

March 2012

AIRBORNE ELECTRONIC ATTACK

Achieving Mission Objectives Depends on Overcoming Acquisition Challenges



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Report Documentation Page

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Highlights of [GAO-12-175](#), a report to the Committee on Armed Services, House of Representatives

Why GAO Did This Study

Airborne electronic attack involves the use of aircraft to neutralize, destroy, or suppress enemy air defense and communications systems. Proliferation of sophisticated air defenses and advanced commercial electronic devices has contributed to the accelerated appearance of new weapons designed to counter U.S. airborne electronic attack capabilities. GAO was asked to assess (1) the Department of Defense's (DOD) strategy for acquiring airborne electronic attack capabilities, (2) progress made in developing and fielding systems to meet airborne electronic attack mission requirements, and (3) additional actions taken to address capability gaps. To do this, GAO analyzed documents related to mission requirements, acquisition and budget needs, development plans, and performance, and interviewed DOD officials.

What GAO Recommends

GAO recommends that DOD conduct program reviews for certain new, key systems to assess cost, schedule, and performance; determine the extent to which the most pressing capability gaps can be met and take steps to fill them; align service investments in science and technology with the departmentwide electronic warfare priority; and review capabilities provided by certain planned and existing systems to ensure investments do not overlap. DOD agreed with three recommendations and partially agreed with the two aimed at reducing potential overlap among systems. DOD plans to assess coordination among systems, whereas GAO sees opportunities for consolidation, as discussed in the report.

View [GAO-12-175](#). For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

March 2012

AIRBORNE ELECTRONIC ATTACK

Achieving Mission Objectives Depends on Overcoming Acquisition Challenges

What GAO Found

The Department of Defense's (DOD) evolving strategy for meeting airborne electronic attack requirements centers on acquiring a family of systems, including traditional fixed wing aircraft, low observable aircraft, unmanned aerial systems, and related mission systems and weapons. DOD analyses dating back a decade have identified capability gaps and provided a basis for service investments, but budget realities and lessons learned from operations in Iraq and Afghanistan have driven changes in strategic direction and program content. Most notably, DOD canceled some acquisitions, after which the services revised their operating concepts for airborne electronic attack. These decisions saved money, allowing DOD to fund other priorities, but reduced the planned level of synergy among systems during operations. As acquisition plans have evolved, capability limitations and sustainment challenges facing existing systems have grown, prompting the department to invest in system improvements to mitigate shortfalls.

DOD is investing in new airborne electronic attack systems to address its growing mission demands and to counter anticipated future threats. However, progress acquiring these new capabilities has been impeded by developmental and production challenges that have slowed fielding of planned systems. Some programs, such as the Navy's EA-18G Growler and the Air Force's modernized EC-130H Compass Call, are in stable production and have completed significant amounts of testing. Other key programs, like the Navy's Advanced Anti-Radiation Guided Missile, have required additional time and funding to address technical challenges, yet continue to face execution risks. In addition, certain systems in development may offer capabilities that overlap with one another—a situation brought on in part by DOD's fragmented urgent operational needs processes. Although services have shared technical data among these programs, they continue to pursue unique systems intended to counter similar threats. As military operations in Iraq and Afghanistan decrease, opportunities exist to consolidate current acquisition programs across services. However, this consolidation may be hampered by DOD's acknowledged leadership deficiencies within its electronic warfare enterprise, including the lack of a designated, joint entity to coordinate activities. Furthermore, current and planned acquisitions will not fully address materiel-related capability gaps identified by DOD—including some that date back 10 years. Acquisition program shortfalls will exacerbate these gaps.

To supplement its acquisition of new systems, DOD is undertaking other efforts to bridge existing airborne electronic attack capability gaps. In the near term, services are evolving tactics, techniques, and procedures for existing systems to enable them to take on additional mission tasks. These activities maximize the utility of existing systems and better position operators to complete missions with equipment currently available. Longer-term solutions, however, depend on DOD successfully capitalizing on its investments in science and technology. DOD has recently taken actions that begin to address long-standing coordination shortfalls in this area, including designating electronic warfare as a priority investment area and creating a steering council to link capability gaps to research initiatives. These steps do not preclude services from funding their own research priorities ahead of departmentwide priorities. DOD's planned implementation roadmap for electronic warfare offers an opportunity to assess how closely component research investments are aligned with the departmentwide priority.

Contents

| | | |
|--------------|--|----|
| Letter | | 1 |
| | Background | 3 |
| | DOD Strategy to Lower Costs Also Reduced Synergy among Systems | 5 |
| | Acquisitions May Not Produce Sufficient Results | 16 |
| | Improvements to Tactics, Techniques, and Procedures and Investments in Science and Technology Are Helping to Bridge Gaps | 30 |
| | Conclusions | 35 |
| | Recommendations for Executive Action | 36 |
| | Agency Comments and Our Evaluation | 37 |
| Appendix I | Scope and Methodology | 40 |
| Appendix II | Analyses of Select Airborne Electronic Attack Systems | 43 |
| Appendix III | Comments from the Department of Defense | 64 |
| Appendix IV | GAO Contact and Staff Acknowledgments | 69 |
| Tables | | |
| | Table 1: Characteristics of Airborne Electronic Attack Systems in Sustainment | 13 |
| | Table 2: Recent and Planned DOD Investments toward Acquiring Airborne Electronic Attack Systems | 17 |
| | Table 3: DOD's Progress Developing and Fielding New Airborne Electronic Attack Systems | 19 |
| | Table 4: Potential Overlap among Communications Jamming Systems Supporting Ground Forces | 25 |
| | Table 5: Primary Airborne Electronic Attack Capability Needs Identified since 2002 | 29 |
| | Table 6: Current DOD Science and Technology Initiatives Related to Airborne Electronic Attack | 32 |
| | Table 7: DOD Planned Acquisition Investments for the EA-6B Prowler, Fiscal Years 2012-2017 | 44 |

| | |
|--|----|
| Table 8: DOD Planned Acquisition Investments for the AN/ALQ-99 Tactical Jamming System, Fiscal Years 2012-2017 | 46 |
| Table 9: DOD Planned Acquisition Investments for the EC-130H Compass Call, Fiscal Years 2012-2017 | 48 |
| Table 10: DOD Planned Acquisition Investments for the F-22A Raptor, Fiscal Years 2012-2017 | 50 |
| Table 11: DOD Planned Acquisition Investments for the EA-18G Growler, Fiscal Years 2012-2017 | 52 |
| Table 12: DOD Planned Acquisition Investments for AARGM, Fiscal Years 2012-2017 | 54 |
| Table 13: DOD Planned Acquisition Investments for IDECM, Fiscal Years 2012-2017 | 56 |
| Table 14: DOD Planned Acquisition Investments for the Next Generation Jammer, Fiscal Years 2012-2017 | 58 |
| Table 15: DOD Planned Acquisition Investments for MALD/MALD-J, Fiscal Years 2012-2017 | 61 |
| Table 16: DOD Planned Acquisition Investments for the F-35 Lightning II, Fiscal Years 2012-2017 | 63 |

Figures

| | |
|--|----|
| Figure 1: Key Analyses Underpinning Airborne Electronic Attack Acquisition Strategy and Investments | 6 |
| Figure 2: Airborne Electronic Attack Family of Systems Strategy for Countering Near-Peer Adversaries | 9 |
| Figure 3: Airborne Electronic Attack Systems Tailored to Counter Irregular Warfare Threats | 11 |
| Figure 4: EA-6B Prowler | 43 |
| Figure 5: AN/ALQ-99 Tactical Jamming System | 45 |
| Figure 6: EC-130H Compass Call | 47 |
| Figure 7: F-22A Raptor | 49 |
| Figure 8: EA-18G Growler | 51 |
| Figure 9: AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) | 53 |
| Figure 10: Integrated Defensive Electronic Countermeasures (IDECM) | 55 |
| Figure 11: Next Generation Jammer | 57 |
| Figure 12: Miniature Air Launched Decoy (MALD)/Miniature Air Launched Decoy—Jammer (MALD-J) | 59 |
| Figure 13: F-35 Lightning II (Joint Strike Fighter) | 62 |

Abbreviations

| | |
|-----------|---|
| AARGM | Advanced Anti-Radiation Guided Missile |
| AESA | Active Electronically Scanned Array |
| ASD (R&E) | Assistant Secretary of Defense for Research and Engineering |
| CEASAR | Communications Electronic Attack with Surveillance and Reconnaissance |
| DARPA | Defense Advanced Research Projects Agency |
| DOD | Department of Defense |
| HARM | High Speed Anti-Radiation Missile |
| ICAP | Improved Capability |
| IDECM | Integrated Defensive Electronic Countermeasures |
| ITALD | Improved Tactical Air Launched Decoy |
| J-UCAS | Joint Unmanned Combat Air Systems |
| LAIRCM | Large Aircraft Infrared Countermeasures |
| MALD | Miniature Air Launched Decoy |
| MALD-J | Miniature Air Launched Decoy—Jammer |
| RDT&E | Research, Development, Testing, and Evaluation |
| TALD | Tactical Air Launched Decoy |

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United States Government Accountability Office
Washington, DC 20548

March 29, 2012

The Honorable Howard P. McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

Airborne electronic attack capabilities are key enablers for U.S. military operations ranging from irregular warfare¹ to major combat against potential near-peer adversaries.² Airborne electronic attack involves the use of aircraft to neutralize, destroy, or temporarily degrade (suppress) enemy air defense and communications systems, either through destructive or disruptive means. These aircraft employ a variety of mission systems and weapons to prosecute threats, and they rely on defensive countermeasures to provide additional protection.

Global proliferation of more sophisticated air defenses and advanced, commercial digital electronic devices has contributed to the accelerated appearance of new weapons designed to counter U.S. airborne electronic attack capabilities and limit U.S. access to theaters of combat. These weapons—some held by both nation-state and nonstate actors—vary from advanced, integrated air defense systems to simpler, digital radio frequency memory devices. As the range of adversary weapons increases, electronic jammers and other equipment must respond with improved capabilities or may have to operate farther from the battle, lessening their effectiveness.

In light of these developments, you asked us to review the Department of Defense's (DOD) airborne electronic attack capabilities and investment

¹Irregular warfare is defined as a violent struggle among state and nonstate actors for legitimacy and influence over the relevant population(s). Irregular warfare favors indirect and asymmetric (dissimilar) approaches, though it may employ the full range of military and other capacities, in order to erode an adversary's power, influence, and will.

²Potential near-peer adversaries can be defined to include countries capable of waging large-scale conventional war on the United States. These nation-states can be characterized as having nearly comparable diplomatic, informational, military, and economic capacity to the United States.

plans. In response to this request, we assessed (1) the department's strategy for acquiring airborne electronic attack capabilities; (2) progress made developing and fielding systems to meet airborne electronic attack mission requirements; and (3) additional compensating actions taken by the department to address capability gaps, including improvements to tactics, techniques, and procedures and investments in science and technology. In a separate report, we plan to address the effectiveness of the department's governance structure for overseeing its electronic warfare policies and priorities and the relationship between electronic warfare and cyber operations.

To assess the department's strategy for acquiring airborne electronic attack capabilities, we analyzed documents outlining mission requirements and acquisition needs including the 2009 Electronic Warfare Initial Capabilities Document, service roadmaps related to airborne electronic attack, budget documents, and program briefings. We corroborated this information through discussions with officials responsible for managing airborne electronic attack requirements and systems, including the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; Navy, Air Force, Army, and Marine Corps requirements branches; U.S. Strategic Command; and the Joint Staff. To assess progress made developing and fielding systems to meet airborne electronic attack mission requirements, we analyzed materials outlining acquisition plans, costs, and performance outcomes including, capabilities documents, program schedules, test reports, budget submissions, and program briefings. These same materials afforded information on key attributes of individual airborne electronic attack systems, which we used to assess potential overlap among systems in development. Further, we identified persisting capability gaps by reviewing DOD analyses related to airborne electronic attack requirements. To supplement our analyses and gain additional visibility and perspective into these issues, we conducted numerous interviews with DOD officials charged with managing airborne electronic attack requirements and those responsible for developing, acquiring, and testing airborne electronic attack systems. To assess additional compensating actions taken by the department to address airborne electronic attack capability gaps, we reviewed service documents outlining recent improvements and refinements to tactics, techniques, and procedures for key airborne electronic attack aircraft. We also reviewed broad agency announcements to understand ongoing science and technology activities. We corroborated this information through interviews with the user community responsible for developing and maintaining operating procedures for airborne electronic attack systems and with DOD airborne

electronic attack research leaders. A more detailed description of our scope and methodology is presented in appendix I.

We conducted this performance audit from February 2011 to March 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DOD invests in electronic warfare capabilities as a means to maintain unimpeded access to the electromagnetic spectrum during war and selectively deny adversary use of the spectrum. Traditionally, electronic warfare has been composed of three primary activities:

- **Electronic attack:** Use of electromagnetic, directed energy, or antiradiation weapons to attack with the intent of degrading, neutralizing, or destroying enemy combat capability.
- **Electronic protection:** Passive and active means taken to protect personnel, facilities, and equipment from the effects of friendly or enemy use of the electromagnetic spectrum.
- **Electronic warfare support:** Actions directed by an operational commander to search for, intercept, identify, and locate sources of radiated electromagnetic energy for the purposes of immediate threat recognition, targeting, and planning, and the conduct of future operations.

Airborne electronic attack—a subset of the electronic attack mission— involves use of aircraft to neutralize, destroy, or temporarily degrade (suppress) enemy air defense and communications systems, either through destructive or disruptive means. These capabilities are increasingly important and complex as networked systems, distributed controls, and sophisticated sensors become ubiquitous in military equipment, civilian infrastructure, and commercial networks— developments that complicate DOD’s ability to exercise control over the electromagnetic spectrum, when necessary, to support U.S. military objectives.

Airborne electronic attack systems increase survivability of joint forces tasked to enter denied battlespace and engage anti-access threats or

high-value targets,³ whether involved in major combat operations against a potential near-peer adversary or in irregular warfare. They also enable access to the battlespace for follow-on operations. Aircraft executing airborne electronic attack missions employ a variety of mission systems, such as electronic jammers, and weapons, such as antiradiation missiles and air-launched expendable decoys. These aircraft also rely on aircraft self-protection systems and defensive countermeasures for additional protection. All four services within DOD contribute to and rely upon airborne electronic attack capabilities using a variety of different aircraft. Each service is also separately acquiring new airborne electronic attack systems.

Section 1053 of the National Defense Authorization Act for Fiscal Year 2010 requires that for each of fiscal years 2011 through 2015, the Secretary of Defense, in coordination with the Joint Chiefs of Staff and secretaries of the military departments, submit to the congressional defense committees an annual report on DOD's electronic warfare strategy.⁴ Each report must contain (1) a description and overview of the department's electronic warfare strategy and organizational structures for oversight; (2) a list and description of all electronic warfare acquisition programs and research and development projects within DOD; and (3) for the unclassified programs and projects, detail on oversight responsibilities, requirements, funding, cost, schedule, technologies, potential redundancies, and associated capability gaps, and for the classified programs and projects, a classified annex addressing these topics, when appropriate.⁵ In response to this requirement, DOD submitted its first Electronic Warfare Strategy of the Department of Defense report in October 2010. The department produced its second electronic warfare strategy report in November 2011.

³Anti-access threats can be defined as those that impede the deployment of U.S. forces into the combat theater, limit the locations from which those forces could effectively operate, or force them to operate from locations farther from the locus of conflict than they would normally prefer. High-value targets are persons or resources that an enemy commander requires for the successful completion of a mission.

⁴Pub. L. No. 111-84, § 1053 (a) (2009).

⁵Pub. L. No. 111-84, § 1053 (b) (2009).

