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**ELECTRONIC WARFARE: RETHINKING THE IMPORTANCE OF
ITS ROLE IN MILITARY OPERATIONS**

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by George Lambert
Lieutenant Colonel, United States Marine Corps

A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this thesis reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

**This thesis is entirely my own work except as documented in footnotes.
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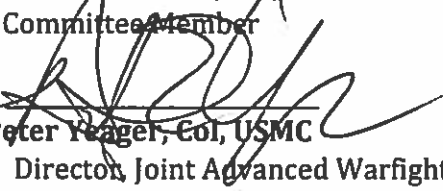
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ABSTRACT

Today, a majority of the information shared or denied on the battlefield traverses the Electromagnetic Spectrum (EMS); thus control of the electro-magnetic spectrum has become essential to modern warfare. Electronic Warfare (EW) plays a critical role in dominating the EMS, but the current mindset regarding electronic warfare is characterized by misperception, misunderstanding, and mismanagement, resulting in EW being devalued and its resources misused.

This thesis will argue how the current EW mindset impacts decisions made from the DoD down to the tactical unit. At the DoD there is a lack of effective joint organizational structure, advocacy and strategy. Devalued and lacking advocacy, EW fails to earn resource investment today and into the foreseeable future. The Services frustrate the lack of unified infrastructure and strategy by approaching EW from service oriented perspectives as opposed to a joint EW approach. At the operational level, commanders allow the current EW mindset to impact the manner in which they structure and populate their supporting EW organizations which results in ineffective EW operational employment and inaccurate force requirements. The entirety of these circumstances perpetuates the current EW mindset.

A review of current and recent planning for and employment of Airborne Electronic Warfare assets in PACOM and CENTCOM's areas of operation support the argument. The desired outcome is the recognition of the importance of the EMS and EW's role. That will occur when the EW mindset changes.

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DEDICATION

This thesis is dedicated to my wife Katie whose constant exposure to the complex concepts related to electronic warfare and EA-6B NATOPS are now second nature. Her tireless efforts to edit the many variations of this thesis and her enduring love and support have both enabled and inspired my efforts. I'd also like to acknowledge and thank my children for enduring the many sacrifices they involuntarily incur, for their patience with me, for tiptoeing around the house so dad could write, and for honoring the invisible "Do Not Disturb" sign. With much love and gratitude I thank you all.

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INTRODUCTION

Background

On July 5th and 6th, 1944 Operations TAXABLE, GLIMMER, and MANDREL were carried out to deceive German naval and air forces closely watching the buildup of the Allied preparation for what would become the D-Day invasion in France. Radar countermeasures in the form of dropping strips of chaff and, in the case of MANDREL, employing Mandrel EW radar jammers to confuse German radar operators and prepare the battlefield for a surprise landing on the beaches of Normandy¹.

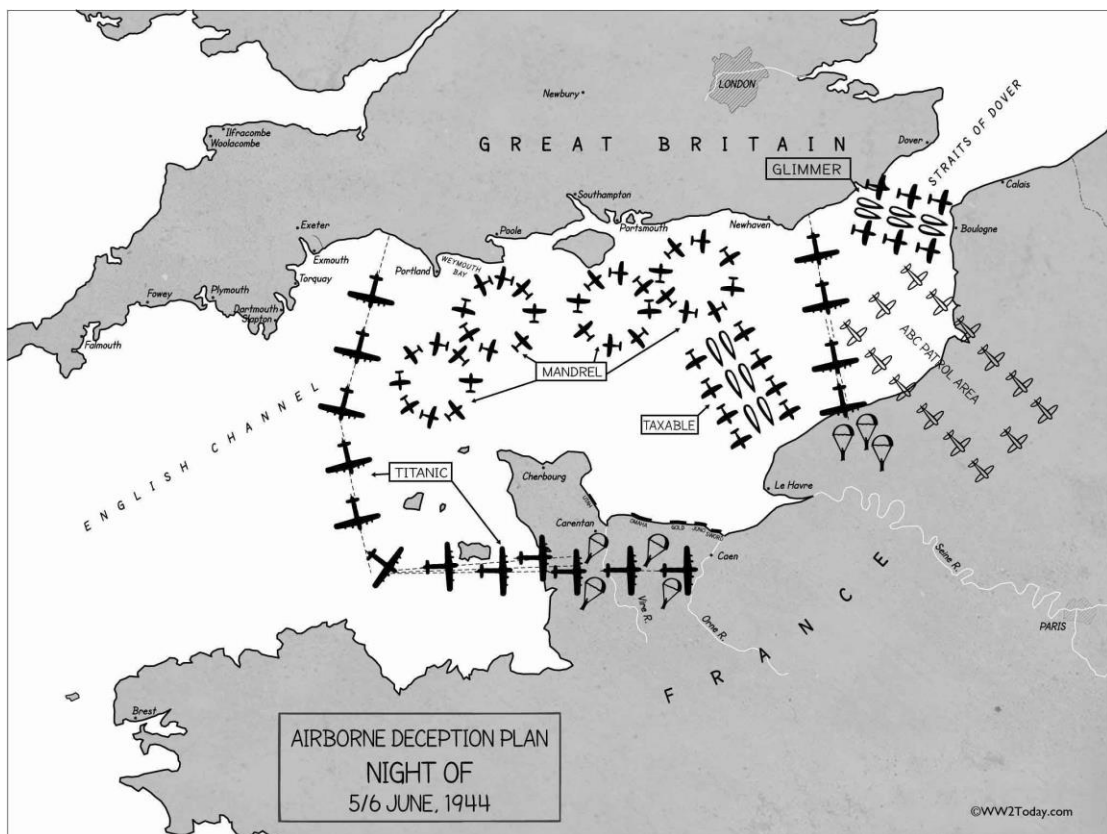


Figure 1. Diagram to show radar counter measures for Operation OVERLORD, 5/6th June 1944.²

¹ The United Kingdom National Archives, "World War II," A The National Archives, <http://www.nationalarchives.gov.uk/education/worldwar2/theatres-of-war/western-europe/investigation/d-day/sources/docs/5/enlarge.htm>, (accessed October 23, 2015).

² World War II Today, "Airborne Deception Plan Night of 5/6 June, 1944," World War II Today, <http://ww2today.com/6-june-1944-0100-taxable-glimmer-mandrel-and-titanic> (accessed 6 Dec 2015).

Figure 1 shows Airborne Electronic Warfare at work prior to the Normandy invasion. Essential to the element of surprise was denying the German commanders information and situational awareness that might provide indications identifying the planned landing beaches. Maximizing the element of surprise by minimizing an enemy's situational awareness regarding the nature and disposition of his adversary was the role of electronic warfare during the tense days leading up to the invasion. As history revealed, the invasion was the turning point in the war in Europe and paved the way for an Allied advance into Germany that secured victory. It was a success in part because allied efforts to deny the Germans access to vital information was cogent. Seventy-one years later, technology has produced capabilities that utilize radar evasive aircraft with state of the art systems designed to make these aircraft autonomous in their efforts to defeat Integrated Air Defense Systems (IADS). Command and Control systems leverage complex architecture to exploit the rapid growth in the speed of information sharing. All are intended to give the commander the upper hand in deriving the advantages of controlling and maximizing the flow of information on the battlefield.

Today the majority of the information shared or denied on the battlefield traverses the Electromagnetic Spectrum (EMS). Control of the electro-magnetic spectrum is more important today than it has ever been. That trend will continue as the United States military and its adversaries become more and more reliant on systems that require access to the EMS in order to control the *information domain*³. Early warning, targeting, communications, data, navigation, information gathering

³ The term information domain is no longer a DoD term. In 2001 the term information domain was contested and information environment and cyber domain subsequently came to be. It is the authors opinion that cyber domain is not a domain due to its use of the Electromagnetic Spectrum (EMS). Given that the EMS defines the physical structure of the domain I believe the domain should be named the Information Domain.

and dissemination, and command and control (C2) are among the many critical capabilities that militaries seek to employ or exploit. These capabilities require access to the EMS in order to function and generate information from the commander.

The problem

Electronic Warfare (EW) plays a critical role in dominating the EMS, but the current mindset regarding electronic warfare is characterized by misperception, misunderstanding, and mismanagement resulting in EW being devalued and its resources misused. A lack of DoD Joint effective organizational structure, advocacy, and strategy perpetuates and contributes to this mindset. Lacking advocacy and being devalued, EW fails to earn resource investment today and will continue to be under resourced into the foreseeable future. The Department of Defense's (DoD) failure to provide the effective organizational structure and strategy to efficiently leverage these capabilities across the spectrum of both joint and combined military operations compromises America's dominance in the EMS and consequently, in the information realm. The services frustrate the lack of unified infrastructure and strategy by approaching EW from Service oriented perspectives as opposed to a joint EW approach. Finally, force requirements, specifically Airborne Electronic Warfare (AEW), generated at the tactical level and validated at the operational level are based on inaccurate data and drive invalid force requirements that aggravate resource shortfalls. These resource shortfalls, coupled with the enduring and persistent need for EW support, create EW capability gaps between Combatant Commands (CMD) and Joint Task Forces (JTF). This thesis will argue that these issues originate from an uninformed mindset regarding EW.

Research approach

The research supporting this thesis comes from existing academic, Department of Defense (DoD) documents, books, articles, interviews, and the author's experiences operating in both PACOM and CENTCOM's area of operations. An analytical argument will be presented utilizing examples of how the current EW mindset impacts current EW employment, AEW global resource allocation, and future investment in EW systems.

Research limitations

Research was limited to materials classified "UNCLASSIFIED". EW is a highly classified subject, so detailed information that would add to the effectiveness of certain arguments was omitted. However, the arguments presented are valid even despite the omission of classified information. The accuracy of some organizational structures, current operating procedures and processes, have changed and continue to change. Compounding the challenge, the differences between Combatant Commands can be significant. As such, these topics are generalized and presented in a manner that aligns doctrinally rather than strictly in practice at each combatant command. Additionally, the time to research this subject to the depth and scope required was limited so a conscious choice was made to refer to the author's past experiences to convey challenges experienced at the tactical and operational level and use them as examples. While these experiences are as much as 8 years old, they still represent data points that support the author's thesis. Finally, this thesis does not research and debate the system of systems approach to the future of EW or the effectiveness of cyber-EW. Whether or not the system of systems approach is the most effective and whether or not the methods envisioned are the best is an interesting discussion, albeit irrelevant to the substance of this thesis.

