided by USSTRATCOM.

bb. USELMS. The USELMS database contains information concerning U.S. military spectrum dependent equipment parameters for communications, communications jamming, radar, radar jamming, electromagnetic support, and electro-optic/infrared equipment. It has the flexibility of allowing queries by name, nomenclature, or frequency band, making it useful for researching new or unfamiliar equipment.

APPENDIX A TO ENCLOSURE G

JOINT ELECTROMAGNETIC SPECTRUM OPERATIONS POINTS OF CONTACT

COMMAND/ ORGANIZATION	TELEPHONE NO.	PLAIN LANGUAGE ADDRESS
JOINT STAFF J39	+1 (703) 695-1937 DSN (312) 225-1937 js.pentagon.j3.list.j39-dd-go-cyber-elec-warfare-ops-div-all@mail.mil SIPR js.pentagon.j3.list.j39-dd-go-cyber-elec-warfare-ops-div-all@mail.smil.mil	JOINT STAFF J3 WASHINGTON DC//
JOINT STAFF J6	+1 (703) 692-0943/1796/571-9734/697-2487/256-1847 DSN (312) 222-0943/1796/9734/222-2487/227-2487/260-1847 js.pentagon.j6.list.spectrum.management@mail.mil SIPR js.pentagon.j6.list.spectrum.management@mail.smil.mil	JOINT STAFF J6 WASHINGTON DC//
USINDOPACOM JEMSOC	+1 (808) 477-0315 DSN (315) 477-0415	HQ USPACOM HONOLULU HI//J2/J3/J6/JFMO/JEMSOC//
USINDOPACOM JFMO	+1 (808) 477-7239/42/30/36 DSN (315) 477-7239/42/30/36	HQ USPACOM HONOLULU HI//J2/J3/J6/JFMO/JEMSOC//
USEUCOM JEMSOC	DSN (324) 412-3952/3982/3986 eucom.stuttgart.ecj3.list.jemso@mail.mil SIPR eucom.stuttgart.ecj3.list.jemso@mail.smil.mil	CDR USEUCOM J3 DIRECTORATE VAIHINGEN GE//J2/J3/J6/JFMO/JEMSOC//
USEUCOM JFMO	+49 (711) 680-7284/8855 DSN (314) 430-7284/8855z eucom.stuttgart.ecj6.mbx.spectrum@mail.mil SIPR	HQ USEUCOM VAIHINGEN GE//ECJ6-F/JFMO//

COMMAND/ ORGANIZATION	TELEPHONE NO.	PLAIN LANGUAGE ADDRESS
	eucom.stuttgart.ecj6.mbx.spectrum@mail.smil.mil	
USSOUTHCOM JEMSOC	+1 (305) 437-2492/0831/1958/3012 DSN (312) 567-2492/0831/1958/3012	HQ USSOUTHCOM J3 MIAMI FL//JEMSOC//
USSOUTHCOM JFMO	+1 (305) 437-1661 DSN (312) 567-1661	HQ USSOUTHCOM J6 MIAMI FL//JFMO//
USCENTCOM JEMSOC	+1 (813) 529-3154/3628 DSN (312) 529-3154/3628 centcom.macdill.centcom-hq.mbx.ccj3-d-ew-electronic-warfare@mail.mil SIPR centcom.macdill.centcom-hq.mbx.ccj3-d-ew-electronic-warfare@mail.smil.mil	USCENTCOM CCJ3 MACDILL AFB FL//JEMSOC//
USCENTCOM JFMO	+1 (813) 827-5366 DSN (312) 651-5366 VOSIP (302) 529-7608 centcom.macdill.centcom-hq.list.ccj6-of-jfmo@mail.mil SIPR centcom.macdill.ceontcom-hq.mbx.ccj6-cof-jfmo@mail.smil.mil	USCENTCOM CCJ6 MACDILL AFB FL//JFMO//
USSPACECOM JEMSOC/JFMO	+1 (719) 554-3277 DSN (312) 692-3277	HQ USSPACECOM COLORADO SPRINGS GO//J2/J3/J6/JFMO/JEMSOC//
USSOCOM JEMSOC	+1 (813) 826-9077/4098 DSN (312) 299-9077/4098 SIPR SOCOM_electronic_warfare@socom.smil.mil	CDR SOCOM MACDILL AFB FL//JFMO/JEMSOC//
USSOCOM JFMO	+1 (813) 299-1509/8098 DSN (312) 299-1509/8098	CDR SOCOM MACDILL AFB FL//JFMO/JEMSOC//
USTRANSCOM JEMSOC	+1 (618) 817-4170 DSN (322) 817-4170 transcom.scott.tcj6.ypx@mail.mil SIPR	CDR USTRANSCOM TCJ3 SCOTT AFB IL//J2/J3/J6/JFMO/JEMSOC//