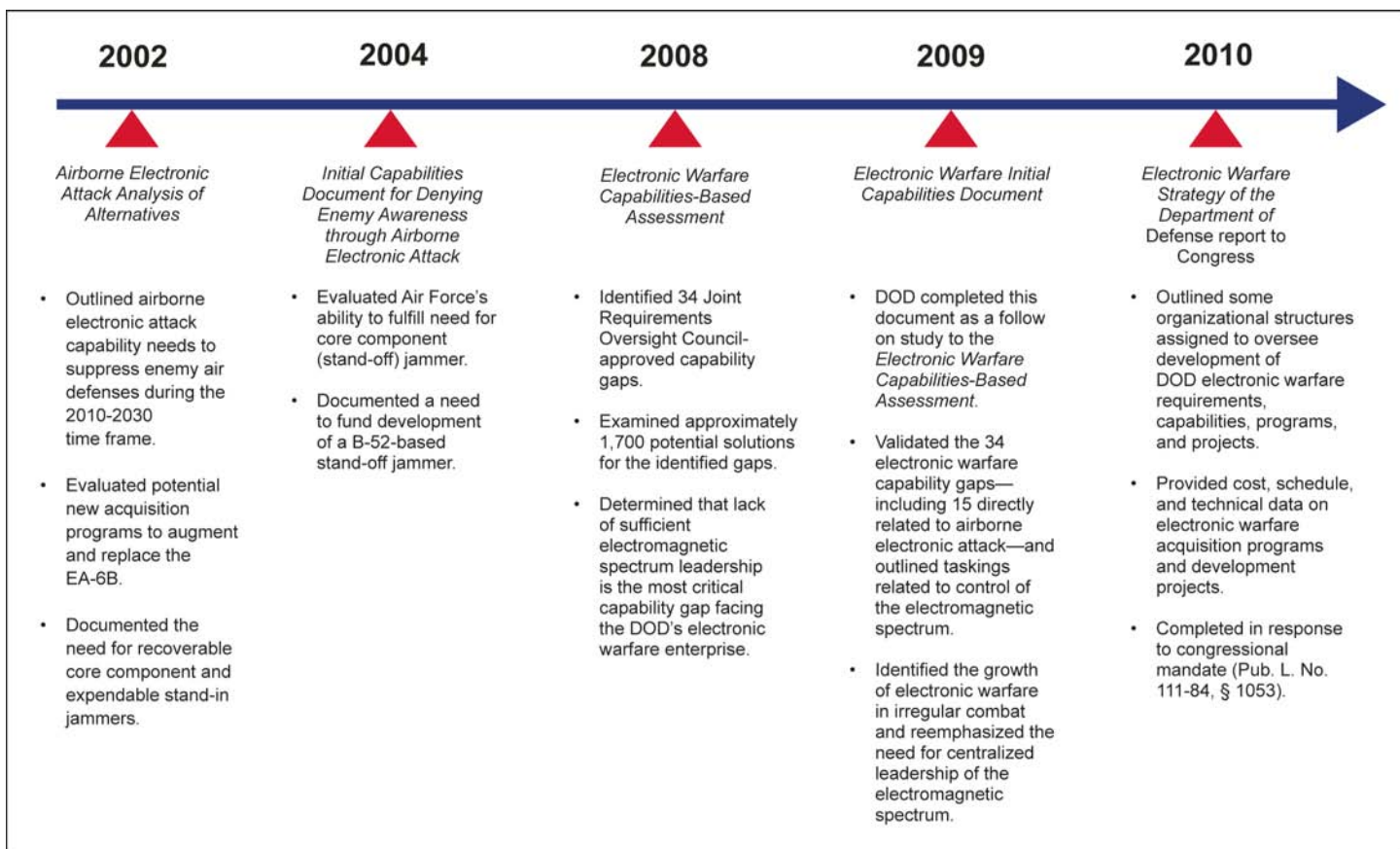
DOD Strategy to Lower Costs Also Reduced Synergy among Systems

DOD's strategy for meeting airborne electronic attack requirements—including both near-peer and irregular warfare needs—centers on acquiring a family of systems, including traditional fixed wing aircraft, low observable aircraft, unmanned aerial systems, and related mission systems and weapons. Department analyses dating back a decade have identified capability gaps and provided a basis for service investments in airborne electronic attack capabilities. However, budget realities and lessons learned from operations in Iraq and Afghanistan have driven changes in strategic direction and program content. Most notably, the department canceled some acquisitions, after which services revised their operating concepts for airborne electronic attack. These decisions saved money, allowing the department to fund other priorities, but reduced the planned level of synergy among airborne electronic attack systems during operations. As acquisition plans for these systems have evolved, operational stresses upon the existing inventory of weapon systems have grown. These stresses have materialized in the form of capability limitations and sustainment challenges for existing systems, prompting the department to invest in improvements to these systems to mitigate shortfalls.

Airborne Electronic Attack Acquisition Strategy Has Evolved

Key DOD analyses completed since 2002 identified capability gaps, provided a basis for service investments in airborne electronic attack systems, and supported an overarching acquisition strategy for achieving these requirements. The department outlined its findings in reports that included an analysis of alternatives, a capabilities-based assessment, and initial capabilities documents. Figure 1 highlights a chronology of these analyses and identifies key airborne electronic attack components of each report.

Figure 1: Key Analyses Underpinning Airborne Electronic Attack Acquisition Strategy and Investments



Source: GAO analysis of DOD documentation.

The 2002 Airborne Electronic Attack Analysis of Alternatives established the primary framework by which the department began investing in new airborne electronic attack capabilities. The analysis focused on those capabilities needed to suppress enemy air defenses from 2010 to 2030. The study identified two primary components required to provide a complete and comprehensive airborne electronic attack solution:

- **Core component:** A recoverable platform or combination of platforms operating in enemy airspace. The core component provides the airborne electronic attack detection and battle management capabilities for reactive jamming.

-
- **Stand-in component:** An expendable air platform providing critical capabilities against certain advanced threat emitters and employed in threat environments not accessible to the core component.

Subsequent to this analysis, DOD developed a system of systems strategy for meeting airborne electronic attack mission needs. A system of systems is a set or arrangement that results when independent and useful systems are integrated into a larger, connected and interdependent system that delivers unique capabilities during military operations. The system of systems strategy established specific roles and operating responsibilities among the military services in a joint environment and expanded the basic core and stand-in component needs into four major capability areas for airborne electronic attack:

- **Stand-off:** Jamming occurring outside of defended airspace. Planned stand-off systems included the Air Force's EC-130H Compass Call aircraft and development of an electronic attack variant of the Air Force's B-52.
- **Modified escort:** Jamming occurring inside defended airspace, but outside of the range of known surface-to-air missiles. Planned modified escort systems included the Navy's EA-18G Growler and EA-6B Prowler aircraft.
- **Penetrating escort:** Jamming occurring inside the intercept range of known surface-to-air missiles. The department planned to rely on aircraft equipped with active electronically scanned array (AESA) radars, including the F-22A Raptor and F-35 Lightning II aircraft to perform this jamming function.
- **Stand-in:** Jamming occurring inside the "no escape range" of known surface-to-air missiles. The department planned to rely on development of recoverable Joint Unmanned Combat Air Systems (J-UCAS) and the Air Force's Miniature Air Launched Decoy—Jammer (MALD-J) to provide this function.

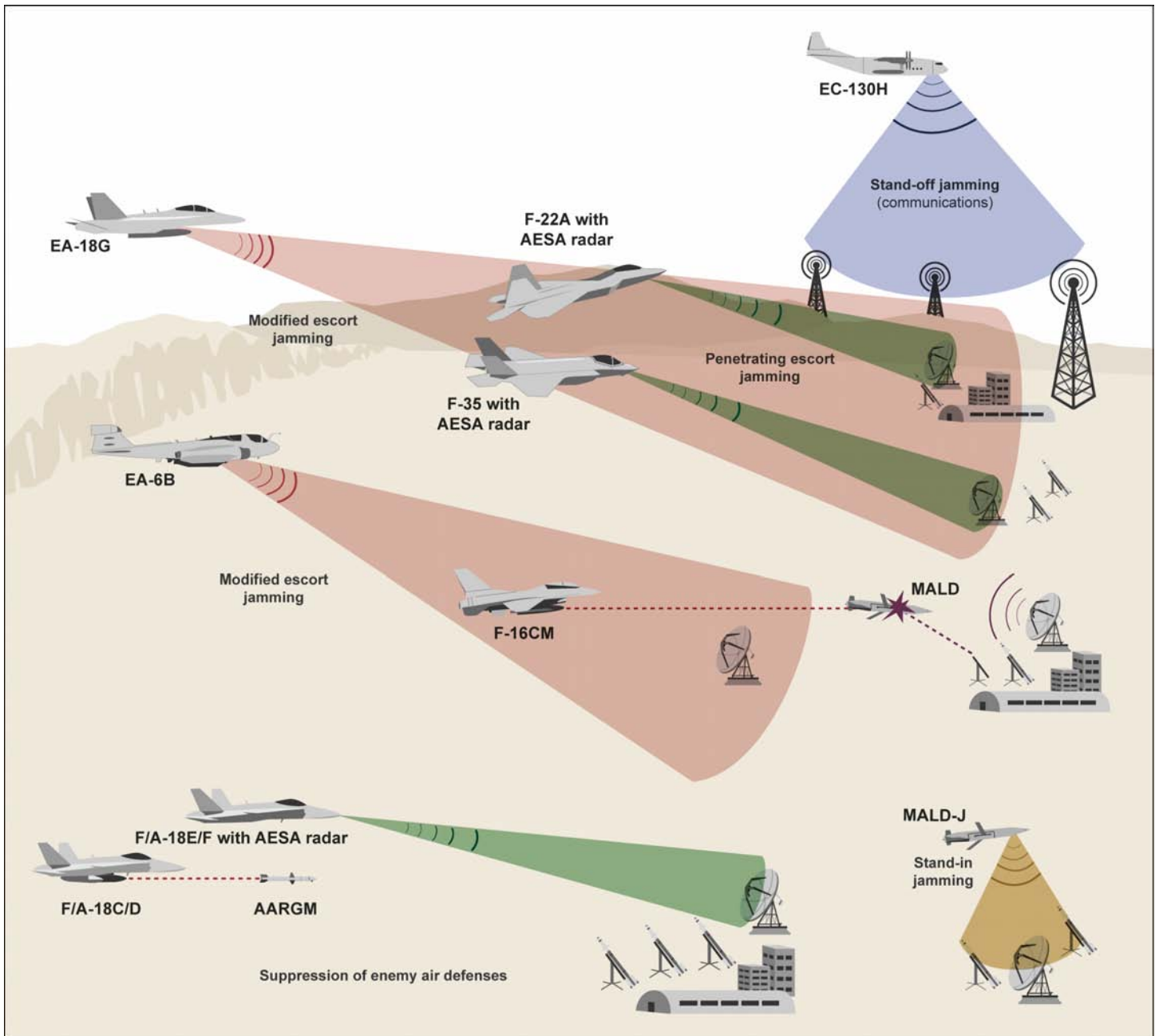
As time progressed, budget issues and lessons learned from operations in Iraq and Afghanistan drove changes to the strategy and program content. Most notably, the department canceled development of two major components of the system of systems—the B-52 Standoff Jammer and J-UCAS—in 2005 and 2006, respectively, citing higher-priority needs and budget constraints. The B-52-based jamming concept was later rejuvenated through the Air Force's Core Component Jammer initiative,

but that program was similarly canceled in 2009. Following these developments, the department revised operating concepts and joint service responsibilities, moving away from its system of systems plans in favor of a family of systems strategy for airborne electronic attack.

A family of systems is fundamentally different from a system of systems. Under a family of systems construct, independent systems—using different approaches—together provide capability effects to support military operations. Unlike the synergy found in a system of systems, a family of systems does not acquire qualitatively new properties or necessarily create capability beyond the additive sum of the individual capabilities of its members. The member systems may not even be connected into a whole. In the case of airborne electronic attack, DOD officials stated that a system of systems would have employed a dynamic, networked capability to share data in real-time among platforms—a concept known as electronic warfare battle management. Under the family of systems strategy, officials stated that this process is less automated and the parts are less connected. Therefore, in making this strategy change, the department traded some unique, synergistic capabilities that the system of system’s interdependent components might have provided in favor of near-term budget savings and other priorities.

Figure 2 outlines the department’s current family of systems strategy for countering near-peer adversaries. This family of systems includes traditional fixed wing aircraft, low observable aircraft, and related mission systems and weapons.

Figure 2: Airborne Electronic Attack Family of Systems Strategy for Countering Near-Peer Adversaries

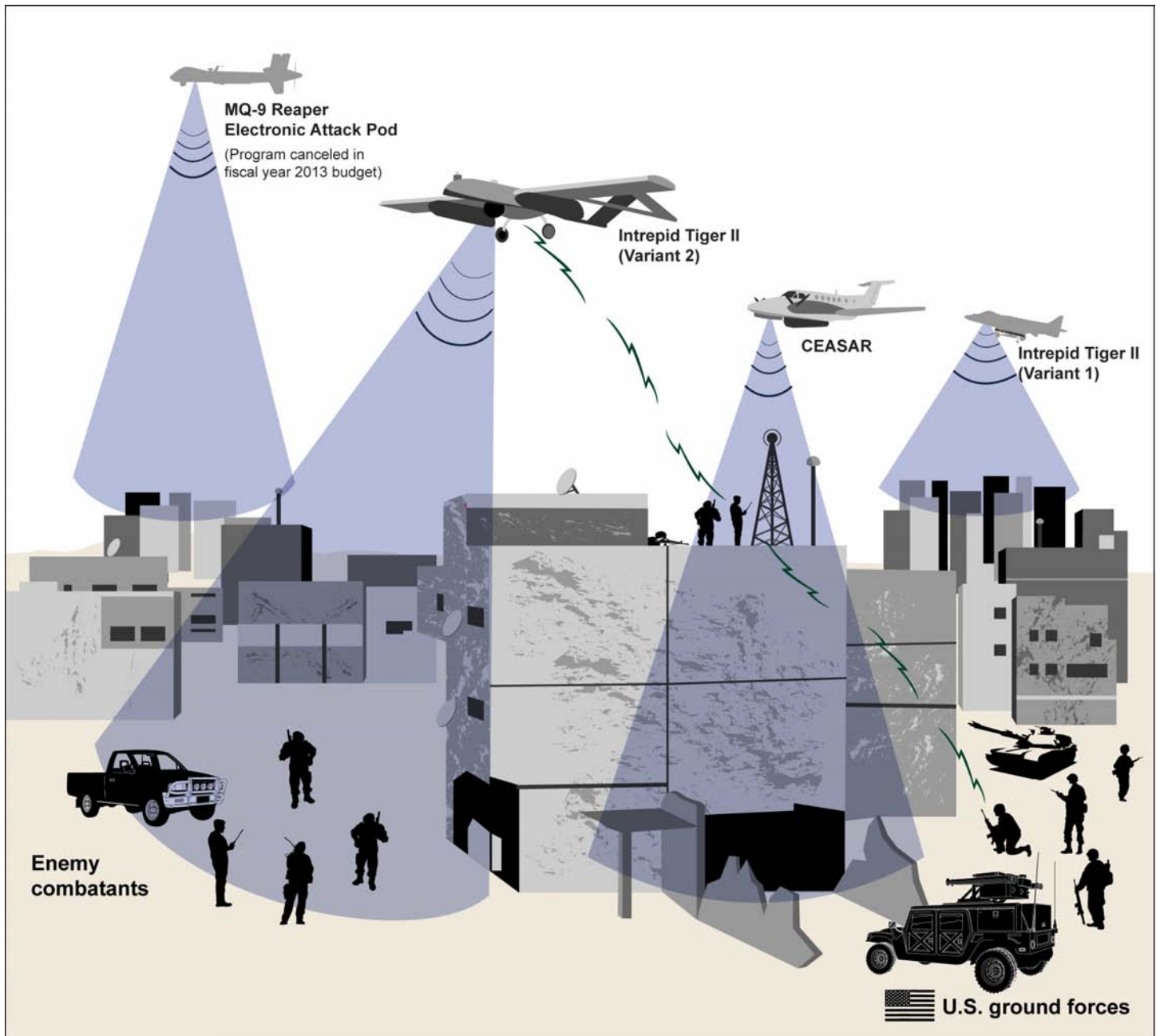


Sources: GAO (presentation); Northrop Grumman (EA-6B); Boeing (EA-18G); Raytheon (MALD and MALD-J); Lockheed Martin (F-35); Department of Defense (EC-130H, F-22A, AARGM, F-16CM, F/A-18C/D, and F/A-18E/F); Art Explosion (all other images).

DOD's 2009 electronic warfare capabilities analysis identified the growth of irregular warfare in urban areas as presenting challenges to military operations. The analysis noted that irregular adversaries can exploit civilian and commercial communications infrastructure to minimize detection and subsequent attack. According to the department, precise electronic attack planning and execution are required to ensure that these threats are defeated while avoiding interruption to U.S. communications capabilities.

The department has used existing airborne electronic attack systems, such as the EA-6B and EC-130H, to meet its near-term irregular warfare needs in Iraq and Afghanistan. However, officials report that these platforms are optimized for countering high-end, near-peer threats, and their use against irregular warfare threats is inefficient and costly. Consequently, the department has begun investing in new, less expensive airborne electronic attack systems tailored to counter irregular warfare threats. These systems are fielded from both traditional fixed-wing aircraft and from unmanned aerial vehicles. Figure 3 illustrates operations involving these systems.

Figure 3: Airborne Electronic Attack Systems Tailored to Counter Irregular Warfare Threats



Sources: GAO (presentation); Department of Defense (MQ-9 Reaper, CORPORA, CEASAR, and Intrepid Tiger II); Art Explosion (all other images).

**Existing Airborne
Electronic Attack Systems
Face Capability
Limitations and
Sustainment Challenges**

As DOD's acquisition plans for airborne electronic attack systems have evolved, operational stresses upon the current inventory of systems have grown. These systems date back to the 1970s and 1980s and were originally designed to counter Cold War era threats. Many of the department's existing airborne electronic attack systems face capability limitations, requiring the department to pursue modernization efforts to increase the effectiveness of the systems or to identify and develop replacement systems. Further, existing systems face sustainment challenges from age, parts obsolescence, and increased operational stresses from lengthy and sustained operations in Iraq and Afghanistan. According to Air Force and Navy officials, these challenges have reduced the availabilities of some systems to warfighters. Table 1 identifies the department's existing airborne electronic attack systems and related characteristics, including future replacement systems identified to date.