CHAPTER 1 – ESTABLISHING THE IMPORTANCE OF THE EMS

Why does it matter?

DoD is currently hamstrung by budget constraints which leave many programs fighting for the fiscal scraps left by programs such as the F-35 Joint Strike Fighter and the U.S. Air Force's next-generation Long Range Strike Bomber. What makes EW worth investing in as opposed to these systems or other programs at risk or already cut by DoD? With the rapid growth in cyber capabilities and investment, is it reasonable to assume the need for EW will diminish? To what extent do self-protect jammers and stealth technologies reduce our reliance on EW? These and other questions are very germane today and provide the greater context within which the relevance of this thesis resides. In fact, these questions inadvertently reveal the problems this thesis seeks to address; from DoD down to the tactical units, EW is undervalued and misunderstood, its structure is broken and its future is uncertain. The intent is not to argue that EW should be "The" priority now or in the future, but that it is not prioritized as high as it should be due to the current mindset regarding EW within DoD and at every level that debases it. By debasing EW it becomes easy to accept risk by under resourcing EW organizations and units and employing it as an afterthought with no clear joint doctrine or long-term sustainment.

Failing to recognize the consequence of this mindset perpetuates a lack of adequate DoD structure, strategy, and compels decision makers to defer investment in EW's future. Hence, it becomes a self-perpetuating problem. The fact that DoD has created a "Cyber Domain" and invests heavily in cyberspace operations while cutting investment in EW is alarming. On one hand, DoD clearly recognizes the need to ensure access to information through cyber networks and the narrowly fixed cyber

domain. On the other hand, it is reducing its' ability to control the majority of the information realm defined by the EMS. This highlights a momentous failure by DoD

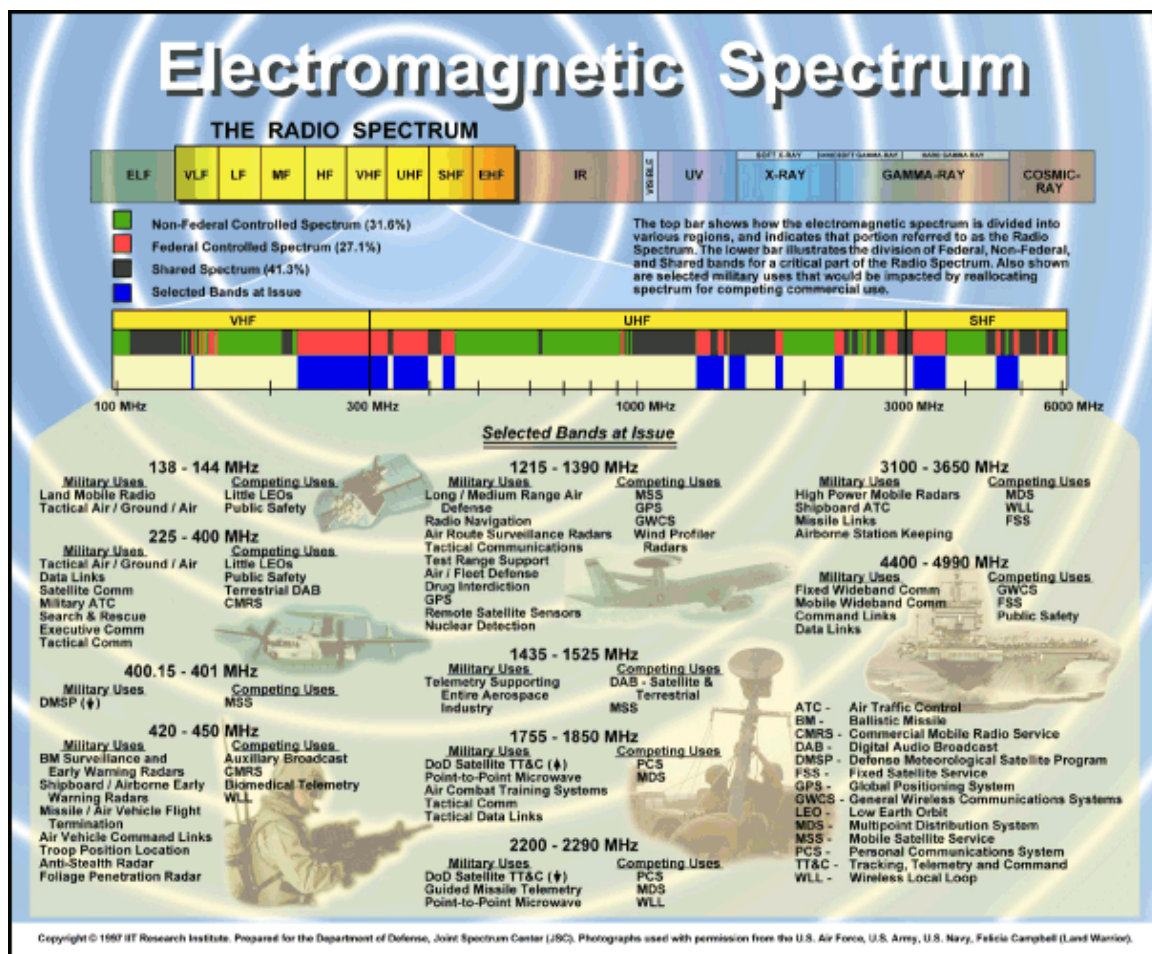


Figure 2. Electromagnetic Spectrum. From FM 34-45.¹

to appreciate the scope and manner in which the information war is fought and the contributions of EW to that fight. It is important to concede that DoD has declared the importance of controlling the EMS and EWs role in doing so, but, to date, senior leader actions signify that DoD's commitment is far less than the rhetoric implies.

Graphically seeing the EMS

¹Headquarters Department of the Army, "Figure A-1. Electromagnetic Spectrum," *globalsecurity.org*, June 9, 2000, under "FM 34-45: Tactics, Techniques, and Procedures for Electronic Attack," <http://www.globalsecurity.org/intell/library/policy/army/fm/34-45/appa.htm> (accessed November 11, 2015).

The Electromagnetic Spectrum (Figure 2) illustrates the degree to which the U.S. relies on the EMS by highlighting only a portion of the EMS and identifying both military and commercial applications that occur within it. Not depicted are lasers and DIRCM, IR imagers, IR missiles, IR flares, and laser guided weapons operating in the Infrared range, and the vast majority of radars such as target tracking and air interdiction radars that operate above 5000 MHz. Not to be overlooked is the degree of competition for access to the EMS. The same competition will exist between the U.S. and its adversaries making the military's ability to deny the enemy access to the EMS even more difficult.

Making the argument

To effectively make the argument that the “current EW Mindset” must be defined, the reader must have a basic understanding of what “information” is, what EW is, EW's relationship to Information Operations (IO), and what Cyber warfare and Cyber EW are. They must understand what Joint Electromagnetic Spectrum Operations (JEMSO) are, how important the EMS is to military operations, and the role EW plays in controlling it. With a more complete understanding of EW's importance to the Combatant Commander (CCDR) and the Joint Task Force Commander (JTFC) the reader will be better able to understand the problems of the current EW mindset at the strategic and operational levels, how that mindset devalues EW, and how its effect on EW employment will negatively impact control of the information domain. Before discussing IO, EW, JEMSO and cyber warfare operations, it is helpful to define the information environment, elements of information, and how information contributes to the decision making process.

Understanding the concept of Information

Antoine Henri Jomini, a staff officer in the French Army during the Napoleonic Wars and noted war theorist, codified basic maxims of war that embraced his one great principle of war. Among them is “To throw by strategic movements the mass of an army, successively, upon the decisive points of a theater of war, and also upon the communications of the enemy as much as possible without compromising one.”² This principle is integral to IO, cyber operations, JEMSO, and electronic warfare operations. At the core of communication is information. An amalgamated definition of information is contextual, communicated data, facts, or knowledge that provides meaning for action that has been obtained from study, observation, instruction, or investigation.³ In terms of military operations, information improves the commander’s situational awareness, which facilitates the decision making process and is communicated through a C2 architecture.

The Information Environment

The information environment consists of three dimensions: the physical dimension, the information dimension, and the cognitive dimension.⁴ The Physical dimension is where physical structures, systems and the communication networks that connect them exist. Elements in the Physical dimension include C2 infrastructure, decision makers, cell phones, computers, newspapers, and TV. Its boundaries cross national, economic, and military lines. The Information dimension is where and how information is collected, processed, stored, distributed, and protected. Actions in the Information domain determine content and how and where information is shared. The

² Ettrich, Brian B., “The Principles of War: Are They Still Applicable?” (Master’s thesis, Naval Post Graduate School, June 2005), 17.

³ This definition was created by the author after reviewing definitions from JP 1-02, JP 3-13 and Webster’s online dictionary.

⁴ U.S. Joint Chiefs of Staff, *Information Operation*, Joint Publication 3-13 (Washington DC: Joint Chiefs of Staff, March 17, 2012).

Information dimension links the Physical and Cognitive dimensions. The Cognitive dimension is abstract and theoretical. It is where the decision process takes place, the mind of the commander, decision maker, and adversary. It is affected by situational awareness, public opinion, cultural norms, morals, personal beliefs, education, experience, and ideologies among other things.

Information is obtained and shared via systems that require access to the EMS to observe conditions and interpret data. A simple example is an early warning radar that observes incoming enemy aircraft. That information is observed, interpreted, then shared to improve a commander's situational awareness and facilitate a decision on how and where to engage enemy aircraft. For decisions to be communicated within C2 architectures, users must have access to that structure and the EMS. The importance of information and the benefit of denying it to enemy commanders through the conduct of IO, JEMSO, and EW have become increasingly more difficult and notably more important. EW plays an important part in this.

Electronic Warfare defined

Electronic warfare is defined as “Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy.”⁵ It consists of three divisions: electronic attack (EA), electronic protect (EP), and electronic warfare support (ES). Electronic attack utilizes the radiation or re-radiation of electromagnetic energy, directed energy, electromagnetic pulse, or anti-radiation missiles to deny, degrade, neutralize, or destroy enemy systems. Electronic protection is friendly actions taken to protect personnel, equipment, and facilities from the effects of enemy offensive use of the EMS.