COMMAND/ ORGANIZATION	TELEPHONE NO.	PLAIN LANGUAGE ADDRESS
	transcom.scott.tcj6.mbx.ypx@mail.smil.mil	
USTRANSCOM JFMO	+1 (618) 817-4170 DSN (322) 817-4170 transcom.scott.tcj6.ypx@mail.mil SIPR transcom.scott.tcj6.mbx.ypx@mail.smil.mil	CDR USTRANSCOM TCJ3 SCOTT AFB IL//J2/J3/J6/JFMO/JEMSOC//
USSTRATCOM JEC	+1 (402) 912-3695 DSN (312) 912-3695	USSTRATCOM JEC OFFUTT AFB NE
USSTRATCOM JEMSOC	+1 (402) 912-3812 DSN (312) 912-3812	USSTRATCOM J3 DIR GLOBAL OPS OFFUTT AFB NE//JEMSOC//
USSTRATCOM JEC/JFMO	+1 (402) 912-3838 DSN (312) 912-3838	USSTRATCOM JEC OFFUTT AFB NE//JFMO//
USSTRATCOM JEC/JEWC	+1 (210) 977-6967 DSN (312) 969-6967 stratcom.jbsa.jewc-opcenter.mbx.jewc-opcenter@mail.mil SIPR stratcom.jbsa.jewc-opccenter.mbx.jewc@mail.smil.mil JWICS usaf-wclack_jewc.opcenter@af.ic.mil	USSTRATCOM JEWC LACKLAND AFB TX
USSTRATCOM JEC/JCER	+1 (702) 652-1846 DSN (312) 682-1846	USSTRATCOM JCER NELLIS AFB NV
USNORTHCOM JEMSOC	+1 (719) 554-1482/3568 DSN (312) 692 1482/3568	HQ NORAD USNORTHCOM PETERSON AFB CO//J2/J3/J6/JFMO/JEMSOC//
USNORTHCOM JFMO	+1 (719) 554-7773 DSN (312) 692-7773 n-nc.peterson.n-ncj6.mbx.jfmo-northcom-omb@mail.mil SIPR n-nc.peterson.n-ncj6.mbx.jfmo-northcom-omb@mail.smil.mil	HQ NORAD USNORTHCOM PETERSON AFB CO//J2/J3/J6/JFMO/JEMSOC//

COMMAND/ ORGANIZATION	TELEPHONE NO.	PLAIN LANGUAGE ADDRESS
USAFRICOM JEMSOC	+49 (711) 708-1390 DSN (314) 421-1390 africom.stuttgart.acj39.list.j398-jemsoc@mail.mil	CDR USAFRICOM J3 STUTTGART GE//J2/J3/J6/JFMO/JEMSOC//
USAFRICOM JFMO	+49 (711) 729-4360 DSN (314) 421-4360	CDR USAFRICOM J3 STUTTGART GE//J2/J3/J6/JFMO/JEMSOC//
DISA JSIRO	+1 (410) 919-2836 DSN (313) 919-2836 disa.sosc@mail.mil SIPR disa.sosc@mail.smil.mil See Enclosure E and CJCSM 3320.02E	DISA FT GEORGE G MEADE MD// DISA FT GEORGE G MEADE MD//JSIR//
DISA PM GEMSIS	+1 (844) 347-2457, #4, #3 disa.global.servicedesk.mbx.enterprise-services-ticket-request@mail.mil SIPR disa.global.servicedesk.mbx.enterprise-services-ticket-request@mail.smil.mil	
NGA	+1 (269) 961-4747 DSN (312) 661-4757 dlamapcatalog@dla.mil	