Table 1: Characteristics of Airborne Electronic Attack Systems in Sustainment

| System | Mission description | Estimated end of service life | Replacement system |
|---|--|---|---|
| EA-6B Prowler | Modified escort jamming | 2020 | EA-18G (Navy) F-35B Lightning II (Marine Corps) ^a |
| AN/ALQ-99 Tactical Jamming System | Modified escort jamming | Mid-band: 2024 Low-band: 2026 High-band: 2028 | Next Generation Jammer |
| F-16CM | Suppression of enemy air defenses | 2024 | F-35A Lightning II |
| AN/ALQ-131 and AN/ALQ-184 Pod Systems | Aircraft self-protection (F-16 and A-10) | 2025 | Electronic Attack Pod Upgrade Program |
| AN/ALQ-135 Internal Countermeasures Systems | Aircraft self-protection (F-15) | 2035 | Eagle Passive/Active Warning Survivability System |
| AGM-88 High Speed Anti-Radiation Missile (HARM) | Suppression of enemy air defenses | 2035 ^b | Advanced Anti-Radiation Guided Missile (AARGM) |
| EC-130H Compass Call (Baselines 0 and 1) | Stand-off jamming (communications) | 2053 ^c | N/A |
| ADM-141 Tactical Air Launched Decoy (TALD)/Improved Tactical Air Launched Decoy (ITALD) | Suppression of enemy air defenses | Unknown ^d | TBD ^e |
| F-22A Raptor | Penetrating escort | TBD | N/A |
| Integrated Defensive Electronic Countermeasures (IDECM) Blocks 1 and 2 | Aircraft self-protection (F/A-18 E/F) | TBD | IDECM Blocks 3 and 4 |

Legend: N/A = not applicable; TBD = to be determined.

Source: GAO analysis of DOD data.

^aIn addition to the fixed wing, airborne electronic attack capability that F-35B Lightning II is anticipated to provide, the Marine Corps plans to rely on its Marine Air Ground Task Force Electronic Warfare concept to replace the warfighting capability and capacity currently provided by the EA-6B. This concept seeks a more holistic approach toward electronic warfare by combining both air and ground capabilities. To date, DOD officials state that the Marine Corps has completed a draft initial capabilities document, a concept of operations, and various electronic warfare gap analyses in support of its concept.

^bThis date refers to the expected service life of the Air Force's inventory of HARM only. Air Force officials told us that retirement of the Air Force's inventory of HARM is aligned with the expected retirement of Block 50/52 F-16 aircraft.

^cAs of January 2012, the EC-130H program schedule showed that center wing box replacement for the 14th Compass Call aircraft should be complete by 2018. A program office official told us that center wing box replacement extends the operational service life of the aircraft an additional 35 years, suggesting an end of service life in 2053, assuming no additional improvements to the fleet.

^dAccording to a Navy official, neither TALD nor ITALD has an estimated end of service life. The Navy plans to continue providing minimal sustainment funds for these systems, as resource availability permits.

^eThe Navy has begun evaluating TALD/ITALD replacement options.

DOD is taking actions to address capability limitations and sustainment challenges across several key systems, such as the following:

- **EA-6B Prowler:** Since its introduction in the 1970s, the Navy and Marine Corps have made significant upgrades to the EA-6B Prowler. The latest of these upgrades—the Improved Capability electronic suite modification (ICAP III) provides the Prowler with greater jamming capability and is designed to improve the aircraft’s overall capability as both a radar-jamming and HARM platform. By the end of fiscal year 2012, 32 EA-6Bs will be upgraded to the ICAP III configuration. Navy officials told us that persistent operations in Iraq and Afghanistan, however, have degraded the condition of EA-6B aircraft. In addition, we have previously reported that parts obsolescence presents the biggest challenge to the EA-6B’s ability to fulfill its mission role.⁶ We noted that although the Navy has made several structural upgrades to the EA-6B fleet, it is actively tracking a number of key components, including cockpit floors, side walls, fin pods, bulkheads, actuators, engine components, landing gear, and avionics software—all of which are at increasing risk for costly replacement the longer the aircraft remains in service.
- **HARM:** According to Navy officials, even though HARM has undergone various block upgrades to provide increased capabilities since fleet introduction in 1983, advancements in enemy radar technology have rendered the weapon somewhat ineffective for typical Navy targets. As a result, the Navy is fielding a major technological upgrade to HARM through its AARGM acquisition program. AARGM provides a new multimode guidance section and modified control section mated with existing HARM propulsion and warhead sections. The Air Force, similarly, is pursuing modifications to HARM control sections on missiles in its inventory—a process that will provide a global positioning system receiver to those units. Air Force officials stated that they have long sought this receiver component addition because of vulnerabilities in the HARM targeting method. This effort is being pursued in conjunction with other modernization efforts for Air Force F-16CM aircraft.

⁶GAO, *Tactical Aircraft: DOD’s Ability to Meet Future Requirements Is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions*, [GAO-10-789](#) (Washington, D.C.: July 29, 2010).

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- **TALD and ITALD:** Navy officials stated that advancements in enemy integrated air defense systems have decreased the effectiveness of both TALD and ITALD units. According to program officials, newer radars can discern from the TALD/ITALD flight profile that the system is a decoy and not a valid target. The Navy has begun evaluating TALD/ITALD replacement options under its Airborne Electronic Attack Expendable program initiative.
 - **EC-130H Compass Call (Baselines 0 and 1):** Although the Air Force initially fielded the EC-130H Compass Call as a communications jammer supporting suppression of enemy air defenses, the system has evolved to include irregular warfare missions and radar jamming. Air Force officials told us that the Compass Call is the most utilized aircraft within the C-130 family and has been continuously deployed since 2003 supporting operations in Iraq and Afghanistan, accelerating the need for the Air Force to replace the center wing box on each of the 14 aircraft in the Compass Call fleet. Further, Air Force officials told us that they are increasing the size of the fleet by one aircraft to alleviate stress on current aircraft and to increase the availability of airborne electronic attack capability to the Air Force. According to a fleet viability assessment completed in 2010, the current size of the fleet is insufficient to meet combatant commander taskings for Compass Call.
 - **AN/ALQ-99 Tactical Jamming System:** The Navy's Low Band Transmitter upgrade to the AN/ALQ-99 system is intended to replace three aging legacy transmitters that suffer from obsolescence and reliability problems. According to Navy officials, persistent use of these transmitters in support of operations in Iraq and Afghanistan has exacerbated system shortfalls. Navy officials told us that they are also identifying options for improving reliability and resolving obsolescence issues with the mid and high bands of the AN/ALQ-99 system. However, Navy officials project that even with these improvements, system capabilities will be insufficient to counter anticipated evolutions in threat radars and missiles beginning in 2018. This shortfall is expected to be addressed by the new Next Generation Jammer.
 - **AN/ALQ-131 and AN/ALQ-184 Pod Systems:** The Air Force has identified obsolescence issues and capability shortfalls affecting these systems, which provide tactical aircraft self-protection. The Air Force is pursuing a replacement/upgrades program designed to move the Air Force to a single, self-protection pod system for its F-16 and A-10 aircraft.

Acquisitions May Not Produce Sufficient Results

DOD is investing in new airborne electronic attack systems to address its growing mission demands and to counter anticipated future threats. However, progress acquiring these new capabilities has been impeded by developmental and production challenges that have slowed fielding of several planned systems. Some programs, including the Navy's EA-18G Growler and the Air Force's EC-130H Compass Call modernization, are in stable production and have completed significant amounts of testing. On the other hand, the Navy's AARGM, the Air Force's Miniature Air Launched Decoy (MALD), and other programs have required additional time and money to resolve technical challenges. In addition, certain airborne electronic attack systems in development may offer capabilities that overlap with one another—a situation brought on in part by the department's fragmented urgent operational needs processes. As military operations in Iraq and Afghanistan decrease, opportunities exist to consolidate current acquisition programs across services; however, this consolidation may be hampered by leadership deficiencies affecting the department's electronic warfare enterprise. Furthermore, current and planned acquisition programs, even if executed according to plan, will not fully address the materiel-related capability gaps identified by the department—including some that date back 10 years.

Investments in New Airborne Electronic Attack Systems Have Yielded Mixed Results to Date

DOD investments to develop and procure new and updated airborne electronic attack systems are projected to total more than \$17.6 billion from fiscal years 2007 through 2016.⁷ These systems represent the department's planned mix of assets for (1) countering near-peer, integrated air defense and communications systems and (2) providing communications and radio frequency jamming against irregular warfare threats. Table 2 outlines the department's recent and planned investments toward developing and acquiring several of these systems.

⁷Investment total includes nearly \$1.1 billion in funding for aircraft self-protection systems, which airborne electronic attack aircraft rely upon to conduct missions.

Table 2: Recent and Planned DOD Investments toward Acquiring Airborne Electronic Attack Systems

Then-year dollars in millions

| System | Current research, development, testing, and evaluation (RDT&E) cost estimate | Current procurement cost estimate | Total RDT&E and procurement funding (through fiscal year 2012) | Remaining RDT&E and procurement funding requirements |
|--|---|--|---|---|
| Next Generation Jammer | \$2,141.5 | N/A | \$402.6 | \$1,738.9 |
| EA-18G Growler | 1,839.4 | \$9,341.6 | 10,032.5 | 1,148.5 |
| AARGM | 631.0 | 1,277.7 | 877.5 | 1,031.2 |
| MALD and MALD-J ^a | 505.1 | 1,339.6 | 953.8 | 890.9 |
| IDECM Block 4 | 254.1 | 609.1 | 271.6 | 591.6 |
| EC-130H Compass Call Modernization | 129.0 | 957.2 | 709.9 | 376.3 ^b |
| MQ-9 Reaper Electronic Attack Pod | 133.4 | 100.3 | 53.1 | 0.0 ^c |
| Intrepid Tiger II | 26.5 | 50.3 | 43.4 | 33.4 |
| Communications Electronic Attack with Surveillance and Reconnaissance (CEASAR) pod | 0.8 | 13.0 | 13.8 ^d | 0.0 |
| Total | \$5,660.8 | \$13,688.8 | \$13,358.2 | \$5,810.8 |

Source: GAO analysis of DOD budget submissions and program baselines.

Notes: Remaining funding requirements for EC-130H Compass Call Modernization represent funding through the end of a 5-year budget forecast. In addition, F-22A Raptor and F-35 Lightning II (Joint Strike Fighter) funding is excluded from this analysis because those aircraft will provide capabilities that support several missions, including airborne electronic attack.

^aMALD and MALD-J figures do not include costs or appropriations related to the previously planned MALD-J Increment II. In its fiscal year 2013 budget submission, the Air Force canceled the Increment II program. Prior to this cancellation, the Air Force planned to invest \$272.3 million in RDT&E funding through fiscal year 2016 to begin developing this new capability.

^bTotal does not include funding needed to support Air Force plans to modernize three additional EC-130H aircraft in fiscal years 2017 through 2018 because the Air Force has not yet identified these funding requirements. However, according to Air Force officials, they expect the 2017 and 2018 modernization budgets to each remain constant with planned fiscal year 2016 funding of \$85.5 million.

^cIn its fiscal year 2013 budget submission, the Air Force canceled the MQ-9 Reaper Electronic Attack Pod program. Prior to this cancellation, remaining funding requirements for the program were expected to total \$180.6 million.

^dTotal excludes approximately \$16.0 million in program funding from the Operations and Maintenance, Army account, which the Army has used, in part, to lease C-12 aircraft to host the CEASAR pod. In fiscal year 2013, the Army plans to request an additional \$10.3 million in Operations and Maintenance funding to support these activities.

As table 2 shows, several airborne electronic attack systems are in an advanced stage of funding. However, under current estimates, over \$6.0 billion in funding is still required to fully deliver these new systems to the warfighter. Further, the department has not yet identified the full

amount of funding required for certain key systems, such as the Next Generation Jammer, which could require billions of additional dollars to field.

Correspondent to their different funding profiles, the department's new systems are also in various stages of development, with some progressing more efficiently than others. Table 3 identifies the mission role(s), developmental status, and fielding plans for these systems. In addition, appendix II provides additional details on the status of several of these programs.

Table 3: DOD’s Progress Developing and Fielding New Airborne Electronic Attack Systems

| System | Mission description | Development status | Actual/estimated fielding date |
|---|---|--|---------------------------------------|
| EA-18G Growler | Modified escort jamming | The Navy has fielded EA-18G aircraft with limited cost and schedule growth to date. Through fiscal year 2011, the Navy placed 90 of the planned 114 Growler aircraft under production contract. Operational testing identified suitability concerns, which the Navy has addressed through software changes. In July 2011, the system completed its first combat deployment supporting operations in Iraq and Libya. The Navy continues to develop new software blocks to add aircraft capability. | 2009 |
| CEASAR pod | Irregular warfare jamming | In September 2011, the Army initiated an operational assessment of the CEASAR system by deploying three pods; two contractor-owned, government-operated C-12 aircraft; and associated operators and support personnel to Operation Enduring Freedom. Following this authorized 1-year assessment, the Army will make a determination on CEASAR’s readiness to transition into a formal acquisition program. | 2011 |
| Large Aircraft Infrared Counter-measures (LAIRCM) | Aircraft self-protection | Current acquisition plans add a next generation missile warning system to LAIRCM to provide improved detection against infrared threat missiles. Recently, the next generation missile warning system completed initial operational test and evaluation, and a full rate production decision is planned for 2012. | 2011 |
| IDECM Blocks 3 and 4 | Aircraft self-protection | IDECM Block 3 entered full rate production in 2011. IDECM Block 4 integrates significant hardware design changes to the ALQ-214 onboard jammer component. These changes will enable the system to operate on F/A-18C/D aircraft, while maintaining the system’s functionality on F/A-18E/F aircraft. Planned concurrency in the Block 4 testing and production schedules increases risk of retrofits to delivered systems. | 2011 (Block 3) 2014 (Block 4) |
| AARGM | Suppression and destruction of enemy air defenses | Hardware and software failures during operational testing in 2010—and subsequent deferral of remaining testing—drove a 9-month fielding delay to the system. Manufacturing quality and reliability concerns prompted the Navy to institute a “fly before you buy” program to screen poor weapons prior to government acceptance. AARGM recently resumed operational testing, but the Navy assesses system suitability as high risk. | 2012 |
| Intrepid Tiger II | Irregular warfare jamming | The Intrepid Tiger II program is developing 2 pod variants for AV-8B (variant 1) and RQ-7B (variant 2) aircraft. Variant 1 entered operational testing in 2011 ahead of planned deployment of initial pods. Design change costs, including a radio system change, were absorbed by reducing pod quantities (14 to 8). Variant 2 testing under the Collaborative On-line Reconnaissance Provider/Operationally Responsive Attack Link demonstration program concluded in April 2011. Full performance of variant 2 pods remains unproven due to platform (RQ-7B) unavailability and integration issues, including susceptibility to electromagnetic interference. | 2012 (Variant 1) TBD (Variant 2) |
| MALD | Suppression of enemy air defenses | MALD operational testing was suspended following anomalies and subsequent crashes of test vehicles in June 2010 and February 2011. System design changes facilitated a return to testing, but an August 2011 test shot also failed. Testing concluded in September 2011. | 2012 |

| System | Mission description | Development status | Actual/estimated fielding date |
|--|------------------------------------|--|---|
| MALD-J | Stand-in jamming | MALD-J employs the same flight vehicle as MALD, with slight differences to account for inclusion of a jammer. The Air Force approved MALD-J entry into low rate initial production in September 2011, with planned production start in May 2012. Operational testing has been reduced from 15 to 7 months in an attempt to mitigate program delays resulting from MALD design deficiencies. DOD states this reflects an increase in test range priority and a decrease in data turnaround time. | 2012 |
| MALD-J Increment II | Stand-in jamming | Funding shortfalls curtailed Air Force plans to award a technology development contract in fall 2011 for MALD-J sensitivity and jamming power improvements—key capability gains intrinsic to Increment II. The program was later canceled in the fiscal year 2013 budget submission. | N/A |
| EC-130H Compass Call (Baselines 2 and 3) | Stand-off jamming (communications) | Baseline 2 modernization—currently scheduled for 8 of the Air Force's planned 15 EC-130H aircraft—adds new capabilities including improved special purpose emitter array transmitters and addresses aircraft obsolescence issues. Modification work on the first of these 8 aircraft began in fiscal year 2011, with 3 more aircraft following in fiscal year 2012. The Air Force is currently studying configuration options for Baseline 3, which officials expect to install on 7 EC-130H aircraft. | 2014 (Baseline 2) 2017 (Baseline 3) |
| F-35 Lightning II (Joint Strike Fighter) | Penetrating escort | F-35 entered low rate initial production in 2007 and has since experienced significant cost growth and schedule delays. Development challenges caused the program to be restructured in 2010, triggering a Nunn-McCurdy cost breach. ^a GAO has repeatedly expressed concerns about the F-35's technology maturity and design stability. The program revised its testing plan and is making progress against a new schedule. | TBD ^b |
| MQ-9 Reaper Electronic Attack Pod | Irregular warfare jamming | Prior to cancelling the program in its fiscal year 2013 budget submission, the Air Force planned to integrate electronic attack pods on Block 5 MQ-9 aircraft—the first units expected to have sufficient power to operate the pods. Program officials stated that electromagnetic interference caused by the pods jamming the MQ-9 command and control systems posed a key technical challenge. The program entered technology maturation phase in 2010 and planned to award an engineering and manufacturing development contract in 2013. | N/A |
| Next Generation Jammer | Modified escort jamming | The Navy plans to award technology development contracts for the system in the third quarter of fiscal year 2013, with award of an engineering and manufacturing development contract to follow in 2015. In November 2010—based on findings from the system's analysis of alternatives—Navy leadership directed the program to pursue a block approach to developing capability, whereby mid-, low-, and high-band jammers would be progressively fielded on EA-18G aircraft and, through a later increment, F-35 aircraft. | 2020 (Mid-band) 2022 (Low-band) 2024 (High-band) ^c |

Legend: N/A = not applicable; TBD = to be determined.

