TRADOC Pamphlet 525-7-16

The United States Army
Concept Capability Plan
for

Electromagnetic Spectrum Operations

for the
Future Modular Force

2015-2024

Version 1.0

28 December 2007

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Foreword

From the Director
U.S. Army Capabilities Integration Center

The warfighting requirements identified in the Army's functional concepts to support the Army's future Modular Force require an exponential increase in the use of the electromagnetic spectrum. Recent years have witnessed an explosion of spectrum-based technologies and uses of wireless voice and data communications systems by the Army as it transforms to a battlespace that is evermore dynamic and has ever increasing demands for information.

The U.S. Army Concept Capability Plan for Electromagnetic Spectrum Operations for the Future Modular Force 2015-2014 identifies the capabilities required to enable the Army to operate in the joint environment of electromagnetic spectrum battlespace during the 2015-2024 timeframe. This concept capability plan (CCP) examines the current and projected electromagnetic spectrum operations (EMSO) capabilities for the future Modular Force to highlight concerns and overlaps in the current approach to spectrum management. The capabilities identified in this CCP provide a coherent way ahead for the further examination of potential doctrine, organization, training, materiel, leadership and education, personnel, and facilities solutions. This CCP represents a holistic view of the Army's collective dependence on electromagnetic spectrum capabilities to support the future Modular Force and joint operations.

New technologies and services have created explosive demand for radio spectrum, not only within the military sector, but also in the civilian sector. Spectrum is a finite natural resource—more cannot be made—and under current rules, demand is outstripping supply. Fortunately, the same technologies that create exploding demand can provide the solution to this problem, by letting more devices use spectrum than is now possible. The realization of these capabilities is essential to achieving the Army's capstone concept objective of becoming a strategically responsive, campaign quality force.

Concept capability plans continually evolve as new technology develops. This CCP will be refined and updated as new learning emerges from research, joint and Army wargaming, experimentation, and combat development. Many of the EMSO capabilities introduced in this CCP are being address in other joint efforts. As this CCP crosses so many joint and Army functional areas, I strongly encourage its use in our interaction with other proponents, Services and joint organizations.

MICHAEL A. VANE
Lieutenant General, U.S. Army
Director, Army Capabilities
Integration Center

Executive Summary

The Operational Problem

a. Lessons learned from the global war on terrorism missions have indicated significant capability shortfalls with electromagnetic spectrum management, specifically the management of radio frequency. The most significant causes for these shortfalls are the exponential increase and accelerated procurement of radio frequency emitters. Many of these radio frequency emitters are commercial off-the-shelf items, issued to and used by deployed tactical forces, which bypassed the Department of Defense electromagnetic spectrum compatibility standards using "operational requirements" as the justification to bypass the spectrum supportability assessment process. Many of these emitters support systems that are critical to commanders for both situation awareness and force protection. A few examples of emitters being utilized today include portable jammers, unmanned aerial systems controllers, squad radios, munitions, sensors, and cell phones.

b. The employment of these Army tactical emitters without formal joint, interagency, and multinational systems coordination exacerbates an already complex situation and presents a serious challenge for all major operations and host nation telecommunications systems. The Army, as all other Services, does not have the tools required to deconflict, in a timely manner, frequencies utilized by numerous emitters on the battlefield. The rapid introduction of new systems designed to enhance freedom of action and force protection has illuminated the urgent need for a flexible capability to conduct EMSO at all echelons on the battlefield in support of both the current and the future Modular Force while avoiding friendly frequency fratricide and violations of national and international laws, standards and policies. Potential adversaries recognize our civilian and military reliance on advanced information technologies and systems, and understand that information superiority provides the U.S. unique advantages. Thus they will implement various information operations means to counter these advantages, including fielding of advanced jamming systems and waveforms. At the same time, adversaries will acquire increasingly advanced communications technologies that in many cases will operate on the same frequencies as U.S. systems, creating potential additional spectrum management/deconfliction issues.

c. This EMSO CCP is intended to focus the Army's efforts to manage the spectrum for all wireless network devices and emitters in a manner in which these devices do not interfere with each other; thereby providing the capabilities needed to realize the objectives of our joint and Army concepts. This CCP presents capabilities that enable the effective application of EMSO assets and capabilities across the full spectrum of conflict in an interdependent, joint, and multinational environment. It describes how Army forces must learn to integrate and deconflict Department of Defense, National, civil, commercial, and host nation spectrum assets. In addition, the EMSO CCP will enable the electronic warfare enterprise during the 2015–2024 timeframe.

Key Ideas

a. This CCP is designed to achieve four imperatives:

- Facilitate the integration of EMSO capabilities across the full spectrum of joint and Army operations.
- Improve the Army's ability to exploit existing EMSO capabilities.
- Deliver EMSO capabilities that address the Army's need (capability requirements) and priorities by influencing the design of future EMSO systems.
- Systematically and deliberately evolve Army EMSO support operations over time to provide dedicated, responsive theater-focused support to strategic, operational, and tactical commanders.

b. Central to achieving these imperatives, the concept describes the need for a layered infrastructure involving specific EMSO enablers at the strategic, operational, and tactical levels. This infrastructure consists of facilities, personnel, organizations, and equipment that extend the global information grid to the "first tactical mile" focused on using the electromagnetic spectrum. This CCP illustrates the integration and contribution of EMSO capabilities in a future Modular Force operational setting using an operational level vignette.

c. This EMSO CCP draws its key ideas and required capability statements directly from the text of the joint and Army concepts. This CCP refines these broad capability statements into EMSO capability statements and provides a detailed description of the capabilities required by the future Modular Force. Additionally, it identifies the EMSO requirements and supporting infrastructure in the current, mid- and far-terms. Although many of these capabilities are yet to be realized, they represent the bridge between the current and future Modular Force. Commanders should interpret the list of required capabilities as the optimum capabilities during the 2015-2024 timeframe.

d. As the Army moves forward in its transformation, and achieves the objective modular construct, we must, in all our mission areas, recognize that our concepts and CCPs are the basis for achieving modular force capabilities. The holistic approach of this CCP should support any number of future capability based assessments. The power and capabilities we generate from and within EMSO are integral components of the future Modular Force's success.

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Department of the Army
Headquarters, United States Army
Training and Doctrine Command
Fort Monroe, Virginia 23651-1047

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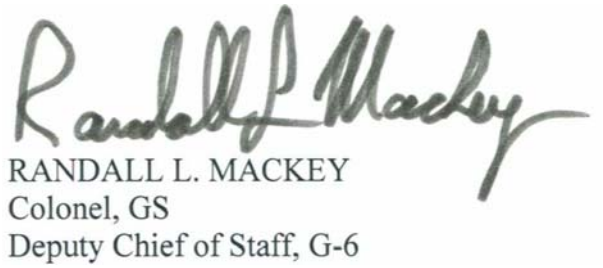
Military Operations

THE U.S. ARMY CONCEPT CAPABILITY PLAN FOR ELECTROMAGNETIC SPECTRUM OPERATIONS FOR THE FUTURE MODULAR FORCE 2015-2024

FOR THE COMMANDER:

OFFICIAL:

ABRAHAM J. TURNER
Major General, U.S. Army
Acting Deputy Commanding General/
Chief of Staff



RANDALL L. MACKEY
Colonel, GS
Deputy Chief of Staff, G-6

History. This pamphlet is a new U.S. Army Training and Doctrine Command (TRADOC) concept capability plan (CCP) developed as part of the Army Concept Strategy for the future Modular Force and as part of the capabilities-based assessment process.

Summary. TRADOC Pamphlet (Pam) 525-7-16, *The U.S. Army Concept Capability Plan for Electromagnetic Spectrum Operations for the Future Modular Force 2015-2024* is the overarching CCP for integrating Army electromagnetic spectrum operations capabilities required during the 2015-2024 timeframe. It focuses on the operational and tactical application of integrated electromagnetic spectrum operations capabilities across the full spectrum of military operations. This concept draws from approved documents addressing the Army's modular forces to include brigade combat teams, divisions, corps, and emerging joint and Army concepts relevant to the Department of Defense (DOD) and Department of the Army (DA) transformation and also draws upon input from subject matter experts in the field of spectrum management.

Applicability. This pamphlet applies to all DOD, DA, and TRADOC activities that identify and develop doctrine, organization, training, materiel, leadership and education, personnel, and facilities solutions to field electromagnetic spectrum operations. All active Army, Army National Guard, and Army Reserve operating forces, and the Army Materiel Command may use this pamphlet to identify future electromagnetic spectrum operations trends in the Army. This

pamphlet may also serve as a reference document to agencies within the joint community that are planning or are concerned with electromagnetic spectrum operations.

Proponent and exception authority. The proponent of this pamphlet is the TRADOC Headquarters, Director, Army Capabilities Integration Center (ARCIC). The proponent has the authority to approve exceptions or waivers to this pamphlet that are consistent with controlling law and regulations. Do not supplement this pamphlet without prior approval from Director, ARCIC (ATFC-ED) 33 Ingalls Road, Fort Monroe, VA 23651-1061.

Suggested improvements. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Director, ARCIC (ATFC-ED), 33 Ingalls Road, Fort Monroe, VA 23651-1061. Suggested improvements may also be submitted using DA Form 1045 (Army Ideas for Excellence Program Proposal).

Distribution. This publication is only available on the TRADOC Homepage at http://www.tradoc.army.mil/tpubs/pamsndx.htm.

Contents

Chapter 1
Introduction

1-1. Purpose

a. This pamphlet provides a capability plan for integrating Army electromagnetic spectrum operations (EMSO) for the future Modular Force and may result in an Army EMSO focused capabilities-based assessment (CBA). This plan will also support ongoing studies that are analyzing similar capabilities across the DOD. The Army EMSO CBA will identify doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) solutions/solution sets for Army EMSO gaps during the 2015-2024 timeframe. Electromagnetic spectrum (EMS) for the purposes of this pamphlet is defined as the range of frequencies of electromagnetic (EM) radiation that has been allocated for specified services under the United States (U.S.) and international tables of frequency allocation, together with the EMS outside the allocated frequency range where use of unallocated frequencies could cause harmful interference with the operation of any services within the allocated frequency range.

b. The objective of EMSO is to enable electronic systems that rely on wireless connectivity to perform their functions in the intended environment without causing or suffering unacceptable frequency interference. EMSO incorporates spectrum management, frequency assignments, policy implementation, and host nation coordination that enables the efficient use of the EMS battlespace for combat operations. EMSO enable and support wireless extensions of many networked communications systems, all subdivisions of electronic warfare (EW), and many other information management systems that support the six Army functional concepts of *Battle Command*, *See*, *Strike*, *Move*, *Protect*, and *Sustain* listed in paragraph 1-4. EMSO consists of planning, operating, and coordinating the use of the EMS through operational, engineering, administrative, and policy implementation procedures.

c. The Army EMSO concept capability plan (CCP) uses approved documents, such as the Army capstone concept, the Army operating and functional concepts, joint operating, functional, and integrating concepts, current approved capability documents, and emerging joint and Army concepts relevant to DOD and Army transformation. The CCP also draws extensively upon input from subject matter experts in the field of spectrum management.

1-2. Functional Area

This EMSO CCP identifies capabilities required to execute EMSO in support of Army operations during the 2015-2024 timeframe. This CCP reaches across the battlespace awareness, command and control (C2), and network-centric (net-centric) operations joint functional areas. In addition, this CCP is fully nested with the Army concept strategy documents, from the capstone, through the two operational and six functional concepts.

1-3. Scope

a. The scope of Army EMSO as depicted in this CCP focuses on specific EMSO enablers at the strategic, operational, and tactical levels supporting the Army expeditionary force. The term “unit,” as presented in this concept, is not a size or a function specific reference, rather unit

and/or unit commander indicates a military group organized for military operations across the full spectrum of military operations. This CCP will ensure that the Army requirements for the "last tactical mile" and the relationship of the tactical environment relative to the operational and tactical levels are well documented.

b. The scope of EMSO CCP is not limited to just communications devices that rely on the EMS, but covers all manner of devices, such as, sensors, radars, jammers, optical devices, that are dependent on using the EMS to be effective.

1-4. Relation to the Family of Joint and Army Concepts

a. *Net-Centric Environnent* (NCE) *Joint Functional Concept.* The EMSO CCP recognizes the importance of operating in a NCE. The NCE joint functional concept is expressed as "an information and decision superiority-based concept describing how joint forces might function in a fully networked environment 10 to 20 years in the future. Within this concept, the networking of all joint force elements creates capabilities for unparalleled information sharing and collaboration, adaptive organizations, and a greater unity of effort via synchronization and integration of force elements at the lowest levels." The NCE joint functional concept also states that "over-reliance on information and communications technologies may result in forces incapable of operating effectively in the absence of those technologies due to failure or attack." The main focus of the EMSO CCP is to identify and describe the necessary capabilities required to enable the warfighter's use of the EMS battlespace to operate effectively in a NCE.

b. *Net-Centric Operational Environment Joint Integrating Concept.* "The net-centric operational environment will translate information superiority into combat power by effectively linking (both horizontally and vertically) knowledgeable entities throughout the battlespace and beyond, thus making possible dramatically new ways of operating and, by extension, decisive advantages in warfighting." EMSO will support achieving information superiority by optimizing the use of the available EMS by friendly forces.

c. TRADOC Pam 525-3-0, *The Army in Joint Operations: The Army's Future Force Capstone Concept.* This capstone concept postulates that "the network-enabled battle command leverages the network effect, the exponential increase in the value of a network as the number of those using it increases. It extends the interconnectedness of headquarters - already significant - to the extremities of the force: individual Soldiers, weapons, sensors, platforms. The network effect enables information superiority and effective battle command. To achieve information superiority, the future Modular Force will rely on a joint-integrated, knowledge-based command, control, communications, computers, intelligence, surveillance, and reconnaissance network of networks, vertically and horizontally integrated from the strategic to tactical level." Military operations rely heavily on systems using the limited EMS to achieve and maintain information superiority. The EMSO CCP will cover EMSO in the full range and intensity of combined military operations to assure information superiority.

d. TRADOC Pam 525-3-1, *The Army Operating Concept for Operational Maneuver*. This concept states that "the future Modular Force will rely on a knowledge-based control, communications, computers, intelligence, surveillance and reconnaissance network of networks,

vertically and horizontally integrated from strategic to tactical level and drawing information, updated in near real time, from a wide variety of automated and manual sources - on-board sensors, unmanned air and ground vehicles, traditional and new intelligence, surveillance, and reconnaissance means, space platforms, and an assortment of correlated databases." EMSO as described in the EMSO CCP will ensure the future Modular Force has a network that has the necessary operational agility to meet the extreme demands of the future operations and will keep pace with the operational tempo.

e. TRADOC Pam 525-3-2, *The Army Operating Concept for Tactical Maneuver*. The EMSO CCP supports a commander's ability to *see first, understand first, act first, reengage at will, and finish decisively*. The *Tactical Maneuver* concept emphasized that "tactical operations relying on the *quality of firsts* depend, in the first instance, on the reduction of uncertainty through superior situational understanding and information superiority. Failure to achieve information superiority or suffering long-term degradation of information and intelligence capabilities with simultaneous shortfalls in situational understanding would force units back into a linear framework and compel them to act more slowly and less decisively." Effective EMSO capabilities will be critical to achieving information superiority.

f. TRADOC Pam 525-3-3, *The U.S. Army Functional Concept for Battle Command 2015-2024*. The *Battle Command* concept states, "An agile, ubiquitous communications network enabled by an integrated system of terrestrial and space-based systems is the network vehicle critical to all aspects of the command function." EMSO is an essential enabler for the network and key to mitigating the challenge of the ever increasing numbers of EMS dependent capabilities employed in the network.

g. TRADOC Pam 525-2-1, *The U.S. Army Functional Concept for See 2015-2024.* The *See* concept defines information superiority as, "All operational environment activities, including asymmetric and asynchronous behaviors, produce "observables" or phenomena that can be perceived and measured, such as EM signature, temperature, chemical composition, orientation, movement, and a number of entities. It is the observable that sensors detect, and data about which fusion and analysis processes and interprets to provide information." EMSO will support achieving information superiority by optimizing the use of the available EMS by the future Modular Force.

h. TRADOC Pam 525-3-6, *The U.S. Army Functional Concept for Move 2015-2024.* The EMSO CCP will enable the *Move* concept's key tenet of operational agility by assuring timely distribution of EMS resources to meet ad hoc mobile network connection requirements for full spectrum operations.

i. TRADOC Pam 525-3-4, *The U.S. Army Functional Concept for Strike 2015-2024.* The *Strike* concept addressed information superiority as "critical to achieve the situational understanding required to employ strike capabilities that best address adversary population social and cultural considerations. Accomplishing this objective will require full integration of strike and information capabilities and operations at all levels of command." The EMSO CCP will cover EMSO in the full range and intensity of combined military operations to assure information superiority.

j. TRADOC Pam 525-3-5, *The U.S. Army Functional Concept for Protect 2015-2024.* The *Protect* concept states, "The future Modular Force will rely on knowledge management through network enabled battle command, to provide a robust common operating picture in support of self synchronization and cooperative engagements, throughout its campaigns and operations." EMSO is an essential enabler for the network and key to mitigating the challenge of the ever increasing numbers of EMS dependent capabilities employed in the network.

k. TRADOC Pam 525-4-1, *The U.S. Army Functional Concept for Sustain 2015-2024.* To support future Module Force logistics reliance on the network for sustainment operations, EMSO will enable the warfighter's use of the EMS and provide the capability to prioritize it as a resource that must be managed, such as ammunition, fuel, rations, or a repair part. "Future Modular Force logistics will be network enabled, providing adaptive and dynamic networks to support logistics operations on the Joint distributed and asymmetric battlefield. The network links joint forces and increases operational effectiveness by allowing distributed forces to communicate, maneuver, and share a common operational picture."

1-5. References
Required and related publications and prescribed and referenced forms are listed in appendix A.

1-6. Explanation of Abbreviations and Terms
Abbreviations and special terms used in this pamphlet are explained in the glossary.