⁵ U.S. Joint Chiefs of Staff, *Electronic Warfare*, Joint Publication 3-13.1 (Washington DC: Joint Chiefs of Staff, February 8, 2012), GL-9.

Electronic warfare support actions taken to identify, locate sources of energy emitted by enemy systems for the purpose of providing threat warning, targeting, and informing the planning process for follow on operations.

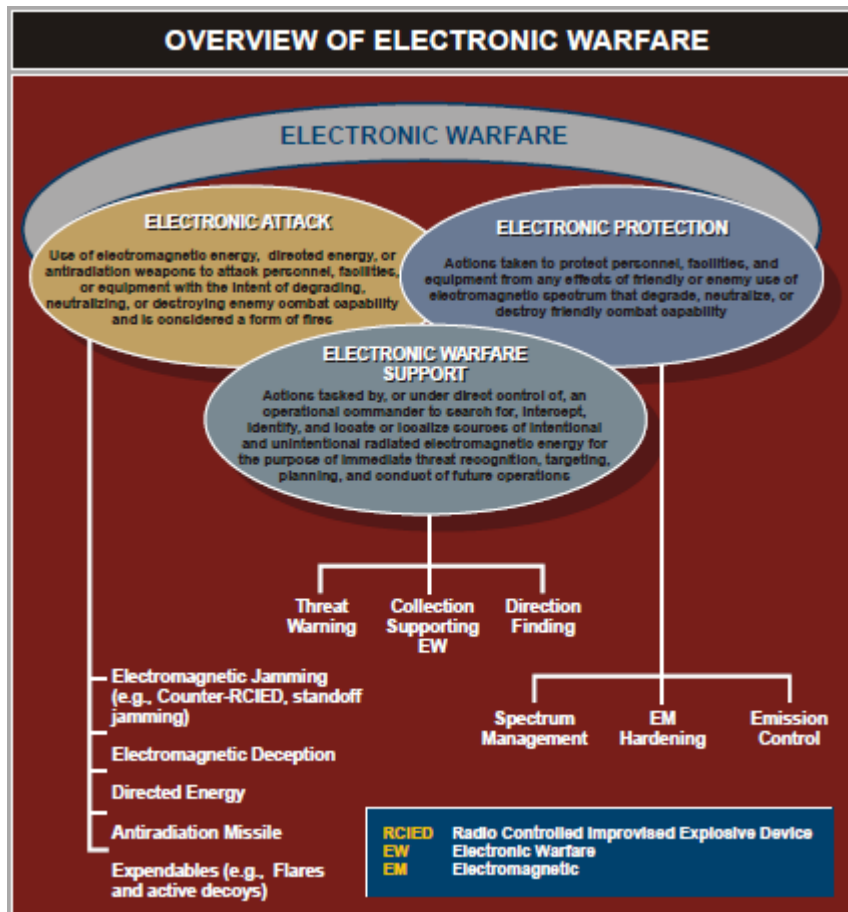


Figure 3. Overview of Electronic Warfare.⁶

Many of EW's divisions are replicated in IO and cyber operations. While this thesis will not attempt to try to clarify these problematic relationships, it is important to note that lacking EW advocacy, strategy, and doctrine at the joint level will continue to exasperate the lack of synchronization and interoperability that exists between these functions.

Airborne Electronic Warfare

⁶ U.S. Joint Chiefs of Staff, *Electronic Warfare*, Joint Publication 3-13.1 (Washington DC: Joint Chiefs of Staff, February 8, 2012), I-3.

This thesis will consider the employment of AEW in two theaters to demonstrate how the current EW mindset affects employment at the tactical and operational levels of war. AEW can be any number of actions taken to attack, defend, and protect or collect information through the EMS. Offensive electronic attack employs electromagnetic energy, directed energy, or anti-radiation weapons to attack enemy personnel or facilities in order to degrade or destroy his capabilities. The majority of these offensive actions employed by AEW platforms include jamming, anti-radiation missiles, and employment of expendables, such as bulk chaff, to deceive enemy radars. Defensive Electronic warfare is intended to protect friendly capabilities and includes jammers, decoys, and expendables (chaff and flares). AEW platforms also play a prominent role in Electronic Warfare Support in searching for, locating, and identifying enemy emitters to provide threat warning and improve friendly knowledge of the enemy's IADS laydown for follow on operations. Generally speaking AEW is extremely reactive to immediate requirements associated with conducting electronic attack and electronic support missions.

Information Operations

Information Operations are defined by JP 1-02 as “the integrated employment, during military operations, of information-related capabilities in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision-making of adversaries and potential adversaries while protecting our own.”⁷ JP 1-02 also refers the reader to electronic warfare, military deception, operations security, and military information support operations. The Secretary of Defense now characterizes IO as “the integrated employment, during military operations, of Information Related

⁷ U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Term*, Joint Publication 1-02 (Washington DC: Joint Chiefs of Staff, November 8, 2010), 114.

Capabilities in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision making of adversaries and potential adversaries while protecting our own.”⁸ Simply put, IO attempts to degrade the enemy’s decision-making process while protecting friendly capabilities. The reader will notice how closely related this is to JEMSO. DoD emphasizes controlling all elements of the EMS to include the ability to disrupt and or control all communications and sensors or weapon systems.

The fiscal year 2011 electronic warfare strategy report identifies the purpose of the strategy, citing as its impetus section 1053 of the National Defense Authorization Act for Fiscal Year 2010, and articulates a maturing, twofold strategy focused on integrating electronic warfare capabilities into all phases and at all levels of military operations, as well as developing, maintaining, and protecting the maneuver space within the electromagnetic spectrum necessary to enable military capabilities.⁹

The quote above indicates an emergent emphasis on the joint employment of EW in support of military operations, but the reality is that after 4 years it is not happening. The current EW mindset still obstructs a joint approach to EW by the services and yields little improvement in EWs current operational employment. With the recent change from EW as a subset of IO to now being a predominant component of JEMSO, the opportunity to redefine the mindset regarding EW is optimal.

Joint Electromagnetic Spectrum Operations

Joint Electromagnetic Spectrum Operations define the future concept enabling a comprehensive approach to controlling the EMS and involves “those activities consisting of Electronic Warfare and joint electromagnetic Spectrum Management operations used to exploit, attack, protect, and manage the electromagnetic

⁸ U.S. Joint Chiefs of Staff, *Information Operation*, Joint Publication 3-13 (Washington DC: Joint Chiefs of Staff, March 17, 2012), ix.

⁹ United States Government Accountability Office, *Electronic Warfare, DOD Actions Needed to Strengthen Management and Oversight, Report to the Committee on Armed Services, House of Representatives* (Washington, DC: Government Accountability Office, March 2012), 3.

operational environment to achieve the commander's objectives."¹⁰ JEMSO support JFC and GCC campaigns and operations by ensuring U.S. access to the EMS, controlling electronic signatures, protect friendly vulnerabilities and deny enemy access to the EMS. JEMSO recognizes that the EMS is now maneuver space and that the U.S. must focus not just on the threat within it but the opportunity it provides to more efficiently facilitate operations.¹¹ JEMSO is also vitally important in that the *Joint Concept for Electromagnetic Spectrum Operations* (JCEMSO) provides the strategy that enables EW to transition from technology driven capabilities to requirements driven technology.¹² In the world of EW, DoD has found uses for new technology rather than designing technology to meet emerging needs.

The JCEMSO lays out USSTRATCOM's vision for how Joint Forces will operate in the future with respect to growing reliance on the electromagnetic spectrum. As articulated above, the growing importance of the United States' ability to operate within and control the EMS cannot be overstated. In order to accomplish this, the JCEMSO identified the need for new structure. The Joint Electromagnetic Spectrum Operations Cells (JEMSOC) at the JTF level will synchronize lines of effort across functional or service component forces. It also advocates for the establishment of component level Electromagnetic Spectrum Operation Cells (EMSOC) to coordinate component level operations that require access to or exploitation of the EMS to accomplish their mission. The JCEMSO also accounts for national agencies and coalition partners by ensuring that those organizations efforts, which will vary by

¹⁰ Bourque, LtCol. Jesse. "Electromagnetic Spectrum Operations: A Conceptual Approach." Power Point Brief, (Deputy Director JEWOC, May 9, 2014), slide 5.

¹¹ U.S. Joint Chiefs of Staff, *Joint Concept for Electromagnetic Spectrum Operations (JCEMSO)* (Washington DC: Joint Chiefs of Staff, March 18, 2015), 3. The idea of the EMS as maneuver space comes from various sources but the JCEMSO promotes the concept of focusing on both the threat and the opportunity.

¹² The concept of technology driving requirements is something I have observed in my career and have seen discussed in much of my research. Reversing this mentality is critical to ensuring the U.S. gets JEMSOs right.

Operation, be synchronized into the EMSO plans to maximize efficiency and avoid conflict. Cyberspace operations and JFCC Space are also linked to the JEMSOC in a supporting role to account for EMSO along those lines of effort. The JCEMSO also recognizes the potential need to establish a functional or component command that fuses EMSO, cyberspace operations and IO at the JTF and CCMD level. The JEMSOC would be the cell that coordinates all JTF EMSO, to include accounting for neutral and enemy actions within the EMS and in the battle space.

The Importance of the EMS

Improved technology provides consumers greater access to and sharing of information that facilitates improved command and control and the opportunity to gain information superiority.

In modern conflict, gaining information superiority has become as important as lethal action in determining the outcome of operations. Information superiority is the operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same.¹³

From a military perspective, this equates to increased coordination, speed, and maneuverability on the battlefield and enables it to respond more quickly to changes in the combat environment. In modern warfare, collecting, processing, and disseminating the unimpeded flow of information, while denying the enemy the ability to do the same, is vital and plays a significant role in determining the outcome of operations.

The DoD recognizes how critical gaining and maintaining EMS superiority is when conducting joint operations.

¹³ U.S. Joint Chiefs of Staff, *Information Operation*, Joint Publication 3-13 (Washington DC: Joint Chiefs of Staff, March 17, 2012), GL-3.