Source: GAO analysis of DOD data.

^aA Nunn-McCurdy cost breach occurs when a program's unit cost exceeds certain statutory thresholds.

^bF-35 does not currently have an approved fielding date. Prior to the program's Nunn-McCurdy breach, the Marine Corps planned to declare initial operational capability for the aircraft in 2012. However, since the breach, DOD has not yet approved a new acquisition program baseline, and the services continue to evaluate potential fielding dates for the F-35.

^cDates provided reflect system fielding plans with EA-18G; fielding dates with F-35 are undetermined.

Some Programs Are Progressing Well

Some airborne electronic attack acquisition programs have reached stable production with limited cost growth or schedule delays. Two primary examples include the following:

- **EA-18G Growler:** Acquisition of the EA-18G Growler—a modified escort jamming platform designed to carry AN/ALQ-99 and future Next Generation Jammer pods—achieved initial capability in September 2009, consistent with its 2007 baseline schedule. Additionally, program costs per aircraft increased less than one-half of 1 percent from 2003 to 2010—an outcome partially attributable to quantity increases from 90 to 114.
- **EC-130H Compass Call (Baselines 2 and 3):** Modernization of the EC-130H Compass Call is on schedule for fielding a new increment of capability, Baseline 2, in 2014 within available funding limitations. Baseline 2 introduces several new capabilities, including reactive radar response and the Joint Tactical Radio System terminal that has been delayed because of testing challenges. However, Compass Call program officials do not expect the radio system delay to affect the program's fielding plans for Baseline 2 aircraft. According to the Air Force, cost considerations are a primary criterion in developing EC-130H capability requirements. The program office does not entertain potential aircraft improvements unless those improvements are accompanied by full funding. The Air Force is initiating technology development activities for a subsequent phase of the modernization program, Baseline 3, and plans to begin production of these aircraft in 2014, with initial fielding scheduled for 2017.

Our previous work has shown that good acquisition outcomes are achieved through the knowledge-based approach to product development that demonstrates high levels of knowledge before significant commitments are made.⁸ In essence, knowledge supplants risk over time. This model relies on increasing knowledge when developing new products, separating technology development from product development, and following an evolutionary or incremental approach to product development. In this approach, developers make investment decisions on the basis of specific, measurable levels of knowledge at critical junctures before investing more money and before advancing to the next phase of

⁸GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-11-233SP](#) (Washington, D.C.: Mar. 29, 2011).

Some Programs Are Underperforming

acquisition. The good outcomes on the EA-18G and EC-130H programs can be attributed, in part, to acquisition strategies embodying elements of best practices.

Other airborne electronic attack acquisition programs have not progressed as efficiently, however. These systems have proceeded through product development with lower-than-desired levels of knowledge and subsequently faced technical, design, and production challenges, contributing to significant cost growth, fielding delays or both. Most notably, these systems entered—or are on track to enter—production before completing key development activities, including achievement of stable designs. We previously reported that concurrency in development and production activities limits the ability of an acquisition program to ensure that the system will work as intended and that it can be manufactured efficiently to meet cost, schedule, and quality targets.⁹

- **MALD/MALD-J:** MALD was authorized for low rate initial production in June 2008 with an initial plan for 300 low rate initial production units in two lots, beginning in March 2009. However, testing failures in 2010 and 2011—coupled with a desire to avoid a potentially costly break in production—prompted the Air Force to extend MALD low rate initial production by two additional lots and increase total quantities under contract to 836. In September 2011, citing “successful completion of MALD-J engineering and manufacturing development activities,” the Air Force exercised a priced option to upgrade 240 of its planned MALD units to the MALD-J configuration, subsequently decreasing MALD quantities to 596. Because all future production lots are now planned as jammer-configured decoys (MALD-J), the 596 total represents the full MALD procurement—without the program having

⁹GAO, *Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed*, [GAO-10-439](#) (Washington, D.C.: Apr. 22, 2010).

ever met the criteria necessary to proceed into full rate production.¹⁰ Since the MALD and MALD-J designs are identical—except for the addition of a jammer module to MALD-J—the absence of a proven manufacturing process for MALD introduces schedule risk to production of MALD-J.¹¹ This risk is accentuated by continuing deficiencies affecting the MALD and MALD-J designs, which have required the Air Force to schedule additional developmental flight tests for each system in February 2012 to test corrective fixes. To the extent that this retesting phase shows a need for additional design changes, the Air Force may be forced to revisit its planned May 2012 production start for MALD-J.

- **AARGM:** The Navy authorized low rate initial production of AARGM units in September 2008 with initial deliveries scheduled to begin in January 2010. A total procurement objective of 1,919 units was set and an initial operational capability scheduled for March 2011. However, as a result of intermittent hardware and software failures in testing, the program was decertified for initial operational test and evaluation in September 2010, and low rate initial production deliveries were delayed until June 2011. The missile has subsequently reentered testing, but significant concerns about the system's reliability remain. Further, Navy officials stated that the current program schedule is oriented toward success with virtually no margin to accommodate technical deficiencies that may be discovered during operational testing. In the event operational testing reveals new or lingering major deficiencies, program officials report the planned April 2012 fielding date will be at risk, and the Navy may be forced to revisit its commitment to the program.

¹⁰Pursuant to DOD Instruction 5000.02 dated December 8, 2008, low rate initial production phase is intended to ensure adequate and efficient manufacturing capability and to produce the minimum quantity necessary to provide production or production-representative articles for initial operational testing and evaluation. In the case of MALD, technical deficiencies and design changes during low rate initial production prevented demonstration of an efficient manufacturing capability, which in turn prevented the system from meeting the department's criteria to enter full rate production. Department policy further states that in order for a system to receive full rate production approval, (1) demonstrated control of the manufacturing process and acceptable reliability, (2) the collection of statistical process control data, and (3) demonstrated control and capability of other critical processes must be shown.

¹¹According to DOD officials, any retrofits (design fixes) are under Raytheon (prime contractor) warranty with no additional cost to the government.

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- **IDECM:** From December 2000 to June 2010, the Navy authorized six different low rate initial production lots of IDECM Blocks 2 and 3, providing system improvements to the jammer and decoy components. Block 2 production units delivered ahead of schedule, but early Block 3 units encountered operational testing failures; later resolved, these failures drove production delays to remaining units. In Block 4, the Navy is introducing significant hardware design changes to the ALQ-214 jammer component. Ground and flight testing to prove out these design changes is scheduled concurrent with transition to production in April 2012, increasing risk that initial Block 4 units will require design changes and retrofits.¹² Officials stated that this concurrency is necessary in order to maintain an efficient production line transition from Block 3 to Block 4 and to meet the desired June 2014 fielding date. They further noted that transition to Block 4 production will initially be for 19 systems, with production rates increasing to as many as 40 per year following completion of testing.

Planned Systems May Offer Capabilities That Overlap, Presenting Opportunities to Consolidate Acquisition Efforts

Certain airborne electronic attack systems in development may offer capabilities that unnecessarily overlap with one another. This condition appears most prevalent with irregular warfare systems that the services are acquiring under DOD's fragmented urgent operational needs processes. For example, the Marine Corps, Army, and Air Force have all separately invested to acquire unique systems intended to jam enemy communications in support of ground forces. Further, Navy and Air Force plans to separately invest in new expendable decoy jammers—systems intended to counter near-peer adversaries—also appear to overlap. Declining military operations in Iraq and Afghanistan—coupled with recent changes in the Air Force's MALD-J program—afford opportunities to consolidate current service-specific acquisition activities. The department's ability to capitalize on these opportunities, however, may be undermined by a lack of designated, joint leadership charged with overseeing electronic warfare acquisition activities.

¹²According to DOD officials, the Navy negotiated a firm fixed price production contract for IDECM Block 4, under which cost risk associated with retrofits is borne by the contractor, without financial burden to the government.

Potential Overlap among Irregular Warfare Systems Driven by Service-Specific Solutions to Urgent Warfighting Needs

DOD is investing millions of dollars to develop and procure airborne electronic attack systems uniquely suited for irregular warfare operations. Services are acquiring these systems under both rapid acquisition authorities as well as through the traditional acquisition process. These systems overlap—at least to some extent—in terms of planned mission tasks and technical challenges to date. Yet, they have been developed as individual programs by the different services. Table 4 highlights overlap among three of these systems.

Table 4: Potential Overlap among Communications Jamming Systems Supporting Ground Forces

| System name | Intrepid Tiger II | CEASAR Pod | MQ-9 Reaper Electronic Attack Pod |
|-----------------------------------|--|---|--|
| Service sponsor | Marine Corps | Army | Air Force |
| Host platform | Variant 1: AV-8B fixed wing aircraft ^a Variant 2: RQ-7B unmanned aerial vehicle | C-12 fixed wing aircraft | MQ-9 Reaper unmanned aerial vehicle |
| Mission description | Communications jamming and surveillance capability in support of ground forces | Denial and disruption of enemy communications systems and improvised explosive devices in support of unit-level ground commanders | Communications and improvised explosive device jamming in support of combatant commander mission needs |
| Technical status | Program recently completed compatibility testing for variant 1 to identify potential electromagnetic interference issues and reduce system fratricide. Interoperability testing will not be completed until after the system has achieved early operational capability (fielding). Initial testing of variant 2 revealed electromagnetic interference with the RQ-7B's safety of flight systems as well as aircrew system feedback and usability issues with the electronic attack payload system interface. | Electromagnetic Interference issues—resulting from continuous low frequency jamming—were identified in testing, subsequently causing impairment to aircraft navigation and communications systems. According to Army officials, these challenges have been overcome with solutions proven during the system's recent 2011 operational assessment. | The Air Force canceled this program in its fiscal year 2013 budget submission. Prior to cancellation, program officials anticipated potential MQ-9 electromagnetic interference issues caused by the jamming pod that could interfere with the aircraft's communications link to ground station controllers. |
| Estimated acquisition cost | \$76.8 million | \$13.8 million ^b | \$233.7 million ^c |

Source: GAO analysis of DOD data.

^aIntegration and fielding on AV-8B aircraft represent minimum (threshold) requirements for the Intrepid Tiger II (Variant 1) pod. Beginning in fiscal year 2012, the Marine Corps plans to transition Intrepid Tiger II (Variant 1) to other fixed and rotary wing aircraft, including the F/A-18C/D.

^bTotal excludes \$26.3 million in funding from the Operations and Maintenance, Army budget account through fiscal year 2013. The Army uses these funds to (1) lease two C-12 aircraft to fly the CEASAR pod and (2) fund aircraft and pod sustainment costs.

^cReflects estimated acquisition cost prior to program cancellation.

According to DOD officials, airborne electronic attack limitations in recent operations, urgent needs of combatant commanders, and the desire to provide ground units with their own locally controlled assets have all contributed to service decisions to individually develop their own systems to address irregular warfare threats. For example, one Marine Corps official told us that his service is focused on increasing its airborne electronic attack capacity to meet Marine Air-Ground Task Force requirements in combat. Marine Corps systems typically equipped to perform these tasks—especially the EA-6B Prowler aircraft—have reached their capacity limits responding to combatant commander taskings. Similarly, Air Force officials stated that ground warfighter requests for airborne electronic attack capabilities sometimes go unfulfilled or are delayed because of the overall constrained capacity during current operations. Further, Army and Marine Corps officials see operational benefits to providing ground unit commanders with smaller airborne electronic attack assets—permanently integrated within the unit—to free up Air Force and Navy assets for larger-scale missions. In addition, the capabilities offered by current jamming pods, such as the AN/ALQ-99, are often overkill for the irregular warfare mission needs—such as counter-improvised explosive device activities—facing ground unit commanders.

Requirements for several of these irregular warfare systems were derived from DOD urgent needs processes—activities aimed at rapidly developing, equipping, and fielding solutions and critical capabilities to the warfighter in a way that is more responsive to urgent requests than the department’s traditional acquisition procedures. As we previously reported, the department’s urgent needs processes often lead to multiple entities responding to requests for similar capabilities, resulting in potential duplication of efforts.¹³ Even under these circumstances, the services have shown it is possible to take steps to share technical information among the different programs and services. For instance, the Army’s CEASAR pod is derived from the AN/ALQ-227 communications jammer used on the Navy’s EA-18G—an attribute that Army officials state reduced design risk in the program and provided opportunities for decreased sustainment costs and reuse of jamming techniques between the two services. Similarly, Air Force efforts to develop electronic attack

¹³GAO, *Warfighter Support: DOD’s Urgent Needs Processes Need a More Comprehensive Approach and Evaluation for Potential Consolidation*, [GAO-11-273](#) (Washington, D.C.: Mar. 1, 2011).

Navy and Air Force Have Not
Agreed on a Common Decoy
Solution

pods flown on MQ-9 Reaper unmanned aerial vehicles (prior to that program's cancellation) leveraged previous technology investments for the canceled B-52-based stand-off jammer.

As military operations in Iraq and Afghanistan wind down—and the services evaluate whether to transition their current urgent needs programs over to the formal weapon system acquisition process—opportunities may exist to consolidate program activities, such as the Intrepid Tiger II and CEASAR systems that are still demonstration programs whose transitions to formal acquisition programs have not yet been determined.

The potential for unnecessary overlap in efforts within the airborne electronic attack area is not limited to irregular warfare systems. With respect to near-peer systems, both the Air Force and Navy are separately pursuing advanced jamming decoys—the Air Force through its MALD-J program, and the Navy through its planned Airborne Electronic Attack Expendable initiative.

The two services have held discussions with one another about combining efforts toward a joint solution, including a meeting between Navy and Air Force requirements offices and acquisition officials in December 2010, but they have not yet reached resolution on a common path forward. According to Navy officials, relatively minor design and software modifications to what was a planned second increment to the Air Force's MALD-J system could produce a system that satisfies both services' mission requirements. However, Air Force officials stated that accommodating the Navy's mission requirements within the system would increase program costs and delay planned fielding of the Increment II system, essentially rendering the planned program unexecutable. Subsequently, Air Force officials stated that unless Increment II, in its planned configuration, sufficiently met Navy requirements, they did not expect the Navy to have any formal role in the program. In July 2011, however, the Air Force suspended MALD-J Increment II activities because of a lack of future funding availability. In February 2012, the Air Force's fiscal year 2013 budget submission officially canceled the program.¹⁴ This cancellation affords an opportunity for continued dialogue

¹⁴According to DOD, the Air Force is to provide a new plan for developing and procuring an Increment II variant of MALD-J and report to the Deputy Secretary of Defense by March 30, 2012.

Leadership Deficiencies
Undermine the Department's
Ability to Reduce Overlap

between the two services on the potential benefits and drawbacks to pursuing a common acquisition solution.

In 2009, DOD completed a capabilities analysis that cited electromagnetic spectrum leadership as the highest priority among 34 capability gaps identified. The study concluded, in part, that leadership deficiencies, or its absence, significantly impede the department from both identifying departmentwide needs and solutions and eliminating potentially unnecessary overlap among the services' airborne electronic attack acquisitions. Specifically, the department lacks a designated, joint entity to both coordinate internal activities and represent electronic warfare activities and interests to outside organizations. Acknowledging this leadership gap, and its relation to acquisition activities, the department has initiated efforts to organize the Joint Electromagnetic Spectrum Coordination Center under the leadership of U.S. Strategic Command. In addition, officials representing the Office of the Assistant Secretary of Defense for Research and Engineering stated that they are considering actions they might take to improve leadership and oversight of electronic warfare acquisition activities across the services. In a separate report, we intend to evaluate planned and existing electronic warfare governance structures within DOD.

Planned Systems Will Not
Fully Address Capability
Gaps

Notwithstanding the considerable investment over the years in new and enhanced airborne electronic attack systems and subsystems, capability gaps, some identified a decade ago, are expected to persist, or even increase, through 2030 as adversary capabilities continue to advance. In a series of studies since 2002, DOD identified existing current and anticipated gaps in required capabilities. Some have persisted for years—for example, deficiencies in certain jamming capabilities to provide cover for penetrating combat aircraft. The analyses found that, in many cases, new materiel solutions were required to close these gaps. Table 5 outlines primary findings from three major analyses.