Chapter 2
Concept Capability Plan

2-1. Introduction

a. Why is this CCP needed? EMSO enables electronic systems relying on wireless connectivity to perform their functions in the intended environment without causing or suffering unacceptable frequency interference. Managing limited EMS to meet all of the requirements of the modern battlefield in a manner that prevents interference across platforms has always been a challenge for the Army and other Services. Future operations, as envisioned and detailed in the family of joint and Army concepts, will rely ever more heavily on electronic systems that require wireless connectivity to allow for integration and synchronized efforts. These operations will be conducted in an increasingly joint, interagency, and multinational (JIM) environment that is relying on network-enabled battle C2 systems to synchronize its efforts. In addition, many neutral and noncombatant entities in the area of operations (AO) are increasing their use of wireless communications; and therefore add to the background EM environment. Each of these aspects will greatly increase the need for spectrum management and deconfliction. These issues drive the need for the development of a CCP that will serve as the foundation for a thorough review of the DOTMLPF. Through the use of illustrative vignettes, the EMSO CCP will describe the application of elements of joint and Army concepts to selected mission, enemy, terrain, troops, time available, and civilians and focus on conditions specific to mission, function, or operation across the range of military operations. The EMSO CCP will provide architecture data sufficient to support experimentation and the continuous refinement of the concept and

capabilities and will include the details sufficient to initiate the CBA within Joint Capabilities Integration and Development System (JCIDS), if needed.

b. Joint Operational Environment

(1) Networks have become fundamental to "creating capabilities for unparalleled information sharing and collaboration, adaptive organizations, and a greater unity of effort via synchronization and integration of force elements at the lowest levels." This trend toward "net-centricity" will continue and will increase in complexity, pervasiveness, effectiveness, and density/layering. The joint operational environment will continue to rely on the network to transfer critical "electronic data" to the right persons at the right time. The network will become the focus for enemy attacks in an effort to destroy, manipulate, or disrupt that critical flow of information. Commanders must consider the vulnerabilities associated with this increased dependence on increasingly complex networks. The transfer of this electronic data throughout the joint operational environment will be increasingly dependent on wireless communications networks and systems and increasingly dependent on effective operations of the EMS.

(2) The dependency on wireless communications technology will continue to expand worldwide and include technologies applied to sensors, weapon systems, munitions, etc., of the current and future Modular Force. The management of EMS will continue to be extremely complex, requiring the significant and proactive development of capabilities to meet the requirements of the future Modular Force. Current combat systems that depend on the EMS to deliver capability to the warfighter are required to go through a spectrum supportability assessment. This assessment requires, as a minimum, receipt of equipment spectrum certification (equipment developed under force modernization programs must comply with federal and international laws, standards and policies), and a reasonable assurance of the availability of sufficient frequencies for operation from DOD and host nations, where applicable. Ensuring this assessment process is done thoroughly, early in the development, and continued in the procurement process has always been a keystone to effective spectrum operations that prevent newly fielded systems from interfering with existing platforms. Unfortunately, this assessment process has traditionally been extremely fragmented and cumbersome, and often results in the introduction of untested systems into real world operations, because of operational necessity.

c. The future operational environment**.** The radio frequency (RF) spectrum is the fundamental resource and key enabler in supporting the wireless, net-centric and network ready (net-ready) vision for the future. Commanders must manage this resource just as any other resource upon which the military depends to conduct operations. EMSO will provide the management of this limited resource at all echelons within the garrison and tactical domains. Commanders must manage the RF spectrum to be consistent with the organizational level of C2 and the net-centric operational levels of the global information grid (GIG) network operations (NETOPS) concept. While the future continues to hold the promise of new technologies to make ever more efficient use of the spectrum, it is still a finite resource. The adversary will continue their efforts to develop new methods that will disrupt our operations that are dependent on EMSO.

d. The Complex EMSO Environment

(1) In most parts of the world the spectrum from 2 megahertz (Mhz) to 30 gigahertz (Ghz), commonly referred to as the radio frequency (RF) spectrum is a congested and finite resource that must be carefully managed in order to accommodate both military and civil interests. Within the DOD, RF spectrum resources are not used exclusively for communications networks but also used by weapons systems, sensors, radars, navigation, data links, intelligence gathering, and receive-only spectrum dependent devices. Additionally, civil spectrum interests are vital to national economies and must be balanced with military spectrum interests. Host nation coordination for spectrum use outside of the continental U.S. is normally a time consuming and bureaucratic process. The DOD is required to comply with all U.S. and international laws, regulations, and standards to ensure compatibility amongst all RF users. Figure 2-1 identifies that in the U.S., the situation is even more complicated since commercial industry vital to our Nation also uses and competes for the use of the RF spectrum.

(2) The DOD is not the sole user of the limited amount of spectrum allocated for government only use, but must share, coordinate, cooperate, and comply with regulations and standards to ensure compatibility among all government spectrum users. Also to be considered are EW operations which provide a unique set of challenges. While the G6 or S6 (primary signal staff officer for the senior mission commander) currently does not manage or direct spectrum operations for non-communication spectrum dependent devices or EW operations that impact spectrum use in the AO, the G6/S6 does needs to be aware of these emitters and spectrum users in their AO to ensure effectiveness of the EMSO process.

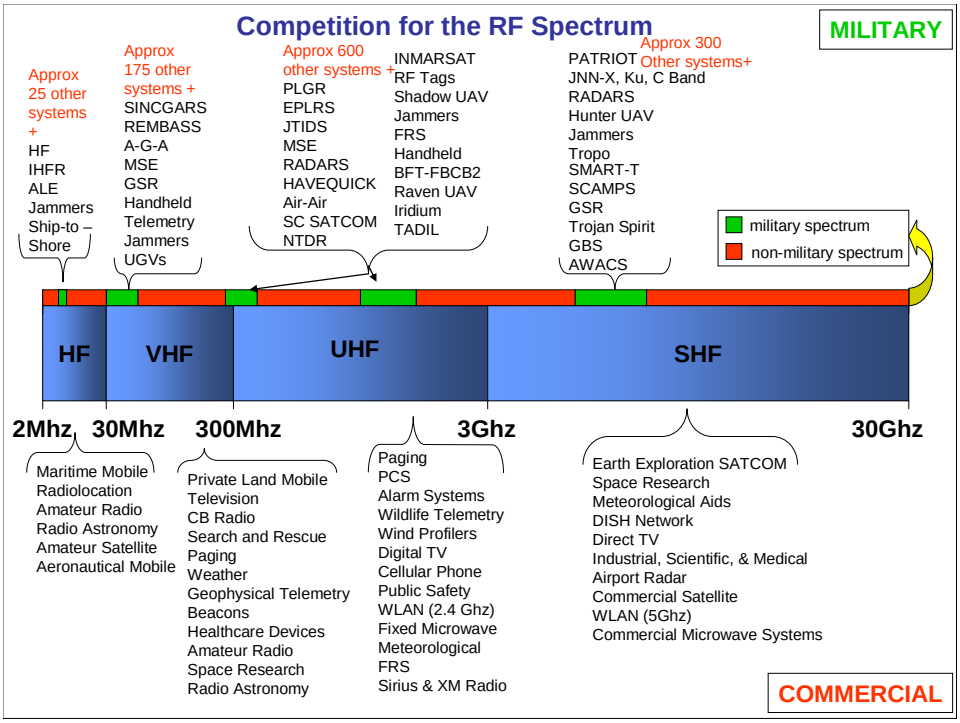


Figure 2-1. RF Spectrum

2-2. The Problem

a. Background

(1) Lessons learned from the global war on terrorism missions have indicated significant capability shortfalls with EMS management, specifically the management of RF. The most significant cause of these shortfalls is the exponential increase and accelerated procurement of RF emitters, many of which are commercial off-the-shelf (COTS) items, being issued to and used by deployed tactical forces which bypassed the DOD EMS compatibility standards using "operational requirements" as the justification to bypass the spectrum supportability assessment process. Many of these emitters support systems that are critical to commanders for both situation awareness and force protection. A few examples of emitters utilized today are portable jammers, unmanned aircraft system controllers, squad radios, munitions, sensors, and cell phones.

(2) The employment of these Army tactical emitters without formal JIM systems coordination exacerbates an already complex situation and presents a serious challenge for all major operations and host nation telecommunications systems. The Army, as all other Services, does not have the tools required to deconflict, in a timely manner, frequencies utilized by numerous emitters on the battlefield. The rapid introduction of new systems designed to enhance freedom of action and force protection has illuminated the urgent need for a flexible capability to conduct EMSO at all echelons on the battlefield in support of both the current and the future Modular Force while avoiding friendly frequency fratricide and violations of national and international laws, standards and policies. Potential adversaries recognize our civilian and military reliance on advanced information technologies and systems, and understand that information superiority provides the U.S. unique advantages. Thus they will implement various information operations means to counter these advantages, including fielding of advanced jamming systems and waveforms. At the same time, adversaries will acquire increasingly advanced communications technologies that in many cases will operate on the same frequencies as U.S. systems, creating potential additional spectrum management/deconfliction issues.

b. Discussion

(1) The EMS is a finite resource; once this valuable enabler of net-centric operations has been apportioned, there is no more. The limited spectrum available for military operations requires extreme care in the frequency allocation and reallocation process within an AO. The onset of new COTS technologies supporting military operations cause spectrum managers to learn how to deal with systems and devices outside the military spectrum allocation. EMSO gaps can only be resolved through a focused analysis of lessons learned from current operations, and collaborative and integrative efforts with existing and approved programmed efforts that identify capability gaps not fulfilled by current requirements documents.

(2) The magnitude of new technologies dependent on EMS being deployed, and the complexities of the noncontiguous nature of current and projected operations, has resulted in capability gaps that must be addressed. Spectrum managers at all levels are required to manage frequencies on a near real time basis to ensure that both blue force operations and force

protection spectrum use is deconflicted. Current lessons learned and many after action reports identify the inability of spectrum managers to mitigate potentially life threatening frequency fratricide incidents, even with tools such as Spectrum XXI (SPXXI). The Army must identify solutions to address the capability gap of current EMSO inability to deconflict all military, national, host nation systems, and nonmilitary systems employed in the AO to include force protection systems, communications systems, sensors, weapon systems, etc., in a manner that is dynamic enough to support the operational tempo of both current and future maneuver operations. This dynamic deconfliction capability must account for all military EMS, civilian government use (host nation if the AO is outside U.S. sovereignty, to include all local, state, and federal use in support of civil operations), and all use by noncombatant or nongovernmental organizations EMS users.

(3) In addition, the approach to resolve these issues must recognize the need for a holistic approach to mitigate risks and resolve the complex issue of EMSO from the strategic to the tactical level. As an example, integrated concept development teams responsible for improvised explosive device, defeat, and EW, which involve a significant level of spectrum management issues focus specifically on materiel solutions and tactics, techniques, and procedures to counter immediate threats to our Soldiers who are in harms way. However, these same efforts have compounded the spectrum deconfliction problem by introducing new RF frequency emitters into the area of responsibility (AOR) that have failed to complete the required DOD EM compatibility certification. Our need for expedient fielding of critical protection for Soldiers has emphasized the need for dynamic spectrum management for our future concept.

(4) Current requirement documentation from programs of record such as Warfighter Information Network-Tactical (WIN-T) and Future Combat Systems (FCSs) generalize capabilities requirements for spectrum management tools that are especially useful for this CCP. While these programs are still in their developmental stages and have no definitive timeline for fielding or spiraling EMSO capabilities, they do an excellent job of identifying EMSO capabilities needed for future combat systems. Another major program of record that used the JCIDS process is the Global Electromagnetic Spectrum Information System (GEMSIS). GEMSIS currently exists as a Joint Requirements Oversight Council (JROC) approved initial capabilities document (ICD) that aids the future focus of this CCP effort and emphasizes the need to develop all EMSO tools to meet the joint operational environment requirements. The details of these programs are highlighted in chapter 4 of this CCP.

2-3. The Concept

a. Overview. Army modernization efforts in recent decades have consistently added wireless systems throughout the force to improve connectivity between systems and networks. This proliferation of wireless systems has expanded across every Army proponent from home station to deployed Soldier, in all other DOD components, throughout the U.S. and all countries worldwide to support near real time transfer of critical information. Some of the many military systems that are now dependent on RF spectrum for connectivity with wireless operations include tactical radios, jammers, munitions, satellite terminals, artillery and air defense radars, other sensors, identify friend or foe transponders, telemetry, geo-location and navigation, unmanned vehicles (air and ground) controls, information operations, and EW. The future of

warfare indicates that this trend towards wireless connectivity that provides for increased operational tempo will continue to grow.

b. Capabilities review. Lessons learned in recent global war on terrorism operations identified the dramatic increase in effectiveness through synergy that results when military systems and capabilities are fully integrated. This EMSO CCP is an example of the effort to identify required capabilities to continue and manage this integration effort. Integrating EMSO capabilities into future network communications systems (for example, WIN-T) will eliminate duplicative technology developments, improve efficiency, and improve military operational effectiveness. The EMSO CCP identifies and examines the current and projected EMSO capabilities for the tactical Army forces in order to find gaps and overlaps in the current approach to spectrum management. The EMSO CCP will review all domains of EMSO to include regulation and policy, spectrum supportability, electromagnetic environmental effects (E3), host nation coordination, frequency records management, tactical frequency deconfliction, and assignment that use complex modeling and simulation (M&S) tools. This review will provide recommendations to synchronize the emerging capabilities with joint, coalition, and other related programs to ensure a comprehensive set of capabilities are developed in support of near term and future operations.

c. EMSO defined. Figure 2-2 illustrates the key functions and competencies within the Army EMSO environment. EMSO consists of planning, operating, and coordinating joint use of the EMS through operational, engineering, administrative, regulatory, and policy implementation procedures. EMSO consist of the following core functions at the strategic, operational, and tactical levels: spectrum management; frequency assignment; host nation coordination; and, policy.

d. Each of these core functions enables the efficient use of the EMS battlespace for military operations, regardless of phase. EMSO enable and support NETOPS, not only for communications systems (strategic, operational, and tactical) and EW, but EMSO is also critical to a myriad of other systems such as; air defense, navigation, munitions, manned and unmanned vehicles of all types (ground and air, UGS/unmanned aircraft system), radar, sensor, and potentially a whole host of other future systems. These electronic systems that are relying on wireless connectivity are part of critical technology insertions that provide the foundation for the net-centric operational environment. The objective of EMSO is to enable these systems to perform their functions in the intended environment without causing or suffering unacceptable frequency interference. The EMS operational environment is the environment in which EMSO, NETOPS, and EW operations must contend. It is essential that all of these activities be coordinated with the primary signal staff officer in the joint community, the J6, and associated primary signal staff officer for Army organizations, the G6, and/or S6 so that operating in the EMS environment takes a holistic approach to maximize efficiency while reducing the chances of frequency fratricide.

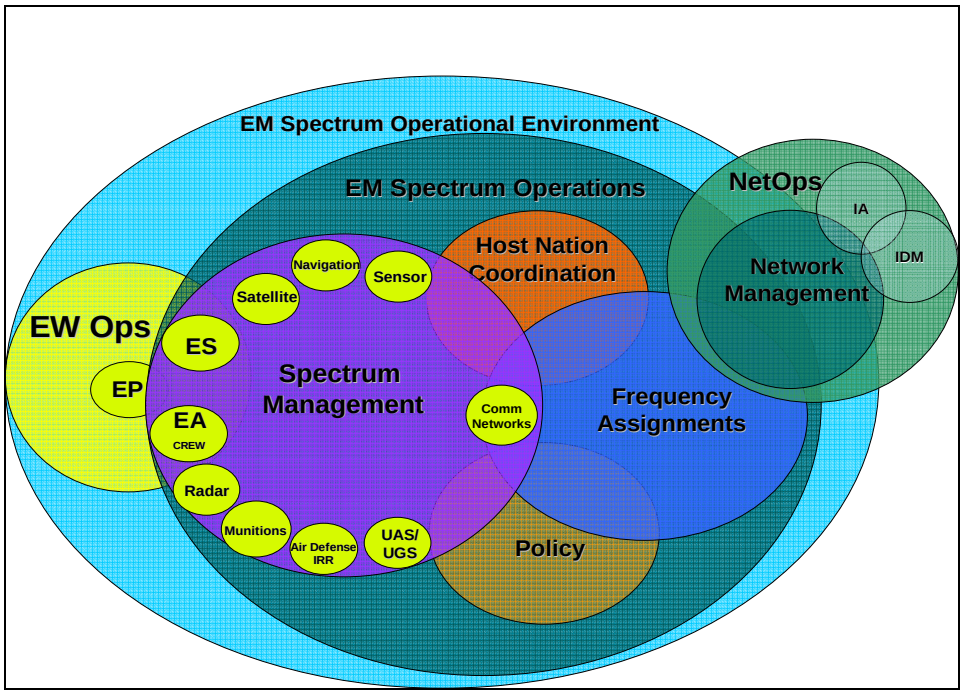


Figure 2-2. EMSO Environment

e. EMSO relationship to NETOPS. Although current doctrine shows spectrum management to be part of NETOPS, under network management (NM), this relationship focuses heavily on communication systems, and only peripherally on the other systems and wireless devices that rely on frequencies that may cause problems within the AO. The exponential increase of new technology in the current and future net-centric operational environment rely heavily on wireless communications has elevated spectrum operations to a critical combat multiplier. Activities such as host nation coordination, spectrum certification, and E3, which often occur outside the NETOPS purview, often have enormous impact on NETOPS effectiveness. At the strategic level NETOPS relies on numerous coordinating activities and agencies, both joint and Army, for spectrum management support in the planning of wireless communications systems that ultimately provides the allocation of frequencies for assignment throughout the network. Once coordination is complete among these activities, NETOPS becomes the focal point of EMSO, especially at the operational and tactical levels, if spectrum interference problems develop. For this reason, emerging concepts documents (both Service and joint), must recognize the full scope of EMSO processes and core functions to identify adequate capabilities to meet the needs of the future Modular Force.

f. EMSO relationship to EW. During the planning of EW operations, EMSO assists in the planning effort by providing spectrum management expertise within the electronic warfare coordination cell (EWCC), and continuous coordination with the G6/S6. During the execution of EW operations (electronic protect, electronic support, and electronic attack), EMSO will be relied upon to deconflict the spectrum resources that will enable the ongoing and future EW operations.

2-4. Army Electromagnetic Spectrum Operations (EMSO) Core Functions

a. Introduction. NETOPS and information management are U.S. Army Signal Regiment core competencies, both of which support full spectrum operations and fall under the staff responsibility of the G6/S6. (See Field Manual Interim (FMI) 6-02.43 for G6/S6 responsibilities). Within the NETOPS core competency are the domains of information assurance, information dissemination management, and NM. NM currently has responsibility for spectrum management. As identified earlier, current military operations are relying ever more heavily on wireless systems for transport to support their mission areas that fall outside the direct control of the G6/S6, which will further increase coordination demands for NETOPS functions.

b. The core functions of EMSO. Spectrum management, frequency assignment, host nation coordination, and policy implementation are the core functions of Army EMSO. EW coordination, especially in the realm of offensive EW operations, will continue to have an ever expanding impact on EMSO. EMSO consists of planning, operating, and coordinating shared use of the EMS through operational, planning, and administrative procedures.

(1) *Spectrum management.* Evaluating and mitigating E3, managing frequency records and databases, deconflicting frequencies, frequency interference resolution, allotting frequencies, and EW coordination to ensure EM dependent systems operate as intended, are all part of spectrum management function.

(2) *Frequency assignment.* The requesting and issuance of authorization to use frequencies for specific equipment such as combat net radio (CNR) and Army common user systems is the function of frequency assignment. This also includes the planning necessary for CNR, Army common user systems, and associated systems. Examples of frequency assignment are assigning the frequencies necessary to generate Joint Tactical Radio System rule sets or assigned frequencies for the WIN-T network.