Table 39. JEMSO-Related Points of Contact

ENCLOSURE H

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GLOSSARY

PART I—ABBREVIATIONS AND ACRONYMS

Items marked with an asterisk (*) have definitions in PART II

ACES	automated communications engineering software
ACP	allied communications publication
AESOP	afloat electromagnetic spectrum operations program
A/F/N	adversary, friendly force, neutral actor
AFFOR	Air Force forces
AGL	above ground level
AMHS	Automated Message Handling System
AMSS*	aeronautical mobile satellite services
ANZUS	Australia, New Zealand, and US
AO	area of operations
AOI*	area of interest
AOR*	area of responsibility
ARFOR	Army force
AWACS	Airborne Warning and Control Systems
B2C2WG	boards, bureaus, centers, cells, and working groups
BDA	battle damage assessment
BSS	broadcasting satellite service
BWENVMT	radio-frequency bandwidth environmental
BWPROPOSED	proposed radio-frequency bandwidth
C-E	communications-electronic
C2	command and control
C3LB	Command, Control, Communications Leadership Board
C4	Command, Control, Communications and Computer
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CaP3	Civil/Military Spectrum Capability Panel (NATO)
CAS	close air support
CC	critical capabilities
CCDR*	combatant commander
CCEB	Combined Communications Electronics Board
CCIB	Command and Control Interoperability Board
CCIR	commander's critical information requirement
CCMD*	combatant command (the organization)
CDRUSSTRATCOM	Commander, U.S. Strategic Command

CECAT	Contested EMOE Characterization and Analysis Tool
CENOT	communications emitter notations
CEOI	communications-electronics operation instructions
CJCS	Chairman of the Joint Chiefs of Staff
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
CJTF	Commander, Joint Task Force
COA	course of action
COG	center of gravity
COM	Chief of Mission
COMSEC*	communications security
CONOPS	concept of operations
CONPLAN	Concept plan
CONUS	Continental United States
COP	common operational picture
CR	critical requirements
CRC	control and reporting center
CREW	counter radio-controlled improvised explosive device EW
CRP	control and reporting post
CRS	cognitive radio systems
CS	Call sign
CT3	common tier 3
CTF	combined task force
CUOPS	current operations
CV	critical vulnerabilities
DCN	datalink coordination net
dCULL	distance culling
DDIL	denied, disrupted, intermittent, limited
DEPORD	Deployment order
DFE SO	Dynamic Force Employment Strategic Opportunities
DIRLAUTH	direct liaison authorized
DISA	Defense Information Systems Agency
DoD	Department of Defense
DoDD	Department of Defense directive
DoDI	Department of Defense instruction
DSA	dynamic spectrum access
DSCA	Defense Security Cooperation Agency
DSN	defense switched network
DTED	digital terrain elevation data
DTT	digital terrestrial TV
E2ESS	end-to-end supportability system