Table 5: Primary Airborne Electronic Attack Capability Needs Identified since 2002

| Capabilities analysis | Analysis sponsor | Needs identified |
|---|------------------------------------|--|
| Airborne Electronic Attack Analysis of Alternatives (2002) | Office of the Secretary of Defense | Stand-in and core component jamming capability needs identified. The analysis outlined 27 potential platform combinations to address these needs. |
| Initial Capabilities Document for Denying Enemy Awareness through Airborne Electronic Attack (2004) | Air Force | Identified Air Force needs for materiel solutions to provide stand-off and modified escort jamming, in light of the then-pending retirement of Navy EA-6B Prowler aircraft. The document also identified penetrating escort and stand-in jamming capability needs unique to the Air Force, while identifying potential materiel solutions. |
| Electronic Warfare Initial Capabilities Document (2009) | U.S. Strategic Command | Identified 34 electronic warfare enterprise-wide capability gaps. Fifteen of these gaps relate directly to the airborne electronic attack mission area. The study concluded that of these 15 gaps, 7 require new materiel solutions. Top priority is fixing leadership shortfalls. |

Source: GAO analysis of DOD data.

The 2002 analysis identified needs for stand-in and core component jamming capabilities and suggested numerous ways to meet these. The 2004 study revalidated these gaps and outlined 10 potential materiel solutions to fill those gaps. It also acknowledged the existence of both near-peer and irregular warfare threats requiring airborne electronic attack solutions. The Army and Marine Corps requested that the analysis address irregular warfare threats because of the growing concern over improvised explosive devices in Iraq and Afghanistan and the suboptimal application of existing systems in the inventory to defeat those threats. The Air Force concluded in its analysis that fulfilling airborne electronic attack mission needs would require developing and fielding multiple new systems.

The most recent study, U.S. Strategic Command's Electronic Warfare Initial Capabilities Document, identified additional capability gaps affecting airborne electronic attack. This 2009 analysis built upon a capabilities-based assessment completed a year earlier and outlined mitigation strategies to address these gaps instead of merely prescribing specific platform solutions. This approach was consistent with the analysis's charter to guide and inform the services' acquisition programs. However, the analysis did recommend specific capabilities and system attributes for

the Next Generation Jammer program to consider that would assist in mitigating some of the gaps identified in the 2009 analysis. The analysis also concluded that new systems would be needed to close nearly half of the gaps identified in airborne electronic attack capabilities.

Improvements to Tactics, Techniques, and Procedures and Investments in Science and Technology Are Helping to Bridge Gaps

To supplement its acquisition of new systems, DOD is undertaking other efforts to bridge existing airborne electronic attack capability gaps. In the near term, services are evolving their tactics, techniques, and procedures for operating existing systems to enable them to take on additional mission tasks. These activities maximize the utility of existing systems and better position operators to complete missions with equipment currently available. Longer-term solutions, however, depend on the department successfully capitalizing on its investments in science and technology. DOD has recently taken actions that begin to address long-standing coordination shortfalls in this area including designating electronic warfare as a priority area for investment and creating a steering council to link capability gaps to research initiatives. However, these steps do not preclude services from funding their own research priorities ahead of departmentwide priorities. DOD's planned implementation roadmap for electronic warfare offers an opportunity to assess how closely component research investments are aligned to the departmentwide electronic warfare priority.

Changing Tactics, Techniques, and Procedures for Existing Systems Can Mitigate Gaps in the Near Term

The refinement of tactics, techniques, and procedures can position the services to maximize the capabilities of existing systems while new capabilities are being developed. As Navy airborne electronic attack operators stated, when a capability gap requiring a new system is identified, warfighters generally do not have the luxury of waiting for the acquisition community to develop and field a system to fill that gap. In the interim, tactics, techniques, and procedures for existing systems must evolve to provide at least partial mitigation to the threat being faced. Development and refinement of new ways to use existing equipment allow the services to maximize the utility of their airborne electronic attack systems and leave them better positioned to complete missions with the assets they have available. The following two systems provide examples where operator communities have refined tactics, techniques, and procedures to meet emerging threats:

- **AN/ALQ-99 Tactical Jamming System:** Navy officials told us that threats encountered in Iraq and Afghanistan operations have driven significant changes to how the AN/ALQ-99 Tactical Jamming System is employed. In essence, tactics, techniques, and procedures for the

system had to evolve to maximize the system's capabilities against irregular warfare threats. According to Navy officials, however, these adaptations represent only a temporary solution as their application—coupled with increased operational activity—has caused jamming pods to degrade and burn out at an increasing rate, subsequently increasing maintenance requirements for the system.

- **EC-130H Compass Call:** According to Air Force officials, EC-130H tactics, techniques, and procedures have rapidly evolved to encompass dynamically changing electronic attack threats, which include irregular warfare. These changes include modifications to both how the operator employs the aircraft as well as to the range of threats targeted by mission planners.

Both Navy and Air Force officials emphasized that sustained investments in tactics, techniques, and procedures offer considerable return on investment and can provide important, near-term solutions to longer-term, persistent threats. According to these officials, these investments position operators to “do more with less”—in effect, offer them the opportunity to mitigate or counteract a threat without the required new system. However, limits exist to the extent to which refinements to current operating approaches for existing systems can bridge capability gaps. For example, it is increasingly difficult to further optimize AN/ALQ-99 jamming pods to counter advanced, integrated air defense systems. Specifically, Navy officials stated that the AN/ALQ-99 has reached its limit in terms of the underlying architecture's capability to grow to counter new, sophisticated types of threats.

DOD Focusing Science and Technology Investments to Close Gaps in the Long Term, but Coordination Remains a Concern

Investment in the science and technology research base is a longer-term approach DOD uses to address capability gaps in mission areas. Electronic warfare, including airborne electronic attack, is supported by research investments in fields such as sensors, apertures, power amplifiers, and unmanned aircraft technology that may help address existing capability gaps. Service components categorize research investments differently from one another, which complicates efforts to clearly define funding devoted to airborne electronic attack. Table 6 identifies some of DOD's current airborne electronic attack-related research investments.

Table 6: Current DOD Science and Technology Initiatives Related to Airborne Electronic Attack

| Agency | Acquisition vehicle | Examples of funded programs/fields | Budgeted funds |
|---|--|--|---|
| Office of Naval Research | Long-range broad agency announcement | Electronics, Sensors, & Network Research Receivers & Antennas Power Amplifiers | A total of \$4.0 million in fiscal year 2011 for all electronic warfare research, but new plans are to increase this amount to approximately \$24.0 million annually |
| Air Force Research Laboratory | Research interests of the office's broad agency announcement | Electro-Energetic Physics Materials & Metamaterials Receiver Technology | A total of \$29.7 million in fiscal year 2011 for all electronic warfare research, decreasing to \$24.2 million in fiscal year 2012, with plans to increase funding in fiscal year 2013 |
| Defense Advanced Research Projects Agency (DARPA) | Project-specific broad agency announcements | Behavioral Learning for Adaptive Electronic Warfare Precision Electronic Warfare | A total of \$20.7 million in fiscal year 2011 and \$18.8 million in fiscal year 2012 for these two electronic warfare research programs |

Source: GAO analysis of DOD data.

However, not all investments in these fields will necessarily improve airborne electronic attack capabilities. Research officials identify the transition to system development and procurement as one of the primary goals of defense research programs, but acknowledge, reasonably, that not every program will successfully develop a transitionable product. Some acquisition programs, such as the Next Generation Jammer and the MQ-9 Reaper Electronic Attack Pod, invest directly in research to guide the transition process and increase the likelihood of success. But even with this direct attention, technology maturation and development for Next Generation Jammer is expected to last 8 to 9 years. Consequently, current science and technology initiatives represent a long-term investment in future capabilities and are less suited to meeting existing needs.

DOD analyses during the past decade have identified coordination deficiencies that constrain the department's ability to capitalize on its science and technology investments. For instance, a 2005 Naval Research Advisory Committee report found that within the Navy, research and development efforts were unduly fragmented, with one laboratory or development activity often being unaware of what another was doing.¹⁵ Further, this study highlighted the lack of a long-range science and technology investment planning process within the Navy. Similarly, in 2007, the Defense Science Board reported that although relevant and valuable science and technology activity was occurring, an overarching, departmentwide strategic technology plan with assigned responsibility, accountability, and metrics did not exist.¹⁶ According to the board, DOD's science and technology activities and investments should be more directly informed by the department's strategic goals and top-level missions—an objective that would require a closer coupling of technologists and users, including requirements and capabilities developers. A 2010 Naval Research Advisory Committee report¹⁷ built on previous findings noted that stewardship of long-term naval capabilities was “vague at best” and lacked specific organizational assignment.¹⁸ The report recognized the Navy as having the lead role within DOD for electronic warfare, but identified sporadic and uncoordinated execution across the technical community—noting little evidence of engagement among the science and technology community at large. Further, the report advised that closer coordination between operational and technical communities was essential for the realization of desired long-term capabilities.

DOD has recently taken actions that begin to address these shortfalls, including formalizing existing investment processes for several key science and technology areas. Most notably, in April 2011 the Secretary

¹⁵Naval Research Advisory Committee, *Science and Technology for Naval Warfare 2015-2030*, NRAC-05-3 (Arlington, Va.: August 2005).

¹⁶Defense Science Board, *2006 Summer Study on 21st Century Strategic Technology Vectors* (Washington, D.C.: Feb. 1, 2007).

¹⁷Naval Research Advisory Committee, *Status and Future of the Naval R&D Establishment* (Arlington, Va.: September 2010).

¹⁸The report characterized long-term naval capabilities as the “Navy-After-Next.” Navy-After-Next represented concepts, platforms, and systems that had yet to be conceived, defined, or both, and for which there was no program of record.

of Defense designated electronic warfare as one of seven priority areas for science and technology investment from fiscal years 2013 through 2017. According to officials from the Office of the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)), this designation carries the promise of increased research funding and has prompted chartering of the interdepartmental Electronic Warfare Priority Steering Council. This council is made up of research officials from ASD (R&E), the services, and various defense science and technology groups, such as the Defense Advanced Research Projects Agency, and is charged with effectively evaluating electronic warfare capability gaps and linking them with research initiatives necessary to fill them. To support this process, the council is developing an implementation roadmap to guide coordination of investments within the electronic warfare area. The council also facilitates ASD(R&E) coordination with requirements teams and service/external research offices to determine the specific fields of inquiry that will be needed to support planning for future electronic warfare capability needs. Previously, this coordination was handled informally, whereas the new council provides authority and visibility to the discussions and decisions made.

Notwithstanding these important steps, services may inevitably face situations where they have to choose between funding their own, service-specific research priorities and funding departmentwide priorities. As the Assistant Secretary of Defense for Research and Engineering testified in 2011, DOD's seven priority areas for science and technology investment are meant to be in addition to the priorities outlined by individual components (i.e., service research agencies and DARPA).¹⁹ In other words, departmentwide science and technology priorities do not necessarily supplant service priorities. Absent strategic direction, however, services have generally been inclined to pursue their own research interests ahead of departmentwide pursuits. DOD's planned implementation roadmap for electronic warfare offers opportunities to assess how closely component research investments are aligned to the departmentwide electronic warfare priority and to coordinate component investments in electronic warfare.

¹⁹Testimony of the Honorable Zachary J. Lemnios, Assistant Secretary of Defense for Research and Engineering, in a hearing before the House Committee on Armed Services, Subcommittee on Emerging Threats and Capabilities, on March 1, 2011.

Conclusions

The rapidity of evolving threats, together with the time and cost associated with fielding new systems, creates a major challenge to DOD and its capacity to fill all of its capability gaps. This dynamic makes it imperative that the department get the most out of its electronic warfare investments. At this point, that does not appear to be the case. The systems being acquired have problems and will not deliver as expected; potential overlap, to the extent that it leads to covering some gaps multiple ways while leaving others uncovered, drains buying power from the money that is available; and DOD acknowledges a leadership void that makes it difficult to ascertain whether the current level of investment is optimally matched with the existing capability gaps.

Within the airborne electronic attack mission area, budgetary pressures and related program cancellations prompted the department to change its acquisition strategy from a system of systems construct—as underpinned by the 2002 analysis of alternatives—to a potentially less robust, but more affordable, family of systems. In addition, new systems, including AARGM and MALD, that are designed to replace or augment legacy assets have encountered technical challenges while in acquisition, subsequently requiring the services to delay fielding plans within each program. Other acquisition programs, including IDECM and MALD-J, are structured with a high degree of concurrency between development, production, and testing that position them for similar suboptimal outcomes. Although individual service decisions to delay or cancel underperforming or resource-intensive programs may be fiscally prudent, the cumulative effect of these decisions creates uncertainty as to when, or if, current departmentwide airborne electronic attack capability gaps can be filled. At present, even if the department successfully acquires the full complement of systems outlined in its family of systems strategy, some capability gaps identified a decade ago may persist. As such, the department can benefit from reevaluating its capability gaps—using structures like the new Electronic Warfare Priority Steering Council—to identify which ones are highest priorities for science and technology investment and to determine areas where it is more willing to accept mission risk. This analysis, when coupled with an examination of current service-specific science and technology investments, can position DOD to realize improved efficiencies in its electronic warfare research activities and better align constrained budgets with highest-priority needs. Additionally, because underperformance in acquisition programs exacerbates existing capability gaps, realistic assessments of higher-risk programs can provide needed insight into what capabilities each platform is likely to deliver and when. Shortfalls in acquisition should not be the deciding factor on which capability gaps the department accepts.

At the same time, services continue to pursue and invest in multiple separate airborne electronic attack systems that potentially overlap with one another. This overlap is most evident in irregular warfare systems, including the Marine Corps's Intrepid Tiger II and the Army's CEASAR systems, but is also present in Air Force and Navy efforts to develop expendable jamming decoys through their respective MALD-J and Airborne Electronic Attack Expendable initiatives. Pursuing multiple separate acquisition efforts to develop similar capabilities can result in the same capability gap being filled twice or more, can lead to inefficient use of resources, and may contribute to other warfighting needs going unfilled. Leveraging resources and acquisition efforts across services—not just by sharing information, but through shared partnerships and investments—can simplify developmental efforts, can improve interoperability among systems and combat forces, and could decrease future operating and support costs. Such successful outcomes can position the department to maximize the returns it gets on its airborne electronic attack investments.

Recommendations for Executive Action

We recommend that the Secretary of Defense take the following five actions:

- Given airborne electronic attack programmatic and threat changes since 2002, complete the following:
 - Conduct program reviews for the AARGM, IDECM, MALD, and MALD-J systems to assess cost, schedule, and performance and direct changes within these investments, as necessary.
 - Determine the extent to which the most pressing airborne electronic attack capability gaps can best be met—using the assets that are likely to be available—and take steps to fill any potential gaps.
 - Align service investments in science and technology with the departmentwide electronic warfare priority, recognizing that budget realities will likely require trade-offs among research areas, and direct changes, as necessary.
- To ensure that investments in airborne electronic attack systems are cost-effective and to prevent unnecessary overlap, take the following actions:
 - Review the capabilities provided by the Marine Corps's Intrepid Tiger II and Army's CEASAR systems and identify opportunities for consolidating these efforts, as appropriate.

-
- Assess Air Force and Navy plans for developing and acquiring new expendable jamming decoys, specifically those services' respective MALD-J and Airborne Electronic Attack Expendable initiatives, to determine if these activities should be merged.

Agency Comments and Our Evaluation

We provided a draft of this report to DOD for comment. In its written comments, which are reprinted in appendix III, DOD concurred with three of our recommendations and partially concurred with two recommendations. DOD also provided technical comments that we incorporated into the report, as appropriate.

DOD concurred with our first recommendation to conduct program reviews for the AARGM, IDECM, MALD, and MALD-J systems and direct changes within these investments, as necessary, identifying a March 2012 Navy review of the IDECM program and planned July 2012 Navy review of the AARGM system. For MALD and MALD-J, DOD plans to conduct a program review in early 2014, which will coincide with a planned full rate production decision for MALD-J. In the interim, DOD intends to continue low rate initial production of MALD-J units. However, because MALD has experienced significant technical challenges within the past 2 years, and because DOD plans to invest an additional \$176.9 million toward MALD-J production through fiscal year 2014, we believe an earlier review may be warranted. In its written comments, DOD also stated that the Deputy Assistant Secretary of Defense for Strategic and Tactical Systems will chair a meeting to review AARGM, IDECM, MALD, and MALD-J with the Navy and Air Force to verify progress, but it did not provide a timetable for this review.

DOD also concurred with our second recommendation to determine the extent to which the most pressing airborne electronic attack capability gaps can best be met—using the assets that are likely to be available—and take steps to fill any potential gaps. Most notably, DOD cited plans for U.S. Strategic Command to annually assess all DOD electronic warfare capabilities—including current requirements, current and planned future capabilities, and the supporting investment strategy—and present this assessment to the Joint Requirements Oversight Council. Further, DOD concurred with our third recommendation to align service investments in science and technology with the departmentwide electronic warfare priority, noting in its written comments that it expects implementation roadmaps for priority areas (including electronic warfare) will serve to coordinate component investments and accelerate the development and delivery of capabilities.

