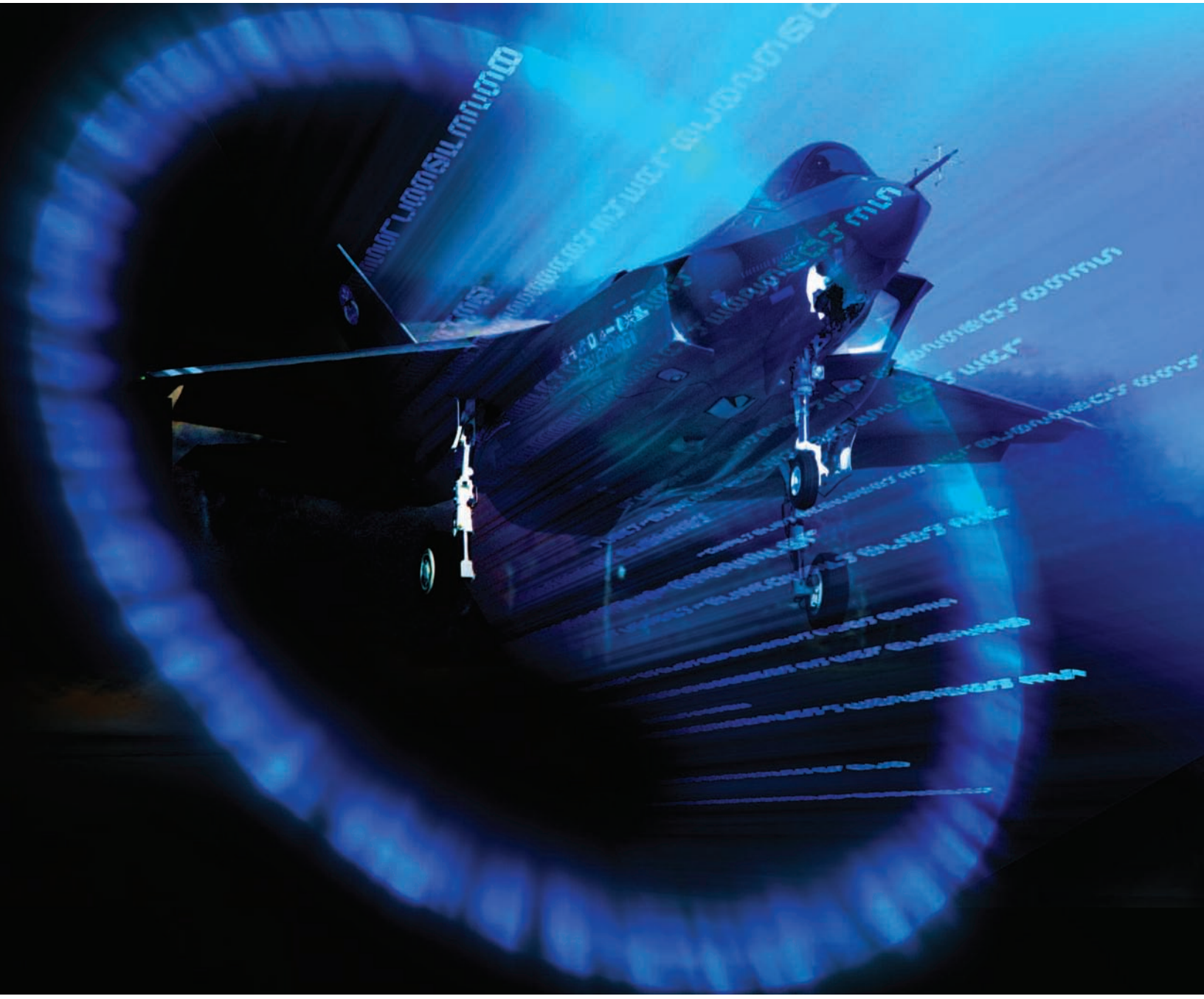
# ELECTRONIC WARFARE

## The Changing Face of Combat



AOC

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# WHY ELECTRONIC WARFARE MATTERS

Throughout the Cold War, the United States was generally thought to be at least a generation ahead of any other country in developing the equipment and skills necessary for EW. Today, however, that edge has eroded due primarily to the proliferation of new information technologies such as cell phones and the internet, the diffusion of knowledge about how such technologies can be exploited or impeded, and the neglect of relevant expertise within the joint force. Although the military competition for mastery of the spectrum usually plays out behind a veil of secrecy, news of major successes or failures sometimes reaches the public. For example, the successful Israeli attack on a nuclear weapons site in Syria last year appears to have been made possible by skillful deception of Syrian air defenses. Additionally, China is aggressively pursuing a strategy focused on attacking and denying an adversary's use of networks, electronics, and information systems while protecting their own systems. In a real world scenario, if successfully implemented, this capability could prevent an adversary from executing a mission in the first days of conflict. In the near future, if the U.S. technological edge continues to erode, U.S. forces may not be able to employ their sensors, or use their computers and communication links effectively in combat, exposing the vulnerability of heavy emphasis on such systems in current military doctrine. Adversaries have proven they can use electronic technologies to elude destruction by U.S. forces while delivering potent blows against America and its allies.

**U.S. MILITARY FORCES CANNOT EXPECT TO CONTROL THE ELECTROMAGNETIC SPECTRUM UNLESS THEY MASTER ALL ASPECTS OF ELECTRONIC WARFARE, PROPERLY TRAIN A SKILLED BODY OF EW OPERATORS, INVEST IN FUTURE TECHNOLOGIES, AND LEARN TO EFFECTIVELY APPLY THESE TECHNOLOGIES IN COMBAT.**

Electronic Warfare (EW) is the struggle for control of the electromagnetic spectrum — to assure that friendly forces can use the spectrum to their full potential in wartime, while denying that use to enemies. U.S. military success depends on unfettered access to the spectrum to enable electronic equipment such as radars, communication links, computer networks, and sensors to work. The purpose of this report is to discuss the challenges and opportunities facing electronic warfare today and recommend steps to secure a durable and viable electronic warfare capability for the future.