E3	electromagnetic environmental effects
EA	electromagnetic attack
EACA	electromagnetic attack control authority
ECM	electromagnetic countermeasures
EEI	essential elements of information
EESS*	Earth exploration-satellite service
EHF	extremely high frequency
EIRP	effective isotropic radiated power
ELNOT	electronic notation
EM	electromagnetic
EMBM	electromagnetic battle management
EMBM–J	electromagnetic battle management–joint
EMCON	emission control
EME	electromagnetic environment
EMI*	electromagnetic interference
EMOE	electromagnetic operational environment
EMS	electromagnetic spectrum
EMSCA	EMS coordinating authority
EMSCM	EMS coordination measures
EMSE	electromagnet spectrum enterprise
EMSEA	electromagnetic spectrum enterprise architecture
EMSO*	electromagnetic spectrum operations
EMSOC	EMSO cells
EMS SSG	EMS Senior Steering Group
EO	electro-optical
EOB*	electromagnetic order of battle
EP*	electromagnetic protection
ERF	electronic remote fill
ES	electromagnetic support
ESG PWG	equipment spectrum guidance permanent working group
ESS	evolved strategic SATCOM
EUR	Europe
EW*	electromagnetic warfare
EWIRDB	electromagnetic warfare integrated reprogramming database
EWPMT	electronic warfare planning and management tool
EXP	experimental records
FAA	Federal Aviation Administration
FARS	frequency assignment retrieval system
FCC	Federal Communications Commission
FDO	Flexible Deterrent Option
FE	frequency/environmental

FFIR	friendly forces information request
FH	frequency-hopping
FISNOT	foreign instrumentation signals intelligence notation
FM	frequency modulation
FMS	foreign military sales
FORCESFOR	forces for unified commands memorandum
fPROPOSED	radio-frequency proposed
FRAGORD	fragmentary order
FRO	flexible response option
FRQ Share	frequency share
FRRS	frequency resource record system
FSS	fixed satellite service
FUOPS	future operations
FUPLANS	future plans
GEMSIS	global electromagnetic spectrum information systems
GFMAP	global force management allocation plan
GFMIG	global force management implementation guidance
GHz	gigahertz
GIANT	GPS interference and navigation tool
GMF	government master file
GPS	global positioning system
HF	high frequency
HHQ	higher headquarters
HN*	host nation
HNS*	host-nation support
HNSWDO	host nation spectrum worldwide database online
HQ	headquarters
IA	interference analysis
IADS	integrated air defense system
IAW	in accordance with
IC	intelligence community
ICM	interference conflict margin
IFF	identification friend-or-foe
IGL	intelligence gain/loss
IMOM	improved many on many
I PWG	International Permanent Working Group
IR	infrared
IRAC	interdepartmental radio advisory committee
ISD	integrated spectrum desktop
ISR	intelligence, surveillance, and reconnaissance

ITU	international telecommunication union
IW	Information Warfare
J-1	Joint Staff Manpower and Personnel Directorate
J-2	Joint Staff Intelligence Directorate
J-3	Joint Staff Operations Directorate
J-4	Joint Staff Logistics Directorate
J-5	Joint Staff Plans and Policy Directorate
J-6	Joint Staff Command, Control, Communications, and Computer Systems Directorate
JACS	joint automated communications-electronics operating instructions System
JANAP	Joint Army-Navy-Air Force Publication
JCEOI*	joint communication-electronics operating instruction
JCER	Joint Center for Electromagnetic Readiness
JDIR	joint (staff) director
JEC	Joint Electromagnetic Spectrum Operations Center
JEMSIAF	joint electromagnetic spectrum information, analysis, and fusion
JEMSMO	joint electromagnetic spectrum management operations
JEMSO*	joint electromagnetic spectrum operations
JEMSOC	joint electromagnetic spectrum operations cell
JEMSOWG	JEMSO working group
JEPAC	Joint Electromagnetic Preparedness for Advanced Combat
JEWC	joint electromagnetic warfare center
JFACC	joint force air component commander
JFC*	joint force commander
JFLCC	joint force land component commander
JFMCC	joint force maritime component commander
JFMO	joint frequency management office
JFSOCC	joint force special operations component commander
JIOC	joint information operations center
JIPCL	joint integrated prioritized collection list
JIPOE	joint intelligence preparation of the operational environment
JIPTL	joint integrated prioritized target list
JNCC	joint network operations control center
JOA	joint operations area
JOC	joint operations center
JP	joint publication
JPG	joint planning group
JPP	joint planning process