DOD partially concurred with our two recommendations related to potentially unnecessary overlap among airborne electronic attack systems, identifying through its written comments plans for the Deputy Assistant Secretary of Defense for Strategic and Tactical Systems to review the Intrepid Tiger and CEASAR systems with the Marine Corps and Army to investigate the efficacy of additional coordination as future acquisition plans are evaluated. Similarly, DOD noted that following the expected March 30, 2012, completion of a new Air Force plan related to developing and procuring an Increment II variant of MALD-J, the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; Office of the Director, Cost Assessment and Program Evaluation; and Joint Staff would review Air Force and Navy plans and assess opportunities for coordination among the MALD-J and Airborne Electronic Attack Expendable initiatives, should funding be allocated for a future expendables program. However, the basis for DOD's partial agreement on these two recommendations appears to stem from its desire to achieve efficiencies through increased coordination among programs—not through consolidation of systems possessing similar capabilities. We emphasize that coordination is not a substitute for consolidation—particularly in the current constrained budget environment—and we encourage DOD to expand the scope of its planned reviews to include assessments of potential unnecessary redundancies within these two sets of systems.

Additionally, DOD commented that our draft report overstated the acquisition duplication among airborne electronic attack systems. Most notably, DOD pointed to its cancellations of the MQ-9 Electronic Attack Pod and MALD-J Increment II programs, as outlined in its fiscal year 2013 budget submission, as evidence that duplication was being managed. These cancellations were announced after we had completed our work and drafted the report. During the period that our draft report was with the agency for comment, we revised our report and recommendations, in coordination with DOD, to account for these recent changes. Most notably, we revised our fourth and fifth recommendations to remove the newly canceled MQ-9 Electronic Attack Pod and MALD-J Increment II systems, respectively, as additional platforms where DOD may identify opportunities for consolidation. DOD's written comments were subsequently crafted in response to our revised set of recommendations. As noted above, opportunities to reduce duplication further remain. We also briefly introduced the Marine Air Ground Task Force Electronic Warfare concept, in response to DOD's comments, while further clarifying that our report did not evaluate ground- or ship-based electronic warfare systems.

DOD also commented that our characterization of the family of systems strategy for airborne electronic attack was misleading, stating that the system of systems synergies envisioned in 2002 continue to be pursued. We acknowledge that DOD is considering options to field additional systems against high-end threats, but we believe that the current acquisition strategy and its distributed approach is very much in line with the definition of a family of systems, as outlined by DOD.²⁰ When DOD embarked on the system of systems strategy in 2002, it envisioned fielding certain major systems, such as B-52 Standoff Jammer and J-UCAS, which were later canceled. Without these planned elements, there is no evidence to suggest that the remaining systems together possess capability beyond the additive sum of the individual capabilities of its members—a characteristic fundamental to a system of systems.

We are sending copies of this report to interested congressional committees, the Secretary of Defense, the Secretary of the Army, the Secretary of the Navy, and the Secretary of the Air Force. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or sullivanm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IV.



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²⁰Office of the Deputy Under Secretary of Defense for Acquisition and Technology, Systems and Software Engineering, *Systems Engineering Guide for Systems of Systems, Version 1.0* (Washington, D.C.: August 2008).

Appendix I: Scope and Methodology

This report evaluates the Department of Defense's (DOD) airborne electronic attack capabilities and investment plans.¹ Specifically, we assessed (1) the department's strategy for acquiring airborne electronic attack capabilities, (2) progress made developing and fielding systems to meet airborne electronic attack mission requirements, and (3) additional compensating actions taken by the department to address capability gaps, including improvements to tactics, techniques, and procedures and investments in science and technology.

To assess the department's strategy for acquiring airborne electronic attack capabilities, we analyzed DOD's documents outlining mission requirements and acquisition needs, including the 2002 Airborne Electronic Attack Analysis of Alternatives, 2004 Initial Capabilities Document for Denying Enemy Awareness through Airborne Electronic Attack, 2008 Electronic Warfare Capabilities-Based Assessment, 2009 Electronic Warfare Initial Capabilities Document, and 2010 Electronic Warfare Strategy of the Department of Defense report to Congress. We also reviewed platform-specific capabilities documents, service roadmaps related to airborne electronic attack, and budget documents to understand how the family of systems construct evolved over time. To identify capability limitations and sustainment challenges facing current airborne electronic attack systems, we reviewed program briefings and acquisition documentation related to these systems. To further corroborate documentary evidence and obtain additional information in support of our review, we conducted interviews with relevant DOD officials responsible for managing airborne electronic attack requirements and overseeing the related family of systems, including officials in the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; Office of the Director, Cost Assessment and Program Evaluation; Office of the Assistant Secretary of the Navy for Research, Development and Acquisition; Office of the Chief of Naval Operations—Information Dominance and Air Warfare directorates; Office of the Assistant Secretary of the Air Force for Acquisition; Air Force Office of the Deputy Chief of Staff for Operations, Plans, and Requirements—Electronic Warfare division; Air Force Air Combat Command; Army Office of the Deputy Chief of Staff for Operations, Plans, and Training—Electronic Warfare division; Marine Air-Ground Task Force Electronic

¹As agreed upon with our congressional requesters, this report does not evaluate ground- or ship-based electronic warfare systems.

Warfare; U.S. Strategic Command; and Joint Staff. We also held discussions with DOD officials responsible for sustaining current airborne electronic attack systems, including officials in (1) Navy program offices for Airborne Electronic Attack, Advanced Tactical Aircraft Protection Systems, Direct and Time Sensitive Strike, and Aerial Target and Decoy Systems and (2) Air Force offices, including the F-22A Raptor and F-16CM program offices and Warner Robins Air Logistics Center.

To assess progress made developing and fielding systems to meet airborne electronic attack mission requirements, we analyzed documents outlining acquisition plans, costs, and performance outcomes, including capabilities documents, program schedules, test reports, budget submissions, system acquisition reports, and program briefings. These same materials afforded information on key attributes of individual airborne electronic attack systems, which we used to assess potential overlap among systems in development. Further, we identified persisting airborne electronic attack capability gaps by reviewing the 2009 Electronic Warfare Initial Capabilities Document, along with earlier analyses related to airborne electronic attack requirements, and compared the capability needs identified in those documents with current DOD investments in airborne electronic attack capabilities. To supplement our analyses and gain additional visibility into these issues, we conducted interviews with relevant DOD officials responsible for managing airborne electronic attack requirements, including officials in the Office of the Chief of Naval Operations—Information Dominance and Air Warfare directorates; Office of the Assistant Secretary of the Air Force for Acquisition; Air Force Office of the Deputy Chief of Staff for Operations, Plans, and Requirements—Electronic Warfare division; Air Force Air Combat Command; Army Office of the Deputy Chief of Staff for Operations, Plans, and Training—Electronic Warfare division; Marine Air-Ground Task Force Electronic Warfare; U.S. Strategic Command; and Joint Staff. We also held numerous interviews with DOD officials primarily responsible for developing, acquiring, and testing airborne electronic attack systems, including officials in the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; Office of the Director, Operational Test and Evaluation; Office of the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation; Office of the Assistant Secretary of the Navy for Research, Development and Acquisition; Office of the Assistant Secretary of the Air Force for Acquisition; Navy program offices for Airborne Electronic Attack, F/A-18 and EA-18G, Direct and Time Sensitive Strike, and Advanced Tactical Aircraft Protection Systems; Army Rapid Equipping Force; and Air Force program offices for MALD/MALD-J and MQ-9 Reaper Electronic Attack Pod.

To assess additional compensating actions taken by the department to address airborne electronic attack capability gaps, we reviewed service documents outlining recent improvements and refinements to tactics, techniques, and procedures for EA-18G and EC-130H aircraft. We corroborated this information through interviews with officials from the Naval Strike and Air Warfare Center and Air Force Office of the Deputy Chief of Staff for Operations, Plans, and Requirements—Electronic Warfare division charged with refining tactics, techniques, and procedures for EA-18G and EC-130H aircraft. We also reviewed broad agency announcements to understand ongoing science and technology activities related to airborne electronic attack. We supplemented this documentation review with discussions with officials engaged in science and technology work tied to airborne electronic attack, including officials in the Office of the Assistant Secretary of Defense for Research and Engineering, Office of Naval Research, Air Force Research Laboratory, and Defense Advanced Research Projects Agency.

We conducted this performance audit from February 2011 to March 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Analyses of Select Airborne Electronic Attack Systems

This appendix provides analyses of 10 selected airborne electronic attack systems. Figures 4 through 13 show images of each system; tables 7 through 16 provide budget data on each system.

Figure 4: EA-6B Prowler



Source: Northrop Grumman.

Estimated end of service life: 2020

Mission description: The primary mission of the Prowler is the suppression of enemy air defenses in support of strike aircraft and ground troops by interrupting enemy electronic activity and obtaining tactical electronic intelligence within the combat area. The EA-6B uses the AN/ALQ-99 radar jamming pod for non-lethal protection by jamming air defense systems and its AGM-88 High Speed Anti-Radiation Missile for lethal physical attack of air defense systems.

Status: In 2010, we reported that the Navy had started replacing its EA-6B aircraft with EA-18G Growlers and expected all Prowlers to be out of its inventory by 2012. However, the Navy projects Prowlers to remain in service until 2016 to further meet the joint expeditionary need. According to the Navy, this is subject to additional change contingent on the fiscal year 2013 budget. The Marine Corps plans to retire its Prowlers by 2020. In addition, the most recent upgrade program for the EA-6B—the third Improved Capability electronic suite modification (ICAP III)—is nearing completion. ICAP III provides the Prowler with greater jamming capability, including the ability to perform selective reactive jamming.

Appendix II: Analyses of Select Airborne
Electronic Attack Systems

Budget: See the following table for budget information.

Table 7: DOD Planned Acquisition Investments for the EA-6B Prowler, Fiscal Years 2012-2017

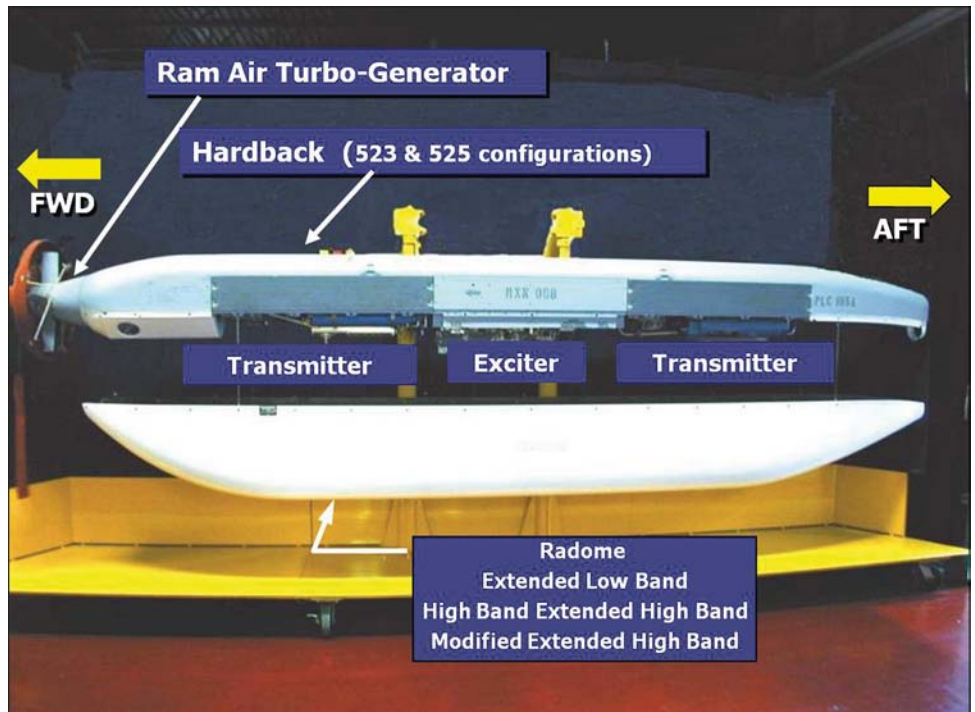
| Then-year dollars in millions | | | | | | | |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$20.222 | \$19.728 | \$19.931 | \$20.280 | \$20.252 | \$20.632 | \$121.045 |
| Procurement | 27.734 | 30.062 | 18.600 | 14.099 | 10.068 | 10.285 | \$110.848 |
| Total | \$47.956 | \$49.790 | \$38.531 | \$34.379 | \$30.320 | \$30.917 | \$231.893 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Note: RDT&E funding is limited to electronic warfare counter response.

Figure 5: AN/ALQ-99 Tactical Jamming System



Source: NAVAIR PMA-234.

Estimated end of service life:

Mid-band: 2024
Low-band: 2026
High-band: 2028

Mission description: The AN/ALQ-99 Tactical Jamming System is an airborne electronic warfare system carried on the EA-6B and EA-18G to support the suppression of enemy air defenses. The system is capable of intercepting, automatically processing, and jamming received radio frequency signals.

Status: Obsolescence issues and advances in adversary technology have reduced the AN/ALQ-99's ability to counter emerging threats. The Navy is developing its Next Generation Jammer program to replace the AN/ALQ-99 and plans to begin fielding the system in 2020. In the interim, the Navy is currently replacing three aging legacy low-band transmitters to resolve obsolescence and reliability problems.

Appendix II: Analyses of Select Airborne
Electronic Attack Systems

Budget: See the following table for budget information.

Table 8: DOD Planned Acquisition Investments for the AN/ALQ-99 Tactical Jamming System, Fiscal Years 2012-2017

| Then-year dollars in millions | | | | | | | |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | - | - | - | - | - | - | - |
| Procurement | \$69.665 | \$49.799 | \$40.078 | \$28.892 | \$35.963 | \$30.945 | \$255.342 |
| Total | \$69.665 | \$49.799 | \$40.078 | \$28.892 | \$35.963 | \$30.945 | \$255.342 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Note: There is no RDT&E funding associated with the AN/ALQ-99 Tactical Jamming System in the fiscal year 2013 budget.

Figure 6: EC-130H Compass Call



Source: 755 Maintenance Squadron, U.S. Air Force.

Estimated end of service life: 2053

Mission description: The EC-130H Compass Call is an airborne, wide area, persistent stand-off electronic attack weapon system able to disrupt and deny adversary use of the electronic battlespace using offensive radio frequency countermeasures. Its primary mission is to deny or disrupt command and control of enemy integrated air defenses, air defense surface-to-air missile and anti-aircraft artillery threats. Its secondary mission is to support ground and special operations forces by denying enemy communications and defeating improvised explosive devices.

Status: The Air Force has evolved the Compass Call since it was first fielded in 1982 to meet modern and emerging threats, including commercial communications, early warning radars, and improvised explosive devices. Upgrades and modernization efforts are completed during regularly scheduled depot maintenance. In 2003, as a response to Operation Enduring Freedom, these upgrades transitioned from “Block” upgrades to “Baseline” upgrades to allow for smaller and more focused modernization efforts. Currently, the Air Force is completing Baseline 1

upgrades, beginning Baseline 2 efforts, and developing Baseline 3 requirements. In addition, the Air Force is also replacing the center wing box on all 14 Compass Call aircraft, which will extend the service life of the fleet. Compass Call has been on continuous deployment in support of operations in Iraq and Afghanistan since 2003; which has accelerated the need to replace the center wing boxes. Finally, to further alleviate stress on the fleet, the Air Force plans to procure an additional aircraft, increasing the size of the fleet to 15 aircraft by fiscal year 2016.

Budget: See the following table for budget information.

Table 9: DOD Planned Acquisition Investments for the EC-130H Compass Call, Fiscal Years 2012-2017

| Then-year dollars in millions | | | | | | | |
|-------------------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$18.509 | \$12.094 | \$12.222 | \$12.559 | \$13.047 | \$12.989 | \$81.420 |
| Procurement | 302.324 | 64.024 | 55.878 | 54.108 | 56.480 | 57.552 | \$590.366 |
| Total | \$320.833 | \$76.118 | \$68.100 | \$66.667 | \$69.527 | \$70.541 | \$671.786 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Air Force fiscal year 2013 budget estimates.

Figure 7: F-22A Raptor



Source: U.S. Air Force.

Estimated end of service life: Not available

Mission description: The F-22A is the Air Force's fifth-generation air superiority fighter that incorporates a stealthy and highly maneuverable airframe, advanced integrated avionics, and a supercruise engine. Originally developed as an air-to-air fighter, additional capabilities will allow the F-22A to perform multiple missions including destruction of enemy air defenses, air-to-ground attack, electronic attack, and intelligence surveillance and reconnaissance.

Status: The F-22A, along with the F-35, is expected to fulfill the Air Force's requirement for penetrating escort jamming capability. The Air Force initiated a formal F-22A modernization and reliability improvement program in 2003 to incrementally develop and deliver increasing capabilities over time. These increasing capabilities would allow the F-22A to provide penetrating escort jamming, as envisioned in the airborne electronic attack family of systems strategy. However, fielding of these capabilities has been delayed because of reductions in program funding. In addition, we have previously reported on schedule delays within the modernization and reliability improvement program and their effect on fielding additional capabilities within expected time frames. Further delays

**Appendix II: Analyses of Select Airborne
Electronic Attack Systems**

in fielding these planned capabilities may affect the Air Force's ability to provide sufficient penetrating escort jamming, increasing mission risk.