The value of electronic warfare can be seen most clearly in current operations in Iraq and Afghanistan. In Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), insurgents initially inflicted the vast majority of U.S. casualties by employing Radio-Controlled Improvised Explosive Devices (RCIEDs) — a specific type of IED with electronic triggering mechanisms such as cell phones, garage door openers or car key fobs. In April 2006, U.S. forces began successfully applying electronic warfare to disable such devices and within six months through today, RCIED attacks and casualties have dropped significantly. These successes continue today and have allowed U.S. forces to better control the portion of the spectrum that RCIEDs utilize, saving hundreds of lives.

Additionally, peer competitors to the U.S. are focusing on electronic warfare as an essential element of their military operations by directly challenging U.S. forces' access to the electromagnetic spectrum.

U.S. military forces cannot expect to control the electromagnetic spectrum unless they master all aspects of electronic warfare, properly train a skilled body of EW operators, invest in future technologies, and learn to effectively apply these technologies in combat.

# UNDERSTANDING THE EW BATTLESPACE: THE ELECTROMAGNETIC SPECTRUM

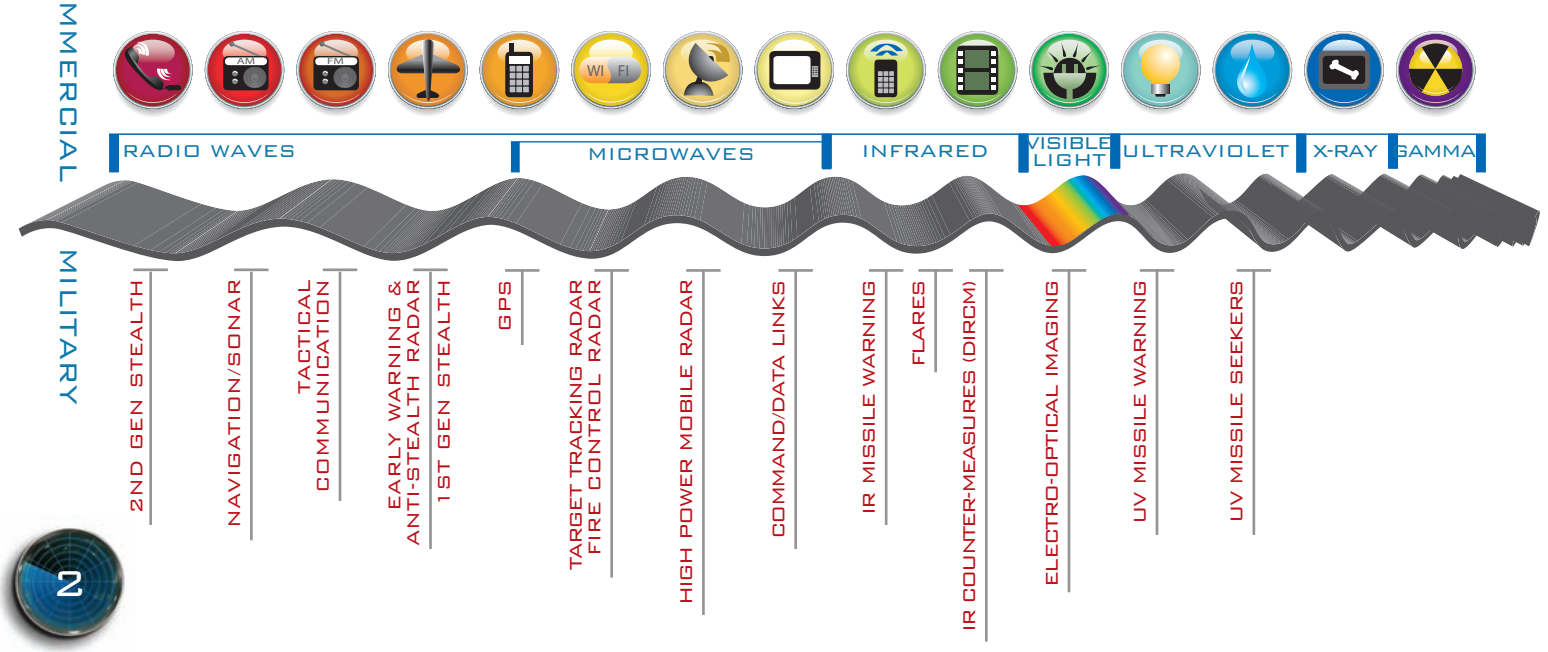
The basic principles of the electromagnetic spectrum are fairly simple. Scientists have identified four fundamental forces that define the universe. Three of them — the strong force that binds atoms, the weak force that decays atoms, and gravity — are not readily manipulated by humans. The fourth, electromagnetism, is the one fundamental force that humans have found relatively easy to channel, store, modify and apply for various purposes.

**THE REALITY TODAY IS THAT THE SPECTRUM IS A VERY BUSY PLACE IN WARTIME AND AN ADVERSARY WILL MIGRATE TO WHICHEVER SEGMENT OF THE SPECTRUM THE U.S. IS NOT CONTROLLING AND EXPLOIT THAT VULNERABILITY TO THEIR ADVANTAGE.**

Scientists generally divide the spectrum up into seven segments (see Fig 1). Radio waves are in the lowest-frequency, longest-wavelength segments of the spectrum. Other, higher frequencies can transmit more information in a given space of time, but they degrade quickly in the atmosphere and therefore require a dedicated conduit, such as an optical cable, to maintain their integrity. The radio-frequency segment of the spectrum has traditionally been the principal battleground within which electronic warfare is waged. However, many of today's advanced military systems are utilizing other segments of the spectrum. This trend requires the U.S. to wage electronic warfare across multiple segments at the same time.