JRFL*	joint restricted frequency list
JSDR	joint spectrum data repository
JSIR	joint spectrum interference resolution
JSIRO	joint spectrum interference resolution online
JSME	joint spectrum management element
JTF	joint task force
JTWG	joint targeting working group
JUONS	joint urgent operational needs
JWICS	joint worldwide intelligence communications system
JWO	JEMSO watch officer
kHz	kilohertz
kW	kilowatt
LMR	land mobile radio
LNO	liaison officer
LOS	line-of-sight
MA	mission analysis
MARFOR	Marine forces
MC4EB	Military Command, Control, Communications, and Computers Executive Board
MEDEVAC	medical evacuation
MEPED	military equipment parametric and engineering database
METOC	meteorological and oceanographic
MHz	megahertz
MIFR	Master International Frequency List (ITU)
MILDEP	Military Department
MISREP	mission report
MNL*	master net list
MOE	measure of effectiveness
MOP	measure of performance
MSS	mobile satellite services
MW	megawatt
NAI	named areas of interest
NATO	North Atlantic Treaty Organization
NAVAID	navigational aid
NAVFOR	Navy forces
NEO	noncombatant evacuation operation
NET ID	network identification
NGA	National Geospatial Intelligence Agency
NGO	nongovernmental organization

NIB*	noninterference basis
NIPRNET	nonsecure internet protocol router network
NTIA	National Telecommunications and Information Administration
NUI	Net Unique Identifier
OA	operational area
OAS	Organization of American States
OC	organization code
OCONUS	outside of the continental United States
OE	operational environment
OPLAN	operation plan
OPORD	operation order
OPR	office of primary responsibility
OPSEC	operations security
OPT	operational planning team
OPTASK EW	operational tasking for EW
OPTASKCOM	operational tasking for communications
OPTEMPO	operating tempo
PAC	Pacific Command
PACE	primary, alternate, contingency, and emergency
PED	processing, exploitation, and dissemination
PIR	priority intelligence requirement
POC	point of contact
PLANORD	planning order
PNT	positioning, navigation, and timing
RDSS*	radio determination-satellite service
RF	radio frequency
RFF	request for forces
RFI	request for information
RFS	request for support
RLA	receiver antenna latitude
RLG	receiver antenna longitude
RNSS*	radionavigation-satellite service
ROE	rules of engagement
RR	radio regulations (ITU)
RSC	receiver state/country
RSSC	regional SATCOM support center
RTSO	real time spectrum operations
RX	receiver

S-D	spectrum-dependent
SA	situational awareness
SAA	satellite access authorization
SAP	special access program
SAR	satellite access request
SAR	search and rescue
SATCOM	satellite communications
SCO	security cooperation organization
SDB	SATCOM database
SDR*	software defined radios
SEM	spherical earth model
SFAF	standard frequency action format
SFCP	shore fire control party
SG	strike group
SHF	super-high frequency
SIGINT	signals intelligence
SINCGARS	single channel ground and airborne radio system
SIPRNET	secret internet protocol router network
SITREP	situation report
SME	subject matter expert
SMM	spectrum management manual
SOF	special operations forces
SOI	signal operations instructions
SOP	standard operating procedures
SPCU	space station non-geostationary
SPCW	space station geostationary
SpWOC	Space Weather Operations Center
SROE	standing rules of engagement
SSB	single side band
SSD	spectrum supportability determination
SS PWG	space system permanent working group
SSRA	spectrum supportability risk assessment
STANAG	standardization agreement
STO	special technical operations
TACC	tactical air control center
TACS	theater air control system
TADIL	tactical digital information link
TASKORD	tasking order
TCSSG	tactical communications senior steering group
TDWG	target development working group
TIREM	Terrain-Integrated Rough Earth Model
TO&E	tables of organization and equipment