Like air, space, land, maritime, and cyberspace domains, military forces maneuver within the EMS to gain tactical, operational, and strategic advantages. The EMS transcends all these domains and enables mission execution and ensures overall operational superiority. It cannot be overstated that all joint functions – including movement and maneuver, weapon engagements (fires), command and control, intelligence, protection, sustainment, and information are enabled by spectrum-dependent system (SDS) capabilities. Further, for these SDSs to be effective, DoD requires access and control of the EMS, which is obtained by conducting joint electromagnetic spectrum operations (JEMSO) i.e., those activities consisting of electromagnetic warfare (EW) and spectrum management operations...¹⁴

These statements clearly define the importance of controlling the EMS from the former Chairman of the Joint Chiefs of Staff's perspective. Consequently, joint EW structure is evolving and attempting to write overarching strategy and doctrine to unify the joint EW effort through the JCEMSO. Improving the organizational structure from the top down based upon DoD produced joint EW policy, strategy, and doctrine, will produce common terminology, ensure system and equipment compatibility and interoperability, prevent unintentional interference between systems (AEW vs. Ground based systems for example) and improve spectrum management operations.

¹⁴ U.S. Department of Defense. *Electromagnetic Spectrum Strategy (2013) A Call to Action* (Washington DC: Department of Defense, September 11, 2013), 2.

CHAPTER 2 – THE EW MINDSET

If EW plays an important role in allowing the U.S. to dominate the EMS, which is vital to U.S. military operations as identified above, then how is it possible that joint employment of EW is so poorly executed, and why is the future vision of EW disconnected from the reality of its future? There exists a skewed mindset regarding electronic warfare that is the root cause of these issues.

The Current EW Mindset Defined

The current approach regarding electronic warfare is characterized by misperception, misunderstanding and mismanagement, which ultimately debases EW at the strategic, operational, and tactical levels. Determining what contributes to the current EW mindset is not difficult. First, electronic warfare is a difficult concept to understand. Many of the terms and concepts are not intuitive and its' operations occur in an invisible realm. It is inherently easy to dismiss or disregard ideas and concepts that cannot be seen or easily comprehended. Second, it is difficult to prove it works (i.e., to prove a negative). For example, if an AEW platform is conducting Counter Remote Control Improvised Explosive Device (CRIED) operations for a convoy and no IEDs are detonated, is that because there was an AEW asset supporting the operation or because no attempt was made to target the convoy? There is usually no way to tell. Third, one cannot see the effects of EW. When a B-1B bomber deploys ordnance against an enemy airfield, the effects and battle damage assessment (BDA) are immediately visible. An EA-6B supporting that same B-1B penetrating an enemy IADS enroute to its' target by conducting EA against that IADS' radars produces no observable effects, or BDA, against those radar systems.

Finally, EW is non-lethal. Lethality invokes a heightened level of concern and awareness when considering employment of weapons and collateral damage. Lethality typically involves more thoughtful and detailed planning and results in more effective employment of kinetic systems. This is not the case when planning for the employment of non-kinetic EW and often results in EW planning that lacks fidelity to maximize the effects of EW operations. A lack of competent DoD joint organizational structure, advocacy and strategy perpetuates and contributes to this mindset. Lacking advocacy and being devalued, EW fails to earn resource investment in both present day and future operations.

The EW Mindset Effect on EW Employment

Problems regarding the non-kinetic targeting process

In addition to the manner in which the current EW mindset affects perceptions of AEW at the operational level, there is another common problem that renders the employment of AEW less effective. The current process to employ AEW is ineffective. It is the enduring problem of “we have always done it this way”, but the question is never asked why. If it is, the answer tends to be that AEW is a lower priority and the risk associated with under resourcing it is acceptable.

At both the tactical and operational levels, the non-kinetic targeting process is a significant problem. It will be illustrated later in more detail and through examples, but there are some generalizations related to non-kinetic target nomination and validation process that are worth mentioning here because they highlight the cognitive reasoning that fundamentally underpins the misapplication of AEW assets which in turn contributes to the current EW mindset.

Lethal vs. non-lethal targeting

Regardless of whether one is attacking a target kinetically or non-kinetically, the approach to targeting should be the same in terms of ensuring a valid and prioritized nomination process exists. This necessity provides the effects desired by the supported commander. More importantly, it ensures that limited resources are employed in a manner that maximizes their utility in accomplishing the JTFC or CDR's mission and that those resources are deployed to the highest priority GCCs and JTFs. That is not to say that there are not differences between kinetic and non-kinetic weapons employment. It is acknowledged that the effects of improperly employing kinetic ordnance make the headlines, whereas a non-kinetic misfire would not. However, dismissing the importance of a thorough target nomination process drives AEW requirements that result in unintended resource shortfalls. This is the first misstep in the process of creating perceptions of an approach to AEW employment.

Fratricide

Fratricide, a devastating problem in any theater, must be considered both for kinetic and non-kinetic targeting. Electronic Attack (EA) coordination can eliminate or minimize this avoidable problem. Consider the impact of Airborne Electronic Attack (AEA) jamming enemy communications that operate in the same frequency range that friendly Forward Air Controllers (FACs) or Joint Tactical Air Controllers (JTACs) are utilizing. Jamming in this frequency range could deny a FAC or JTAC access to the EMS and prevent the timely application of close air support coordination between the FAC and supporting aircraft. Moreover, disrupted communications between the FAC and supporting aircraft may lead to blue-on-blue fratricide. Proper coordination would ensure that the FAC or JTAC frequencies were deconflicted

before the operation began, thereby ensuring expeditious and continuous information flow. Another example is EA interference with Joint Stand Off Weapons and other weapon systems. EA may negatively affect munitions' accuracy by severing associated guidance links between weapons and aircraft. If guidance is affected and accuracy is reduced, bad things can result. With proper integration, the probability of electronic fratricide is significantly reduced.

The issues discussed above influence the tactical employment of EW and occur in all theaters. It is important to identify these issues as they play a significant role in shaping the conditions within which EW operates, as well as shaping perceptions regarding its' effectiveness and ultimately inform the mindset. As these perceptions develop, they compound the already complex and nuanced nature of EW, which is often difficult to understand. Misunderstanding EW and how to employ it leads to problems, such as under manning critical EW billets in the joint forces and further perpetuates employment inefficiencies and perpetuates the cycle. In the long term, this diminishes the importance of EW and makes investment in its' future difficult to justify in a fiscally constrained environment. Hence, the importance of recognizing the inaccuracy of the current EW mindset and investing in its' future will ensure a gap in EW capability will not continue grow.

Looking toward the future of EW

The Strategy Analytics Advanced Defense Systems service predicts that there will be a shift back towards reestablishing AEW systems with particular emphasis on combat in an Anti-Access/Area Denial environment.¹ Given the lack of legacy

¹ Anwar, Asif, "Conventional Airborne Electronic Warfare will be a Future Priority," Strategy Analytics, https://www.strategyanalytics.com/strategy-analytics/blogs/components/defense/defense/2014/03/27/conventional-airborne-electronic-warfare-will-be-a-future-priority#.VmXdo7xrX_Q (accessed December 4, 2015). . Anwar suggests that there is an increasing shift back towards conventional airborne electronic attack in order to operate in an Anti-Access/Area Denial environment and concludes that there will be an increase in worldwide airborne

systems and the short time remaining before they are retired, DoD will be forced to rely heavily on Boeing's 4th generation EA-18G, 5th generation fighter/attack aircraft employing stealth technology, the Next Generation Jammer, decoys and Unmanned Aerial Systems employing EW payloads. In an article titled "The Enduring Need for Airborne Electronic Attack", M. Thomas Davis, David Barno, and Nora Bensahel highlight the divergent contest between gradually developing stealth technology and rapid high-tech advances in surface-to-air missile systems.² Countries conducting A2/AD are defining future environments within which air campaigns may be fought. This highlights an enduring need to penetrate complex and sophisticated IADS as an enabler to conduct air campaigns in an A2/AD milieu. Whether or not the system of systems approach to replacing legacy AEW will be fielded in time to coincide with the sundown of legacy platforms is in doubt.

Investing in the future of EW; things to think about

As JEMSCC forges joint EW strategy and defines future requirements it must ensure it carefully invests in capabilities that will bear success. The cost and rate of developing current stealth aircraft against that of surface-to-air missile systems (SAMs), particularly modern "Double Digit" SAMs, does not favor stealth technology. Looking at the F-22 and F-35 5th generation aircraft as examples, Davis, Barno, and Bensahel note that these aircraft have been in development for roughly 20 years from concept to employment. The cost and difficulty in changing stealth

electronic attack investment to include Unmanned Aerial Systems carrying EW payloads. The term "worldwide" is significant because it will potentially challenge the U.S. and congest the EMS.
²Davis, Thomas, Barno David, Bensahel Nora, "The Enduring Need for Electronic Attack in Air Operations," *CNAS.org*, January 2014, under "The Enduring Need for Electronic Attack," http://www.cnas.org/sites/default/files/publications-pdf/CNAS_ElectronicWarfare_DavisBarnoBensahel.pdf (accessed 23 Nov. 2015). The authors argue here that given that 4th generation fighter attack aircraft will be conducting operations in Anti-Access/Area Denial for another 15 years that conventional airborne EW assets will be required to support them. They also see convention systems as cost effective options to augment 5th generation fighters.

technology during this process is enormous as compared to technology improvements made to SAMs. This results in stealth being less effective against the systems that they were designed to counter, and potentially obsolete before they become fully operational. Recalling Moore's law, regarding the rate at which computing power of modern processors (components of modern SAMs) doubles every 2 years and comparing that to the average life of a stealth aircraft, it is feasible that SAMs could improve 20-25 times over the operational lifespan of an F-22 or F-35.³ The F-18E/F and EA-18G are 4th generation non-stealth/higher RCS aircraft that will be in operation beyond 2030 and may be critical elements of near-term future air campaigns. 4th generation aircraft will operate with 5th generation aircraft and both will require AEW support to maximize their effectiveness against systems with more complex radars and increasing threat ranges. The low cost and rapid development of the EA-18G currently employing the ALQ-99 jamming system and evolving to Next Generation Jammer and unmanned systems provides a viable solution.⁴ While these are reasonable considerations and address concerns over an expected gap in AEA capabilities in the future, it is important to note that the EA-18G equipped with the Next Generation Jammer may be physically incapable of conducting effective AEA when SAMs become more capable and stand-off ranges push it far enough away to render alignment solutions impossible to achieve. While a seemingly a bit too

³ Templeton, Graham, "What is Moore's Law," *extremetech.com*, July 29, 2015, under "Moore's Law," <http://www.extremetech.com/extreme/210872-extremetech-explains-what-is-moores-law> (accessed December 28, 2015).