(3) *Host nation coordination.* Each nation has sovereignty over its EMS in its geographic area and negotiates the use of that EMS on a case by case basis. The sovereignty of the country evaluates each DOD request for the use of spectrum, based on the perceived potential for electromagnetic interference (EMI) to local receivers. Use of military or commercial EMS systems in host nations requires coordination and negotiation that result in formal approvals and certifications.

(4) *Policy Implementation*

(a) International use of the EMS is coordinated globally through the International Telecommunications Union and the World Radio Communication Conference held every two to three years. In the U.S. at the national level, the responsibility of EMS management is divided between the National Telecommunications and Information Administration for government frequencies and the Federal Communications Commission for nongovernment frequencies.

(b) The U.S. Military Communications Electronics Board (MCEB) is the main coordinating body for signal matters among DOD components. The MCEB functions under the

policies and directives of the Secretary of Defense and the Joint Chiefs of Staff. The MCEB guides the DOD in preparing and coordinating technical directives and agreements and for the use of the EMS designated for DOD as the primary user.

(c) The main policy mechanism for managing EMS usage for DOD systems is DOD Directive 4650.1, Management and Use of the Radio Frequency. The directive establishes policy requiring any DOD component developing or acquiring spectrum-dependent equipment to make a written determination there is reasonable assurance of spectrum supportability. Further, no spectrum-dependent systems will proceed into production, or in the case of COTs, be fielded without the spectrum supportability determination. The MCEB Frequency Panel established the Equipment Spectrum Guidance Permanent Working Group to provide coordinated military guidance to DOD components on spectrum dependent systems/equipment in accordance with DOD Directives, allied, National, and International rules, regulations, and standards on spectrum management. AR 5-12, chapter 4, prescribes DD Form 1494 (Frequency Allocation-to-Equipment Process) as the application for spectrum certification. In accordance with AR 5-12, paragraph 4-2, an approved DD Form 1494 or waiver must be completed for all systems and equipment that emit or receive Hertzian waves. Hertzian waves are EM waves, usually of RF, produced by the oscillation of electricity in a conductor. While in theory, the process prescribed in AR 5-12 should ensure there are zero DOD systems fielded that create spectrum interference problems; practical experience has many examples, where rapid acquisition processes fail to adhere to regulations which cause problems throughout the DOD and Army.

c. EMSO management process. The EMSO management process is comprised of three interacting and continuous functions: planning, coordinating, and operating (see fig 2-2). During full spectrum operations these functions occur concurrently.

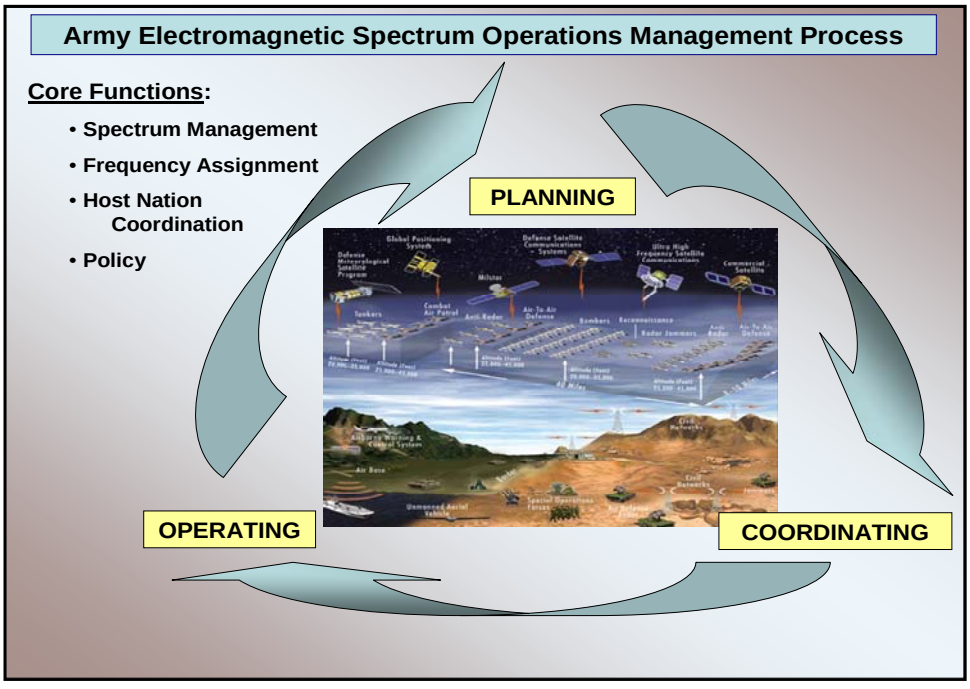


Figure 2-3. Army EMSO Management Process

(1) *Planning.* Spectrum planning includes the identification of spectrum requirements for training, predeployment, deployment, redeployment, and reconstitution of Army forces, in the continental U.S. and outside the continental U.S. Spectrum planning is an on-going process that must be deliberate, as well as dynamic to support future Modular Force operations. It requires the collection, storage, and protection of critical spectrum data, and assured access to spectrum planners on a global scale. Additionally, planning for the establishment of lines of communication for coordination of spectrum use with national and international government, and nongovernment agencies is critical to the spectrum planning process.

(2) *Coordinating.* Coordinating spectrum use is the process of collaborating with National, host nation, government and nongovernment agencies, and JIM in specific operational areas. This function will ensure initial spectrum availability and supportability for operations. Establishing lines of communication in the planning process for coordinating spectrum allocation at the National and international level are primarily a matter of policy. Coordination at the operational and tactical force level for the future Modular Force will require prior coordination as well as a dynamic, near real time collaboration tool.

(3) *Operating.* The operating function enables and sustains the functions of planning and coordinating and includes the process to conduct and sustain spectrum operations. EMSO ensure the efficient use of allocated spectrum and associated frequencies in a given AO. The operating function enables dynamic, near real time frequency assignment, reassignment, interference resolution, and deconfliction across all users in an AO. The architecture provides for interoperability with National and local government and nongovernment agencies, as well as JIM.

d. Summary. EMSO functions as depicted in figure 2-2, of planning, coordinating, and operating are executed in a continuous cycle from training to the onset of deployment notification, through deployment, reception, staging, onward movement and integration, decisive operations, recovery and redeployment to home station. The functions of spectrum are interrelated and supportive of a commander's ability to understand, plan, and dedicate specific capabilities to enable full spectrum operations at home or abroad, on-the-move or at-the-halt. Future Modular Force spectrum dependent capabilities will require performance of these functions in near real time. In order to fulfill this requirement the processes that support EMSO must be deliberate, dynamic, and supportable on a global scale.

2-5. Army EMSO and Military Operations

a. EMSO will be applied to enable full spectrum operations; from homeland security to humanitarian missions, to major combat operations.

b. Homeland security. The ability to communicate over wireless devices is dependent on the availability of EMS. In a crisis, whether it is a terror attack on our Nation or a catastrophic natural disaster, wireless communications will be used to transmit critical information between government agencies, local authorities, civil and military rescue and security personnel, etc., in an effort to save and defend the lives of our citizens. The tragedies of September 11, 2001 and

more recently, Hurricane Katrina, have demonstrated the complexities of crisis situations in this wireless dependent world.

(1) *Homeland security vignette.* An explosion occurred outside the terminal of a major U.S. international airport. Initial signs indicate a terror attack involving possible chemical munitions. Intelligence reports indicate that there is a high probability of follow on attacks from suspected terrorists in retaliation to U.S. operations abroad. Local municipal and state authorities have requested federal assistance to secure the area (fig 2-4).

(2) As state, local, and federal agencies mobilize, U.S. Northern Command alerts the responsible joint task force (JTF) for the area in question, and assigns a brigade combat team (BCT) or a combat support brigade (maneuver enhancement) (CSB (ME)) to secure the affected area. The JTF spectrum manager selects the emitter template of the assigned BCT or CSB (ME), inputs this data into the automated EMSO tool, and designates the AO in order to assign frequencies to all emitters/networks/groups. Requests that cannot be filled from the existing resource frequency allocation are automatically flagged and generated directly to the regional DOD area frequency coordinator for adjudication. Additionally the spectrum manager requests common public safety and safety of life frequencies for interagency use with local, state, and other federal authorities.

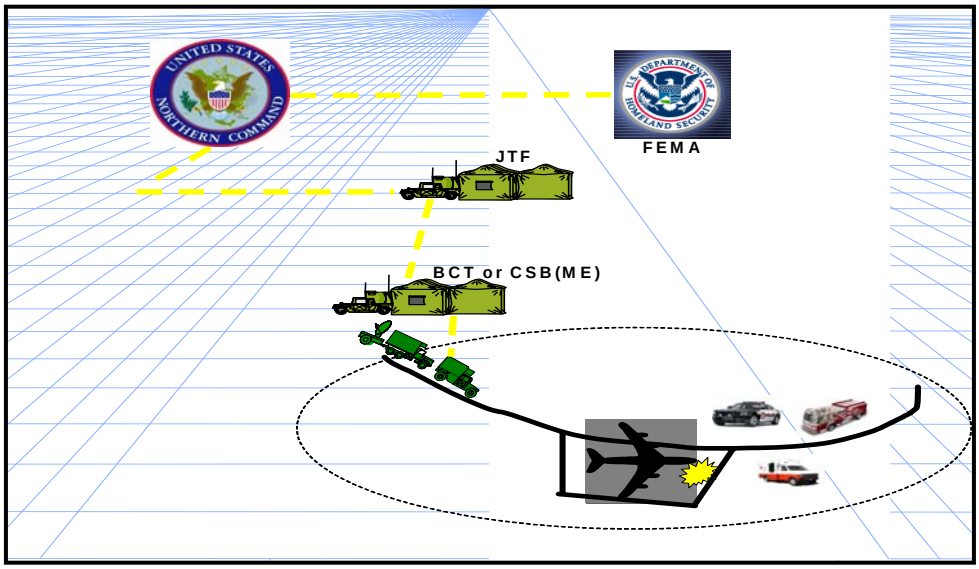


Figure 2-4. Homeland Security

(3) Potential EMI effects are avoided through automatic assignment of new frequencies to the BCT or CSB (ME) security team while en route. Modeling and simulations during training exercises for this type of event captured the data for all wireless communications and emitters used in this situation allowing for dynamic deconfliction of frequencies for all agencies involved.

c. Humanitarian mission.[1] Cultural tensions in the Lithostan region have been mounting in the area for the past 5 years and are centered on ethnic and religious differences. The civil unrest is responsible for the deaths of an estimated 120,000 government employees and civilians. The citizens of Listhostan have become weary of the government and its inability to stop the civil unrest. The Lithostanian military advisors presented a warning to the government that there is a strong possibility of a coup within the next few weeks. Based on Lithostanian's military inability to maintain civil authority, the government of Lithostan has asked the United Nations and U. S. for assistance in quelling the unrest. The international airport of Lithostan has become the location of a large operations base supporting the humanitarian mission. It is the site of multiple bases of operations supporting coalition, joint, interagency, and international humanitarian organizations. Each organization present has significant requirements for spectrum allocations in an area which the local government controls the spectrum. Heavy restrictions of the available spectrum are imposed on non-host nation entities to allow local government, commercial, and private sector communications.

(1) *Humanitarian mission illustrative vignette.* The United Nations authorizes a combined joint task force led by a U.S. Army commander. The combined joint task force commander has directed his staff to conduct crisis action planning to update existing contingency plans for humanitarian operations. The primary Signal staff officer for the coalition force, (C6) cell immediate concerns are the determination of user requirements, processing frequency requirements, frequency deconfliction, frequency interference resolution, evaluating and optimization of spectrum use, the joint restricted frequency list, communications security, and host nation restrictions. Additional tasks and functions include building and distribution of CNR load sets, analysis on proposed line-of-sight radio links, coordination with the EW officer within the EWCC cell to mitigate frequency fratricide (where one combat operation kills the use of approved frequencies by other friendly units), and to ultimately provide the commander with a spectrum implementation plan. Based on available data, the C6 cell established all frequency allocations for the U.S. and coalition elements and the resource requirements have been coordinated, deconflicted, and approved using the available EMSO spectrum management tools.

(2) Due to increased civil unrest, and the need to gather covert intelligence, an interagency intelligence force moves into the airport to set up its headquarters. The EMSO spectrum analyzer module detects sensor interference between the airport network, the intelligence force communications and sensor systems, and the combined joint task force base communications systems. The C6 spectrum manager quickly updates the EMSO spectrum knowledge repository to add the communications network resources of the intelligence force. With data import and export capability the EMSO tool was able to provide an alternate course of action that enabled the interagency intelligence force to establish communications to support their intelligence gathering missions. With the establishment of the interagency network and the ability to communicate current security status, inbound combined joint task force military and commercial aircrafts were able to perform their resupply humanitarian operations.

d. Major combat operations. Due to the high mobility of Army operations, the dispersal of Army units, and the wide range of Army spectrum dependent systems, Army frequency use requires extraordinary planning. However, the noncontiguous battlefield, urban warfare, and the

[1] No diagram is provided for the humanitarian mission vignette due to the abstract nature of the mission.

complexities that these situations bring will require proactive as well as reactive capabilities to ensure mission accomplishment. Army frequency management techniques and procedures will continue to change to support Army acquisition of modern real time frequency agile systems and those requiring high data rates and related increases in bandwidth. This dynamic environment presents a unique challenge to Army frequency management personnel responsible for tactical maneuver forces. For example, during major combat operations, platform sensor data and Soldier sensor data are pushing information through wireless network devices (WND) to the GIG where they populate data warehouses that Logistics C2 systems interrogate as part of the Army Battlefield Command System (ABCS) to populate the logistics common operational picture. Each and every platform and Soldier C2 system is being monitored in this way. This dynamic environment presents a unique challenge to Army frequency management personnel responsible for tactical maneuver forces.

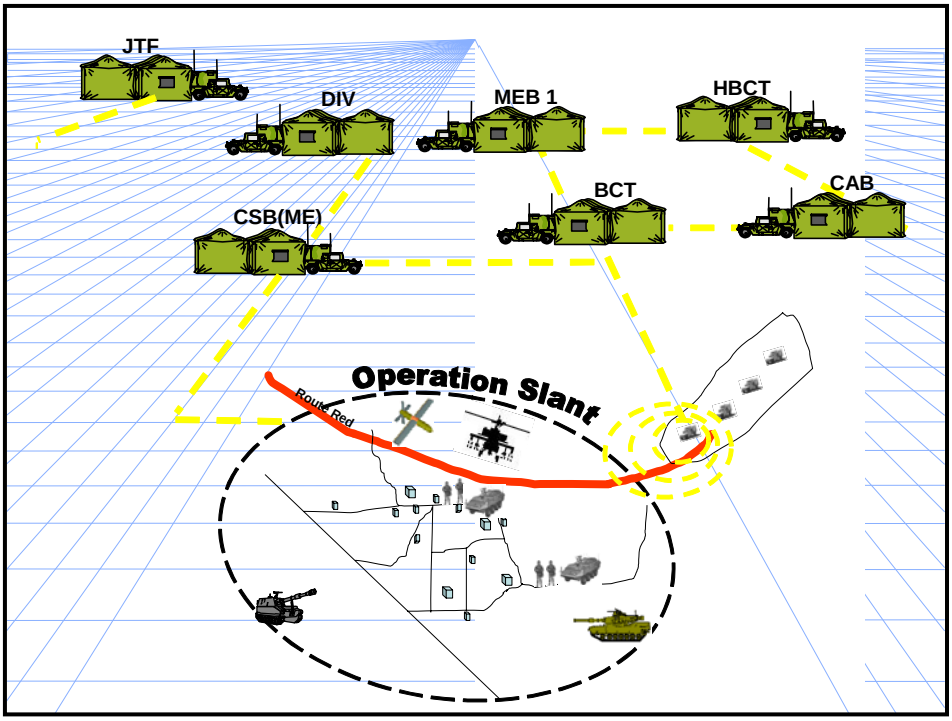


Figure 2-5. Major Combat Operations

(1) *Major combat operations vignette.* Division (DIV) receives mission from JTF commander to provide support to local civil authorities in sector A of the division's AO. The commander tasks Infantry Company A of Marine Expeditionary Brigade (MEB) 1 to perform search/security patrols in a built-up urban area of their assigned AO. Mission objective is to locate and destroy enemy munitions and weapons used against local civil authorities during the last 24 hours. An adjacent heavy BCT is tasked to provide unmanned aircraft system, armor and artillery support as needed. Additionally, the combat aviation brigade provides attack helicopter support. The mission is code named Operation Slant (fig 2-5).

(2) The spectrum manager at the DIV coordinates with the heavy BCT (HBCT), Marine Expeditionary Brigade 1, CSB (ME), and combat aviation brigade, to input emitter templates for the task organization into the spectrum database under Operations Slant folder. The DIV spectrum manager selects the emitter templates of the assigned units within the designated AO in order to allocate frequencies to all emitters/networks/groups and then inputs this data into the automated EMSO tool. Requests that cannot be filled from the existing resource frequency allocation are automatically flagged and requests are automatically generated directly to the theater area frequency coordinator for adjudication. Additionally the spectrum manager requests common public safety and safety of life frequencies for interagency use with local civil authorities.

(3) During the conduct of the operation, which is within 10 kilometers of the divisions main supply route, named Route Red, the DIV spectrum manager runs an analysis on spectrum usage along the projected convoy route. The effects simulator module of the EMSO tool quickly alerts the G6 of potential frequency fratricide between an Army convoy on the main supply route operating radio controlled improvised explosive device defeat systems and Army units conducting Operation Slant. The DIV spectrum manager utilizes the cognitive radio module of the EMSO tool to initiate automatic deconfliction and mitigation action for near real time policy based radios and legacy platforms. The EMSO tool allows for manual intervention for updates to be made or provides automatic update functions based on current situational input.

(4) The immediate need for interference resolution calls for an on the move update and thus the DIV spectrum manager selects the automatic option and the updated policies and frequency plans change request is sent to change the C2 platforms via over the air reprogramming instructions. As an addition to the radio updates, the EMSO tool also provides an alternate route for the convoy based on input from the convoy planning module and the current intelligence updates. With the communications updates, and alternate route changes, the EMSO tool also sends an automatic update to the NETOPS tool to ensure all changes are made to the common operational EMS picture. The BCT spectrum manager acknowledges the changes made to the common operational EMS picture and implements action measures. The convoy commander on the main supply route is immediately notified of changes made to his operating frequencies and is instructed to verify and acknowledge receipt.