TOPOMAN	topographic manager
TPFDD	time-phased force and deployment data
TPFDL	time-phased force and deployment list
TRANSEC	transmission security
TSK	transmission secure keys
TSN	track supervision net
TTP	tactics, techniques, and procedures
TV	television
TX	transmitter
UAV	unmanned aerial vehicle
UFO	UHF follow on
UFO/E	UFO/EHF
UFO/EE	UFO/EHF enhanced
UHF	ultra-high frequency
UN	United Nations
US/U.S.	United States
US&P*	United States and its possessions
USCENTCOM	US Central Command
USELMS	US electromagnetic system
USEUCOM	US European Command
USG	US Government
USINDOPACOM	US Indo-Pacific Command
USNORTHCOM	US Northern Command
USSOCOM	US Special Operations Command
USSOUTHCOM	US Southern Command
USSTRATCOM	US Strategic Command
USTRANSCOM	US Transportation Command
VHF	very high frequency
VPN	voice product net
WW	Weather wing
XAL	transmitter antenna location
XLG	transmitter antenna longitude
XSC	transmitter state/country

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PART II—DEFINITIONS

administration. Any governmental department or service responsible for discharging the obligations undertaken in the Constitution of the International Telecommunication Union, in the Convention of the International Telecommunication Union and in the Administrative Regulations. (Source: ITU RR).

aeronautical mobile-satellite services. A mobile-satellite service in which mobile earth stations are located on board aircraft; survival craft stations and emergency position-indicating radio beacon stations may also participate in this service. Also called aeronautical mobile-satellite services (AMSS). (Source: ITU RR).

aeronautical mobile service. A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies. (Source: ITU RR).

allocation (of a frequency band). Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned. (Source: ITU RR)

allotment (of a radio frequency or radio frequency channel). Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions. (Source: ITU RR)

area of influence. An area inclusive of and extending beyond an operational area wherein a commander is capable of direct influence by maneuver, fire support, and information normally under the commander's command or control. (DoD Dictionary. Source: JP 3-0)

area of interest. That area of concern to the commander, including the area of influence and areas adjacent to it, and extending into enemy territory. Also called AOI. (DoD Dictionary. Source: JP 3-0)

area of responsibility. The geographical area associated with a combatant command within which a geographic combatant commander has authority to plan and conduct operations. Also called AOR. (DoD Dictionary. Source: JP 1)

assigned frequency. The center of the frequency band assigned to a station. (Source: ITU RR)

assigned frequency band. The frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance. Where space stations are concerned, the assigned frequency band includes twice the maximum doppler shift that may occur in relation to any point of the Earth's surface. (Source: ITU RR).

Assignment. (of a radio frequency or radio frequency channel). Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions (Source: ITU RR).

call sign. A combination of alphanumeric or phonetically pronounceable characters (trigraph) that identifies a communication facility, command, authority, activity, or unit; used primarily for establishing and maintaining communications. Also called CS. (Source: CJCSI 3320.03).

call word. Pronounceable words that identify a communications facility, command, authority, activity, or unit; serves the same functionality as the call sign. (Source: CJCSI 3320.03).

channeling plan. An FCC and NTIA administration term for the systematic division of a frequency band into a collection of sub-bands, blocks, and/or channels, that are applicable to a radiocommunication service or services using the frequency band. Also called a frequency plan or frequency arrangement by non-US administrations. (Source: ITU-R Report F.1399 (2001))

cognitive radio system. A radio system employing technology that allows the system to: (1) obtain knowledge of its operational and geographical environment, established policies, and its internal state, to dynamically and autonomously adjust its operational parameters and protocols according to the knowledge obtained, in order to achieve predefined objectives; and (2) learn from the results obtained. Also called CRS. (Source: ITU-R Report SM.2152).

combatant command (organization). A unified or specified command with a broad continuing mission under a single commander established and so designated by the President, through the Secretary of Defense and with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Also called CCMD. (Source: JP 1, Volume 2)

combatant command (command authority). Nontransferable command authority, which cannot be delegated, of a combatant commander to perform those functions of command over assigned forces involving organizing and employing commands and forces; assigning tasks; designating objectives; and giving authoritative direction over all aspects of military operations, joint training, and logistics necessary to accomplish the missions assigned to the command. Also called COCOM. (Source: JP 1, Volume 2)

combatant commander. A commander of one of the unified or specified combatant commands established by the President. Also called CCDR. (Source: JP 3-0)

communications security. Actions designed to deny unauthorized persons information of value by safeguarding access to, or observation of, equipment, material, and documents regarding the possession and study of telecommunications or to purposely mislead unauthorized persons in their interpretation of the results of such possession and study. Also called COMSEC. (DoD Dictionary. Source: JP 6-0)

controlling authority (COMSEC). The official responsible for directing the operation of a cryptonet and for managing the operational use and control of keying material assigned to the cryptonet. Also known as CONAUTH. (Source: CNSSI 4006)