⁴ Davis, Thomas, Barno David, Bensahel Nora, "The Enduring Need for Electronic Attack in Air Operations," *CNAS.org*, January 2014, under "The Enduring Need for Electronic Attack," http://www.cnas.org/sites/default/files/publications-pdf/CNAS_ElectronicWarfare_DavisBarnoBensahel.pdf (accessed 23 Nov. 2015). The authors contend that the cost of stealth technology and other technologies that would be required to counter "Double Digit SAMs" in the future would be excessive and that the U.S. will still have to rely on 4th generation aircraft in future conflicts. Rather than the massive cost of modifying stealth technology and other expensive systems associated with the F-22 and JSF a cost effective option that improves the survivability of both 4th and 5th generation aircraft is NGJ and the EA-18G.

tactical, this highlights the forethought that must be applied now to prevent making investment mistakes that compromise our dominance over the EMS in the future.

CHAPTER 3 – DOD, WHERE THE SOLUTION STARTS

Problems within DoD

The DoD has ignored its lack of effective policy, organizational structure, and strategy for too long, and while it comments on the need for EW integration at the joint level, the mindset curtailing effective employment continues. A 2012 GAO Report found:

...DOD only partially addressed four other key characteristics of a strategy, including (1) resources, investments, and risk management and (2) organizational roles, responsibilities, and coordination. For example, the reports identified mechanisms that could foster coordination across the department and identified some investment areas, but did not fully identify implementing parties, delineate roles and responsibilities for managing electronic warfare across the department, or link resources and investments to key activities.¹

In fact, service level organizations appear to be the highest level where EW doctrine and strategy emerge. Unfortunately, it is service specific, not joint. According to the deputy secretary of Defense in March of 2015:

The [Defense Science Board (DSB)] programmatic and strategic level and should recreate the mechanisms needed to develop EW strategies, synchronize programs, and advise the Secretary and Deputy Secretary of Defense on EW matters. The DSB recommends, and I concur, that we establish an oversight committee to address these shortfalls, especially at the points where EW and cyber are converging.²

The Pentagon's establishment of a new Electronic Warfare Executive Committee created to refocus the services on EW matters relating to strategy and operational capability in March of 2015 is certainly a step in the right direction.

¹ United States Government Accountability Office, *Electronic Warfare, DOD Actions Needed to Strengthen Management and Oversight, Report to the Committee on Armed Services, House of Representatives*. GAO 12-479 (Washington, DC: Government Accountability Office, March 2012), Introduction.

² Deputy Secretary of Defense, *Establishment of an Electronic Warfare Executive Committee*, Memorandum for Secretaries of the Military Departments (Washington D.C: March 17, 2015), 2.

However, a fundamental overhaul of EW's importance in maintaining dominance within the EMS and through JEMSO must start with a change to the current EW mindset. Considering the observations in the GAO Report from 2012 and the time it took for DoD level action in 2015, as noted in Deputy Secretary of Defense's Memo of 2015, it could be argued that the current mindset undervaluing EW is to blame. As the DoD begins reshaping its perspective on EW and actually taking action to ensure there is no gap in the future of EW capacity to support the mission, it is important to understand that change will be slow. The impacts of a multi-decade lapse in interest will have lingering effects. In short, catching up on long overdue investment, developing a joint EW strategy, and improving EW organizational structure will not immediately alter the current EW mindset.

DoD EW organizational structure

U.S. Strategic Command (USSTRATCOM) is responsible for information operations, defense of the Global Information Grid (GIG) and network warfare. USSTRATCOM originally established three Joint Functional Component Commands (JFCC) to manage these missions and support the U.S. cyber warfare strategy. First, the Joint Task Force Global Network Operations was responsible for protecting the GIG and JFCC Network Warfare was responsible for offensive computer network operations. Next, the Joint Information Operations Warfare Center (JIOWC) is among many joint organizations that support CCMDs, JTFs, and the Services by integrating joint information operations into existing military plans, crisis and contingency response operations, as well as theater specific exercises.³

USSTRATCOM has also been designated as the advocate for joint electronic warfare and relies upon three subordinate organizations, the Joint Electromagnetic Spectrum

³ Elsworth, Adam T., *Electronic Warfare* (New York: Nova Science Publishers, Inc., Aug 2010), 21.

Control Center (JEMSCC), the Joint Electronic Warfare Center (JEWEC) and the Joint Electromagnetic Preparedness for Advanced Combat organization. USSTRATCOM also employs electronic warfare experts in its non-kinetic operations staff. The JEMSCC is the focal point of joint electronic warfare advocacy across DoD. Its responsibilities include advocacy for joint electronic warfare capability requirements, resources, strategy, doctrine, planning, training, and operational support. The JEWEC is the largest organization of the three. It provides EW planning and technical support to all combatant commands and other organizations such as the Department of Homeland Security. It also provides assistance to each of the military Services in developing Service specific EW capability and resource requirements. Its specialized EW experts develop and innovate existing and emerging EW capabilities and tactics, techniques and procedures (TTP) in support of tactical units utilizing laboratories and test ranges. As EW migrates from IO to JEMSO, it will be important to define the new roles of these organizations.⁴

Integrating EMSO and Cyber

The JCEMSO was released in mid-March 2015. In addition to having to ensure that organizational structure supports the improved implementation of EW into joint operations, those same organizations will have to redefine the relationship between JEMSO and cyber. Typically they have been divergent, but that must change. Cyberspace operations and EMSO must be integrated to ensure code and energy are both protected and attacked through supporting, combined, and integrated fires⁵. The Services are seeking to replace traditional AEW with a system of systems

⁴ U.S. Joint Chiefs of Staff, *Electronic Warfare*, Joint Publication 3-13.1 (Washington DC: Joint Chiefs of Staff, February 8, 2012), I-7 - I-8.

⁵ Bourque, LtCol. Jesse. "Electromagnetic Spectrum Operations: A Conceptual Approach." Power Point Brief, (Deputy Director JEWEC, May 9, 2014), slide 17. Bourque highlights the importance of integrating EW and cyberspace operations as opposed to the current relationship wherein they are mutually exclusive.

approach, which includes cyber EW. This provides even greater impetus for ensuring the integration of cyber operations and EMSO. Cyber EW will deliver digitally persistent executable code from EMS into information technology systems to accomplish, to an extent, what AEW has done for decades, attacking IADS.⁶

Understanding where the line exists and what is required to make this combination of capabilities a holistic joint approach to solving EW's problems and challenges in the future will be difficult but necessary. In June 2009 U.S. Cyber Command (USCYBERCOM) was established as a sub-unified command under USSTRATCOM at Fort Meade. Its mission statement is "USCYBERCOM plans, coordinates, integrates, synchronizes and conducts activities to: direct the operations and defense of specified Department of Defense information networks and; prepare to, and when directed, conduct full spectrum military cyberspace operations in order to enable actions in all domains, ensure US/Allied freedom of action in cyberspace and deny the same to our adversaries."⁷ While DoD refers to Cyberspace as a domain, this thesis considers the *Information Domain* a more suitable title. In the near future, the EMS Domain will likely be created as DoD is drafting the proposal to accomplish this now, in 2016. Beyond the digital code/data realm of cyberspace operations, there is a more comprehensive field of activity that depends on the EMS for global information and data transfer. Given that a fair portion of the cyberspace domain falls within the physical structure of the EMS, it only makes sense to consider the entire EMS, plus the digital realm, as the information domain. By focusing primarily on the cyberspace domain, DoD ignores the many other capabilities and operations that occur within the remaining portion of the EMS. If these remaining activities take a backseat to cyber

⁶Bourque, LtCol. Jesse. "Electromagnetic Spectrum Operations: A Conceptual Approach." Power Point Brief, (Deputy Director JEWG, May 9, 2014), slide 17.

⁷ USSTRATCOM, "Cyber Command Fact Sheet," U.S. Department of Defense, http://www.stratcom.mil/factsheets/2/Cyber_Command/ (accessed October 15, 2015).

operations, then the importance of EW is further diminished and the EW mindset persists. By failing to recognize the full expanse of the information domain, the entirety of the EMS, it becomes marginalized by planners and decision makers. In reality, the EMS offers operational maneuver space that must be controlled in much the same way as land, air, maritime, and space domains are.⁸ In fact, the Information domain spans all domains connecting them and enabling force projection around the globe through access to the information generated and shared within it. If this paradigm shift becomes universally accepted, it is possible that a DoD-wide effort to integrate EMS capabilities across all domains will generate the interest and advocacy to ensure IO, cyberspace operations, EMSO, and EW investments occur.

Changing the way the U.S. deals with challenges to EMS access

The U.S. has enjoyed considerable “elbow room” in terms of its’ ability to access and control the EMS. Thanks to rapidly increasing demand and resulting contest for limited space within the EMS, the United State’s ability to access and control the EMS has waned.⁹ In the past, the DoD could invest in technology to maintain its dominance, but with increasing ease of access and improving technology, complex systems are becoming more vulnerable. DoD has also been guilty of allowing new technology to write its EW doctrine, rather than developing new technology to support it. If technology continues to drive requirements, and by default, doctrine, the U.S will never have an effective joint EW strategy. JCEMSO provides a solid starting point for joint EW strategy and in conjunction with cyberspace operations, the opportunity to align joint EW investment for the future.

⁸ Bourque, LtCol. Jesse. “Electromagnetic Spectrum Operations: A Conceptual Approach.” Power Point Brief, (Deputy Director JEW, May 9, 2014). The concept of the EMS as maneuver space is presented in this brief and in the JCEMSO and provides a strong argument for considering the EMS as a domain. Currently, DoD considering creating the EMS domain.