There are three basic forms of EW: (1) Electronic Attack (EA), the offensive use of electromagnetic energy to deny, degrade or disrupt enemy capabilities; (2) Electronic Protection (EP), the defensive measures taken to guard equipment against such attacks; and (3) Electronic Support (ES), the detection, localization and identification of hostile emitters to understand an adversary's use of the spectrum. The reality today is that the spectrum is a very busy place in wartime, and an adversary will migrate to whichever segment the U.S. is not controlling and exploit that vulnerability to their advantage. More sophisticated enemy systems will hop in frequency, utilize multiple segments of the spectrum, or subtly manipulate signals so that the U.S. is deceived as to the location and character of the source. This creates a cat-and-mouse game that requires constant vigilance from the first to last day of any conflict.

FIGURE 1. ELECTROMAGNETIC SPECTRUM AND USES



# CHALLENGES AND OPPORTUNITIES FOR JOINT ELECTRONIC WARFARE


There's an old adage that electronic warfare is a friend in wartime and a victim in peacetime. It doesn't take much imagination to see why mastery of the electromagnetic spectrum is important in an era often referred to as the Information Age. Every technology used in modern commerce and combat — from computer chips to wireless networks to digital radars — depends on components operating in specific regions of the spectrum.

Control of the spectrum is a strategic capability that confers great power and will be necessary for every conflict in the foreseeable future. There has not been a single conflict since the Vietnam War that has done more to change the face of EW in such a short period of time as OIF and OEF. We are in a rare period when U.S. leadership is beginning to understand the value of EW, and investment in EW technologies is on the rise. This value can be clearly seen in U.S. Central Command where a small cadre of EW specialists – the Combined Theater EW Coordination Cell (CTEWCC) – is responsible for ensuring U.S. and coalition access to the spectrum and preventing friendly interference. The CTEWCC works closely with EW coordination cells in Iraq and Afghanistan to plan and execute EW operations in the region. This mission is immense and complex, but it continues to save many lives.

The successful application of EW today once again underscores the requirement for this capability. To secure the future of EW, there are several broad challenges that need to be addressed. First, the U.S. needs to strengthen its investment infrastructure – the network of investment strategy, process, funding, and oversight – and stabilize science and technology (S&T) funding to meet the future demands of keeping pace with increasingly sophisticated and unpredictable threats. EW is not alone in the rise and fall of available resources during times of conflict and relative peace. But historically, its peaks and valleys are more dramatic. This trend is antithetical to the nature of EW. The cat-and-mouse game never ends; it is constant, even when there is no major conflict. Therefore, U.S. EW investment strategy, and the resources dedicated to research and experimentation, must be constant too.

To meet this challenge and avoid an investment "valley," U.S. military research labs must be provided freedom and resources to look beyond current operations and programs of record for new EW solutions and applications against emerging threats. There never will be an EW technology that is a "silver bullet." EW investment must be flexible, and coordination between the service research labs must be strengthened. Furthermore, an effective investment strategy recognizes that each service brings a unique perspective to solving a challenge, and therefore, parallel investment among the research laboratories can provide new solutions without duplication. Finally, adversaries are learning new ways to apply commercial technology to advance their military capability. This creates additional pressure to develop and quickly field new technologies in response. For this reason, it is critical to empower service research labs to effectively guide new technologies through critical points in the development process.

The second challenge is that EW leadership in the Pentagon must be consolidated. Unfortunately, there are serious gaps in coordination of joint EW among the services and fragmentation in guidance from leadership in the Pentagon. There are several offices within the Office of the Secretary of Defense (OSD) and organizations under OSD authority that have some responsibility for EW, but there is no single office – no single point of contact – to directly influence acquisition, guide investment, and help ensure the services are funding critical EW technologies and capabilities. The health of U.S. EW is left largely to each service, which can create an imbalance in capability and skill that leaves U.S. forces vulnerable when they truly have to fight together in combat.

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Finally, the pool of experienced EW practitioners is shrinking. Each service faces unique challenges to sustain its EW community for the future. It is ironic that EW is more valuable today than in previous eras, but there are fewer EW experts in the field. There is not sufficient joint training today to ensure warfighters, all of whom rely on controlling the spectrum, have a fundamental understanding of EW combat. The following is a closer look at how each service is addressing the challenges and opportunities for the future of EW.