Earth exploration-satellite service. A radiocommunication service between earth stations and one or more space stations, which may include links between space stations, in which–information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from active sensors or passive sensors on Earth satellites;–similar information is collected from airborne or Earth-based platforms;–such information may be distributed to earth stations within the system concerned;–platform interrogation may be included. This service may also include feeder links necessary for its operation. Also called EESS. (Source: ITU RR)

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

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. (Source: JP 3-85)

electromagnetic interference. Any electromagnetic disturbance, intentionally or unintentionally induced, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electromagnetic spectrum-dependent systems and electrical equipment. Also called EMI. (DoD Dictionary. Source: JP 3-85)

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. (DoD Dictionary. Source: JP 3-85)

electromagnetic operational environment. The electromagnetic operational environment is a composite of the actual and potential electromagnetic energy radiation, conditions, circumstances, and influences that affect the employment of capabilities and the decisions of the commander. 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. Also called EMOE. (Source: JP 3-85)

electromagnetic order of battle. A subset of the overall order of battle that consists of the identification, strength, command structure, disposition, and operating parameters of the electromagnetic spectrum dependent systems (Source: JP 3-85)

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. (DoD Dictionary. Source: JP 3-85) electromagnetic spectrum-dependent systems. Electromagnetic spectrum-dependent systems include all devices that are intended to radiate or receive electromagnetic energy and include communications, radars, sensors, weapon systems, navigation, satellites, and receive-only systems. Also known as S-D systems. (Source: JP 3-85)

electromagnetic spectrum management. The operational, engineering, and administrative procedures to plan and coordinate operations within the electromagnetic operational environment. (DoD Dictionary. Source: JP 3-85)

electromagnetic spectrum operations. Coordinated military actions to exploit, attack, protect, and manage the electromagnetic environment. Also called EMSO. (DoD Dictionary. Source: JP 3-85)

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. (DoD Dictionary. Source. JP 3-85)

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. (DoD Dictionary. Source: JP 3-85)

electromagnetic warfare frequency deconfliction. Actions taken to integrate those frequencies used by electromagnetic warfare systems into the overall frequency deconfliction process. (DoD Dictionary. Source: JP 3-85)

electromagnetic warfare integrated reprogramming database. The primary DoD-approved source for technical parametric and performance data on non-communications electromagnetic emitters and associated systems which directly supports software reprogramming of EW systems such as radars, radar warning receivers, combat identification systems, electromagnetic support and attack systems, and target sensing systems. Also called EWIRDB. (Source: CJCSI 3320.01)

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. See also electromagnetic warfare. (DoD Dictionary. Source: JP 3-85) expander. A single letter code (A through Z) used in conjunction with a suffix and call sign to identify a sub-element of the position, mission, or function. (Source: CJCSM 3320.03)

generated joint communications-electronics operating instruction. The final product of all inputs consisting of randomly generated data that was initially input into the UN-generated JCEOI. From this product, a user can define output pages and revise many of the products based on requirement changes or output options. (Source: CJCSM 3320.03)

generation authority. The authority placed upon a staff component, individual, or commands having overall responsibility for generating the JCEOI. This includes gathering all information from subordinate elements, combining requirements, making changes to the original document and creating reserve editions. (Source: CJCSM 3320.03)