Budget: See the following table for budget information.

Table 10: DOD Planned Acquisition Investments for the F-22A Raptor, Fiscal Years 2012-2017

Then-year dollars in millions

| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
|--------------|------------------|------------------|------------------|------------------|------------------|------------------|--------------------|
| RDT&E | \$571.320 | \$511.767 | \$503.242 | \$387.510 | \$430.947 | \$463.263 | \$2,868.049 |
| Procurement | 232.032 | 283.871 | 291.741 | 248.001 | 282.249 | 329.775 | \$1,667.669 |
| Total | \$803.352 | \$795.638 | \$794.983 | \$635.511 | \$713.196 | \$793.038 | \$4,535.718 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Air Force fiscal year 2013 budget estimates.

Note: The above budget figures are only for F-22A modernization efforts only and do not include \$104.118 million in fiscal year 2012 funds for equipment, program support, and shutdown activities necessary to preserve assets for long-term F-22A fleet sustainment.

Figure 8: EA-18G Growler



Source: Boeing.

Fielding date: 2009

Mission description: The EA-18G Growler replaces the EA-6B Prowler as DOD's tactical electronic attack aircraft. Like the Prowler, the EA-18G will provide full-spectrum electronic attack to counter enemy air defenses and communication networks. The EA-18G incorporates jamming capabilities, such as the AN/ALQ-99 Tactical Jamming System, and the use of onboard weapons such as the High Speed Anti-Radiation Missile, for the suppression of enemy air defenses. The Growler is the Navy's platform to fulfill modified escort jamming capability needs.

Status: The Growler program entered full rate production in 2009, with a planned acquisition of 88 aircraft. However, in 2009, the Office of the Secretary of Defense directed the Navy to buy an additional 26 aircraft, bringing the total units to be acquired to 114. Through fiscal year 2011, the Navy placed 90 of 114 planned EA-18G aircraft under contract for production. Production is slightly ahead of schedule and has incorporated the increase in total units with limited per-unit cost growth.

In 2010, the Director, Operational Test and Evaluation, declared the Growler operationally effective, but also found that the aircraft was unsuitable for operations based on maintainability concerns. Since then, the Navy has taken steps to improve the EA-18Gs suitability through software fixes, and the system recently completed follow-on operational test and evaluation. In addition, initial deployment of the aircraft in support of operations in Iraq, Libya, and Afghanistan recently concluded, and the Navy is assessing the aircraft's performance, including the remaining challenges mitigating electromagnetic interference with the AN/ALQ-99. Additional software improvements are planned through fiscal year 2018.

Budget: See the following table for budget information.

Table 11: DOD Planned Acquisition Investments for the EA-18G Growler, Fiscal Years 2012-2017

| Then-year dollars in millions | | | | | | | |
|-------------------------------|--------------------|--------------------|-----------------|-----------------|-----------------|-----------------|--------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$17.100 | \$13.009 | \$15.311 | \$16.002 | \$16.106 | \$16.393 | \$93.921 |
| Procurement | 1,022.715 | 1,027.443 | 21.970 | 8.111 | 0.000 | 0.000 | \$2080.239 |
| Total | \$1,039.815 | \$1,040.452 | \$37.281 | \$24.113 | \$16.106 | \$16.393 | \$2,174.160 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Note: The above budget figures do not include \$34.151 million in fiscal year 2013 for procurement of initial spares.

Figure 9: AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)



Source: NAVAIR PMA-242.

Estimated fielding date: 2012

Mission description: AARGM is an air-to-ground missile for carrier-based aircraft designed to destroy enemy radio-frequency-enabled surface-to-air defense. AARGM is an upgrade to the AGM-88 High Speed Anti-Radiation Missile (HARM) and will utilize existing HARM propulsion and warhead sections with new guidance and modified control sections.

Status: The Navy authorized AARGM production in September 2008, with deliveries scheduled to begin in January 2010. A total of 1,919 units were planned, with initial operational capability scheduled for March 2011. The program began operational testing in June 2010 after a 9-month delay owing, in part, to concerns about the production representativeness of test missiles. The Navy halted operational testing in September 2010 after hardware and software deficiencies caused a series of missile failures.

These testing challenges prompted the Navy to delay AARGM's planned initial operational capability date and undertake corrective actions to the system. These actions included an evaluation of the AARGM system through laboratory, ground, and flight tests from November 2010 through June 2011. Following this testing, Navy officials concluded that previous testing anomalies were successfully corrected but that the system was at high risk of not meeting suitability requirements during operational testing. The Navy found that insufficient system reliability and manufacturing quality controls remain open deficiencies that will likely result in an excessive number of system failures experienced by operational units, which could prevent the Navy from effectively executing planned missions. To address reliability concerns, the Navy instituted a "fly before you buy" program to screen poor weapons prior to government acceptance. As of July 2011, one-third of missiles delivered for testing were returned to the factory for repair.

Recently, the AARGM system resumed operational testing. The Navy now plans to field the system beginning in April 2012 and make a full rate production decision and contract award in June and July 2012, respectively.

Budget: See the following table for budget information.

Table 12: DOD Planned Acquisition Investments for AARGM, Fiscal Years 2012-2017

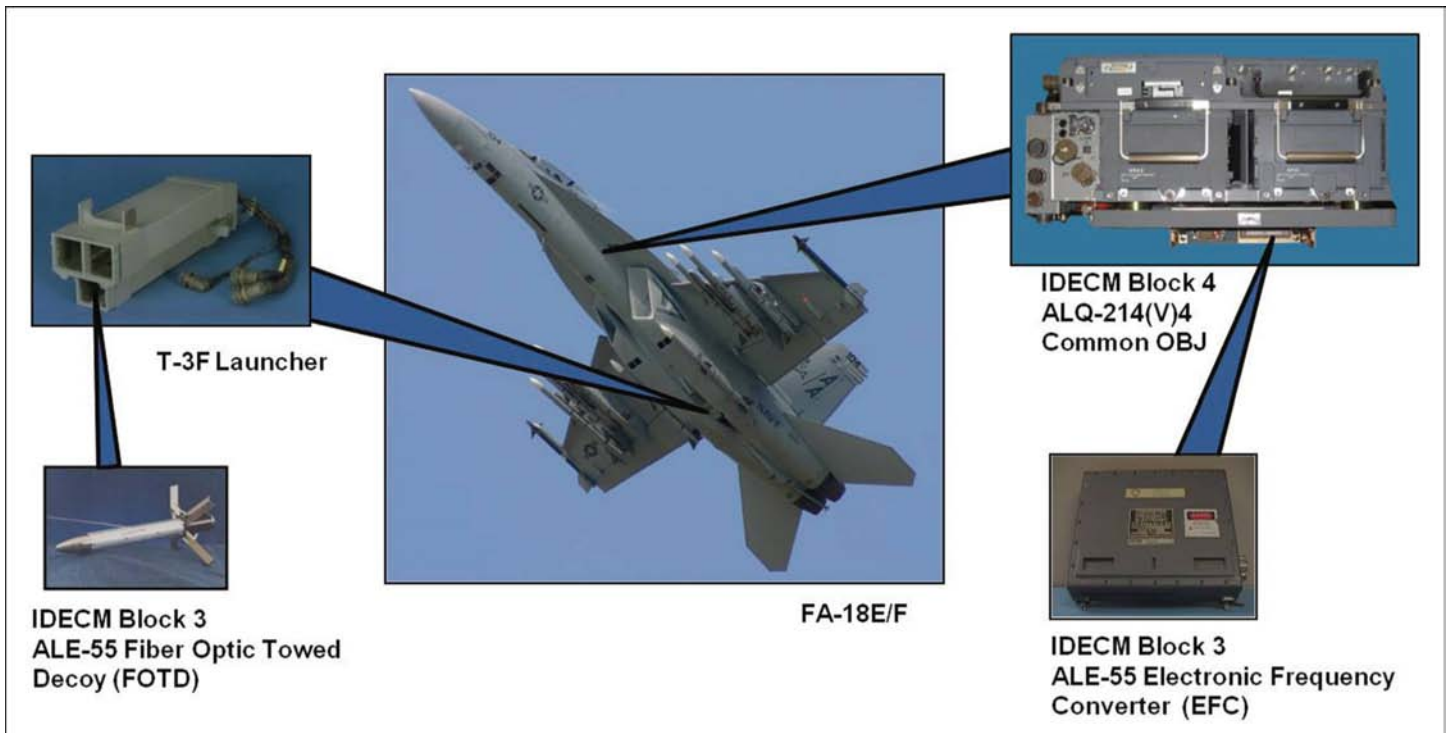
| Then-year dollars in millions | | | | | | | |
|-------------------------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$6.684 | \$6.995 | \$7.426 | \$5.470 | \$5.142 | \$5.028 | \$36.745 |
| Procurement | 71.561 | 86.721 | 112.022 | 126.324 | 158.073 | 160.820 | \$715.521 |
| Total | \$78.245 | \$93.716 | \$119.448 | \$131.794 | \$163.215 | \$165.848 | \$752.266 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Note: The above budget figures do not include \$0.209 million in fiscal year 2012 for procurement of initial spares.

Figure 10: Integrated Defensive Electronic Countermeasures (IDECM)



Source: U.S. Navy.

Estimated fielding date: 2014 (Block 4)

Mission description: IDECM is a suite of self-protection countermeasure systems designed for the F/A-18E/F, including onboard jamming and off-board decoy jamming capabilities. The Navy has fielded IDECM in different blocks dating back to 2002 (Block 1), 2004 (Block 2), and 2011 (Block 3). Each block improved the system’s jamming capabilities, decoy capabilities, or both. Block 4—the phase of production currently in development—extends IDECM onboard jamming capabilities to F/A-18C/D aircraft.¹

¹The F/A-18C/D will not be equipped with IDECM’s off-board jamming components (towed decoys) because these aircraft lack the necessary infrastructure to support these components.

Status: IDECM Block 4 entered development in 2009 and includes redesign of the ALQ-214 onboard jammer from the component design used for earlier blocks. This redesign is driven by the need to reduce weight in order to accommodate the IDECM onboard system on F/A-18C/D aircraft. Essentially, the new ALQ-214 will perform the same onboard jammer function as found in IDECM Blocks 2 and 3 but with a different form and fit. The Navy expects to transition current IDECM Block 3 full rate production to Block 4 units by April 2012. This production transition will occur concurrent with ground and flight testing of the Block 4 system—a strategy that could drive costly design changes, retrofits, or both to units in production, in the event that the ALQ-214 redesign effort does not materialize on schedule. To mitigate this risk, Navy officials stated that Block 4 full rate production will initially be for 19 systems, with production rates increasing to as many as 40 per year following completion of testing. Further, DOD officials report that Block 4 production will be executed under a firm fixed-price contract—a strategy that DOD officials state will place the financial burden of any retrofits on the vendor.

Budget: See the following table for budget information.

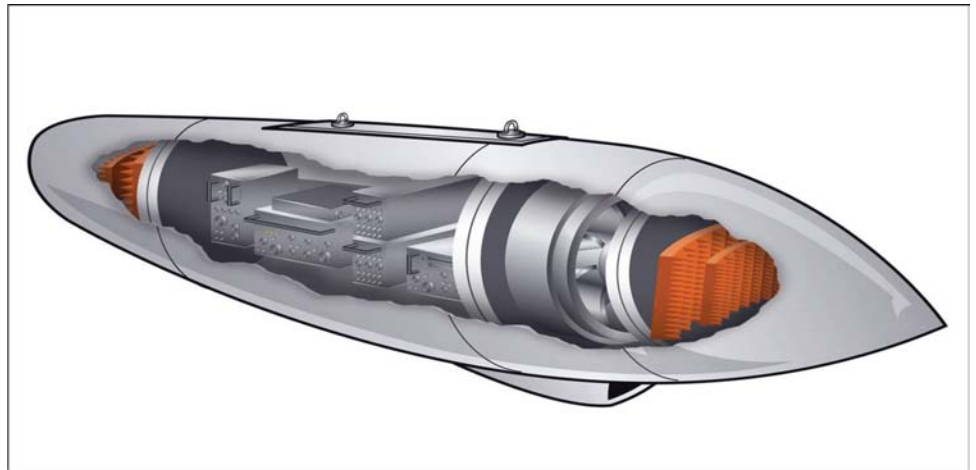
Table 13: DOD Planned Acquisition Investments for IDECM, Fiscal Years 2012-2017

| Then-year dollars in millions | | | | | | | |
|-------------------------------|------------------|-----------------|-----------------|------------------|------------------|-----------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$62.100 | \$29.874 | \$14.408 | \$13.897 | \$2.711 | \$2.848 | \$125.838 |
| Procurement | 40.272 | 57.067 | 84.305 | 102.388 | 133.449 | 51.569 | \$469.050 |
| Total | \$102.372 | \$86.941 | \$98.713 | \$116.285 | \$136.160 | \$54.417 | \$594.888 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Figure 11: Next Generation Jammer



Source: NAVAIR PMA-234.

Estimated fielding date: 2020 (Mid-band on EA-18G)

Mission description: The Next Generation Jammer will be an electronic warfare system to support the suppression of enemy air defenses, replacing and improving the capability currently provided by AN/ALQ-99 Tactical Jamming System. The Navy's EA-18G will employ the Next Generation Jammer as the electronic attack payload. In a separate increment of capability, the Navy plans to integrate the Next Generation Jammer onto the F-35B, which will eventually replace Marine Corps EA-6B Prowlers. Each increment of capability will be divided into developmental blocks—Block 1 for mid-band, Block 2 for low-band, and Block 3 for high-band frequencies.

Status: The Next Generation Jammer is nearing completion of technology maturation activities performed by four different contractors before the program's entry into the technology development phase. The Navy plans to enter the technology development phase in the third quarter of fiscal year 2013, with an engineering and manufacturing development contract planned for 2015. The Navy has adopted an evolutionary block approach to fielding the Next Generation Jammer. Initial operational capability for Block 1, on the EA-18G aircraft, is scheduled for 2020. The Navy expects to field Blocks 2 and 3 on the EA-18G in 2022 and 2024, respectively. Fielding dates for the F-35 increment's blocks are currently undetermined.

Appendix II: Analyses of Select Airborne
Electronic Attack Systems

Budget: See the following table for budget information.

Table 14: DOD Planned Acquisition Investments for the Next Generation Jammer, Fiscal Years 2012-2017

Then-year dollars in millions

| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
|--------------|------------------|------------------|------------------|------------------|------------------|------------------|--------------------|
| RDT&E | \$170.910 | \$187.024 | \$269.916 | \$321.817 | \$429.390 | \$528.777 | \$1,907.834 |
| Procurement | - | - | - | - | - | - | - |
| Total | \$170.910 | \$187.024 | \$269.916 | \$321.817 | \$429.390 | \$528.777 | \$1,907.834 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Navy fiscal year 2013 budget estimates.

Note: There is no procurement funding associated with the Next Generation Jammer in the fiscal year 2013 budget.

**Figure 12: Miniature Air Launched Decoy (MALD)/Miniature Air Launched Decoy—
Jammer (MALD-J)**



Source: Raytheon.

Fielding dates:

2012 (MALD—actual)
2012 (MALD-J—estimated)

Mission description: MALD is an expendable decoy able to represent small, medium, or large aircraft in order to saturate or degrade enemy air defense systems. MALD-J is a variant of MALD that adds jamming capability to the decoy and forms the stand-in jamming component for the airborne electronic attack family of systems. The Air Force plans to acquire a total quantity of 596 MALD and 2,404 MALD-J units.

Status: The Air Force approved MALD for low rate initial production in 2008. The Air Force expected to procure 300 MALD units in low rate production before transitioning to full rate production. However, following flight testing failures in summer 2010—attributable, in part, to design issues with the fuel filter—and a later test failure in February 2011 caused by foreign object debris in the fuel line, the MALD system was decertified, and remaining initial operational testing and evaluation activities were suspended. After additional corrective actions by the program office to the

MALD design, the system reentered operational testing in July 2011, with test shots fired in late August 2011. According to Air Force testing officials, during the last test shot in the August series (OT-8), the engine for one decoy never started after it detached from the host aircraft, causing that MALD unit to crash. This operational testing event was the final one scheduled for MALD, and DOD officials report that, in January 2012, the Air Force Operational Test and Evaluation Center delivered the MALD initial operational test and evaluation report assessing system performance.

As a result of MALD's testing shortfalls, the Air Force authorized additional low rate initial production purchases for MALD quantities—to the extent that the Air Force will now purchase the entire 596 unit inventory of MALD quantities under low rate initial production, without ever authorizing or achieving full rate production. Technical deficiencies and design changes during low rate initial production prevented demonstration of an efficient manufacturing capability, which in turn prevented MALD from meeting the department's criteria to enter full rate production. DOD policy states that in order for a system to receive full rate production approval, the system must (1) demonstrate control of the manufacturing process and acceptable reliability, (2) collect statistical process control data, and (3) demonstrate control and capability of other critical processes.² Because the MALD and MALD-J designs are identical—except for the addition of a jammer module to MALD-J—the absence of a proven manufacturing process for MALD introduces cost and schedule risk to production of MALD-J.