# ARMY EW FACES A RELENTLESS FOE

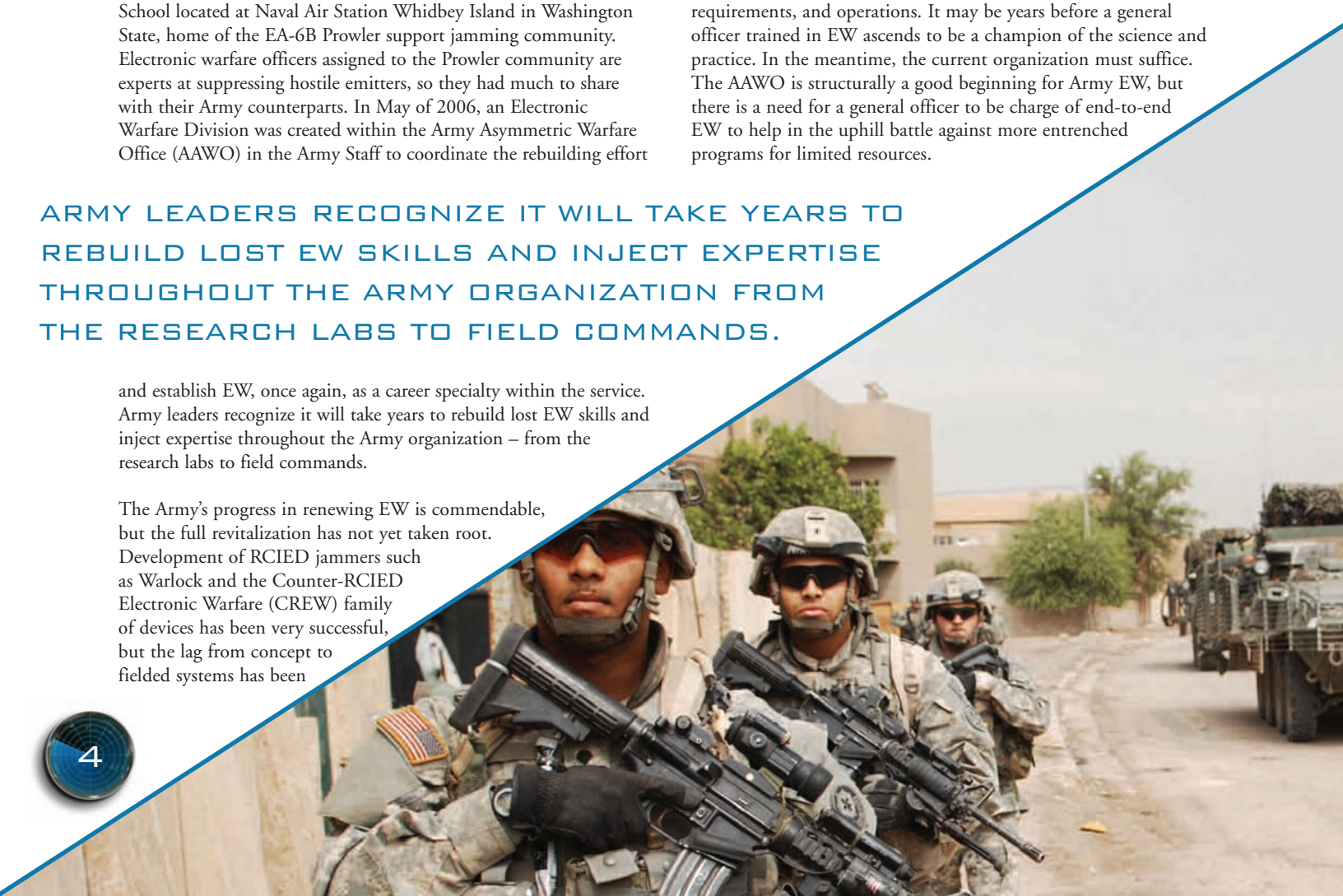
In the five years since it began fighting in Iraq, the U.S. Army has learned all too well the consequences of neglecting electronic warfare skills. During the Vietnam War, the service correctly viewed electronic warfare as a vital force protection measure and enabler of tactical operations. But once the service departed Indochina, its EW capabilities gradually atrophied. As a result, it was unprepared for the hit-and-run tactics of insurgents in Iraq, who relied heavily on handheld electronic devices for communications and triggering weapons.

When the Army first encountered insurgent RCIEDs, field commanders quickly grasped that electronic warfare might be the most effective way of countering such devices. By 2005, the service decided that a systematic effort was required to rebuild its neglected EW skills, not just because of Iraq but also because future adversaries were likely to copy successful insurgent tactics. The first step in revitalizing Army EW was to send soldiers to the electronic warfare centers of other services for training. In January of 2006, soldiers bound for Iraq and Afghanistan began receiving instruction in signal detection and jamming techniques at the Electronic Attack Weapons School located at Naval Air Station Whidbey Island in Washington State, home of the EA-6B Prowler support jamming community. Electronic warfare officers assigned to the Prowler community are experts at suppressing hostile emitters, so they had much to share with their Army counterparts. In May of 2006, an Electronic Warfare Division was created within the Army Asymmetric Warfare Office (AAWO) in the Army Staff to coordinate the rebuilding effort and establish EW, once again, as a career specialty within the service. Army leaders recognize it will take years to rebuild lost EW skills and inject expertise throughout the Army organization – from the research labs to field commands.