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. (DoD Dictionary. Source: JP 3-85)

host nation. A nation which receives forces and/or supplies from allied nations and/or North Atlantic Treaty Organization to be located on, to operate in, or to transit through its territory. Also called HN. (DoD Dictionary. Source: JP 3-57)

host-nation support. Civil and/or military assistance rendered by a nation to foreign forces within its territory during peacetime, crises or emergencies, or war based on agreements mutually concluded between nations. Also called HNS. (DoD Dictionary. Source: JP 4-0)

joint communications electronic operation instruction. An electronic or paper product that consist of the Joint Force command, control, and communications directory of units, call signs, and words and frequencies. Additionally, the joint communications-electronic operating instruction provides procedures for conducting electronic, visual and verbal communications methods (e.g., sign or countersign, smoke or pyrotechnics, suffix and expanders) to supplement or enhance radio communications. Also called JCEOI. (Source: CJCSM 3320.03)

joint electromagnetic spectrum operations. Coordinated military actions to exploit, attack, protect, and manage the electromagnetic environment. (DoD Dictionary. Source: JP 3-85) joint force commander. A general term applied to a combatant commander, subordinate unified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force. Also called JFC. (Source: JP 1, Volume 1)

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. (DoD Dictionary. Source: JP 3-85)

land mobile service. A mobile service between base stations and land mobile stations, or between land mobile stations. (Source: ITU RR)

master net list. A communications list containing: net name or description, net ID, organizational code, restrictions, frequency type, power, reuse class, reuse zone, and call word or color word requirements. List is developed for an operations plan to support requirements that can reasonably be expected in an area of responsibility. (Source: CJCSM 3320.03)

non-interference basis. A condition of use relative to other specified uses that affords no protection from harmful interference from the other specified users and prohibits causing harmful interference to the other specified users. Also called NIB. (Source: NTIA Manual)

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. (DoD Dictionary. Source: JP 3-85)

radiocommunication service. A service as defined IAW the ITU or respective Administration involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes. In these Regulations, unless otherwise stated, any radiocommunication service relates to terrestrial radiocommunication. (Source: ITU RR)

radio determination satellite service. A radiocommunication service for the purpose of radiodetermination involving the use of one or more space stations. This service may also include feeder links necessary for its own operation. Also called RDSS. (Source: ITU RR)

radionavigation. Radiodetermination used for the purposes of navigation, including obstruction warning. (Source: ITU RR) radionavigation-satellite service. A radiodetermination-satellite service used for the purpose of radionavigation. Also called RNSS. (Source: ITU RR)

sensing (within the context of CRS within this document). The capability for the CRS to detect other signals within its reception range to determine temporary unused/unoccupied EMS.

software-defined radio. A radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard. Also called SDR. (Source: ITU-R Report SM.2152).

space research service. A radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes. (Source: ITU RR)

specified combatant command. A command, normally composed of forces from a single Military Department, that has a broad, continuing mission, normally functional, and is established and so designated by the President through the Secretary of Defense with the advice and assistance of the Chairman of the Joint Chiefs of Staff. (Source: JP 1, Volume 2)

subordinate unified command. A command established by commanders of unified commands, when so authorized by the Secretary of Defense through the Chairman of the Joint Chiefs of Staff, to conduct operations on a continuing basis IAW the criteria set forth for unified commands. (Source: JP 1, Volume 2)

suffix. A two-digit number (01-99) used in conjunction with tactical organization's call sign to indicate a specific position, mission, and function. Suffixes may be further expanded by letter (expander) to identify a sub-element of the position, mission, or function identified by the suffix. (Source: CJCSM 3320.03)

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. (DoD Dictionary. Source: JP 3-85) telecommunication. (1) Communication by wire, radio, optical or other electromagnetic systems. (Source: ITU RR); (2) Any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems. (Source: ITU Constitution, Geneva, 1992, CS 1012)

unified command. A command with a broad continuing mission under a single commander, composed of significant assigned components of two or more Military Departments that is established and so designated by the President, through the Secretary of Defense with the advice and assistance of the Chairman of the Joint Chiefs of Staff. (Source: JP 1, Volume 2)

United States and its Possessions. The term "United States and its Possessions" includes the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, and the territories and possessions (but less the Canal Zone). Also called US&P. (Source: NTIA Manual)

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