⁹ Bourque, LtCol. Jesse, “The Spectrum in defense: From Commodity to Maneuver Space,” (paper presented to JEW, San Antonio, TX, August 12, 2014), 1.

Unfortunately, the vision and the reality of the future of EW may be headed in opposite directions. DoD wants to maintain EW capabilities that dominate an adversary's ability to control his own access to the EMS for the foreseeable future. A system of systems approach has emerged as a means to do so but, investment in future EW capabilities to make this a reality, struggle to keep pace with the retirement of legacy systems.

Service perspectives

Service perspectives drive their individual efforts in developing EW capabilities for the future. Further, their specific missions drive their individual requirements. However, it is arguable that a joint approach to developing capabilities to conduct JEMSO and control the EMS is more important than in any other domain given the degree to which all the services and functional components share the EMS. Moreover, institutional perspectives drive service solutions in controlling the EMS and often fail to address the problems other services are seeking to resolve. The result is a compilation of service specific solutions that do not address joint EMS challenges and problems. Comprehension of service perspectives begins with an understanding of how each service is employed.

To characterize the Service force providers, the Army deploys as a large, dense, 'stationary' enterprise with tens of thousands of EM transmit/receive apertures; the Navy during operations is medium-sized, spread, mobile, and federated with hundreds of apertures; the Marines in combat are relatively small, light, highly-mobile, and task-organized with thousands of apertures; the Air Force in the fight is essentially localized into remote formations, moving at hundreds of knots and engaged *away* from friendly force concentrations with tens (of thousands) of apertures...¹⁰

¹⁰ Bourque, LtCol. Jesse, "The Spectrum in defense: From Commodity to Maneuver Space," (paper presented to JEWIC, San Antonio, TX, August 12, 2014), 4. Bourque presents a compelling argument that highlights DoDs lack of oversight that results in each of the Services approaching EW from a mission specific perspective. One can't blame the Service Chiefs for filling voids that currently exist due to limited availability of EW resources.

When put into perspective, it becomes clear that each service's mode of employment drives diverse EMS capability development wherein needs which are optimized to their specific mission. Service requirements are misaligned with CCMDs and JTFs based on the joint manner in which CCMDs and JTFs employ. DoD must provide the guidance that ensures compatible and interoperable systems are developed to provide joint level EMS capabilities to joint forces. Providing structure and doctrinal guidance at the joint level would do well to synchronize EW efforts across the services and CCMDs, but those innovations must account for problems that exist in multiple areas, that if not recognized, will derail efforts to adapt EW now and in the future.¹¹

The Services are not working to align EW efforts in a manner that maximizes efficiency. As discussed above, each service is developing its own systems and tactics to meet its mission. This drives the cost of EW investment up, and given the effect that the EW mindset has on EW, investment makes it difficult to accept these higher than necessary costs at the expense of other programs. Lacking DoD EW strategy or organizational hierarchy, there is little impetus to find common ground and make EW more affordable. This Service-oriented approach, coupled with the current EW mindset and invalid force requirements, exacerbating EW shortfalls, ensures the near and mid-term gap in EW capability as well its long-term uncertainty. Further compounding the problem at the service level is the current budget shortfall. Lacking money, each service may be forced to make decisions to cut EW programs in order to keep higher priority programs on track with the hope that another service will maintain its' investment in EW. Again, it is interesting that DoD and the services are

¹¹ An important point is that in my opinion EW will always be a joint endeavor. As the JCEMSO highlights, the EMS links all domains and all military operations. The services ought to approach EW systems in the same manner in which they approached the Joint Strike Fighter.

willing to risk compromising access to the EMS and the potentially adverse effects on targeting, navigation, and command and control.

Now is the time for DoD to reorient itself and take the action it has failed to take for so long. Bourque observes:

...a review of our current National Military Strategy indicates that one of two unfortunate changes have befallen us: either our senior leadership understands the worsening dynamics and fleeting opportunities across the EMS Domain and chooses to *incorrectly* regard/dismiss them as a subset of the narrower cyberspace challenge, *or* our senior leadership somehow remains fundamentally ignorant of Spectrum dynamics themselves and their inevitable cascading impact, extending to *all* future warfighting capabilities.¹²

Perhaps, the manifestation of the current EW mindset is revealed in this assessment of DoD's leadership and their approach to the EMS and EW.

¹² Bourque, LtCol. Jesse, "The Spectrum in defense: From Commodity to Maneuver Space," (paper presented to JEWCC, San Antonio, TX, August 12, 2014), 20.

CHAPTER 4 – GCC/JTF: TURNING A BLIND EYE

While a lack of DoD-driven strategy and leadership bears much of the blame for failing to alter the current EW mindset, perceptions of EW's importance at the operational level is where the current EW mindset affects the employment of EW. For the discussion that follows, this thesis will reference the employment of AEW as its example. CCDRs and JTFCs are responsible for creating and manning their respective infrastructure to accomplish their missions. Organizational structure means little if it is not properly manned, and diminishes the ability of those organizations to provide critical capabilities. Hence, many of the problems with employing AEW at the operational and tactical levels are exacerbated by a lack of effective organizational structure.

Joint EW organizational structure

In execution at the joint operational level, the information operations division of the J-3 performs EW coordination. The J-3 normally functions as the EW staff director and is responsible for integrating all EW activity with other functional or service disciplines into the operation. At the outset of an operation, the CCDR or JFC's EW staff identifies staffing requirements for EW to facilitate the planning and execution of EW operations. Normally, the JTF EW staff consists of J-2, J-3, and J-6 representatives. The J-2 has responsibility for all source intelligence information used to define the EW threat and enemy order of battle. The J-6 serves as the network operations director ensuring that coordination between EW operations, information operations, and weapon systems which all utilize the EMS, are synchronized to mitigate interference. The Joint Targeting Coordination Board (JTCB) theoretically develops targeting priorities and non-kinetic targeting guidance. The JTCB does not

involve itself in EW fires mission planning but it does ensure that non-kinetic fires are synchronized with intelligence, operations, fires, and maneuver lines of effort through proper coordination. As will be discussed later, the JTCCB is not a functioning part of the EW fires target nomination and validation process. The IO officer should also be a member of the EW staff to ensure that EW operations are coordinated with information operations.¹

With a clear understanding of the JTF or CCMD mission, the EW staff may request that combatant commander or JTF commander establish an EW Coordination Cell (EWCC). Functional and component commands may be required to augment the EWCC to facilitate the integration of their EW requirements within the overall mission. Like all JTFs, the EW staff is task organized based upon the mission and its scope, and may differ from operation to operation and theater to theater. This will normally be the case when EW is expected to play a significant role in the JTF mission, much like it does in Afghanistan, Iraq, and may do in China, and North Korea. Accordingly, a component command EWCC will be designated as the joint EWCC responsible for planning operational level EW.

How EW cells integrate EW into joint operations

What follows is a partial list of duties that a EWCC is expected to conduct ISO EW operations. If the current EW mindset influences the CDR or the JTFC's decision to underman or dismantle the EWCC, the duties listed below are not accomplished and EW planning, integration, and employment becomes ineffective. EWCC duties are to:

- (a) Plan, coordinate, and assess offensive and defensive EA requirements.

¹ U.S. Joint Chiefs of Staff, *Electronic Warfare*, Joint Publication 3-13.1 (Washington DC: Joint Chiefs of Staff, February 8, 2012), II-1.

(b) Maintain current assessment of EW resources available to the JFC (to include number, type, and status of EW assets) and analyze what resources are necessary to accomplish the objective of the JFC.

(c) Prioritize EW targets based on JFC objectives, the EW plan, and available assets.

(d) Represent EW within the joint targeting coordination board.

(e) Plan, coordinate, integrate, and deconflict EW in current and future operations taking into consideration non-traditional capabilities (e.g., IO, space, special operations), within the operational area.

(f) Compile and coordinate EWS requests from all components according to the priorities set by the JFC.

(g) Coordinate through the chains of command to resolve any component or multinational EW requests that cannot be met at the JCEWS/EWC level.

(h) Monitor and adapt execution of EW plans in current operations and exercises.²

EW support is identified, requested, and validated in different manners within GCCs and JTFs. Many factors affect how EW requirements are identified and planned, not the least of which is whether the conflict is conventional or asymmetric. What follows is a general summary of how EW requests are generated and processed at the operational level.

Each request for EW support is processed, prioritized, and forwarded to the next HHQ in the chain of command. They are ranked based upon importance for each command in the chain. Once it reaches the JEWCC/EWCC, it is prioritized IAW

² U.S. Joint Chiefs of Staff, *Electronic Warfare*, Joint Publication 3-13.1 (Washington DC: Joint Chiefs of Staff, February 8, 2012). II-4 – II-6.

the Joint Force Air Component Commander (JFACC) or Combined Force Air Component Commander (CFACC) precedence. If the request is ordered at a high enough level, it is approved and the appropriate unit is tasked with providing support.

The demand for AEW

EW capabilities can be employed by a variety of airborne and ground based systems. Generally, airborne electronic warfare platforms are considered low density/high demand assets. Because the demand is so high and resources are limited, the distribution of those resources amongst GCCs requires a high degree of service and joint interdependence. DoD has identified persistent electronic warfare capability gaps, and these shortfalls have been consistently highlighted by the combatant commands as some of their highest warfighting priorities. According to a Center for Strategic and International Studies report, the U.S. Strategic Command identified 34 capability gaps affecting electronic warfare, including a lack of leadership , which was recognized as the most critical gap, across the department.³

The ability to conduct AEW operations varies amongst the services, but the requirement for integrated electronic warfare operations in support of each service and functional component is enduring. The demand for electronic warfare support goes beyond DoD and extends to national agencies such as the Central Intelligence Agency, the National Security Agency, and Defense Intelligence Agency. These agencies also provide support to the EW mission, as well as creating a need for civilian-military coordination and increasing the footprint of EW operations for the JTFC. To integrate service and agency EW requirements at the GCC or JTF level

³ United States Government Accountability Office, *Electronic Warfare, DOD Actions Needed to Strengthen Management and Oversight, Report to the Committee on Armed Services, House of Representative*, GAO 12-479 (Washington, DC: Government Accountability Office, March 2012), 2.

requires subject matter expertise from all services and agencies with an understanding of the collective capabilities of the joint force's EW assets. Failing to exercise EW structure that ensures EW is incorporated and integrated into operational plans as described above, results in the mismanagement of these low density/high demand assets. PACOM and CENTCOM present two distinctly different examples of how the current EW mindset results in ineffective tasking of AEW resources.