Chapter 3
Required Capabilities

3-1. Introduction

a. Future warfighter capabilities depend on the synchronized acquisition of systems that can adapt to the changing boundaries between war and peace, military and commercial, and national borders. Increased flexibility and ability to rapidly adapt is required to meet future changes in the spectrum regulatory environment. As with the transition from fixed tuned radios to field tunable radios in the 1970’s, a transformation to environmentally and regulatory adaptive wireless communications must be initiated. The future warfighter will require capabilities that adaptively overlay existing regulatory and EM environments – docile in garrison, dominant in

battle. Spectrum management must be unified, not fractured along arbitrary lines of organizations, missions, systems, or locations. Individually acquired wireless management systems must be integrated into the broader context of the GIG and must collectively support all wireless GIG components, communications and noncommunications capabilities alike.

b. The functional capabilities required by a joint force or Army commander to execute comprehensive EMSO down to and including the tactical level are outlined below. These capabilities provide the commander with the tools required to enable, through availability of RF spectrum, network-centric operations across the full spectrum of military operations. These EMSO capabilities will integrate with joint command and control systems (JC2), sharing information across the GIG, integrating into the global position systems and other force tracking systems. Interpret this current list of required capabilities as the optimum capabilities during the 2015-2024 timeframe. The EMSO required capabilities listing is not all inclusive and will be further refined and developed as the Army EMSO concept matures, and as JCIDS analysis is executed. Technological and threat advances may also drive changes to the listed capability requirements.

3-2. EMSO Capabilities

a. The Army EMSO functions, as detailed in chapter 2, and their related capabilities collectively contribute to the commander's ability to s*ee first, understand first, act first, and finish decisively*.

b. Planning capabilities. As a minimum, planning capabilities should include those listed below.

(1) Interoperability with JC2, ABCSs, EW Planning Systems, and GIG.

(2) Plan in near real time. There is always latency in information transfer, so all capabilities are in near real time.

(3) Automated tools that reflect spectrum operations in support of operational mission planning and rehearsal, simulation-based acquisitions, and national level spectrum management. These tools should provide M&S that reflect spectrum considerations within planning tools of all appropriate mission areas.

(4) Access to the global catalog of spectrum clients (emitters) down to platform, unit, sensor, individual level and the ability to track these clients in near real time.

(5) Collect, store, protect, and retrieve spectrum data in an adaptive and dynamic fashion.

(6) Global directory service for spectrum coordination by use of a coherent and interoperable joint architecture with EW operations systems.

c. Coordinating capabilities. As a minimum, coordinating capabilities should include those listed below.

(1) Interoperability with JC2, ABCSs, EWCC Systems, and GIG.

(2) Coordinate in near real time and collaborate across all Army echelons, JIM, national and international government and nongovernment agencies.

(3) Account for existing EMS infrastructure in the AO, which includes U.S (friendly), host nation, and International Telecommunications Union spectrum regulations. The objective standard for this capability would be an ability to access in near real time emitter mapping data and signal intelligence survey data that would further support a complete common operating spectrum picture. This common operating spectrum picture should allow for two-way transfer that allows the EW and signal intelligence enterprises to be able to have a view of the emitters found in an AO (friendly, host nation, background, and unknown). Ideally, this spectrum picture would allow for two-dimensional and three-dimensional viewing. The ability to add a temporal perspective; for example, show when a convoy with an assigned set of frequencies will enter and exit an AO, would only add to the situational awareness and situational understanding common operational picture. Finally, the picture must map systems such as radar systems and EW activities that have potential to interfere with known friendly systems. Ultimately, the capability will allow for next generation emitters, especially known friendly systems, to automatically self-populate the common operational spectrum picture.

d. Operating capabilities. As a minimum, operating capabilities should include those listed below.

(1) Interoperability with JC2, ABCSs, EW systems, and GIG.

(2) Operate in near real time.

(3) Deconflict spectrum use between friendly radar, sensors, weapons systems, and geo-location/navigation and communications capabilities. Support automatic spectrum detection, sensing, analysis, and deconfliction to support near real time interactive identification and use of unused spectrum resources. Deconfliction must take into consideration adversary and noncombatant use of the spectrum and friendly offensive electronic attack capabilities. As identified in the coordination capabilities, this operational capability must allow for a common operating spectrum picture to be developed with all of the capabilities outlined above and available to the “last tactical mile” force or unit.

(4) Share tactical EMSO information to and from the common operational EMS picture.

(5) Integrate spectrum operations into net-centric operations with the use of automatic warnings to users of C2 systems or other situation awareness tools of potential spectrum conflicts and to display these warnings on the common operational EMS picture. (An example is friendly use of millimeter wave obscuration on the battlefield which might cause EMSO disruption in a localized area.).

(6) Develop automated tools that reflect spectrum operations in support of operational mission planning and rehearsal, simulation-based acquisitions, and national level spectrum management. These tools should reflect spectrum considerations within planning tools of all appropriate mission areas across all levels of war – strategic, operational, and tactical.

(7) Analyze and minimize E3 utilizing modeling & simulation techniques considering co-site EMI, hazards of EM radiation to ordnance, personnel, and other radiation hazards (RADHAZ).

Chapter 4
Bridging Current to Future Capabilities

4-1. Introduction

a. This chapter serves to detail current capabilities, address the development and spiraling of those capabilities, and to describe optimum future required capabilities needed to support the future Modular Force. Identifying the gap between current (both fielded and approved for fielding) and future capabilities needed allows for a planned migration of technologies to the future. This "bridge" ensures the best possible solutions for near and mid-term forces, while ultimately fielding an optimal future solution. The future capabilities described in this chapter are crafted to advance the optimal future solutions and these capabilities are bounded only by the timeframe, anticipated threat, and expected spectrum of military operations that our forces are projected to encounter.

b. The following description from the GEMSIS operational concept provides an excellent summary of emerging capabilities that will need to be incorporated in to future systems.

(1) Advances in computational capabilities, software defined radios, and the standardization of the software communications architecture above 2 megahertz are enabling the convergence of wired networks with wireless communications toward an outcome of seamless communications across the entire spectrum of military operations. Dedicated and compartmentalized communications and management functions must be transformed to become the unified implementation of the wireless GIG and internet protocol-based management applications hosted by the GIG.

(2) Increased computational capabilities also enable wireless technology to become both environmentally and regulatory adaptive, while achieving a significantly reduced spectrum footprint. The envisioned transformation of software defined radios into WND will provide the capability to sense the local EM environment and dynamically coordinate spectrum access to operate autonomously. The set of expected WND capabilities include a very wide operating frequency range, numerous waveform technologies (such as, code division multiple access, ultra-wideband), multiple and steerable antenna mainbeams and nulls, and random modulation recognition.

(3) Dynamic self-coordination increases freedom of low level forces to operate near autonomously and re-task them through exploitation of shared awareness and commander's intent.

(4) WNDs are expected to assume supplementary roles in addition to implementing the GIG. Through the exploitation of EM environment sensing, WND will provide increased EM situational awareness, and provide the potential to conduct signal collection anywhere in the battlespace. WND will also have the ability to disrupt or deny the enemy's access to the EMS, or to adaptively exploit the enemy's networks.

(5) Regulatory specifications for spectrum access are currently contained in unstructured text and lead to potentially inconsistent interpretation. Spectrum regulatory specifications must be uniformly quantified and transformed into 'radio readable instructions' to support increased responsiveness in mission planning and adaptiveness in operations.[2] These 'radio readable instructions,' involving spectrum allocated services, applications and user's channeling plans, and technical specifications, also offer a path to improve strategic spectrum planning and automated assessments.

4-2. Other Ongoing Joint Capabilities Integration and Development System (JCIDS) Spectrum Programs

a. This EMSO CCP is supported by, as well as supports, other ongoing and approved CCPs, such as: *Network Transport and Services*, *Space,* and *EW*. In addition, the joint NM functional solutions analysis that has developed from the JROC approved net-centric operational environment joint capabilities document will provide additional understanding of capability gaps that have already been identified in recent studies.

b. During the functional area analysis and functional needs analysis of the above effort that was conducted from 2004 to 2006, the joint community identified a specific functional area capability gap that was broadly defined as "limited assured access to and management of the EMS." In 2003, the Joint Chiefs of Staff developed a detailed capability gap analysis, now being overseen by the Defense Information Systems Agency. This study gained JROC approval in January 2006 for an ICD that is currently developing a materiel solution titled the GEMSIS. The significant detail and research produced by the GEMSIS analysis documents, especially in view of their joint perspective, must be considered significantly in this chapter as their framework of analysis is very similar to the core competencies, functions, and domains that were identified in chapter 2 for Army EMSO.

c. Figure 4-1 depicts the GEMSIS effort as the objective program during the 2015–2024 timeframe for the key intermediate programs of the Coalition Joint Spectrum Management Planning Tool (CJSMPT) and WIN-T as all current and programmed efforts are leading to that development. Figure 4-1 represents the incremental goal of bridging the gap from current to future capabilities.

[2] The Defense Advanced Research Projects Agency Next Generation (XG) program is currently probing this arena.

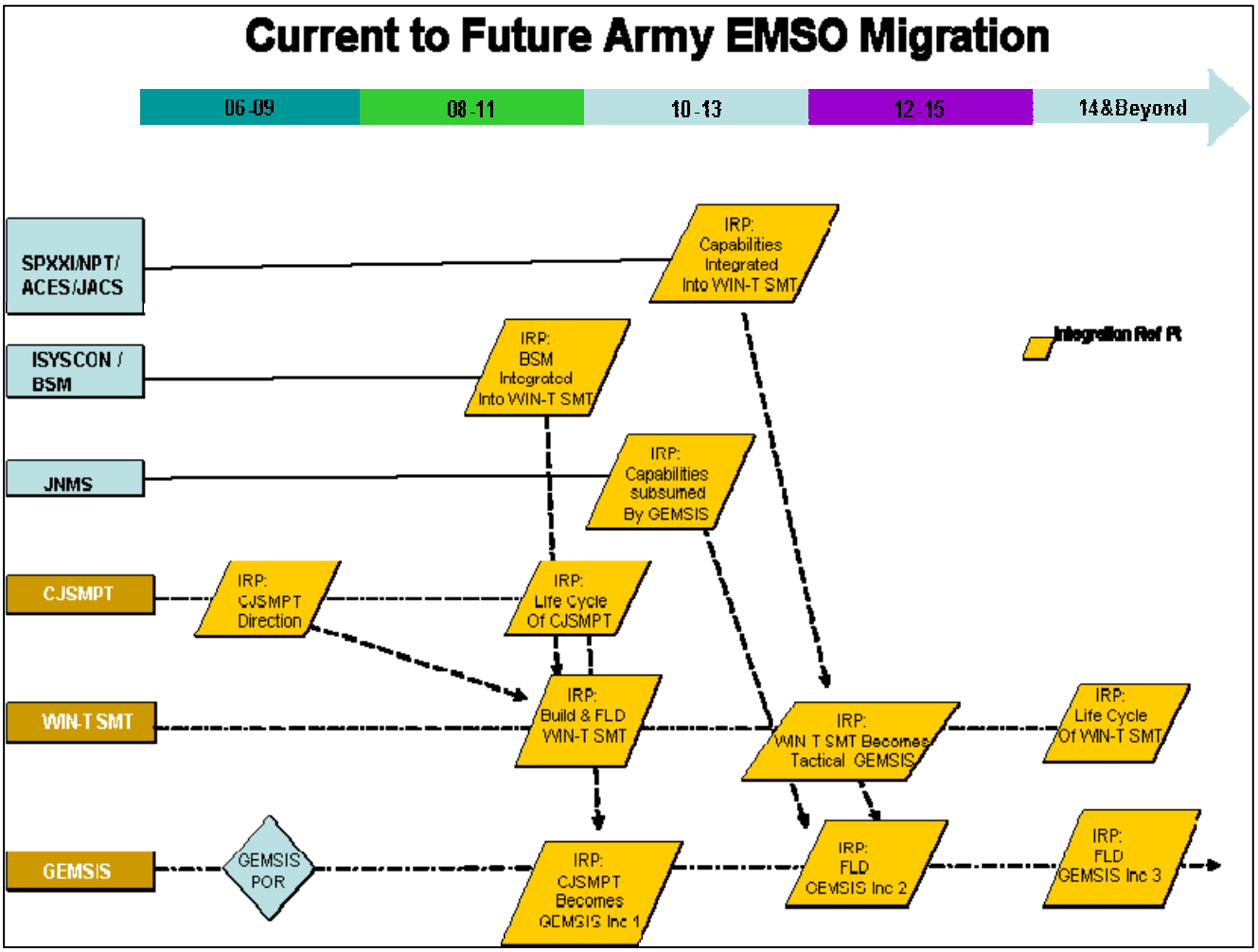


Figure 4-1. Army EMSO Migration

4-3. Assessment of Current EMSO Capabilities

a. Transformation while conducting the global war on terrorism creates many challenges to the Army and to our armed forces as a whole. The greatest challenge is the pursuit to rapidly field the best equipment to Soldiers and leaders engaged in combat to provide them the means to adapt to a new paradigm of war fighting strategies and to combat an adaptive and elusive enemy. This pursuit has resulted in a flood of new technology, which includes the fielding of numerous wireless spectrum-dependent devices. Spectrum managers at the tactical level are not equipped, trained, or organized to execute the functions of planning, coordination, or management at the pace required for current military operations. This section provides an assessment of current capabilities for planning, coordinating, and operating.

b. Current Spectrum Planning Capabilities and Known Current Shortfalls

(1) Current tactical spectrum management tools are not capable of planning networks in a disparate manner. The tools are largely stove-piped systems designed to handle only specific

functional area systems or equipment, for example, communications, spectrum, sensors, and others, without considering the interaction of the full range of emitters throughout the AO. Nor do these tools consider the effect of systems that do not emit, but nonetheless affect the EMS, such as specialized obscurants. Even within an specific functional area, such as communications, the information systems control that is used to plan the mobile subscriber equipment (MSE) network with both Band I (M225-400) and Band III (M1350-1850) radios, is not able to take into account the single channel tactical satellite (M225-400) that may be operating in the same area. The spectrum management tools are largely static databases that identify frequencies that are currently approved for use. These tools lack the ability to do dynamic M&S to assess the effects of emitters or systems that do not emit, but still affect the EMS in an ever-changing environment.

(2) The Joint Network Management System (JNMS) program provides joint and service component commanders a common, automated planning, and management tool that will plan, monitor, and control the joint communications and data backbone associated with a JTF or joint special operations task force. It includes the following capabilities: high level planning, to include creation/editing and/or loading of data bases; definition of network sites and units; assignment of responsibilities and schedules; generation and distribution of planning data, joint communications-electronics operating instruction, communications service requests, detailed planning and engineering, activation and modification, to include planning and engineering for circuit switches, asynchronous transfer mode, defense message system, commercial and military satellite communications systems, data networks, message switches, transmission systems, and single channel networks. JNMS indirectly supports spectrum management within the network.

c. Current Spectrum Coordination Capabilities and Known Current Shortfalls

(1) Current doctrine addresses the relationship between the various staff elements but is not all-inclusive. Without a common operational EMS picture, coordination is somewhat haphazard. Not all emitters or systems that affect the EMS, are accounted for so must be dealt with by exception. As an example, an air defense artillery battery collocates next to an airfield. In this scenario, the radars used by the air defense artillery unit may cause problems for the airfield but the G6 and fires have no formal coordination channels or millimeter wave obscuration in support of offensive operations against a fortified position. The millimeter wave obscuration can defeat friendly millimeter wave based systems that are required to identify where hostile units are located and to engage them from standoff locations. There is no current method to integrate these different requirements without affecting the ability of the other in accomplishing their critical mission.

(2) The process becomes much more complicated in a JIM environment. The joint staff has adopted SPXXI as the joint standard for spectrum management and it is the only frequency deconfliction tool currently available to the force. It meets the requirement to provide frequency allocations to a variety of communications planning tools used by the Services. SPXXI was not designed to support tactical spectrum management operations. It was developed to plan future events and therefore does not adequately support current battlefield operations. It operates in a client server environment with four regional servers employed in U.S. European Command, U.S. Pacific Command, U.S. Central Command, and the Joint Spectrum Center. SPXXI was

developed using 1990s inefficient technology that does not support the mobile, noncontiguous environment that characterizes operations today or as the Army envisions in the future. Typically, it takes hours, days, and in some cases, even weeks to submit and receive frequency assignments for tactical units. This is clearly not responsive enough to support forces deploying for tactical maneuver operations. SPXXI has been fielded to all the Services as software only and is being maintained by the Joint Spectrum Center with various incremental patches and hardware upgrades.

d. Current Spectrum Operating Capabilities and Known Current Shortfalls

(1) As both planning and coordinating are relatively static processes the operating function is largely done by exception. Once the initial planning is implemented coordinating and operating is done as problems arise. Most operating functions are reactive vice proactive because there are no tools or processes that enable dynamic EMSO. Army communications engineering software (ACES)/Joint Automated Communications-Electronics Operating Instruction System (JACS) combine information from the spectrum manager (frequencies, and communications-electronics operating instruction data), communications security manager (key tags with associate key data), and the network manager (assigns communications security keys to the network laydown and downloads to the Common Tier 3 (CT3) data transfer device) into a single database. ACES/JACS provides enhanced automated functions and allows for better cryptonet management, engineering, generation, distribution of joint communications-electronics operations instructions/single operating instruction and electronic protection fill data for CNR operations, automated net control device/data transfer device application software user functions, export/import American Standard Code for Information Interchange vertical ACES/JACS data to standard frequency action format (SFAF), MSE routines, and tactical satellite frequency assignments.

(2) Battlefield spectrum management is the systematic planning, managing, engineering, and coordinating of EMS use by units engaged in combat and training for combat. At each level, the primary signal staff officer (G6/S6) and the spectrum managers are responsible to the commander for spectrum management. A specially trained, noncommissioned officer, with the military occupational specialty of 25E, performs the day-to-day battlefield spectrum management functions at division, corps, and echelons above corps levels. The spectrum manager coordinates with superior, subordinate and adjacent units, and with other staff sections. Battlefield spectrum management is truly only a management process and is essentially a totally manual process to manage spectrum and will ultimately find most of its capabilities put into software rules that are fully integrated directly in to spectrum dependent devices.

4-4. Spiraling Current Capabilities

a. This section describes the current plans, if no plan currently exists, for the spiraling of current capabilities to the future optimum capabilities to support EMSO objectives outlined in this concept.

b. Known Spectrum Planning Program of Records and Associated Fielding Plans

(1) CJSMPT is a current initiative in the form of a joint capabilities technical demonstration (JCTD) to bring an interim capability to the EMS manager. It is hoped while CJSMPT is developed that the development and integration of databases and current capabilities will provide a step in the direction of enabling the EMS manager to have a clearer picture of the spectrum and be able to do some preliminary M&S to mitigate spectrum problems during operations.

(2) A WIN-T spectrum management tool (SMT) will provide integrated dynamic EMSO capability to request, allocate, plan, and assign the efficient use of EMS for all communications and noncommunications emitters employed within the AOR. WIN-T will assist in the generation of an electronic submission, receipt, and automatically implement SFAF, satellite access request (SAR), and gateway access request data (documents/reports) to request satellite access and/or adjust satellite coverage. WIN-T will provide the capability to exchange positive control information with Satellite Communications (SATCOM) Operation Centers to coordinate/deconflict WIN-T's usage of satellite resources. A complete listing of the WIN-T SMT capability is attached at appendix B.

c. Known Spectrum Coordination Program of Records and Associated Fielding Plans

(1) The CJSMPT JCTD will develop an integrated RF spectrum planning and management tool that will enable frequency managers to perform RF spectrum planning from brigade through JTF for both mission planning and the conduct of combat operations. The program will focus on: RF spectrum optimization and conflict mitigation that considers environmental factors, operational priorities, host nation allocation and assignments, and international spectrum management policies and regulations; development of visualization tools to provide commanders and warfighters a picture of dynamic RF spectrum usage; and development, integration and population of U.S. and coalition forces RF spectrum databases while conforming to emerging net-centric concepts.