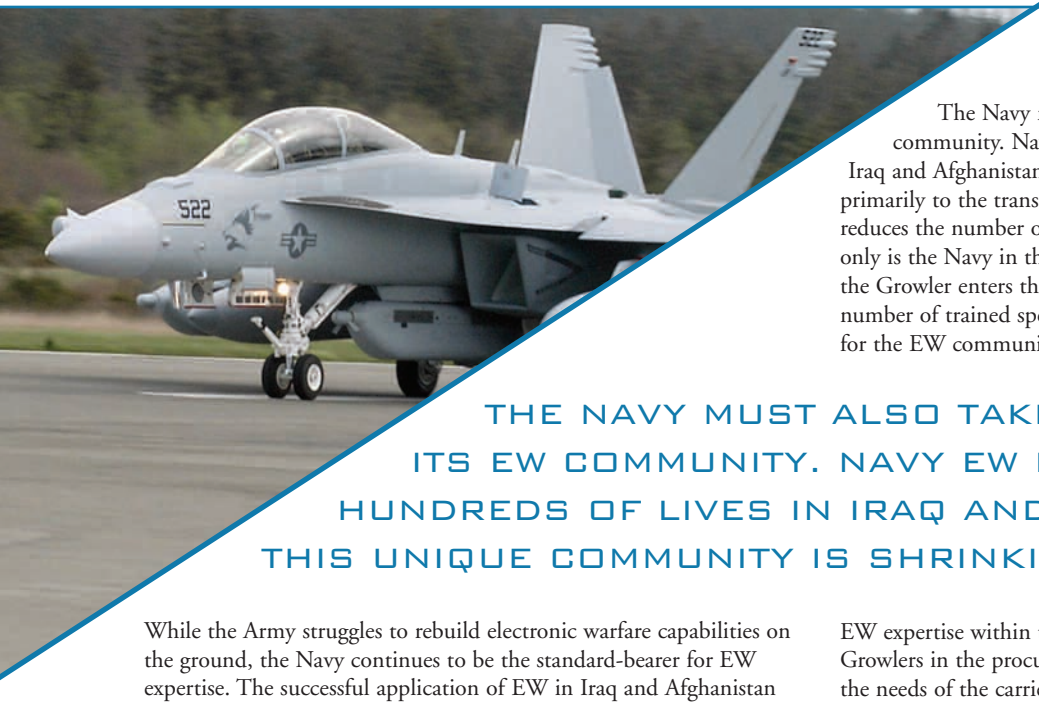
The Army's progress in renewing EW is commendable, but the full revitalization has not yet taken root. Development of RCIED jammers such as Warlock and the Counter-RCIED Electronic Warfare (CREW) family of devices has been very successful, but the lag from concept to fielded systems has been too long. And, all too often, systems were fielded without comprehensive testing in a realistic environment. Iraq insurgents quickly adapt commercial electronics to continually create new devices and weapons to attack U.S. forces, but it can take many months to introduce a new countermeasure system in response, not including the training time to effectively use the system. Prior to the conflicts in Iraq and Afghanistan, EW technology was simply not a prominent part of the Army's investment strategy. But the challenges of urban warfare – operating in dense electronic environments where it is difficult to differentiate between civilian and enemy use of the spectrum – are forcing the Army to rethink what critical technologies it needs to invest in and deliver quickly to the field. The service is now exploring ways of accelerating the development of new equipment to stay ahead of insurgents, while leveraging emerging technologies such as smart antennas and software-defined radios that can re-establish a tactical edge in ground EW.

The viability of Army EW relies on current leadership in the Army Staff to "reinstitutionalize" EW into Army doctrine, training, requirements, and operations. It may be years before a general officer trained in EW ascends to be a champion of the science and practice. In the meantime, the current organization must suffice. The AAWO is structurally a good beginning for Army EW, but there is a need for a general officer to be charge of end-to-end EW to help in the uphill battle against more entrenched programs for limited resources.

ARMY LEADERS RECOGNIZE IT WILL TAKE YEARS TO REBUILD LOST EW SKILLS AND INJECT EXPERTISE THROUGHOUT THE ARMY ORGANIZATION FROM THE RESEARCH LABS TO FIELD COMMANDS.



# NAVY MUST MAINTAIN ITS EW COMMUNITY




The Navy must also take steps to maintain its EW community. Navy EW expertise has saved hundreds of lives in Iraq and Afghanistan. But this unique community is shrinking due primarily to the transition from the Prowler to the Growler, which reduces the number of EWOs in each aircraft from three to one. Not only is the Navy in the process of reassigning the surplus of EWOs as the Growler enters the fleet, but the service must also reduce the number of trained specialists in the pipeline. This will make it harder for the EW community to stay together and will limit the sharing of

THE NAVY MUST ALSO TAKE STEPS TO MAINTAIN ITS EW COMMUNITY. NAVY EW EXPERTISE HAS SAVED HUNDREDS OF LIVES IN IRAQ AND AFGHANISTAN. BUT THIS UNIQUE COMMUNITY IS SHRINKING...

While the Army struggles to rebuild electronic warfare capabilities on the ground, the Navy continues to be the standard-bearer for EW expertise. The successful application of EW in Iraq and Afghanistan is due primarily to Navy electronic warfare officers (EWOs) adapting their traditional stand-off jamming mission to counter RCIEDs and leading the training of the first Army EWOs deployed to theater in early 2006.

The Navy's principal provider of airborne electronic attack is the EA-6B Prowler. The Prowler has been the most capable airborne jammer in the world since the cold war, providing precise suppression of enemy radars and communications for coalition aircraft and forces on the ground. But the Prowler is an aging, maintenance-intensive aircraft. Some of its core EW systems were developed decades ago, and are not well suited to coping with the diverse array of emerging electronic threats. Therefore, the Navy has funded development of a replacement aircraft, the EA-18G Growler. This new aircraft incorporates the advanced ICAP III electronic warfare suite currently installed on some Prowlers and several additional enhancements that provide greater frequency coverage, improved survivability, and the ability to selectively and precisely jam enemy sensors and tactical networks.

The Navy should be applauded for its dedication to this new program. The Growler has remained on-cost and on-schedule throughout development and the first Growlers will be delivered to the fleet beginning in June 2008. A major concern about the Growler is that it will continue to carry the legacy ALQ-99 jamming pod used on Prowlers today, which will need to be upgraded within the next decade. The service has begun design of a "Next Generation Jammer (NGJ)," and the same acquisition strategy used for the Growler must be applied to this program so the system can arrive no later than 2015. The Navy must strictly define system requirements and not allow "mission creep" to set in, which will balloon the cost of the program and delay its development.

EW expertise within the joint forces. Furthermore, the number of Growlers in the procurement plan (85) is barely sufficient to meet the needs of the carrier Navy and is inadequate to support joint missions for other services.

Despite the high profile of EW, the Navy leadership of the specialty is fragmented. Today, there is no single-point-of-contact within the Navy for EW and that trend is likely to continue as the community shrinks. One recent, positive development is the establishment of an EW office within Naval Network Warfare Command that has the responsibility to look at full-spectrum Naval EW. Unfortunately, this office is inadequately staffed for its mission. It remains to be seen if this office provides the mechanism to consolidate Navy EW, but it is a step in the right direction. Regardless, due to the importance of EW in the service, the Navy needs to identify a flag officer with authority over EW programs and open a career path for Navy EW officers to ascend to senior leader status. It would serve the Navy well to ensure this community stays together and remains the standard for EW expertise in the services.