The following examples are based on the author's experiences as a planner and EW subject matter expert in the Korean Theater of Operations (KTO) from 2010 to 2012 and as a squadron Electronic Warfare Officer and squadron commander conducting AEW operations in support of operations in Iraq and Afghanistan from 2007-2010 and 2014.

The PACOM Example

The EWCC (-)

As of 2011, within PACOM, the JFACC at Osan Air Base Korea, supporting the Sub-Unified Commander, U.S. Forces Korea had an Electronic Warfare Coordination Cell as a component of the command organizational makeup. As described above, its purpose is to integrate AEW capabilities into operations in the Korean Theater of Operations (KTO). However, the organization was not manned and the EWCC did not function, though personnel were assigned to fill key billets and would populate them should a conflict on the Korean peninsula break out. By not manning the EWCC, the comprehensive integration of offensive and defensive AEW into KTO plans and operations was impossible to achieve.

The impacts of a non-operational EWCC

The impact of failing to man and operate a functional EWCC ultimately created inaccurate AEW force requirements and created effects which rippled across DoD in terms of global AEW resourcing. If the current EW mindset devalues EW, then it is easy to make the decision to apply EWCC personnel resources to another “higher priority” organization or cell. Thus, AEW is limited by a lack of effective integration, its ability to support mission accomplishment is hindered, and perceptions regarding its employment and effectiveness perpetuate the mindset. Without an EWCC, the functions are left undone.

Failing to plan, coordinate, and assess EA requirements, assess current EW resource availability, and analyze resources requirements means that the JFACC has an unclear understanding of what AEW force requirements are needed to execute existing OPLANS. There will be too little or too much, but in either case, the global demand for these scarce resources will be affected. Overestimating requirements means that a GCC elsewhere may have to conduct operations without the needed level of AEW support. Underestimating AEW requirements results in less than optimal AEW support until additional resources can be pulled from another theater. That erroneous estimate has a detrimental effect on the flow of forces into theater as well as the potential to create basing problems, since additional resources have not been accounted for in the original basing plan.

Lacking a plan to allocate AEW assets during plan execution

The process by which support is requested and prioritized based on AEW capability and JFACC priorities lacks fidelity in the KTO as of 2011. While this may have changed since then, the takeaway is that the JFACC had to make the decisions that resulted in a non-functioning EWCC; most likely referring to his understanding

of and the importance he placed on integrating EW operations. As a result, during multiple planning meetings, discussions revolved around how limited AEW assets would be allocated. EWCC representatives (in name only) were unable to outline a process by which AEW assets would be requested, coordinated, and assigned to support various strikes IAW JFACC mission priorities during the plan's execution. In other words, there was no way to determine how the JFACC would allocate AEW resources to support the mission. Again, if there is no plan to integrate AEW assets, the ability of the JFACC to accurately define AEW force requirements to support existing OPLANs is compromised. A review of KTO OPLANs would likely reveal the employment of AEW as an afterthought that lacks coordination and deconfliction.

PACOM; the end result in the KTO

When putting these issues in context it becomes clear that a complete lack of understanding of how to employ AEW assets can permeate planners and executors alike and is exacerbated by apathy towards defining requirements in terms of AEW assets needed to support a given plan. As will be consistently highlighted in this thesis, misunderstanding EW and undervaluing AEW and EW assets and capabilities creates the foundation for a lack of EW vision for the future. This dismissive mindset at all levels can and will make sacrificing the future of AEW, EW, and JEMSOs easy.

The CENTCOM Example

The same result, just a different problem

CENTCOM presents a very different problem set, but nonetheless one that still impacts global AEW force distribution. In the case of CENTCOM, the process and organizations exist, but the people and commitment to properly integrate AEW

into operations does not. It would be misleading to argue that CFACC CENTCOM undervalues EW and that he lacks a plan for its employment. However, it is accurate to say that failing to properly populate his EWCC and JEWCC (the JEWCC has since been eliminated) has produced inaccurate force requirements much like in the KTO.

Creating false perceptions about the true demand for AEW

The non-kinetic target nomination and validation process has created the impression of an AEW resource shortfall that generates an increased demand from CENTCOM. The general consensus seems to be that AEW resource shortfalls are the most prevalent reasons for inefficiency in the AEW engagement and that other than that, the process is functioning somewhat effectively. The demand is there for AEW support in CENTCOM's AO, but the number of aircraft available to meet the demand is insufficient. The reality is that this is far from the truth; the perceived demand for AEW in CENTCOM's AO does not exist to the extent that planners believe it does. Inefficiency and ignorance stemming from the current EW mindset influences the manner in which AEW operations are planned and executed.

The target nomination and validation process is broken

The non-kinetic target nomination and validation process has produced a demand signal in CENTCOM's AO that is based upon the complete and utter incompetence of a process designed to efficiently allocate limited resources. Battalion EWOs are poorly trained, have little to no understanding regarding the employment of AEW systems, and lack an understanding of how to employ current intelligence resources to assess existing local EMS threats. While supporting Counter Insurgency (COIN) operations, the battalion EWOs request specific threats to be targeted in order to support their unit's mission. These requests are where the process initially goes astray.

When a ground mission is assigned, supporting EWOs complete Electronic Attack Request Form (EARF) that identify the threats or IED initiators that the EWO considers a threat to the ground force. Each request is forwarded to the next higher headquarters and prioritized against other requests until it arrives at the EWCC or the JEWCC. The EWCC/JEWCC is responsible for validating and prioritizing each request to ensure that the highest priority missions are resourced and an AEW unit is formally tasked via the Air Tasking Order (ATO). EWO training promulgates a mindset of complacency, wherein the EWOs arrive in theater with little to no understanding of the task at hand. EWO training teaches them what EW is, what capabilities exist at their disposal, and how to request them. Unfortunately, EWOs do not learn to assess local threats, nor do they learn how to employ AEW assets. What is most concerning is that the employment of AEW assets is no longer determined by the specialists employing these systems, instead they are employed by the EWOs who are not trained to employ them. Many pervert the process to increase the probability of their mission to be supported. Some EWOs have knowingly filled out requests with false mission information to trigger higher priority levels and improve the probability of getting their mission AEW support. Many prefer to cut and paste previous requests, without assessing the current and actual local EMS threat. While this may seem outlandish, several have admitted to doing this when mission planners contacted them for mission specifics. In other cases, the precise support requested was inconsistent with the CONOPS and rendered AEW support ineffective. This should not be surprising given their lack of knowledge in the subtly nuanced planning of AEW operational employment. Again, the EW mindset is at play, as this would not occur if these same units were requesting kinetic fires support. The supported unit

would not be dictating the ordnance that an F/A-18 would employ in support of their mission.

While not all requests for AEW support are plagued by these problems, many are. Because of this, it becomes even more critical to have a thorough and proper validation process at the operational level. Emphasis must be placed on the generation of both the Joint Tactical Air Strike Request (JTASR) and the EARF and the process by which they are routed through tactical unit level chains of command up to the Combined Air Operations Center (CAOC) and ultimately, to the EWCC for tasking to AEW platforms. The lack of staffing and unfamiliarity of the process results from the CFACCs decision to minimally man the EWCC and JEWCC. This results in no validation being performed from the original submission of the JTASR/EARF and missions tasked that do not require scarce AEW support. It is evident that the process generates a demand signal that is not consistent with actual requirements.

The impacts of a broken target nomination and validation process

The result of the flawed non-kinetic target nomination and validation process is that 57.53% of the requested non-kinetic targets did not exist in the target area or had not been observed for some time. This would be analogous to requesting a kinetic strike on a weapons cache that was no longer there. In many cases the requested targets had never been observed in the target area. The data was based on information from squadron mission planners, intelligence officers, signals intelligence section, and Electronic Warfare Officers collected and assessed. The squadron's data was then vetted through all U.S. AEW units in CENTCOM's AOR and gained universal concurrence. The data collected was presented to the Combat Plans Chief and the CAOC Director, but failed to transform the manner in which the non-kinetic targeting

process was carried out. The reason provided for not properly vetting non-kinetic targets was the JEWCC lacked the manpower to do so.

If over one half of AEW tasking, in support of COIN operations, assigns scarce resources to attack targets that do not exist in the operating area, force requirements cannot be accurately determined. When an AEW platform is tasked to support a mission attacking non-kinetic targets that do not exist, a false demand signal is created. This false demand, if prioritized high enough, may prevent a lower priority yet valid mission from being supported.

An example of invalid force requirements affecting AEW allocation

A Request for Forces modification was published in 2007 that increased the force requirement for AEW platforms in Iraq. The details of this RFF are classified and thus, will be omitted. The metrics that the EWCC used to determine that a gap existed between the number of EARFs submitted and the number supported, was based on similar data, as described above. The metrics and resulting perceived resource shortfall also demonstrated a lack of understanding of EW employment, the mindset problem, in that it did not account for a single AEW platform's ability to support multiple missions. It was also plagued by other false or inaccurate assumptions. Regardless, AEW assets were diverted from PACOM to support CENTCOM operations, based on inaccurate force requirement data.

The importance of discussing real problems in both PACOM and CENTCOMs AORs, in this chapter, is that regardless of the manner in which invalid AEW force requirements manifest themselves, it can be argued that they originate from an EW mindset that drives commanders to accept risk by under manning their EW organizational structure. As a result, the lack of proper integration or the lack of efficient employment becomes "the way we've always done it."