Deficiencies affecting the MALD vehicle have already contributed to MALD-J program delays. The MALD-J low rate initial production decision review—previously planned for September 2009—was delayed until September 2011. Operational testing has subsequently been delayed and is now expected to begin in May 2012. To mitigate this schedule delay, the Air Force has moved to compress MALD-J operational testing from 15 months to 7 months, which program officials report reflects an increase in test range priority and decrease in data turnaround time. According to DOD officials, however, test range execution issues such as aircraft and test equipment availability could potentially extend MALD-J operational testing beyond the currently projected completion date. In addition, the Air

²DOD Instruction 5000.02, *Operation of the Defense Acquisition System* (Dec. 8, 2008).

Force delayed, and later canceled, plans to develop a second increment of capability for MALD-J—one intended to provide more advanced jamming capabilities. Prior to these decisions, the Air Force’s fiscal year 2012 budget submission outlined plans to budget \$54.8 million in research, development, testing, and evaluation funding to MALD-J Increment II in fiscal year 2013. According to DOD, the Air Force is to provide a new plan for developing and procuring an Increment II variant of MALD-J and report to the Deputy Secretary of Defense by March 30, 2012.

Budget: See the following table for budget information.

Table 15: DOD Planned Acquisition Investments for MALD/MALD-J, Fiscal Years 2012-2017

| Then-year dollars in millions | | | | | | | |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
| RDT&E | \$14.917 | \$0.000 | \$0.000 | \$0.000 | \$0.000 | \$0.000 | \$14.917 |
| Procurement | 83.022 | 87.556 | 89.348 | 92.448 | 94.987 | 95.059 | \$542.420 |
| Total | \$97.939 | \$87.556 | \$89.348 | \$92.448 | \$94.987 | \$95.059 | \$557.337 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: Department of the Air Force fiscal year 2013 budget estimates.

Note: RDT&E data are for MALD-J Increment II only. There is no RDT&E funding for MALD or MALD-J.

Figure 13: F-35 Lightning II (Joint Strike Fighter)



Source: Lockheed Martin.

Estimated fielding date: To be determined

Mission description: The F-35 Joint Strike Fighter is a family of fifth-generation strike aircraft to replace and complement existing Navy, Air Force, and Marine Corps aircraft, such as the F-16 and the F/A-18. The F-35, along with the F-22A, is expected to fulfill DOD's requirement for penetrating escort jamming capability.

Status: The F-35 program entered low rate initial production in 2007, with a planned baseline acquisition of 2,886 aircraft. The program experienced development challenges, including delays in testing, leading to a program-wide review. Based on this review, DOD restructured the program in 2010, increasing the time and funding for development. This restructure triggered a breach of the critical Nunn-McCurdy cost growth threshold. Presently, the program plans to procure 2,457 aircraft, and the services are still reviewing scheduled plans for operational capability and fielding.

Appendix II: Analyses of Select Airborne
Electronic Attack Systems

Budget: See the following table for budget information.

Table 16: DOD Planned Acquisition Investments for the F-35 Lightning II, Fiscal Years 2012-2017

Then-year dollars in millions

| | FY 2012 | FY 2013 | FY 2014 | FY 2015 | FY 2016 | FY 2017 | Total |
|--------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
| RDT&E | \$2,708.228 | \$2,699.498 | \$2,464.703 | \$1,899.685 | \$1,426.668 | \$1,075.495 | \$12,274.277 |
| Procurement | 6,334.916 | 6,149.445 | 6,310.537 | 7,786.763 | 9,927.117 | 11,207.769 | \$47,716.547 |
| Total | \$9,043.144 | \$8,848.943 | \$8,775.240 | \$9,686.448 | \$11,353.785 | \$12,283.264 | \$59,990.824 |

Legend: RDT&E = research, development, testing, and evaluation.

Source: DOD fiscal year 2013 budget estimates.

Note: The above budget figures do not include \$31.874 million in fiscal year 2012 RDT&E funds and \$31.748 in fiscal year 2013 RDT&E funds for the Air Force Aircraft Engine Component Improvement Program.

Appendix III: Comments from the Department of Defense



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

MAR 23 2012

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office (GAO)
441 G Street NW
Washington, DC 20548

Dear Mr. Sullivan:

This is the Department of Defense (DoD) response to the GAO draft report, GAO-12-175, "AIRBORNE ELECTRONIC ATTACK: Achieving Mission Objectives Dependent on Overcoming Acquisition Challenges," dated March 2012, (GAO Code 120942). While the GAO assessed numerous electronic warfare programs and plans in its review, the Department finds two significant misinterpretations in the GAO report. These misinterpretations appear to stem from recent changes in the Department's acquisition plans, results of the most recent President's Budget submit, in addition to nuanced misunderstandings.

First, the Department finds the GAO's characterization of acquisition duplication overstated. Regarding airborne expendables, GAO found a lack of coordination between Navy and Air Force. In fact, Navy has been investigating its concept of operations and requirements for a new expendable and the potential of the Air Force's Miniature Air Launched Decoy (MALD) to meet its requirements for some time. While the MALD-Jammer (MALD-J) Increment II was canceled in the 2013 budget, the Department is still evaluating future expendable options and the dialogue for acquisition coordination will continue as requirements are determined. Regarding irregular warfare systems, GAO found a lack of coordination among irregular warfare electronic attack (EA) systems, including Army's CEASAR pod, Marine Corps CORPORAL and Intrepid Tiger efforts, and Air Force's MQ-9 EA Pod. On the whole, GAO has mischaracterized these systems and acquisition plans. MQ-9 EA Pod was to provide a high end irregular warfare capability requiring unique development, but was canceled with the February submission of the 2013 budget for being late to need. CORPORAL utilized the Intrepid Tiger II v2.0 EA pod to demonstrate a service oriented architecture to support Electronic Warfare Battle Management (EWBM) and Intelligence, Surveillance and Reconnaissance (ISR) data sharing. Besides its focus on developing a services oriented architecture, CORPORAL ended in April 2011, so its inclusion as EA duplication is not applicable. Intrepid Tiger II v1.0 and CEASAR both provide electronic attack, but integrate on very different aircraft to meet Marine Corps and Army mission needs, respectively. The Army and Marine Corps recognize there may be opportunities to jointly leverage developments from Intrepid Tiger II and CEASAR in addition to implementing a common EWBM architecture, and the Department will continue investigating this.


Second, the Department finds GAO's characterization of a change in strategy misleading. Starting in 2002, the Department outlined plans for high-end electronic attack capabilities to address near-peer threats, commonly referred to as the Airborne Electronic Attack (AEA)

System of Systems (SoS). The Department continues to support a robust investment in the AEA SoS with capabilities fielded, or in development, across all four mission areas: Stand Off, Modified Escort, Penetrating Escort, and Stand-In. These investments include: expanding our EA-18G Growler fleet and improving its effectiveness with the Next Generation Jammer (NGJ), upgrading and expanding the EC-130H Compass Call fleet, and fielding air-launched expendable decoys/jammers, among other investments. The synergies envisioned in the 2002 AEA Analysis of Alternatives (AoA) continue to be pursued, but not all platforms considered have proven affordable, as noted in the B-52 jammer and Joint-Unmanned Combat Air System cancellations. The Department continues to consider its options to field additional systems to meet the high-end, near peer threats. Concurrently, the Department is taking an affordable approach to adding capabilities to support ground operations, a different threat requiring more capacity than the higher-end and more costly AEA SoS platforms provide. These new systems, such as Intrepid Tiger and CEASAR, take advantage of lower cost payloads and more efficient platforms to meet mission needs. This approach results in significant savings.

Finally, while the Department recognizes that the GAO report was not focused on ground Electronic Warfare (EW) systems, it feels strongly that an introduction of the Marine Air Ground Task Force (MAGTF) EW concept would serve as an invaluable reference for how the Marine Corps plans to actively confront expected airborne electronic attack capability gaps following the retirement of EA-6Bs. The F-35 will take on many of the airborne EW responsibilities, but it is not capable of meeting all of the foreseeable electronic attack requirements which is why MAGTF EW was developed. That holistic approach toward electronic warfare truly leverages their ground and air capabilities in a collaborative manner to seek control of the electromagnetic environment on the battlefield.

Detailed comments on the report recommendations are enclosed in addition to recommended corrections to the draft report. The Department appreciates the opportunity to respond to your draft report and looks forward to working with you as we continue to develop electronic attack capabilities.

Sincerely,



David G. Ahern
Deputy Assistant Secretary of Defense
Strategic and Tactical Systems

Enclosure:
As stated

GAO Draft Report Dated March 2012
GAO-12-175 (GAO CODE 120942)

“AIRBORNE ELECTRONIC ATTACK: ACHIEVING MISSION OBJECTIVES
DEPENDENT ON OVERCOMING ACQUISITION CHALLENGES”

DEPARTMENT OF DEFENSE COMMENTS
TO THE RECOMMENDATIONS

The GAO made five recommendations for the Secretary of Defense. The first three recommendations are made in the context of assessing the impact of programmatic and threat changes in airborne electronic attack since 2002. The last two recommendations are made in the context of assessing cost-effectiveness and duplicity of programs.

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense conduct program reviews for the AARGM, IDECM, MALD, and MALD-J systems to assess cost, schedule, and performance and direct changes within these investments, as necessary.

DOD RESPONSE: Concur. The Department agrees these programs have experienced challenges, and correspondingly, the Secretary’s staff has existing plans to review these programs to assess cost, schedule and performance and direct changes, as necessary. Each program is being addressed as follows:

Regarding AARGM, GAO states concern that the current program plan to complete Initial Operational Test and Evaluation (IOT&E) leaves no margin to achieve the fielding date if testing reveals deficiencies. In response, the Department requires operational test for the express purpose of identifying deficiencies in a weapon system prior to fielding and has structured its acquisition process to manage the risk of identifying deficiencies by requiring a Full Rate Production (FRP) decision review. Since decertification from the first Operational Test (OT) period, AARGM has been reviewed numerous times by Department leadership. The Under Secretary of Defense for Acquisition, Technology and Logistics conducted reviews of AARGM in October 2010 and April 2011 to assess progress against corrective actions. AARGM completed IOT&E in March 2012, with ten of ten planned live fire events and over 365 flight hours, which have utilized a stable software load and hardware from the first lot of initial production that had the corrective actions incorporated. The program expects the test report within 90 days and is confident it is on track to address anomalies identified in testing. The Joint Staff also recently reviewed the program status and requirements at a Functional Capabilities Board, and the Assistant Secretary of the Navy for Research, Development and Acquisition (ASN(RDA)) has conducted several reviews to monitor execution and adjust plans as necessary. ASN(RDA) will conduct an FRP review of AARGM in July 2012 to review the results of IOT&E and assess the readiness to award full rate production.

Regarding IDECM, GAO states concern that concurrent flight test and full rate production of IDECM Block 4 increases the risk of costly retrofits. The Department recognized this risk and mitigated it by negotiating a Firm Fixed Price contract with the vendor that places the financial burden of any retrofits on the vendor. As an engineering change proposal to IDECM Block 3, Block 4 does not have a formal milestone, however appropriate reviews are planned and production transitions gradually with only 23 units in the first buy. DOT&E has coordinated

with the Navy to develop a disciplined test and evaluation schedule that informs leadership on progress and test results as Block 4 proceeds. Further, ASN(RDA) chaired the third of five In-Process Reviews (IPR) of Block 4 on 19 March 2012 to assess production readiness, cost, schedule, performance, test progression, adherence to the Key Performance Parameters (KPPs), and other technical performance measures, maturity of the interfaces, and risk status. The first two IPRs on Block 4 were conducted after the Preliminary Design Review (PDR) and Critical Design Review (CDR) to monitor the progress of this upgrade. The last two IPR's will be informed by operational assessment and formalized operational testing results, respectively.

Regarding MALD and MALD-J, GAO states concern that MALD did not, and will not, complete an FRP decision review, and that concurrency between development, production and test increases risk. In response, the Air Force will not conduct an FRP decision for MALD because that decision is replaced by a MALD-J FRP decision. Since deciding to add a stand-in jamming capability to MALD, the Air Force planned to transition all MALD production to the much more effective MALD-J, once ready. Low rate initial production will continue until an FRP decision is authorized. While Low Rate Initial Production (LRIP) quantities have increased due to issues uncovered in test, the Department mitigated this risk through a warranty that requires the vendor to address any design fixes uncovered in test at no cost to the Government. The FRP decision review will be chaired by Commander, Air Armament Center and is currently planned for 2nd quarter FY 2014. The Deputy Assistant Secretary of Defense for Strategic and Tactical Systems, will chair a meeting to review AARGM, IDECM, MALD and MALD-J with the Navy and Air Force to verify progress and investigate the efficacy of additional coordination as future acquisition plans are evaluated.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense determine the extent to which the most pressing airborne electronic attack capability gaps can best be met using the assets that are likely to be available and take steps to fill any potential gaps.

DOD RESPONSE: Concur. The Department already has these actions underway, with key events recently complete and others ongoing. In February 2012, the Department completed its review of key airborne electronic attack capabilities in developing the fiscal year 2013 budget. In accordance with DoD priorities, adjustments were made to the following electronic attack programs: fully funded Next Generation Jammer; continued support for MALD-J; increased readiness for the AN/ALQ-99 Tactical Jamming System; continued support of conversion of one C-130 to an EC-130H Compass Call; supported the Pod-Upgrade Program (PUP) that provides advanced electronic attack capabilities for F-16 and A-10 aircraft; eliminated the MQ-9 Electronic Attack Pod for being late to need as operations in Iraq ceased and Afghanistan draws down; enhanced electronic attack test range infrastructure; and enhanced training capabilities against electronic attack, among other areas. Beyond these recently completed actions, in a December 1, 2011, memorandum, the Joint Staff requested Strategic Command, as the joint Electronic Warfare (EW) capabilities advocate, present an annual assessment of all DoD EW capabilities to the Joint Requirements Oversight Council (JROC). The assessment is to include current Joint Warfighter requirements, current fielded capabilities, planned future capabilities, and the investment strategy needed to maintain and achieve those capabilities.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense align service investments in science and technology with the department-wide electronic warfare priority,

recognizing that budget realities will likely require tradeoffs among research areas, and direct changes, as necessary.

DOD RESPONSE: Concur. The Secretary of Defense directed this action in an April 19, 2011, memorandum, "Science and Technology (S&T) Priorities for Fiscal Years 2013-17 Planning," which included Electronic Warfare/Electronic Protection as one of seven priority areas. As directed in the memo, "The Assistant Secretary of Defense for Research and Engineering, with the Department's S&T Executive Committee and other stakeholders, will oversee the development of implementation roadmaps for each priority area. These roadmaps will coordinate Component investments in the priority areas to accelerate the development and delivery of capabilities."

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense review the capabilities provided by the Marine Corps's Intrepid Tiger II and Army's CEASAR systems and identify opportunities for consolidating these different efforts, as appropriate.

DOD RESPONSE: Partially concur. Intrepid Tiger II provided the electronic attack payloads for the AV-8B Harrier (Intrepid Tiger II v1) and Shadow Unmanned Aerial Vehicle (UAV) (Intrepid Tiger II v2), which are 85% common in hardware and 95% common in software despite being packaged in completely different pods and form factors for the respective platforms. The CEASAR pod leverages the EA-18G's AN/ALQ-227 Communications Countermeasure Set jammer and integrates it on a C-12 aircraft. Because of CEASAR's extremely successful combat assessments, the two existing aircraft will remain in service indefinitely, and the payload will be integrated onto an Army UAV for future consideration. CEASAR exploits the payload capacity and available prime power from an Army Division level UAV to maximize the jamming capability and best provide the required jamming in support of the land forces. The Deputy Assistant Secretary of Defense for Strategic and Tactical Systems, will chair a meeting to review Intrepid Tiger, CEASAR and EWBM plans with the Army and Marine Corps to investigate the efficacy of additional coordination as future acquisition plans are evaluated.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense assess Air Force and Navy plans for developing and acquiring new expendable jamming decoys, specifically those services' respective MALD-J and Airborne Electronic Attack Expendable initiatives, to determine if these activities should be merged.

DOD RESPONSE: Partially concur. The Navy has been evaluating the ability to leverage the MALD vehicle to meet Navy decoy jamming requirements through its AEA initiative, which is currently focused on risk reduction efforts. Navy activities include a Joint Concept Technology Demonstration, designated Countermeasure Expendable with Replaceable Block Elements for Reactive Unmanned Systems (CERBERUS), which utilizes the MALD vehicle and develops modular electronic attack payloads to provide additional capabilities. In addition, the Air Force is to provide a new plan for developing and procuring an Increment II variant of MALD-J and report to the Deputy Secretary of Defense by March 30, 2012. After that report is complete, the offices of the USD(AT&L), Cost Assessment and Program Evaluation (CAPE), and Joint Staff will review the Navy and Air Force expendable plans and assess opportunities for coordination, should funding be allocated for a future expendables program.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, key contributors to this report were Bruce Fairbairn, Assistant Director; Christopher R. Durbin; Laura Greifner; James Kim; Scott Purdy; Sylvia Schatz; Brian Smith; and Roxanna Sun.

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