Finally, the future of Navy EW also rests in ship self-protection. Many countries are pursuing advanced anti-ship missiles, both sea-skimming and ballistic, that pose a major threat to the service fleet. While there has been progress in countermeasures, the supporting self-protection system on all ships was designed in the 1970s. The Navy is pursuing modernization of these systems through its Surface Electronic Warfare Improvement Program (SEWIP). This program provides incremental upgrades to the legacy system, but there is not a complete plan to infuse new technology for ship self-protection in the near future.

# MARINES FOCUS EW ON AIR-GROUND INTEGRATION

As the smaller of the two services funded by the Navy Department budget, the Marine Corps has a broader set of EW requirements than the Navy. Not only must the Marine Corps participate as a Tactical Aviation (TacAir) partner with the Navy aboard aircraft carriers, but also as shore based operations supporting expeditionary ground forces – the Marine Air-Ground Task Force (MAGTF). Today, Marine airborne electronic attack capabilities are principally found in four Prowler squadrons (20 aircraft), augmented by various other MAGTF capabilities, including Radio Battalion assets on the ground and Unmanned Aerial Systems (UAS). As such, Marines execute more of an expeditionary role – a concept of EW operations that is slightly different than the Navy's support of the carrier air wing.

The Corps faces the same challenges with the Prowler as the Navy; however they will not pursue the Growler as a successor. Rather, they will opt to continue operating ICAP III upgraded Prowlers, selecting the "best-of-breed" Prowler airframes, as a bridge to next-generation EW capabilities that are more agile, supportable and self-sufficient. The vision of Marine leaders is to control the entire spectrum in combat by fielding a fully integrated, networked and interoperable aviation element that can execute a responsive, persistent, lethal and adaptive operation. This capability would enable the MAGTF or Joint Force Commander to direct EW operations, but also give small combat units on the ground more control of jamming assets distributed throughout a battlespace. This vision is in response to the new demands of asymmetric warfare in places like Iraq that will continue to characterize the nature of combat for the foreseeable future.

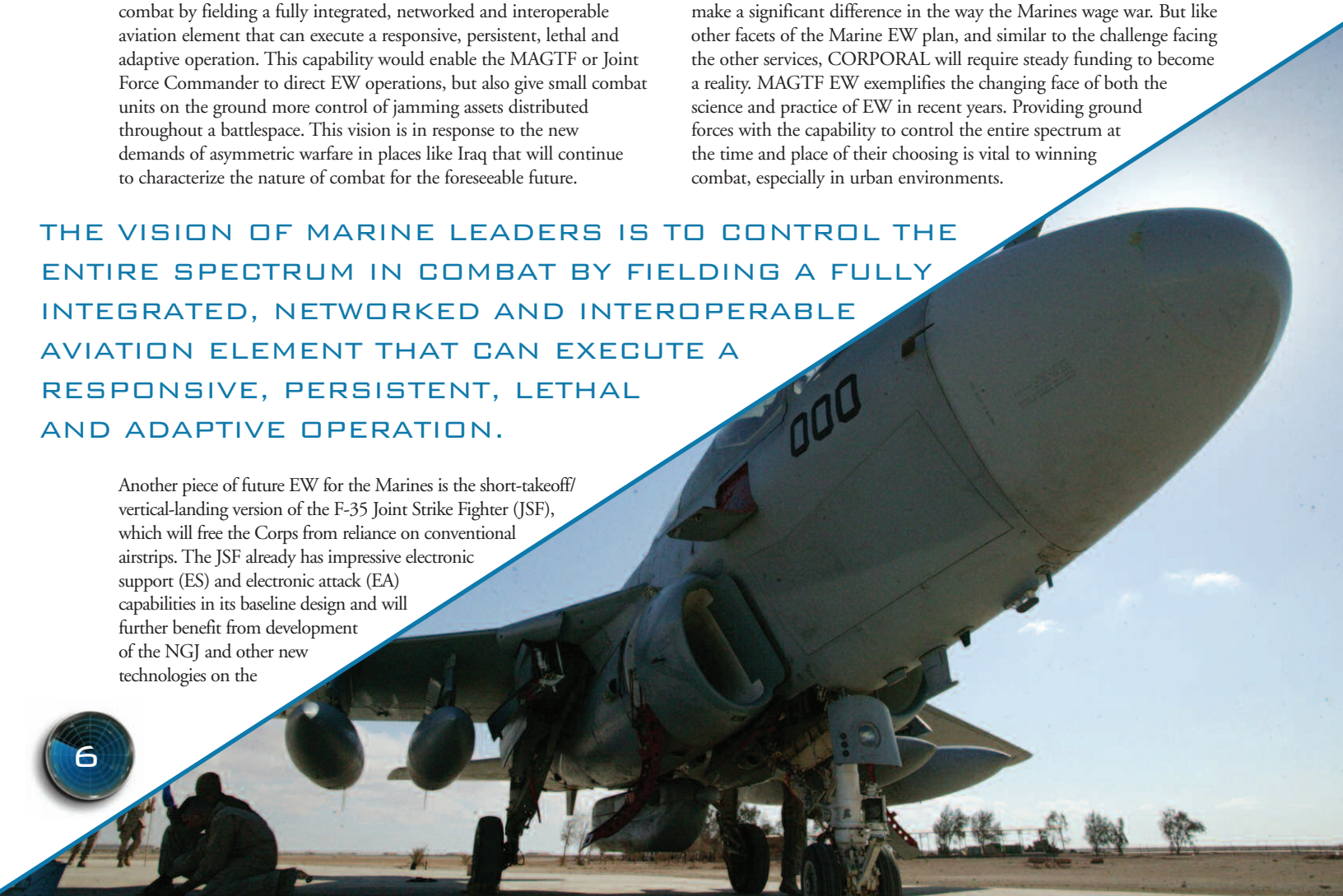
horizon that will feed into the Marines' vision for EW. Furthermore, all service variants of the JSF will eliminate reliance on current low-density, high-demand assets, such as the Prowler and Marine Harriers.