(2) The CJSMPT has been fully funded by the Joint Improvised Explosive Device Defeat Organization and will be fielded in phases. The first phase will produce a capability that is focused on mitigating the effects of counter remote controlled improvised explosive device electronic warfare systems on the friendly emitters. It will be fielded to the U.S. Central Command AOR. The second phase will produce enhancements and refinements to the improvised explosive device defeat capabilities and develop the mission planning capability which was the original focus of the CJSMPT. This phase will be completed in late 2008. The third phase will be the assessment of the JCTD followed by fielding to Service spectrum managers by mid 2009. The CJSMPT will then transition into and become the first increment to GEMSIS, the objective DOD spectrum management system.

(3) WIN-T will assist in the generation of an electronic submission, receipt, and automatically implement SFAF, SAR, and gateway access request data (documents/reports) to request satellite access and/or adjust satellite coverage. WIN-T will provide the capability to exchange positive control information with SATCOM Operation Centers to coordinate/deconflict WIN-T's usage of satellite resources.

d. Known Spectrum Operations Program of Records and Associated Fielding Plans

(1) WIN-T will provide an integrated dynamic EMSO (such as, requesting, allocating, assignment, deconfliction, protection, and revocation) capability to plan and efficiently use EMS for all communications and noncommunications emitters employed within the AOR. WIN-T will be able to dynamically access available RF spectrum. WIN-T frequency assignment process will allow reuse of available spectrum to minimize harmful interference. WIN-T will provide the capability to exchange positive control information with SATCOM Operation Centers to coordinate/deconflict WIN-T's usage of satellite resources. (The WIN-T capabilities development document is JROC approved and WIN-T SMT detailed listing from its final capabilities production document is attached as appendix B.)

(2) WIN-T will provide network visualizations showing networking components (for example, routers, switches, radios, security devices/encryptors), operational states, and their link status. WIN-T will provide network visualizations showing mobile node(s) locations and link status.

4-5. Optimum Capabilities

a. This section describes desired future optimum capabilities supporting EMSO objectives outlined in this concept. These capabilities must be provided for all planning, coordinating, and operating functions across all organizational levels.

b. These capabilities are consistent with all ongoing JCIDS spectrum programs.

(1) Develop a single joint architecture for devices using the EMS that extends over the GIG, accounts for mobile wireless operations, and provides a GIG common operational spectrum picture.

(2) Deconflict spectrum use between friendly radar, signal collection, EW, weapons systems, advanced obscuration, geolocation/navigation, and communications capabilities. Support automatic spectrum detection, sensing, analysis, and deconfliction to support near real time interactive identification and use of unused spectrum resources. Deconfliction must take into consideration adversary use of the spectrum, as well as friendly offensive electronic attack capabilities and advanced obscuration use.

(3) Integrate spectrum operations into net-centric operations that support transformation from the current preplanned and static frequency assignment strategy into decentralized, autonomous, and adaptive spectrum operations that will support the integration of sensors, weapons systems, and software communications architecture for DOD utilizing the GIG. Account for existing EMS infrastructure in the AOR, which includes U.S., host nation, and International Telecommunications Union spectrum regulations.

(4) Analyze and minimize E3 utilizing M&S techniques considering co-site EMI, hazards of EM radiation to ordnance, and other RADHAZ.

(5) Increase efficiency of DOD spectrum use by eliminating inefficient preplanned and static frequency assignment of frequencies in favor of spectrum assigned based upon current need and EM environment.

(6) Develop automated tools that reflect spectrum operations in support of operational mission planning and rehearsal, simulation-based acquisitions, and national level spectrum management. These tools should reflect spectrum considerations within planning tools of all appropriate mission areas.

(7) Develop a capability to predict intermodulation interference as the use of multiplexing antennas increases on the battlefield. The simultaneous transmission of two approved frequencies may create an unacceptable problem when/if they produce intermodulation.

4-6. GEMSIS Program Summary

a. In January 2006, JROC approved the GEMSIS program ICD. Defense Information Systems Agency was appointed as the executive agent for the ICD. The GEMSIS program includes the optimum capabilities identified by the current CCP effort, to include the requirement to work "the last tactical mile of spectrum operations." The GEMSIS program is currently at the analysis of alternatives phase in the JCIDS process. GEMSIS provides a specific and detailed joint resource that identifies a series of optimizing solutions to capability gaps. The analysis documents leading to the GEMSIS solution identified the following seven spectrum domains: tactical spectrum coordination; frequency assignment; spectrum certification; E3; strategic spectrum planning; spectrum modeling; and spectrum information as the basis for spectrum operations. These domains were associated with specific tasks identified with these domain areas based on reviews of the joint and Service universal task lists and specific DOD directives, Service regulations, U.S. federal regulations, and allied and international agreements.

b. GEMSIS, as a system of systems, provides a full range of capabilities to the warfighter. In addition to the mission planning and tactical spectrum management capabilities, it has the requirement to address spectrum supportability, the process of determining whether a proposed capability can access the spectrum necessary to function as conceived, and whether it will fit into the existing RF environment without causing harmful interference to capabilities already present. GEMSIS will also support several other domains, of spectrum management. The domains are National policy and regulation, E3, host nation coordination, and frequency records management. Though many aspects of spectrum management lie outside of tactical operations, tactical frequency deconfliction and assignment, and spectrum certification and supportability remain the most critical capabilities to the warfighter.

c. The GEMSIS ICD is recognized as the cornerstone of the DOD joint spectrum management modernization effort. The exact relationship between GEMSIS, the Army WIN-T SMT, and FCS needs further synchronization. While the GEMSIS program objectives are fully comprehensive, the program is likely to be fielded in stages or increments. Identified functional gaps between the Army component and the combatant command are intended to be filled in the short term by the CJSMPT with funding being provided by the Joint Improvised Explosive

Device Defeat Organization (JIEDDO). Current programming initiatives have recommended that CJSMPT be identified as increment one of the GEMSIS program by fiscal year 2011. By increment two of the GEMSIS program, CJSMPT is scheduled to be funded by program of record funds approved in the normal budgetary process.

d. As GEMSIS enters the analysis of alternatives phase of the JCIDS process, the Army should initiate participation in this program to ensure the development of the tactical spectrum management capability is consistent with Army requirements. The WIN-T SMT details these requirements and should be evaluated for consideration as an initial increment of GEMSIS that has potentially greater capability than the CJSMPT. The GEMSIS ICD can be used to immediately initiate an EMSO capabilities development document which will focus on the definitions of the requirements for the "last tactical mile." WIN-T SMT will provide an integrated dynamic spectrum management (for example, requesting, allocating, assignment, deconfliction, protection, and revocation) capability to plan and efficiently use EMS for all communications and noncommunications emitters employed within the AOR. This capability will be exportable as an independently executable software package for other users. The WIN-T SMT frequency assignment process will allow reuse of available spectrum to minimize harmful interference and WIN-T will be able to dynamically access available RF spectrum. WIN-T SMT will interface with the joint standard spectrum allocation process. WIN-T SMT now expects to be fully integrated in to the GEMSIS program of record. The EMSO CCP can also integrate in to the WIN-T capabilities production document.

Chapter 5
Army EMSO Operational Architecture

5-1. Army EMSO Architecture

a. The primary purposes for developing Army EMSO architecture products are to support the development of the Army EMSO CCP, and to describe how EMSO integrate with and perform as a part of the future Army. Included in this concept are the operational high level graphic in operation architecture view (OV-1) and operational activity model (OV-5) of the operational architecture products. The activity model is based on the approved joint architecture used to support GEMSIS. This model will need to be expanded to provide greater detail to the tactical spectrum coordination activity as the CCP develops.

b. The Army EMSO OV-1 consists of the Army EMSO concept graphically depicted in figure 5-1. The OV-1 presents a top level view of the interoperability requirements with the current and known future organizations and graphically illustrates the information exchange requirements.

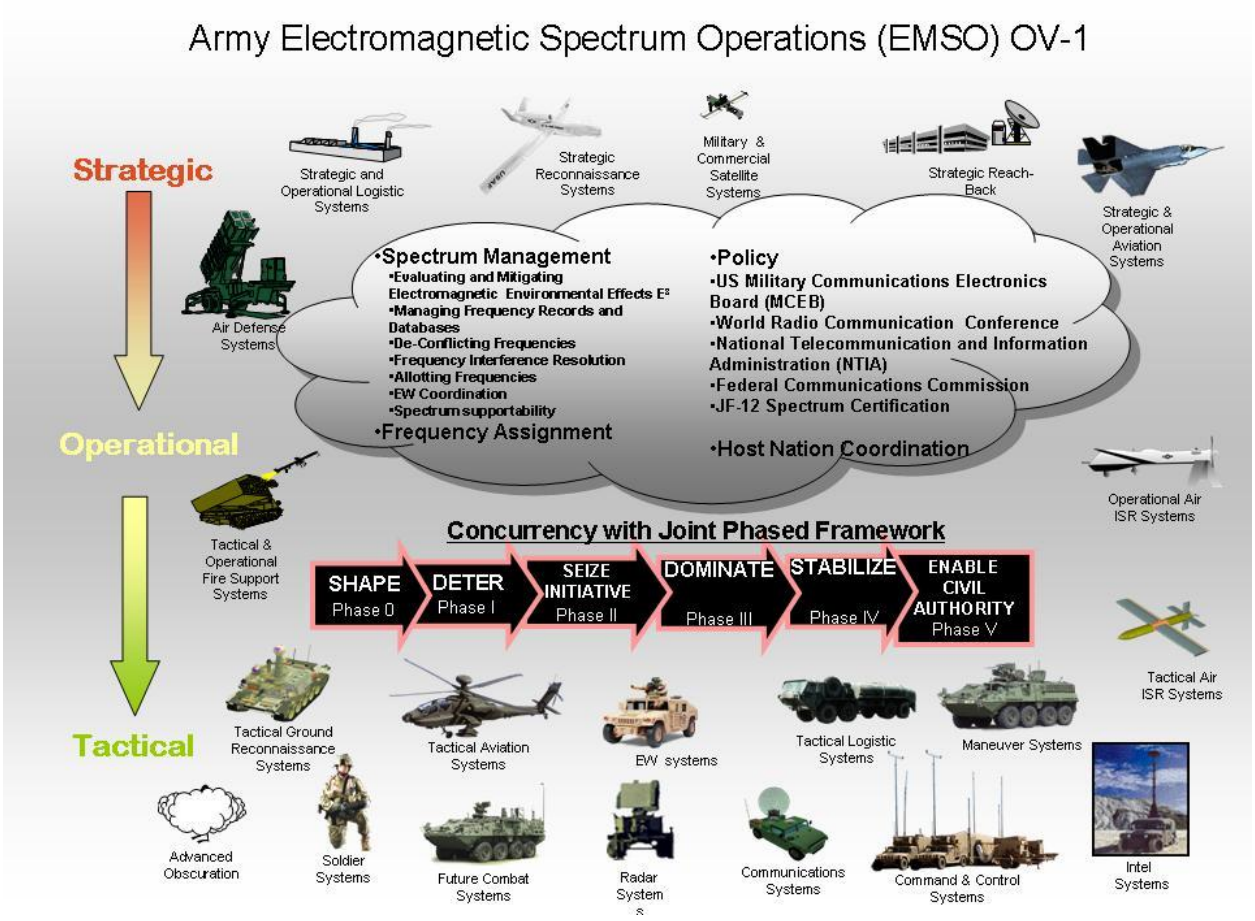


Figure 5-1. Army EMSO OV-1

c. EMSO represents the spectrum capabilities and joint enabling concept that will support all levels of warfare (strategic, operational, and tactical) across all phases of operations through the acquisition of supportable and adaptive spectrum-dependent capabilities. Military readiness, mobilization, strategic operations, and space-based capabilities depend on the availability of the EMS to plan and execute missions. Global communications, the sustaining infrastructure, interagency, local government, and multinational operations similarly depend on spectrum planning and execution. Airspace management and navigation, intelligence collection, information operations, and battlespace communications require the deconfliction of Service and mission requirements during mission planning, across a broad range of the EMS. Bandwidth on demand will require the cultivation of autonomous spectrum operations, highly integrated with NETOPS. E3 associated with radiation hazards will be minimized in both acquisition decisions and real time operational awareness.

d. The future warfighter will benefit from expanded operational options through the adoption of WND that are integrated in the joint GEMSIS program. With universal spectrum access, the GEMSIS program will enable WND to provide a standard wireless GIG implementation and increase the integration of sensors and weapons with C2 from the strategic level through the operational level to the tactical level. GEMSIS will enable WND to exhibit space, time,

frequency, and network agility while conducting multiple and simultaneous communications, intelligence collection, and information operations missions. With a reduced spectrum footprint, the probability of detection is reduced and spectrum reuse will be increased by GEMSIS enabled WND. All of these capabilities will meet the EMSO requirements in that GEMSIS will enable the "last tactical mile" of GIG objectives. Combat developers must ensure that this "adaptive" or dynamic management ability will include CNR, Joint Tactical Radio System, and the many other military systems that are now dependent on RF spectrum for connectivity with wireless operations include tactical radios, jammers, munitions, satellite terminals, artillery and air defense radars, other sensors, identify friend or unknown transponders, telemetry, geolocation and navigation, unmanned vehicles (air and ground) controls, information operations, and EW.

5-2. Army EMSO Activity Model

a. The Army EMSO activity model defines and documents the missions, activities, and tasks performed or supported by Army EMSO operational nodes and organizations; the information and resources used and consumed in the performance of those missions, activities, and tasks; the controls and constraints on the performance of the missions, activities, and tasks; and the outputs of the missions, activities, and tasks. The OV-5 includes missions, activities, and tasks performed, or to be performed, by all Army EMSO nodes and organizations. As an activity model, it focuses on "what" activities need to occur as opposed to "how" activities are accomplished. This approach allows the activity model to be applicable to both the current and objective architectures. The activity model is provided in integration definition language function modeling graphical format and is a duplication of the GEMSIS activity model as it captures the essence of the EMSO CCP activities.

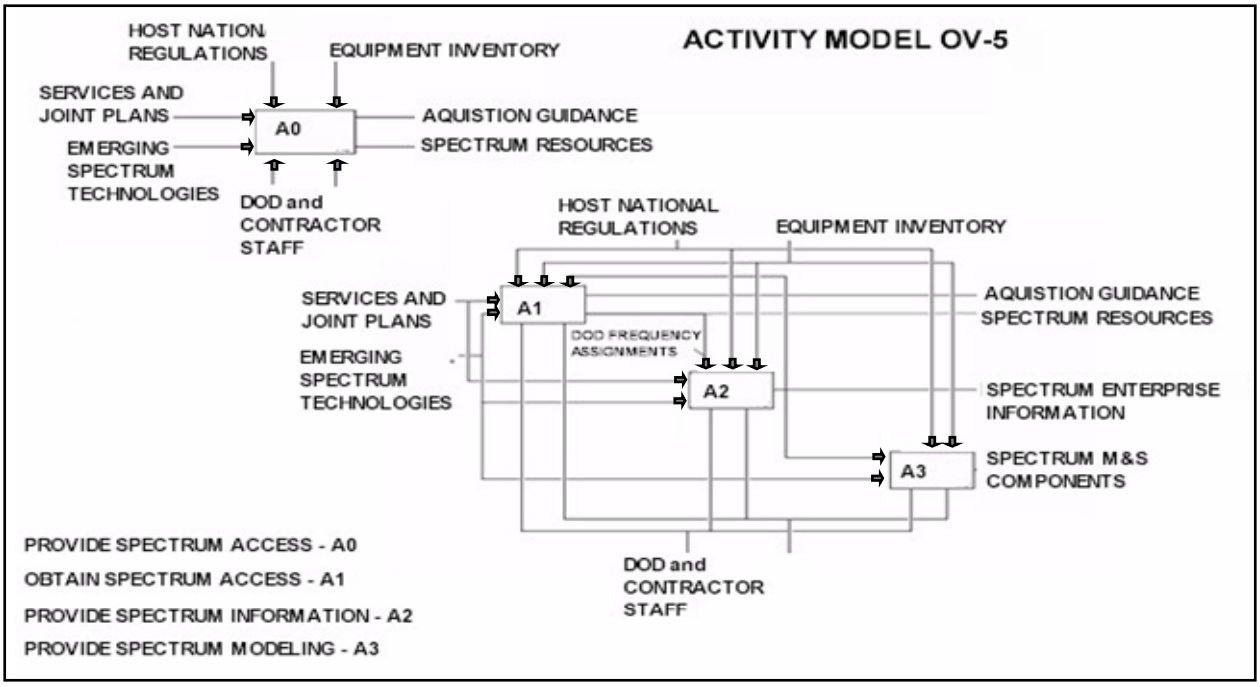


Figure 5-2. OV-5: EMSO Activity Model

b. Army EMSO must be consistent with the GEMSIS JROC approved joint architecture diagramed in figure 5-3 and linked to key tasks.

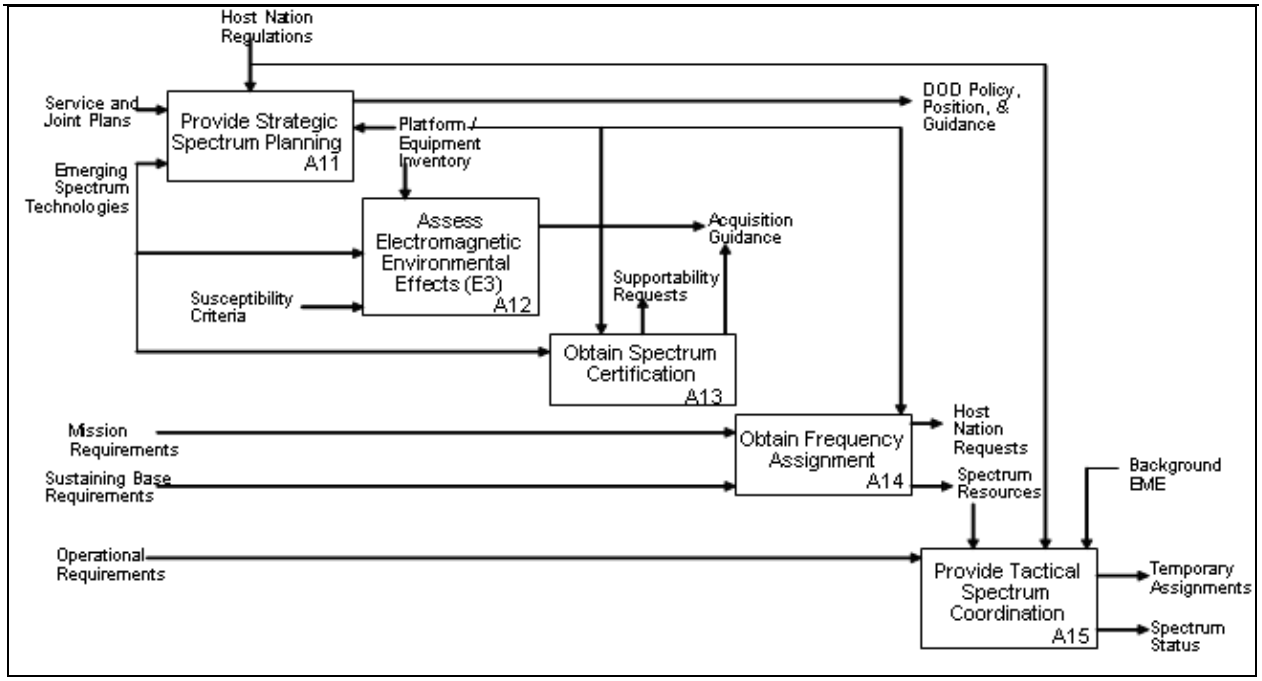


Figure 5-3. OV 5 EMSO Key Tasks

c. Table 5-1 below provide the extended activity model greater definition and detail to the broad activities identified in the diagrams above.