CONCLUSION

The commander must be able to fight, assess, decide, and adapt faster than his/her adversary. A critical requirement facilitating this is unimpeded access to the EMS and the information exchanged within it. A critical capability is the application of EW intended to deny the enemy access to information, thereby reducing his situational awareness, the speed at which he completes the decision making cycle, and his ability to respond to changes on the battlefield. In the future, these battles will play out amidst a complex electromagnetic spectrum likely identified as another domain. To be successful, and for the U.S. to fully develop the EW capabilities required to contribute to EMS control, a change in the current EW mindset must occur. The first step in changing the current EW mindset so that it better supports joint operations is to recognize that the EMS is maneuver space that is far more important now than it has ever been. A paradigm shift within DoD must be universally understood and accepted:

The EMS is not only a critical enabler for all joint functions, but also fosters cross-domain synergy by connecting operations within and across the land, maritime, air, space, and cyberspace domains. Achieving EMS superiority is becoming an essential precondition for successful joint military operations. JCEMSO elevates the view of Electronic Warfare (EW)/EMS management from a supporting activity to one that recognizes EMSO as an overarching operational function that enables the commander to integrate, synchronize, and direct joint operations¹

Next, DoD must recognize that strategy and doctrine drive technology requirements and not the other way around. There must be a comprehensive vision for EW that drives EW technology development and considers access requirements, risk, and threats, both now and for the future.

¹ U.S. Joint Chiefs of Staff, *Joint Concept for Electromagnetic Spectrum Operations (JCEMSO)*, (Washington DC: Joint Chiefs of Staff, March 18, 2015), vii.

At the functional or component level of the JTF or CCMD, the process by which EW operations are planned and incorporated into current operations must be improved. This starts with changing the mindset regarding EW at each level. The vital role it plays can no longer be dismissed. A failure to accurately plan for the employment of EW resources results in ambiguous force requirements. When force requirements become “best guesses”, resulting shortfalls in assets and capabilities across DoD make prioritized distribution of those resources impossible. CCMDs that have a legitimate capability requirement may have to gap that requirement because other CCMDs have overestimated their force requirement due to poor planning. To overcome this, the future of EW employment must also restructure the organizations that task EW resources assigned to that CCMD.

When commanders and supporting staff understand the importance of incorporating and synchronizing EW operations, with other operations, a critical change in the EW mindset will occur. It becomes difficult to dismiss EW as an ad hoc capability that can be accounted for as an afterthought. Recognizing the importance of controlling both friendly and adversary access to the EMS makes the commander and his staff acutely aware of the effect EW has on operational success. Most importantly, the probability of operational success decreases when the commander elects to accept risk to EW operations by diverting personnel and fiscal resources to other efforts and organizations. Commanders and staffs recognize that the rigors of properly integrating and validating EW’s employment are critical requirements of joint and combined operations. While it has been easy to defer EW’s future investment based on the collective result of years of ignorance and irrelevance, the CCCR and JTFC now have a keen interest in countering emerging enemy

capabilities and technologies and meeting the demands identified in the commander's vision of future operations.

Another key step in overcoming the current EW mindset, is the need for a combination of clear DoD-driven doctrine that encourages service interoperability and commonality and that would maximize operational effectiveness, not just in the application of joint EW, but also in the employment of all capabilities from IO to cyber to JEMSOs. Alex T. Elsworth explains in his book *Electronic Warfare* that "... the ability to maximize the capabilities of a joint force requires guidelines and an organizational framework that can be used to integrate them effectively."²

While the JCEMSOs is the right direction and a good start to chart a course for the future of joint EW, there are still significant impediments to effectively and efficiently incorporating EW into joint operations; the current EW mindset being foremost. Joint EW is not the end all be all and certainly not the most important consideration across the spectrum of U.S. military operations. Its importance ebbs and flows based on the type of operation and the technological capability of the adversary. The same can be said regarding the importance of all capabilities and lines of effort in support of mission accomplishment. Unfortunately, for too long, its integration into joint operations has suffered from a mindset that devalues it.

The future of EW is uncertain, but the end state is not; the U.S. must control the EMS. Unlike Air Superiority, there is no deterring an adversary from operating in the EMS. The U.S. must instead possess the capability to control it and control all adversaries operations within it. For that, EW is vital, which is what the new EW mindset should be.

² Elsworth, Adam T., *Electronic Warfare* (New York: Nova Science Publishers, Inc., Aug 2010), 108.

RECOMMENDATIONS

The fact that the current mindset regarding electronic warfare must change is clearly indisputable. The recommendations made below are intended to help bring about that change. However, all is predicated on the U.S. military grasping the importance of the EMS, which cannot be overstated. “All joint functions – movement and maneuver, fires, command and control, intelligence, protection and sustainment rely on capabilities that use the spectrum...DoD must act now to ensure access to the congested and contested electromagnetic environment of the future.”¹ Given that the Department of Defense is likely to designate the EMS as a domain, it appears as if this is a forgone conclusion and will play a significant role in helping to alter the mindset regarding EW.

Two recommendations for improved strategic level engagement follow. DoD must ensure that the organizational structure is capable of executing the Joint Concept for Electromagnetic Spectrum Operations.

The first recommendation is to invigorate joint advocacy for EW that leverages the importance of EW in achieving operational success. The goal should be for planners and CCDRs/JTFs to view EW in the same manner in which air superiority is viewed. Within the U.S. military, from top to bottom, air superiority is considered both inevitable and essential. Regardless of service or rank, U.S. military personnel recognize air superiority as an enabler for all military operations. Consequently, superiority in the EMS, and by default, EW’s role in achieving it must be viewed in the same manner. To accomplish this, DoD must have an EW advocate; the Joint Electromagnetic Spectrum Control Center (JESCC). The JESCC should

¹ U.S. Department of Defense, *Electromagnetic Spectrum Strategy (2013) A Call to Action*, (Washington DC: Department of Defense, September 11, 2013), page not numbered.

continue to serve as a focal point of joint electronic warfare advocacy across DoD, but its efforts must be overtly supported by and enthusiastically endorsed by the Under Secretary of Defense for Policy USD(P), who is responsible for providing DoD with overall EW policy development, implementation, and oversight in mission areas under the cognizance of the USD(P), including international activities, homeland defense, stability operations, cyberspace, special operations, and low-intensity conflict missions.² USD(P) must provide clearly defined objectives for the JESCC, outline milestones for the major tasks to be conducted during implementation of the policy, and define the manner in which progress shall be assessed. These actions will predicate and invigorate efforts at the joint level to more effectively integrate EW into organizational structure, plans, and operations. DoD level oversight, driving clearly defined implementation and integration milestones managed through USSTRATCOM and JESC would demonstrate a commitment to fighting and maneuvering in the Information Domain and make the Services accountable for compliance.

The second recommendation is that the above referenced EW policy be the foundation for DoD EW strategy in support of JEMSO. Included in the DoD EW strategy should be the purpose and scope of joint EW operations and a clear assessment of the threat to be countered by EW with the capacity to expand that threat assessment as technology improves. Additionally, it should include a thorough risk assessment that highlights the dangers to the United States if access to the EMS is lost, to identify current shortfalls and gaps. Further, the assessment should define resource investment strategies to address identified threats, risks and shortfalls.

² U.S. Department of Defense, *DoD Directive 3222.04: Electronic Warfare (EW) Policy*, Reissue DoDD 322, (Washington DC: Department of Defense, March 26, 2014), 7.

At the operational level, four recommendations are made to leverage EW capabilities more effectively. First, and specific to CENTCOM, but applicable to EW in support of COIN or Phase 4 operations, is an overhaul of the AEW request process. Eliminate the Electronic Attack Request Form. Reevaluate AEW priorities and adjust the AEW prioritization support matrix to rank missions based on highest threat areas and operations/mission/CONOPS that expose U.S. forces to the highest risk of IED threats. Other factors should be considered as well such as civilian density and self-protect capability. This would allow units assigned to support the highest priority missions the opportunity to conduct threat assessments and develop supporting plans that best meet the commander's expectation for desired effects. Also, this will allow AEW assets to maximize support to multiple missions by synchronizing their plans.

Second, ensure that at a minimum the EWCC or other EW coordination cell is manned to perform all duties that enable the integration of EW capabilities into JTF operations. The EWCC must be capable of conducting 24-hour operations and must have the expertise to assess EW operations and evaluate force requirements accurately. CCMD EWCCs should be capable of evaluating existing plans and leveraging specific platforms or system expertise to improve the employment of EW resources in support of those plans. They must also ensure that force flow and basing solutions support OPLAN and CONPLAN execution. The EWCC should also have the manpower capacity to enable liaison between the J-2, ISR/D, IO cell, cyber cell, and other organizations to ensure that EW operations are synchronized with other lines of effort and that fratricide is minimized.

The third recommendation is to add a non-kinetic Joint Targeting Board to periodically review JFACC or CFACC EW fires priorities, review trends in EMS threats, assess and validate requests for non-kinetic fires, and provide feedback to the

EWCC. The Targeting Board should receive periodic updates from supporting units and from the J-2 in order to re-evaluate EW fires prioritization.

The fourth recommendation is perhaps the most important in altering the current EW mindset, because it involves building habits that correct the current, faulty approach to incorporating EW into plans, operations, and exercises. The greatest challenge is to make EW a tangible, discernable capability that the joint force instinctively recognizes as vital to operational success. This change will not occur easily, nor will it occur rapidly, even with DoD level advocacy. In the end, the operator at the tactical level must drive the demand that the operational level satiates. To facilitate this change the U.S. military must train as it will fight. It is in the execution of exercises or through other training venues that the requirement to plan for, conduct, and fight against EW operations must reside. The train as you fight mindset will determine how U.S. forces approach both the planning and execution of EW operations and there must be an evaluation process that holds them accountable and determines whether the unit or force is combat ready. This will ensure that planning and the resulting execution incorporates EW in a manner that maximizes its effectiveness and accurately defines resource requirements. Finally, JTFs must be exposed to the effects of EW operations. They must be forced to work in an environment where access to the EMS and the information contained within it are denied, where early warning, targeting, communications, data, navigation, information gathering and dissemination, and command and control (C2) are lost or partially denied. This experience instills the need for a capability or condition much like the U.S. experience in Normandy when commanders observed the value of air interdiction and the need for air superiority to conduct successful operations. Those experiences and lessons have endured for generations and still drive the U.S.

military's approach to all types of warfare as well as its' investment in future capabilities. Only by experiencing the effects of EW can operators truly appreciate its' value and begin to alter the current mindset regarding EW.

There are many more opportunities to change the current mindset and improve the employment of EW operations. The opportunities presented here would significantly synergize the strategic and operational perspectives regarding electronic warfare.

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VITA

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