The challenge of EW facing Marines on the ground is similar to the challenge confronting the Army — an unconventional foe using new commercial technologies such as cell phones to launch hit-and-run attacks against exposed U.S. forces. Marine planners determined early in the Global War on Terror that their combat units needed more control over EW and intelligence resources. The solution is a promising new program called Collaborative On-line Reconnaissance Provider Operationally Responsive Attack Link (CORPORAL). The program networks signals intelligence from multiple sources with a compact electronic system on all Litening Pod capable aircraft, such as AV-8 Harriers, F-18s, and the Prowler. CORPORAL also consists of a communications jammer on the Shadow 200 UAS.

CORPORAL will allow Marine units to have more flexibility to summon tactical EW capabilities when needed, and the program could make a significant difference in the way the Marines wage war. But like other facets of the Marine EW plan, and similar to the challenge facing the other services, CORPORAL will require steady funding to become a reality. MAGTF EW exemplifies the changing face of both the science and practice of EW in recent years. Providing ground forces with the capability to control the entire spectrum at the time and place of their choosing is vital to winning combat, especially in urban environments.

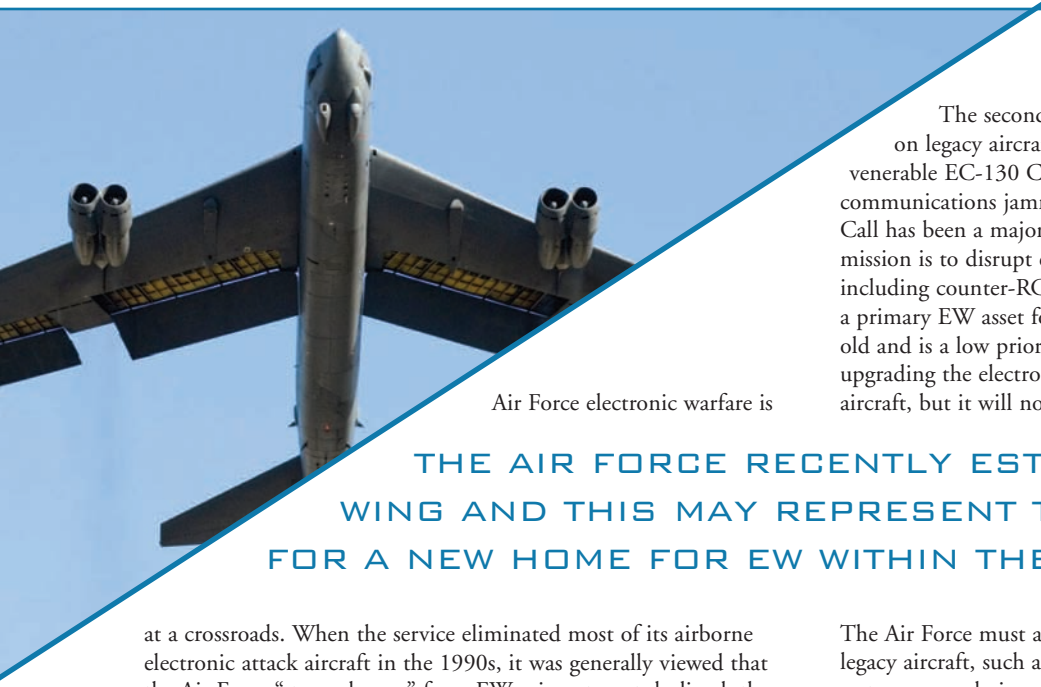
**THE VISION OF MARINE LEADERS IS TO CONTROL THE ENTIRE SPECTRUM IN COMBAT BY FIELDING A FULLY INTEGRATED, NETWORKED AND INTEROPERABLE AVIATION ELEMENT THAT CAN EXECUTE A RESPONSIVE, PERSISTENT, LETHAL AND ADAPTIVE OPERATION.**

Another piece of future EW for the Marines is the short-takeoff/vertical-landing version of the F-35 Joint Strike Fighter (JSF), which will free the Corps from reliance on conventional airstrips. The JSF already has impressive electronic support (ES) and electronic attack (EA) capabilities in its baseline design and will further benefit from development of the NGJ and other new technologies on the



# AIR FORCE EW STRUGGLING TO REGAIN LOST GROUND





Air Force electronic warfare is at a crossroads. When the service eliminated most of its airborne electronic attack aircraft in the 1990s, it was generally viewed that the Air Force "stepped away" from EW – investment declined, the community fragmented, and leadership lost sight of the mission's value. But as the Air Force establishes its new Cyber Command, there are opportunities for EW to play an important role in the service once again. To regain lost ground, the service faces challenges on four fronts.

The first challenge is the way ahead for its "system-of-systems" approach to airborne electronic attack. The Air Force has a long-standing requirement, a cornerstone of which is stealth technology, to field and integrate a collection of capabilities to provide greater protection of its aircraft against sophisticated air defense systems and early warning radars. However, stealth alone does not provide sufficient protection from modern enemy air defenses. Due to delays in development and an overall lack of dedicated funding for key pieces of this "systems-of-systems," most notably the stand-off jamming system – the B-52 Core Component Jammer – the Air Force faces an alarming capability gap beginning in 2012 when Navy Prowlers are no longer available to support the Air Force. Any discussion of future Air Force EW must recognize that the service, like each of the other services, is investing in capabilities in the "black" world. Regardless, there will be an increased risk to U.S. aircraft, and there is no adequately funded plan to fill this gap until at least 2017.