Table 5-1
EMSO Key Tasks

Activity		Definition / Decomposition
A0 Provide Spectrum Access		Ensure adequate spectrum access to accomplish all DOD missions and activities
A1 Obtain Spectrum Access		The planning, assessment, and acquisition of spectrum resources to accomplish DOD missions
A11 Provide Strategic Spectrum Planning.		Maintain awareness of emerging regulatory and technology issues and develop and promote optimized DOD spectrum positions and policies
A111	Project DOD-Wide Spectrum Requirements	Maintain data and models required to project DOD spectrum requirements for any level of deployment or sustaining base. A1111 Monitor Service and Joint Plans A1112 Maintain Spectrum Dependent Platform-Equipment Inventories A1113 Determine Force Requirement Projections
A112	Monitor and Influence Regulatory Environment	Track worldwide regulatory environments and optimize DOD spectrum access. A1121 Attend Regulatory Conferences A1122 Collect Regulatory Information A1123 Evaluate Impact of Changes A1124 Determine Impact Mitigation Strategy
A113	Monitor and Influence EST	Track DOD, Federal, and commercial research, develop, and fielding to identify potentially beneficial technology for DOD adoption and to identify upcoming competitive spectrum situations. A1131 Monitor Emerging Spectrum Technologies A1132 Identify Beneficial Technologies A1133 Identify Spectrum Competition A1134 Determine Competition Mitigation Strategies
A114	Coordinate DOD Positions	Develop and implement proactive responses to identified regulatory and technology challenges. A1141 Participate in U.S. Position Working Groups A1142 Coordinate Positions with Combatant Commands A1143 Coordinate Emerging Technologies A1144 Coordinate Requirements with Host Nations
A115	Maintain DOD Spectrum Policy	Ensure that current DOD policy and guidance is aligned with regulatory, interoperability, and compatibility requirements. A1151 Review Existing Policy A1152 Update Policy A1153 Coordinate Policy A1154 Distribute Policy

Table 5-1
EMSO Key Tasks, continued

Activity		Definition / Decomposition
A12 Assess Electromagnetic Environmental Effects (E3)		Determine materiel susceptibility to E3
A121	Identify SD Acquisitions	Identify acquisition programs involving spectrum dependent
A122	Review Acquisition Documentation	Review and comment upon the adequate treatment of E3 considerations in the acquisition program. A1221 Review Mission Needs Statement (ICD) A1222 Review Operational Requirements Document (capabilities development document) A1223 Review Test & Evaluation Master Plan A1224 Participate in Integrated Process Team
A123	Provide Acquisition	Provide initial guidance on E3 issues.
A124	Determine E3 Risks	Measure and/or analyze specific materiel for E3 vulnerabilities. A1241 Determine EMI Risks A1242 Determine RADHAZ Risks A1243 Determine Lightning Risks A1244 Determine Precipitation Static Risks A1245 Determine ESD Risks A1246 Determine Electromagnetic Pulse Risks A1247 Determine Risks from Non-emitting Hazards
A125	Provide Acquisition Decision Inputs	Provide E3 assessments to the milestone decision authority. A1251 Track Program Milestones A1252 Report on Force Compatibility A1253 Report on Supportability Issues
A13 Obtain Spectrum Certification		Predict and obtain Host Nation support for spectrum use
A131	Provide Regulatory Guidance	Provide E3 assessments to the milestone decision authority. A1251 Track Program Milestones A1252 Report on Force Compatibility A1253 Report on Supportability Issues
A132	Acquire Technical Characteristics	Acquire required technical characteristics to determine and obtain Host Nation supportability. A1321 Maintain Technical Data Requirements A1322 Receive or Measure Spectrum Dependent Characteristics A1323 Maintain Quality Submissions
A133	Determine Joint Compatibility	Determine compatibility with the intended force structure. A1331 Determine Intra-Platform Compatibility A1332 Determine Inter-Platform Compatibility A1333 Determine RADHAZ Potential A1334 Determine Compliance to E3 Standards
A134	Predict Host Nation Supportability	Based on Host Nation information and historical supportability, predict the Host Nations supportability position. A1341 Establish Intended Deployment A1342 Determine Alignment with Regulatory Requirements A1343 Review Historical Support A1344 Document Predicted Support Status
A135	Obtain Host Nation Support	Prepare, submit, and negotiate Host Nation supportability. A1351 Determine Foreign Release ability A1352 Prepare Host Nation Request A1353 Track Request Status A1354 Respond to Inquiries A1355 Record Supportability Outcome A1356 Report Supportability Outcome
A136	Provide Acquisition Decision Input	Provide supportability status to the milestone decision authority. A1361 Track Program Milestones A1362 Report on Force Compatibility A1363 Report on Supportability Issues A1364 Recommend Program Corrective Actions

Table 5-1
EMSO Key Tasks, continued

Activity		Definition / Decomposition
A14 Obtain Frequency Assignment		Identify and negotiate required spectrum access with Host Nations
A141	Determine Spectrum Access Requirements	Based on force requirements, identify necessary frequency resources. A1411 Identify Force Structure A1412 Identify Platform-Equipment Involvement A1413 Determine Frequency Reuse A1414 Determine Required Resources
A142	Forward Host Nation Request	Interact with Host Nations to acquire required frequency A1421 Format Request A1422 Submit Request A1423 Track Request
A143	Distribute Spectrum Resources	Record, allot, and distribute acquired frequency resources. A1431 Record Host Nation Response A1432 Allot Resources A1433 Distribute Allotments A1434 Provide operational plan Annex K Inputs
A15 Provide Tactical Spectrum Coordination		Determine and coordinate optimum frequency use.
A151	Monitor Background Electromagnetic Environment (BEME)	Maintain knowledge about the background EM environment A1511 Initially Populate BEME A1512 Update BEME A1513 Monitor Collection Requirements A1514 Monitor Information Operations Use A1515 Distribute BEME
A152	Process Spectrum Request	Determine general supportability of a required spectrum use. A1521 Determine Completeness A1522 Determine Host Nation Compliance A1523 Determine Frequency Resource Availability
A153	Evaluate RADHAZ Constraints	Maintain RADHAZ mitigation constraints A1531 Identify RADHAZ Potential A1532 Determine Ordnance Load A1533 Enunciate Proximity Constraints
A154	Assign Spectrum Access	Determine specific frequency use(s) A1541 Nominate A1542 Select Optimum Frequency A1543 Distribute Temporary Assignment A1544 Distribute Allotments A1545 Distribute Joint Communications-Electronics Operations Instructions
A155	Coordinate Joint Restricted Frequency List	A process within the Information Operations Cell to ensure compatible spectrum A1551 Collect Joint Restricted Frequency List Inputs A1552 Identify Potential Conflicts A1553 Reconcile Conflicts A1554 Distribute Approved Joint Restricted Frequency List
A156	Report and Resolve Interference	Report and resolve interference in accordance with Joint Spectrum Interference Resolution instructions (CJCSI 3320.02) A1561 Characterize interference A1562 Assess Self-Interference A1563 Assess Natural Phenomenon A1564 Report to Higher Headquarters A1565 Request Joint Spectrum Center Joint Spectrum Interference Resolution Support A1566 Negotiate and Implement Resolution
A157	Report Spectrum Use	Report overall and specific performance of resources in satisfying required spectrum use. A1571 Report Nomination Failures A1572 Respond to Inquiries

Table 5-1
EMSO Key Tasks, continued

Activity		Definition / Decomposition
A2 Provide Spectrum Information		The acquisition, standardization, storage, and distribution of spectrum enterprise information
A21	Identify Requirements	Identification of Spectrum Enterprise Information requirements due to changes in technology, regulation, or DOD inventory.
A22	Acquire Information	The identification, negotiation, and acquisition of information for the spectrum repository.
A23	Standardize Information	The mapping and formatting required to provide seamless spectrum information from a multitude of different DOD, host nation, and commercial sources
A24	Access/Distribute Information	The controlled and secure access and distribution of spectrum information on demand.
A25	Provide ability to add, change, and delete data	Provide ability to add, change, and delete data
A26	Provide backup/recovery and information assurance	Provide backup/recovery and information assurance
A27	Monitor Information Quality	The periodic assessment of information quality and completeness and the initiation of quality improvement actions.
A3 Provide Spectrum Modeling		The identification, development, distribution, and maintenance of models of spectrum phenomenon in support of simulation based acquisitions, mission rehearsals, and internal sponsor programs.
A31	Identify M&S Requirements	Identification of spectrum models for electromagnetic control, E3, spectrum manager Applications.
A32	Coordinate with M&S Environments	Coordination with DOD and Service M&S activities to ensure adequate representation of spectrum phenomenon.
A33	Acquire Supporting Data /Measurements	The acquisition of measurement data to develop or validate Spectrum M&S Components.
A34	Develop or Acquire M&S Components	The development of Spectrum M&S Components.
A35	Distribute M&S Components	The distribution of Spectrum M&S Components.
A36	Maintain M&S Components	The maintenance of Spectrum M&S Components.
A37	Perform EMS M&S	Conduct EMS Modeling and/or Simulation

Chapter 6
DOTMLPF Implications and Questions

6-1. Introduction

a. There are profound implications for the Army and the joint community as we evolve the Army EMSO concept; consequently, synchronization across the DOTMLPF domains is required. Some study issues transcend the specific area of EMSO and should be examined fully as the Army, and the joint community moves to an advanced form of EMSO. There is one unifying idea: the Army must become a learning organization to a greater extent than ever before and must better understand the cognitive processes as they apply to EMSO. Army concepts normally include a discussion of the implications of the concept for DOTMLPF. Those implications should be explicit enough to generate some action for change within the DOTMLPF domains by responsible offices.

b. The primary implications arising from the Army EMSO CCP, vice an exhaustive list, are described below. However, many of the items cited below will require additional analysis before comprehensive actionable recommendations emerge.

(1) What is the most effective organizational design for implementation of the Army EMSO concept?

(2) What are the required objective and threshold capabilities for the Army EMSO?

(3) What operational and organizational challenges remain from today's conceptual efforts in the future?

(4) What EMSO capabilities does the Army have to provide to other services in order for them to implement the Army EMSO concept?

6-2. Doctrine

a. Emerging doctrine will focus on the necessary capabilities to engage adversaries across the full range of operations with a joint force that shares common systems, tactics, techniques, and procedures, and doctrine. The doctrinal concepts necessary to initiate the organizational and cultural changes described in TRADOC Pamphlet 525-2-1 and TRADOC Pamphlet 525-3-2 are promulgated in Field Manual (FM) 1, FM 3-0, and FM 6-0. As the future Modular Force nears operational readiness, these documents will evolve. The Army's system of doctrine production and dissemination will become more responsive. The degree of modularity envisioned requires doctrine that is more synergistic and adaptive. Standardization of information management procedures is necessary to effectively execute a networked approach to operations.

b. At the same time, tactics and operational doctrine must stress the art of war - flexible and adaptive solutions that depend upon human creativity. Doctrine principles provide an authoritative guide for leaders and Soldiers, but still provide freedom to adapt to circumstances. Concepts and doctrine drive the evolution of organizations. New doctrine and tactics, techniques, and procedures will be required to effectively plan and manage battles collaboratively and must seamlessly be integrated with joint doctrine to optimize planning and execution of warfighting operations at all levels. Doctrine questions include, but are not limited to, the following.

(1) How do EMSO empower the Army to conduct net-centric operations in a JIM environment across the full spectrum of military operations?

(2) What are the impacts of rules of engagement, policies, and law on Army EMSO?

(3) How do we manage/exploit the full range of the EMS so as to ensure the Army can conduct operations to defeat the enemy without degrading/defeating our capabilities across the EMS?

(4) What are the limits to interdependence among branch and service functions?

6-3. Organization

a. To effectively support future operations, organizations must transform into more modular, scalable, mission-focused organizations with multifunctional capabilities. They must become more versatile and agile and be able to be tailored to support joint operations and must possess capabilities to adequately support the operations of maneuver and support forces. Joint mutual support becomes the key factor in determining Service roles and missions and mission context will determine the apportionment of Army headquarters and forces. The range of missions assigned to Army forces will force an alignment change from the traditional command echelons.

b. Army Headquarters will support the combatant commander with the command structure appropriate for land operations. The rank of the commander and the functions of the headquarters will not necessarily correspond to the numbers of forces assigned to it. Higher headquarters will be organized and equipped to exercise unit protection over highly flexible task organizations. In many operations, the number and composition of subordinate units will differ dramatically from industrial age warfare echelons. As each operation unfolds, the makeup of the deployed Army force will evolve, shifting in composition as the mission and circumstances require. While units stationed with the headquarters may align for training and readiness, actual operational groupings will be based upon mission requirements. Organizational questions include, but are not limited to, the following.

(1) What does the appropriate organization structure consist of to enable effective Army EMSO?

(2) Can current organizational structures be augmented to satisfy the capabilities of Army EMSO?

(3) Is a complete new organizational structure required to achieve the capabilities of Army EMSO?

(4) What types and mixes of capabilities must reside in the Army EMSO construct? How should those capabilities be organized for Army EMSO?

6-4. Training

a. Doctrine and organizational change cannot be realized without changes to our training systems. Training ensures that our future Modular Force is able to conduct the operations envisioned in our joint and Army concepts. In past operations, Army forces were task organized in support of joint operations with joint or multinational forces and were often required to overcome a lack of prior collective training to become effective fighting organizations. Lack of prior training resulted mostly from the ad hoc nature of tailoring the task force to meet specific mission, and the limited amount of time from alert to deployment. The future Modular Force will place additional demands on training, as well as the design and organization of the force to facilitate training. Modularity may ease training, while the requirement for multi-functionality will require more diverse training. Having recognized the need for flexible tailoring of forces and command elements in the future Modular Force, peacetime training should be designed.

Battle staffs should routinely engage in exercising varying force packages in difficult and demanding tasks that they will perform in war in order to identify and correct weaknesses and gaps in protection.

b. All leaders and units must train tasks that contribute to leader development. As new military occupation skills are required or old occupation skills are combined or changed the Army must be prepared to conduct training through distance learning or other distributed learning techniques. The Army must adopt a joint and expeditionary mindset. The point is to build synergy and synchronization across disparate force packages that potentially could be mixed to accomplish ever changing national objectives. Compounding this need for increased force package training is a requirement to dramatically reduce deployed elements. To ensure that a lean deployed staff is effective with ever changing force structures, it must be continuously trained in complex joint and multinational operations at the operational and tactical levels. This training is essential to build the basis for trust and rapport, leader development, and to identify abilities and limitations of force packages and their protection elements. For ad hoc coalitions, the same methodology applies, but the time available may be condensed or occur during deployment or actual hostilities.

c. As a means to frequently train the skills and techniques associated with C2 of tailored force packages the future Modular Force battle command system must provide embedded training modules supported by low-cost, low-overhead, simulations. Army embedded training modules shall complement new equipment training, battle staff training, home station sustainment training, and institutional training. Embedded training shall also provide the tools to assess operations and evaluate individual and collective task performance based on combined arms training strategies so that lessons are captured and focused retraining may occur.

d. Furthermore, the EMSO tool must have the embedded capability to individually train commanders and staff planners on essential operational process skills that apply through all levels of war. Train a new set of multifunctional staff skills, both individually and collectively, in order to support smaller deployed headquarters and varying force packages. Constructive and virtual simulations must complement field training and training at the combat training centers. Small unit training will remain the bedrock of readiness and effectiveness and will be supported by Army applications in their operational mode. Training questions include, but are not limited to, the following.

(1) How does current training enable EMSO?

(2) How can the Army adapt its training to better enable current forces to engage in EMSO as integral parts of joint and combined arms teams, and independently when and as necessary?

(3) How will evolving technologies and ongoing/planned changes in organization affect the ways in which Army units and leaders operate and what are the training implications of these changes to support EMSO?

(4) What training designs will develop units and leaders that can capitalize on the full range of EMSO capabilities and fully contribute their own capabilities as members of the joint team?

(5) What is the proper training required for contractors and DA civilians on the battlefield to support EMSO missions?

(6) What type, scope, and frequency of training must the future Modular Force conduct to enable effective EMSO?

6-5. Materiel

a. Resources are always limited. Lack of materiel restricts the unit's ability to execute missions. Modernization and sustainment ensure that baseline capabilities are maintained and future capabilities are pursued within funding and resource levels. Unit sustainment and the supporting logistics structure must be planned in detail. Realization of the future Modular Force EMSO concept is dependent upon the development and incorporation of advanced technology on the battlefield. EMSO materiel solutions must proceed along a top-down, joint-driven path. In a networked, distributed operational approach to warfare, the optimization of the entire system is more important than the strict optimization of a single weapon, staff element, or past program.

b. The potential operational benefits of these advancements in technology will be profound. Distributing EMSO capabilities among multiple distributed units and enabling multi-echelon collaborative planning from joint to tactical levels will eliminate much of the sequential processes in today's planning and should allow a more rapid military decision making process quicker. Spectrum managers at all echelons will have a clearer, common understanding of intent and fuller appreciation of the implications of planning decisions across units and formations. Expanded situational understanding and multi-echelon collaboration will facilitate the use of mission orders and expand span of control, enabling greater decentralization and simultaneity that will be critical to maintaining the operational tempo of future operations.

c. Access to a common operational picture or common information environment will enable spectrum managers to self-synchronize their actions during operations and make adjustments in response to changing situations. The sum of these technological advancements will enable Soldiers on the battlefield to anticipate more reliably and apply force more precisely and effectively, simultaneously shaping the future battle while conducting current EMSO, across the spectrum of conflict. Materiel questions include, but are not limited to, the following.

(1) In a distributed operation environment, what unique EMSO capabilities are required for support and sustainment forces, systems, and associated lines of communications?

(2) How will EMSO capabilities enhance a unit's ability to maintain freedom of movement during operations?

(3) How will EMSO capabilities enable dominant and continuous situational understanding throughout the tactical operations?

(4) How will units be assured of a fully networked EMSO system that is able to be tailored for use in tactical maneuver operations?

(5) How will units maintain a real time EMSO operating picture, including a single spectrum common operational picture integrated into the ABCS and JC2?

6-6. Leader Development

a. One of the keys in enabling effective EMSO will be the development of leaders who can perform effectively across the spectrum of military operations in a complex, uncertain, and dynamic operational environment. Leadership will need to focus on developing the enduring competencies of self-awareness and adaptability in order to enable future leaders to function effectively. Leaders must be developed, trained, and educated to be self-aware, innovative, and adaptive throughout training and operations. They must think strategically and successfully apply the joint operational art across the range of unit protection operations. The magnitude of changes will not occur overnight. Doctrine will provide intellectual foundation, educational opportunities will prepare leaders for how to think, and experience will convert knowledge into operational competence.

b. The Army system of leader development must focus on the human qualities of initiative, flexibility, trust, and teamwork to realize the full benefit of unit protection. The Army must instill audacity in our leaders and condition them away from passivity in the absence of certainty. Significant changes will also occur within the mix of specialist and generalists that comprise all staffs. The rapid evolution of automated systems and capabilities require a change in leader development to ensure future leaders can leverage these new tools. Emerging technology will help leaders focus on critical decisions, highlight opportunities for initiative, and facilitate teamwork. Future Modular Force leaders must be trained to aggressively manage information and instill trust in the output of decision support tools that automated systems provide. Leader development questions include, but are not limited to, the following.

(1) How can we develop more adaptive leaders?

(2) How do we develop leaders ready to deal with the complexity of the contemporary operating environment, threats, and interagency implications?

(3) How do we provide collaborative, distributed problem solving and decision aids that empower battle command to support commanders, as well as staffs to advising commanders during planning, preparation, and execution of operations?

(4) How are leaders enabled to know the terrain and weather and appreciate their tactical implications for tactical concealment, employment of weapons, mobility, and seeking positions of advantage?

(5) How are leaders empowered to understand the operational environment as well as, or better than, the threat?

(6) How will units enable leaders to know the enemy, friendly unit locations, and their capabilities?

(7) How will units adapt to emerging EMSO situations more quickly than an adversary?

6-7. Personnel

a. Soldiers are the Army's greatest resource and the most important factor in maintaining and effecting unit readiness. Implementing force stabilization policies that reduce personnel turbulence better supports a lifetime training and education paradigm, and reduces the redundancy that occurs in some training cycles is also important. The personnel management system must adapt to force stabilization and undergo analysis regarding continuing in its current form to ensure that it provides the career paths needed to fully prepare leaders for the future Modular Force.

b. The modular and distributed nature of the EMSO capabilities proposed will require new combinations of military and civilian personnel. New organizational constructs will rely on experienced civilian personnel to provide the expertise needed to support global operations. The right combinations of the active Army and reserve components, Army civilian and contractor attendants can only be determined through research and exercise. Personnel questions include, but are not limited to, the following.

(1) How does the Army recruit and retain personnel necessary to perform Army EMSO?

(2) What skills sets are required for Army civilian EMSO personnel?

(3) What is the best means of identifying Soldiers that would have the right skills to become EMSO personnel?

6-8. Facility

a. Improving strategic response will require upgrades of Army facilities infrastructure. The facilities and infrastructure of the Army will require significant investment of resource to train and deploy forces in accordance with future Modular Force concepts. These facilities will have varying capabilities of training, projection, reach, and knowledge. Installation information facilities will enable distributed information sharing among the sustaining base and deployed forces during all phases of operation. Prior to deployment, fixed facilities on the installation, can collect, process, and analyze large volumes of data such as terrain databases that must be pre-positioned down to platform level. Installations will require suitable facilities for skilled civilian personnel supporting a military staff to leverage supporting EMSO.

b. The future Modular Force must support the concept, "train-as-you-fight" and strive to create a realistic training environment for Soldiers and their organizations. Specific implementation resources, plans, and procedures must be initiated with sufficient lead to reach maturity with the Future Modular Force. Facilities questions include, but are not limited to, the following.

(1) Are there adequate facilities available to Soldiers and units sufficient to allow them to maintain acceptable levels of training effectiveness?

(2) What infrastructure is required at installations to adequately support EMSO missions in both training and operational constructs?

(3) What infrastructure is required in theater to support EMSO missions?

Chapter 7
Hypothesis Testing, Wargaming, and Experimentation Study Questions

7-1. Introduction

a. The Army is pursuing the most comprehensive transformation of its forces since the early years of World War II. This transformation is happening while the Nation is at war. The urgency of supporting the current fight with the latest available technology or improved methods blurs the distinction between the current and future Modular Force. The Army today seeks to accelerate the incorporation of select future Modular Force capabilities into the current Modular Force to support today's fight. Simultaneously, the Army is trying to ensure the lessons learned from the current operations are used to develop future Modular Force capabilities.

b. Current operations to fight insurgency tactics indicate how adaptive the enemy can be and how much more agile and adaptive and determined that our leadership must be, not only on the battlefield, but also in the development of innovative concepts. Clearly, materiel development will not be as fast as developing nonmateriel solutions to lessons learned from recent operations. As new concepts are developed, and even the use of rapid fielding of materiel solutions, emphasize the need for effective and efficient experimentation to mitigate risk while considering and improving capabilities for the future Modular Force.

7-2. Experimentation

a. Experimentation is the process of exploring innovative methods of operation to assess feasibility, evaluate utility and or determine limitations of the concepts being explored. Experiments conducted in support of JCIDS efforts use the 2015–2024 timeframe. The Army also conducts war games using futuristic scenarios (15 to 20 years and beyond) to explore concepts in order to better define which of those concepts should be the subject of experimentation. Army experimentation is conducted in the form of discovery (usually in a constructive M&S environment), hypothesis (also in a M&S environment but with human in the loop role players) and demonstration (live or simulation) settings.

b. Discovery experiments are designed to inform a concept. The setting tends to lack the degree of control necessary to infer cause and effect, but are often seen today as COTS solutions are introduced into the current battlefield.

c. Hypothesis testing experiments. Hypothesis testing experiments are the traditional type used by individuals to build, confirm, and advance knowledge. This occurs by seeking to falsify specific hypotheses (specifically "if…then" statements) or discovering their limitations. In order to conduct hypothesis-testing experiments, the experimenter shall create a situation in which one or more factors of interest can be observed systematically under conditions that vary the values of factors thought to cause change in the factors of interest, while other potentially relevant factors are held constant.

d. Demonstration experiments are used to display knowledge and the settings tend to be somewhat orchestrated. Often times the Army uses this method to display prototypes of emerging technologies that are nearing maturity and are potentially ready for fielding to the force.

7-3. Modeling and Simulations (M&S)

Models and simulations are often called upon to make an informed assessment. Scenarios or vignettes are built to look at one or more sets of conditions that will best help to evaluate these hypotheses, but the raw data is often not conclusive or requires reasoned review by seasoned subject matter experts to confirm the reliability of these simulation or modeling efforts.

7-4. Concept Development and Experimentation

a. Concept development and experimentation is fundamentally a risk reduction activity; failure to conduct effective concept development and experimentation significantly increases developmental risk for the future Modular Force and operational risk to the current Modular Force. Specific actions are required to reduce operational risk to the current Modular Force and developmental risk for the future Modular Force.

(1) *Operational risk to the current force.* Increase the capabilities of the current Modular Force through prototype experiments that test the compelling solutions and develop DOTMLPF capability packages to support the spiraling forward of future Modular Force capabilities to satisfy critical current force operational needs.

(2) *Developmental risk for the future Modular Force.* Reduce future Modular Force developmental risk by developing concepts and capabilities that meet the needs of the future joint force commander through rigorous concept development experimentation.

b. Army efforts. Army wargaming and experimentation to support this CCP for Army EMSO and their impact on DOTMLPF sets will be developed and studied using approved defense planning scenarios and vignettes. If required, other scenarios and vignettes may be recommended or other methods found to evaluate aspects of spectrum operations. Experimentation will help define how the capability requirements, outlined in chapter 3 of this CCP, can best be implemented. However, it can not be overemphasized that spectrum is a joint resource and it is critical that Army efforts must be consistent with ongoing joint efforts to improve EMSO across the DOD.

c. Joint efforts. Joint wargaming and experimentation will also support this CCP. Active participation in other Service and joint events are critical to the full assessment of the Army's DOTMLPF solution sets. Army EMSO organizations and operations as they are part of joint operations will be tested, evaluated, and modified as conditions (that is, in scenarios and vignettes) change during experimentation. Scenarios and vignettes selected for experimentation will provide an illustration of how Army EMSO organizations will conduct or support operations throughout the deployment cycle while supporting the full spectrum of conflict. Although the vignettes will be based on a hypothetical theater, they will test the new modular organizational structure and how all organizations will execute EMSO functions while performing their assigned missions. Logical excursions will then be conducted to evaluate what the results might be if they were performed in a different theater or varying set of factors for mission, enemy, terrain, troops, time available, and civilians.

7-5. Wargaming

a. Wargaming is a process of discovery and assessment. Discovering insights into the Army space warfighter and assessing the validity of strategic visions and emerging concepts, while looking 20 to 30 years into the future. Wargaming begins by attaining operational research on future warfighting systems and concepts and applying them to simulated military operations in order to prove or disprove visionary ideas and to discover gaps and seams in future Army EMSO operations.

b. Wargaming examines the Army functional concepts of *Battle Command*, *See*, *Move*, *Strike*, *Protect*, and *Sustain*, the results of which inform experimentation and eventually informs the development of Army EMSO concept of operations, tactics, techniques, and procedures, architectures, and future systems. Wargame personnel lead participation in Army, JIM wargames to integrate Army EMSO assets, concepts, and visions into wargame scenarios, orders of battle, force laydowns, and computer simulations.

7-6. Past and Future Experimentation and Wargames

a. Past experimentation and wargames. TRADOC and its proponent schools have conducted extensive experimentation that has implications on the Army EMSO CCP. The following is a list of major experiments and wargames conducted over the last two years involving space operations support.

(1) Focused experiments and events on FCS brigade operations.

(2) Extensive experimentation results are available from the NM functional needs analysis documentation which is a classified study available from the joint staff , command and control section. Much of their study efforts are supported by additional RAND Corporation studies.

b. Future Experimentation. The following experiments and wargames will further assist in defining the Army EMSO CCP.

(1) Those experiments listed in the TRADOC Army Concept Development and Experimentation Plan.

(2) The CJSMPT Joint Implementation and Experimental Fielding.

c. In addition to these listed events there are many small analysis events and experiments that occur within the battle lab and throughout various installations that will also provide insights to help further refine this CCP.

7-6. Study Questions

In addition to the integrated questions list in chapter 6, these questions support future experimentation:

- How do we manage/exploit the full range of the EMS so as to ensure the Army can conduct operations to defeat the enemy without degrading/defeating our capabilities across the EMS?
- What are the identified Army EMSO capability shortfalls?
- In a distributed operation environment, what unique EMSO capabilities are required for tactical maneuver forces?
- What are the best organization and capabilities to develop and conduct an integrated, EMSO campaign?
- What are the new organizational solutions required to manage the complex activities comprised within EMSO?
- How are responsibilities for EMSO for bases, base clusters, lines of operations, etc. determined/tasked?
- How are EMSO executed? What are the required tasks? Who communicates with whom/what in EMSO missions? What challenges would the EMSO configuration have across all mission sets?
- What advanced training support packages, organizations and methodologies are required to support adequate Soldier training and development for EMSO?
- What constitutes a sufficient level of EMSO to enable freedom of maneuver operations?
- How is EMS information managed and disseminated to enable a shared level of situational awareness among all echelons?
- What is the training impact of each new system/equipment, to include short-term transformation and long-term sustainment?
- How can science and technology enable EMSO? How can unmanned systems enable EMSO missions?
- What are future Modular Force vulnerabilities to technology failures?
- What critical assets are required in each unit to enable EMSO?
- What are the primary implications of noncontiguous, high-tempo, distributed, networked EMSO for battle command?
- How do integrated EMSO capabilities provide sufficient near real time situational understanding to support self-synchronization during tactical maneuver operations?
- What are the current critical EMSO capability shortfalls for near-term, mid-term, and far-term?

- What technologies are so compelling as to warrant immediate prototyping? What prototypes are under development?
- How will emerging technologies introduced in the EMSO CCP increase effectiveness for successful EMSO? What is the best mix of these technologies?

Chapter 8
Alternative CCP

8-1. Introduction

a. Currently, an effort is ongoing to review the WIN-T Increment 1 capabilities production document currently at TRADOC for approval to determine if this document provides a complete concept for tactical integrated EMSO. Appendix B is a list of WIN-T SMT capabilities. In addition, the GEMSIS program in conjunction with the CJSMPT joint urgent operational needs are other programs that have documented and JROC approved joint concepts that the Army has been involved in developing. As stated earlier, since spectrum is a joint resource for all of the services, a joint concept is consistent with Army needs.

b. In addition, there is an ongoing effort with the NM functional solutions analysis to further investigate spectrum management and on the important role that RF spectrum plays in military operations across the services and the need to do more to ensure this finite resource is managed efficiently and effectively.

8-2. Future CCP and JCIDS Efforts

a. The integrated concept development team preparing this CCP consisted of twelve core members and six supporting members. Each of these proponents is likely to develop its own concept or plan for how it will operate in the future. The number of proponents involved and the range of their proponent responsibilities indicates that the development of additional CCPs, which require spectrum enabling capabilities, is likely.

b. However, in view of the other ongoing JROC approved spectrum programs cited throughout this CCP, there may be a need to take this CCP to an Army focused CBA process. The underlying intent of this CCP is to provide a holistic view of the Army's collective dependence on the EMS requirements to support the future Modular Force and joint operations.

Appendix A
References

Section I
Required Publications
ARs, DA pams, FMs, and DA forms are available at Army Publishing Directorate (APD) - Home Page. TRADOC publications and forms are available at TRADOC Publications.

AR 5-12
Army Management of the Electromagnetic Spectrum.

Joint Functional Concept for Battlespace Awareness.

Net-Centric Environment Joint Functional Concept. (Available at http://www.dtic.mil/futurejointwarfare/concepts/netcentric_jfc.pdf)

Net-Centric Operational Environment Joint Integrating Concept.

TRADOC Pam 525-2-1
The U.S. Army Functional Concept for See 2015-2024.

TRADOC Pam 525-3-3
The U.S. Army Functional Concept for Battle Command 2015-2024.

Section II
Related Publications
A related publication is a source of additional information. The user does not have to read a related reference to understand this publication.

Army Concept Capability Development Plan.

Army Concept Development and Experimentation Plan.

Army Strategic Planning Guidance.

Capstone Concept for Joint Operations.

CJCSI 3170.01B
Joint Capability Integration Development System Manual.

CJCSI 3170.01E
Joint Capability Integration Development System Instructions.

CJCSM 3320.02A
Joint Spectrum Interference Resolution. (Available at http://www.dtic.mil/cjcs_directives/cdata/unlimit/m332002.pdf.)

CJCSM 3500.04D
Universal Joint Task List.

DA Pamphlet 25-40
Army Publishing: Action Officers Guide.

Defense Planning Guidance. (Available at
http://www.defenselink.mil/dodcmsshare/briefingslide/138/020510-D-6570C-001.pdf.)

FM 3-14
Space Support to Army Operations.

FM 7-15
Army Universal Task List.

FMI 6-02.43
Signal Leader's Guide to the Network.

Joint Publication 3-14
Joint Doctrine for Space Operations.

National Military Strategy. (Available at
http://www.defenselink.mil/news/Mar2005/d20050318nms.pdf.)

National Security Strategy. (Available at http://www.whitehouse.gov/nsc/nss.html.)

TRADOC Pamphlet 525-3-0
The Army in Joint Operations: The Army Future Force Capstone Concept.

TRADOC Pam 525-3-1
The Army Operating Concept for Operational Maneuver 2015-2024.

TRADOC Pam 525-3-2
The Army Concept for Tactical Maneuver 2015-2024.

TRADOC Pam 525-3-4
The U.S. Army Functional Concept for Strike 2015-2024.

TRADOC Pam 525-3-5
The U.S. Army Functional Concept for Protect 2015-2024.

TRADOC Pam 525-3-6
The U.S. Army Functional Concept for Move 2015-2024.

TRADOC Pam 525-4-1
The U.S. Army Functional Concept for Sustain 2015-2024.

TRADOC Pam 525-7-4
Concept Capability Plan for Space Operations 2015-2024.

TRADOC Regulation 10-5
U.S. Army Training and Doctrine Command

TRADOC Reg 25-35
Preparing and Publishing U.S. Army Training and Doctrine Command Administrative Publications

U.S. Army Space Reference Text. (Available at http://www.fas.org/spp/military/docops/army/ref_text/.)

Section III
Prescribed Forms

This section contains no entries.

Section IV
Referenced Forms
Except where otherwise indicated below, the following forms are available on the Army Knowledge Online and Army Publishing Directorate Websites.

DA Form 2028
Recommended Changes to Publications and Blank Forms.

DA Form 1045
Army Ideas for Excellence Program Proposal.

Appendix B
Warfighter Information Network-Tactical (WIN-T) Spectrum Management Tool (SMT) for Network Management List

1. SMT shall provide an integrated dynamic spectrum management (for example, requesting, allotting, assignment, deconfliction, protection, and revocation) capability that shall plan the efficient use of EMS and provide frequency allotments and assignments to Army forces within the AOR (threshold = objective).

2. SMT's network simulation capability shall support points of interest for all nodes and movement paths in the network. These points of interest can be automatically created by the SMT simulation upon significant changes in the network (such as, network congestion) or manually by the operator. The operator can navigate from points of interest to points of interest (threshold). Points of interests shall be automatically generated for interference events (objective).

3. SMT shall provide the ability to develop movement paths for mobile platforms contained in the maneuver or network plan and associate movement characteristics to those platforms. Mobile platforms shall include ground-based (threshold), air-tier based (such as, unmanned aerial vehicle (UAVs)), (objective) and sea-based (objective) assets (such as, UAVs, rotary and fixed wing aircraft, ships, boats).

4. SMT planning and simulation module shall provide the ability to control movement, including initiation of movement, fast-forward, and rewind capability, and a stop/pause capability (threshold = objective).

5. SMT shall provide terrain profiling for ultra high frequency (UHF) line of sight (LOS), super high frequency LOS, 802.16, and generic waveforms (threshold); all known waveforms (objective).

6. SMT shall provide the ability for the operator to manually develop an allotment plan for the AOR (threshold). SMT shall provide the ability to analyze the AOR-wide spectrum resource and partition that resource into sub-resources (allotments and assignments) (objective).