The second challenge is modernization of EW systems on legacy aircraft. The face of Air Force EW today is the venerable EC-130 Compass Call, the service's primary communications jamming aircraft. Like the Prowler, the Compass Call has been a major EW success in Iraq and Afghanistan as its mission is to disrupt enemy voice and data communications, including counter-RCIEDs. While the aircraft is expected to remain a primary EW asset for many years, the airframe is nearly 35 years old and is a low priority for revitalization. The Air Force is gradually upgrading the electronic warfare capability of all 14 Compass Call aircraft, but it will not be complete for several more years.

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The Air Force must also modernize self-protection systems on other legacy aircraft, such as the F-16, A-10, and B-52. Many of these systems were designed in the 1970s and are not effective against emerging weapons that threaten U.S. forces. A positive step in addressing this challenge is the recent establishment of the EW Life-Cycle Management Group (LCMG) to provide direction for service EW capabilities from the research lab to the field. The LCMG is primarily supported by the 542d EW Sustainment Group, whose mission is to efficiently manage EW systems on legacy aircraft to ensure our U.S. warfighters have the capabilities they need in times of conflict.

The third challenge is to determine how EW will be organized within Air Force Cyber Command and how EW will evolve under the Air Force's broad concept of cyber operations. There is a lot of synergy between EW and cyber warfare – tactics and techniques that impair networks supporting enemy electronics. Additionally, the Air Force recently established the 450th EW Wing and this may represent the best option today for a new home for EW within the service.

The final challenge is to reestablish a dedicated EW career path within the Air Force and a fundamental level of training that can reopen doors for EW expertise in the service. The pool of EW practitioners in the Air Force has essentially disappeared as years pass from the time EW was a dedicated mission. As the Army is realizing, expertise takes a long time to rebuild. EW is a critical element of air operations, and the Air Force.

# CONCLUSION: EW NEEDS MORE FOCUS AND COORDINATION

In the years since the Cold War ended, the U.S. has faced increasing competition for military control of the electromagnetic spectrum. From radio-controlled roadside bombs to integrated air defenses, America's enemies are seeking to assert mastery of the spectrum while denying access to their adversaries. It is no exaggeration to say EW electronic warfare has become the face of combat in the Information Age.

As the requirement to control the entire spectrum becomes clear, America's military services face many challenges to modernize their electronic warfare systems, invest in next-generation capabilities, and continue to grow an EW community of experts. There has been progress in each service and cooperation between the services is improving, but the EW scene today is still characterized more by fragmentation of effort and insufficient investment. Policymakers must do a better job of oversight to ensure the services address these challenges and coordinate resources – funding, expertise, research & development, and joint operations. To this end, the AOC identifies three overarching recommendations with six specific actions that will to put U.S. joint EW capability on a path to success:

## LEADERSHIP

- **Establish an office in the Office of the Secretary of Defense to oversee budget and planning of joint EW activities, including system acquisition, coordination, planning, and training.** This office would have the authority to coordinate planning and direct the services to close gaps, eliminate wasteful redundancy, and save resources. While the services are already informally coordinating EW research, there needs to be more systematic and authoritative oversight of such efforts, led by a general officer with appropriate experience.

- **Designate a Flag/General Officer in each service with broad management and oversight of service EW programs.** While the services are identifying some new leadership structures for EW, there is no one Flag/General officer in any service with appropriate EW experience and express authority over EW programs.

## INVESTMENT

- **Develop an EW Critical Technologies List and adequately fund development of those technologies to meet operational needs within the next 10-15 years.** To help coordinate investment strategy and limited resources, the Defense Department should authorize the creation of a study that identifies and prioritizes critical EW technologies over the next 10-15 years. Such a list should include technology readiness levels (TRLs), be updated regularly, and be submitted to Congress.

- **Authorize the creation of a joint EW modernization program.** This program would find efficiencies by coordinating service programs and would help inject needed additional funding for next-generation EW systems. A potential model for such a program is the Defense Department's Cryptographic Modernization Program, an initiative to upgrade the Department's cryptographic inventory over the next 10-15 years. The initiative is an integrated partnership between the National Security Agency, the services, operational commands, the Joint Staff, defense and other federal agencies, and industry.

## READINESS

- **Build on successes in Iraq and Afghanistan.** Permanently establish a joint services, theater-wide EW coordination cell to serve combatant commands, similar to the CTEWCC that has been established in U.S. Central Command. This EW coordination cell can help combatant commands plan EW aspects of future operations and will deploy when needed in support of operations.

- **Improve training, retention and renewal of electronic warfare skills.** Each service is responsible for its own EW personnel training, but there is no common standard or curriculum for basic EW education. The Defense Department, in coordination with the services, should establish a joint training and education center to help ensure joint EW training and that each service has a pool of personnel educated in the fundamentals of EW. Numerous observers have noted that the EW workforce is shrinking, so it is time to give revitalization of EW community skills attention so that no service lacks EW expertise, especially in times of conflict.

A healthy and joint EW capability is vital to U.S. warfighters. It always has and will continue to save lives. Government and industry must work together for EW to receive the attention it deserves in joint military preparations. The AOC is dedicated to assuring that America never loses sight of how important control of the electromagnetic spectrum is to all facets of conflict and commerce.


*The Association of Old Crows (AOC), founded in 1964, is a nonprofit international professional association engaged in the science and practice of Electronic Warfare (EW), Information Operations (IO), and related disciplines. The name "Old Crows" emerged from the first large-scale use of Electronic Warfare during the World War II Battle of Britain and the US and allied bombing raids over Europe. The Allied radar countermeasure operators used the code name "Ravens", which military jargon later changed to "Crows." The AOC mission is to advocate the need for a strong defense capability emphasizing electronic warfare and information operations to government, industry, academia and the public. Visit our web site at www.crows.org.*

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