7. SMT shall provide the ability to create, import, export, edit, display, and delete a restricted frequency list (threshold = objective).

8. SMT shall deconflict all known and generic waveforms against all other known communications and noncommunications emitters within the AOR and against the EM environment background (threshold = objective).

9. SMT shall be able to import and edit a background signal environment background using the SFAF format (threshold = objective).

10. SMT shall provide automated frequency assignment for MSE, UHF LOS, high-capacity networking waveform (HNW), and network centric waveform (NCW) waveforms (threshold) and known emitters and waveforms (objective) within the AOR.

11. SMT automated frequency assignments shall consider both the current network and the known, applicable communications and non communications emitters contained in the background environment, and shall consider interference effects as part of the assignment process (threshold = objective).

12. SMT shall support near real time spectrum management and frequency assignment for HNW and NCW (threshold = objective).

13. SMT shall provide the ability to manually assign frequencies for all known waveforms (threshold = objective).

14. SMT shall include parametric data in its planning such as antenna take-off angle, fresnel zone, antenna pattern effects, or overlay capabilities (threshold = objective).

15. SMT shall allow for the inclusion of additional propagation models as they become available (threshold = objective).

16. SMT shall provide spectrum usage data in tabular and graphical format (threshold = objective).

17. SMT shall maintain a data repository that associates WIN-T units (threshold); all units (objective); with platforms, platforms with emitters, and emitters with technical characteristics required to support the deconfliction, assignment, and interference analysis functions.

18. SMT shall have the capability to perform course of action analysis (that is, M&S) for planned and existing networks allowing network managers to plan, assess, and train for network courses of action. This simulation shall perform as follows: 500 nodes at 20x real time, (threshold); 1000 nodes at 30x real time (objective).

19. SMT shall be scalable and adaptable to support employment at all tactical echelons (objective).

20. SMT can be exported as a standalone package for other DOD forces (objective).

21. SMT shall provide a spectrum requirements estimate for assignable emitters based on a mission or network plan (objective).

22. SMT shall provide jammer analysis against all known and generic waveforms/emitters within the AOR (objective).
Note: Known waveforms, emitters and nonemitters are defined as Enhanced Position Location Reporting System, Single Channel Army Radio System , MSE, Joint Network Node, UHF tactical satellite, high frequency & high frequency automatic link establishment (automatic link

establishment), commercial and military C-band, X-band, Ku-band SATCOM, super high frequency SATCOM, global broadcast system, wireless, wideband networking waveform, HNW, NCW, advanced obscurants, counter radio-controlled improvised explosive device electronic warfare (CREW) and CREW II Jammers (Dependency: Characteristics and models for these jammers shall be developed under the CJSMPT, JCTD, and Soldier radio waveform and imported into the SMT.)

23. SMT shall optimize frequency reuse for all known and generic emitters within the AOR (objective).

24. SMT shall provide the ability to make advantageous use of primary and secondary spectrum (objective).

25. SMT shall include, but shall not be limited to, the following propagation models, free space, Longley-Rice, terrain integrated rough Earth model (threshold); and additional propagation models associated with counter remote controlled improvised explosive device electronic warfare systems (objective). (Dependency: CJSMPT JCTD activity shall produce these propagation models and provide them to WIN-T for inclusion).

26. SMT shall also account for weather effects modeling (objective).
Note: Propagation models shall be selected automatically by the system or manually by the operator.

27. SMT shall provide the ability to construct a formation from combinations of units and platforms, create and edit movement paths, associate formations to movement paths, and conduct deconfliction and interference analyses based on the emitters contained on the platforms (objective). Basic unit data should be extracted or extractable from battle command systems (objective).

28. SMT shall allow the operator to create radio models or waveforms models to input additional systems in the network plan that may not be contained in the database (objective).

29. SMT shall provide the ability to import radio or waveform models that have been developed outside SMT, but that meet SMT import specifications (objective).

30. SMT shall provide CNR cryptonet planning and cryptonet deconfliction functions. SMT shall generate a CNR cryptonet plan (threshold = objective).

31. SMT shall generate the single operating instruction and communications-electronics operating instruction (threshold = objective).

32. SMT shall allow the frequency manager the ability to create and edit a SFAF (threshold) and to generate a SFAF based on the current network plan and transmit it electronically to the next higher echelon (objective).

33. SMT shall allow the operator to import a SFAF formatted text file (threshold = objective).

34. SMT shall allow the operator to create and edit a SAR (threshold = objective).

35. SMT shall be able to import a satellite access authorization (threshold = objective).

36. SMT shall automatically generate an electronic submission, receipt, and automatically implement SFAF, SAR, satellite access authorization, gateway access request, and gateway access authorization data (objective).

37. SMT SFAF messaging shall support U.S. Military Communications Electronics Board Publication 7 (threshold); U.S. Military Communications Electronics Board Publication 8 (objective).

38. SMT shall provide interference and coverage analyses for platforms containing MSE, UHF LOS, HNW, and NCW waveforms (threshold); known and/or generic emitters (objective) that are moving, including platforms equipped with jammers (objective).

39. SMT shall provide coverage analysis for MSE, UHF LOS, HNW, and NCW waveforms (threshold) all known and generic waveforms and emitters (objective).

40. SMT shall support the development of terrestrial (threshold) and air-tier relay sites (objective).

41. SMT shall provide spectrum management services to other NETOPS functions such as capacity planning and analysis so that the effects of frequency assignments and reuse can be factored into broader NETOPS functions (objective).

42. SMT shall provide explicit interference analysis (such as, interference analysis available directly to the operator as opposed to interference analysis conducted as part of a larger frequency assignment process) for all known and generic waveforms/emitters within the AOR (threshold) and if interference is predicted, make change recommendations to the operator (objective).

43. SMT shall provide an interference reporting capability consistent with the requirements of CJCSM 3320.02A and the joint spectrum interference report (objective).

44. SMT shall store and archive spectrum use data to support after action reporting, historical data and interference resolution (objective).

45. SMT shall provide an electronic interface to ACES and JACS to receive planning inputs from ACES and JACS terminals and provide the single operating instruction and cryptonet plans to ACES and JACS. SMT shall provide the single operating instruction and cryptonet plans to ACES and JACS operators who in turn shall download appropriate data to common fill devices such as, simple key loader, and automated net control device such as, the AN/CYZ-10 (threshold = objective).

46. SMT shall provide an electronic interface to a data distribution device such as, the simple key loader (threshold = objective).

47. SMT shall interface with the joint standard spectrum allocation process (threshold = objective).

48. SMT shall provide an SFAF interface with the SPXXI client and regional server (threshold = objective).

49. SMT shall provide an interface to the regional satellite support cell and Wideband SATCOM Operations Center controllers for SAR and satellite access authorization exchanges (objective).

50. SMT shall provide an electronic interface with the UAV control cell for frequency resource requests, assignments, and conflict and interference resolution (objective). (Dependency: Concept of operations for UAV control needs to establish the operational elements responsible for control of the UAV as a system.)

51. SMT shall provide a SFAF-based interface to JNMS (threshold); based on the Interface Control Document developed by the Interface Control Working Group (ICWG) with JNMS (objective).

52. SMT shall provide an ICWG-based electronic interface to the FCS NM system (objective). Note: ICWG interfaces are those that have been defined and approved by the U.S. Army ICWG, which is composed of technical representatives from the WIN-T, FCS, Joint Tactical Radio System communities, and chaired by the WIN-T Program Manager, Unit of Action Networks Program Manager, Joint Tactical Radio System Program Manager, and the Army Chief Information Officer/G6.

53. SMT shall provide an ICWG-based electronic interface to the joint wireless networking waveform network manager to provide spectrum resources and receive interference reports and usage data (objective).

54. SMT shall provide an electronic interface to future Modular Force NETOPS systems to input a network plan and export a frequency plan based on that network plan (objective).

55. SMT shall provide an electronic interface with the WIN-T Distributed Networking Agent to provide near real time spectrum management and frequency assignment (objective).

56. SMT shall provide a direct electronic interface to Navy, Marines, and Air Force NM and spectrum management systems (objective). Dependency: Navy, Marine Corps, and Air Force NM and spectrum management systems will be designed to support on of the interface formats already supported by the SMT, namely SFAF U.S. Military Communications Electronics Board Publication 7, U.S. Military Communications Electronics Board Publication 8 formats, or the ICWG-defined formats.

57. SMT shall interface with the CJSMPT using an ICWG-based electronic interface. (Dependency – CJSMPT shall implement the ICWG interfaces and shall engage with the WIN-T program to establish the interface formats (objective)).

58. SMT shall interface with the common joint/Army database structures to facilitate the seamless exchange of data elements (objective).

59. SMT shall provide Army planning (signal annex) information to the JNMS for preparation of the joint signal annex and support bi-directional exchange of network planning (objective).

60. SMT shall provide a map-based display for spectrum management. The map based display shall use standard DOD mapping toolkits and standard DOD and Army maneuver and signal symbol sets (threshold = objective).

61. SMT shall provide two dimensional and three dimensional visualization of terrain and coverage areas, networking connectivity, spectrum resources, mobile node(s) locations, coverage analysis, and usage (threshold = objective).

62. SMT shall provide a common operational EMS picture that depicts spectrum usage for all known communications and noncommunications emitters in the AOR (threshold = objective).

63. SMT shall track allocated spectrum in support of the spectrum common operational picture (threshold = objective).

64. SMT shall provide a visual display of regulatory and policy information (such as, National Telecommunications and Information Administration table of allocations, frequency band designators, system descriptions, host nation frequency agreements) as reference data to the operator (threshold). Automate and integrate table of allocation rules into the assignment process (objective).

65. SMT shall provide a visual display of spectrum management-related information such as channel plans and allotment plans as reference data to the operator (threshold = objective).

66. SMT shall have the capability to simplify network graphs based on a set of filters (such as, WIN-T nodes, nodes with greater than a certain load percentage) (objective).

67. SMT software design shall enable ease of installation, operation, maintenance, training, and management. Its elements shall include graphic and multimedia user interfaces and training aids that facilitate plug and play installation (objective).

68. SMT software design, to include controls, displays, configuration, connections, required procedures and operating environments, shall minimize human performance errors, interface problems, and workload (physical, cognitive) requirements. The software design shall conform to applicable human factors engineering design criteria and standards, to the maximum extent possible. Software shall be easy, intuitive, and efficient to use (objective).

69. The SMT software shall be simple, consistent, and efficient to use. The software shall conform to the DOD human computer interface style guide while making allowances for previously designed software. The software shall automate complex tasks and minimize user actions and Soldier memorization requirements (objective).

70. The SMT software interface shall provide the following characteristics (objective).

(a) Consistency throughout the interface design, including consistency of information display, interactive procedures, commands, and data entry tasks.

(b) Simple, adaptive, flexible design that minimizes user actions.

(c) Prompts and structuring features to guide operator tasks.

(d) Immediate, informative feedback and status visibility.

(e) Automate tasks and provide appropriate defaults to reduce workload.

(f) Shortcuts for frequent tasks.

(g) A menu hierarchy that reflects task needs and allows rapid access to frequently selected options.

(h) Six hundred and sixty automatic data validation, informative error messages, and warnings prior to situations where operators may lose data or damage the system.

(i) Design to help users' recognize, diagnose, and recover from errors.

(j) A useful, task based help system.

71. Integrated electronic technical manuals shall be integrated these into the workflows (objective).

72. SMT vendor shall produce paper and electronic tech manuals (objective).

73. SMT vendor shall produce classroom training and computer based training (objective).

74. SMT shall operate on a common hardware/software III family, intel-based laptop or desktop computer running Windows version 2000 or later (objective).

Glossary

Section I
Abbreviations

ABCS	Army Battlefield Command System
ACES	Army communications engineering software
ALE*	automated link establishment
AGA*	air-to-ground-to air
AO	area of operations
AOR	area of responsibility
AWACS*	airborne warning and control system
BCT	brigade combat team
BEME*	background electromagnetic environment
BFT*	blue force tracker
BSM*	battlefield spectrum management
C2	command and control
CAB*	combat aviation brigade
CBA	capabilities-based assessment
CBS (ME)	combat support brigade (maneuver enhancement)
CCP	concept capability plan
CJCSI*	Chairman of The Joint Chiefs of Staff Instruction
CJSMPT	coalition joint spectrum management planning tool
CNR	combat net radio
COTS	commercial off-the-shelf
CREW	counter radio-controlled improvised explosive device electronic warfare
DIV	division
DOD	Department of Defense
DOTMLPF	doctrine, organization, training, materiel, leadership and education, personnel and facilities
E3	electromagnetic environmental effects
EM	electromagnetic
EMI	electromagnetic interference
EMP*	electromagnetic pulse
EMS	electromagnetic spectrum
EMSO	electromagnetic spectrum operations
EPLRS*	enhanced position location and reporting system
EW	electronic warfare
EWCC	electronic warfare coordination cell
FBCB2*	Force XXI battle command, brigade-and-below
FCS	Future Combat System
FLD*	field
FM	field manual
FMI	field manual interim
FRS*	family radio service

G6	designator for primary Signal staff officer for an Army organization commanded by a general officer
G8	designator for primary resource management officer for an Army organization commanded by a general officer
GBS*	Global Broadcast System
GEMSIS	Global Electromagnetic Spectrum Information System
GIG	global information grid
GSR*	ground surveillance radar
HBCT*	heavy brigade combat team
HERO	hazards of electromagnetic radiation to ordnance
HF*	high frequency
HNW	high-capacity networking waveform
ICD	initial capabilities document
ICWG	Interface Control Working Group
IHFR*	improved high frequency radio
INMARSAT*	international marine/maritime satellite
ISYSCON*	integrated systems control
IRP*	integration reference point
ISR*	intelligence, surveillance, and reconnaissance
J6	designator for a primary Signal staff officer for a joint organization
JACS	joint automated communications-electronics operating instruction system
JC2	joint command and control
JCIDS	Joint Capabilities Integration and Development System
JCTD	joint capabilities technical demonstration
JIM	joint, interagency, and multinational
JNN*	joint network node
JNMS	Joint Network Management System
JROC	Joint Requirements Oversight Council
JTF	joint task force
JTIDS*	Joint Tactical Information Distribution System
LOS	line of sight
MCEB	Military Communications Electronics Board
MEB*	Marine expeditionary brigade
M&S	modeling and simulation
MSE	mobile subscriber equipment
NCE	net-centric environment
NCW	network centric waveform
NETOPS	network operations
NM	network management
NTDR*	near term digital radio
OV	operational architecture view
PCS*	personal communication system/service
PLGR*	precision lightweight GPS (global positioning satellite) receiver
RADHAZ	radiation hazards
REMBASS*	Remotely-Monitored Battlefield Sensor System
RF	radio frequency

S6	designator for primary signal staff officer not commanded by a general officer
SAR	satellite access request
SATCOM	satellite communications
SC*	single channel
SCAMPS*	single channel anti-jam man-portable systems
SFAF	standard frequency action format
SINCGARS*	Single Channel Ground to Air Radio System
SMART-T*	secure mobile anti-jam reliable tactical-terminal
SMT	spectrum management tool
SPXXI	Spectrum XXI
TADIL*	tactical digital information link
TRADOC	Training and Doctrine Command
UAV	unmanned aerial vehicle
UGV*	unmanned ground vehicle
UHF	ultra-high frequency
U.S.	United States
WIN-T	Warfighter Information Network-Tactical
WLAN*	wireless local area network
WND	wireless network device

* Found in figures and tables only.

Section II
Terms

battlefield spectrum management
The systematic planning, managing, engineering, and coordinating of electromagnetic spectrum use by units engaged in combat and training for combat. Battlefield spectrum management is truly only a management process and is essentially a totally manual process to manage spectrum and will ultimately find most of its capabilities put into software rules that are fully integrated directly in to spectrum dependent devices.

coalition joint spectrum management planning tool
A developmental program which will provide an integrated RF spectrum planning and management tool that will enable frequency managers to perform RF spectrum planning from Brigade through JTF for both mission planning and the conduct of combat operations. The program will focus on: RF spectrum optimization and conflict mitigation that considers environmental factors, operational priorities, host nation allocation and assignments, and international spectrum management policies and regulations; development of visualization tools to provide commanders and warfighters a picture of dynamic RF spectrum usage; and development, integration and population of U.S. and coalition forces RF spectrum databases while conforming to emerging net-centric concepts.

electromagnetic spectrum operations (EMSO)
EMSO enables electronic systems that rely on wireless connectivity to perform their functions in the intended environment without causing or suffering unacceptable frequency interference. EMSO incorporates spectrum management, frequency assignments, policy implementation, and

host nation coordination that enables the efficient use of the electromagnetic spectrum battlespace for combat operations.

Fresnel zone
In radio communications, one of a (theoretically infinite) number of concentric ellipsoids of revolution which define volumes in the radiation pattern of a (usually) circular aperture. Fresnel zones result from diffraction by the circular aperture.

global electromagnetic spectrum information system (GEMSIS)
GEMSIS is a developmental program consisting of a system of systems that provides a full range of capabilities to the warfighter. In addition to the mission planning and tactical spectrum management capabilities, it has the requirement to address spectrum supportability, the process of determining whether a proposed capability can get access to the spectrum necessary to function as conceived and whether it will fit into the existing radio frequency environment without causing harmful interference to capabilities already present.

joint network management system (JNMS)
JNMS provides joint and service component Commanders a common, automated planning and management tool that will plan, monitor and control the Joint communications and data backbone associated with a JTF or joint special operations task force.

joint operational environment
Joint operational environment establishes a framework for developing a range of potential alternative future operational environments. It examines future threat capabilities and identifies environmental influences on modern conflict. It then discusses potential implications of future operational environments for the joint training, experimentation, and doctrinal development communities.

network operations (NETOPS)
NETOPS provides assured and timely net-centric services across strategic, operational and tactical boundaries in support of DOD’s full spectrum of warfighting, intelligence and business missions.

spectrum XXI (SPXXI)
SPXXI is the joint standard for spectrum management and it is the only frequency deconfliction tool currently available to the force. It meets the requirement to provide frequency allocations to a variety of communications planning tools used by the Services.

warfighter information network-tactical (WIN-T)
WIN-T is the Army's on-the-move, high-speed, high-capacity backbone communications network, linking warfighters on the tactical ground units with commanders and the GIG, the U.S. DOD’s worldwide network- centric information system. WIN-T is a critical enabler of LandWarNet, the Army's far-reaching effort to transform into joint, network-centric, knowledge-based warfare; the network provides a clear operational picture for theater combatant commanders by using true satellite on-the-move capabilities, robust network management and

high-bandwidth radio systems to keep mobile forces connected, communicating and synchronized.

WIN-T spectrum management tool (SMT)
WIN-T SMT will provide integrated dynamic electromagnetic spectrum operations capability to request, allocate, plan and assign the efficient use of electromagnetic spectrum for all communications and noncommunications emitters employed within the AOR.