U.S. Airborne Electronic Attack Programs: Background and Issues for Congress

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SUMMARY

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U.S. airborne electronic warfare (EW) programs involve developing and procuring EW aircraft and EW systems that are mounted on U.S. aircraft. The President's FY2020 budget request for the Department of Defense (DOD) proposes funding for a number of airborne EW programs.

The Role of Airborne EW in Modern Warfare

EW is a component of modern warfare, particularly in response to threats posed by potential adversaries such as Russia or China. EW refers to operations that use the electromagnetic spectrum (i.e., the "airwaves") to detect, listen to, jam, and deceive (or "spoof") enemy radars, radio communication systems, data links, and other electronic systems. EW also refers to operations that defend against enemy attempts to do the same.

The shift in the international security environment from the post-Cold War era to an era of renewed great power competition has led to an increased focus on EW in U.S. defense planning and programming, particularly aspects of EW related to high-end warfare.

U.S. Airborne Electronic Attack Capabilities

Airborne EW capabilities are a component of U.S. military airpower. Although dedicated U.S. EW aircraft are relatively few in number compared with U.S. fighters, strike fighters, and attack aircraft, they play a role in helping to ensure the combat survivability and effectiveness of other aircraft and friendly forces on the ground.

DOD's three primary manned EW electronic attack aircraft are the Navy EA-18G Growler, the Air Force EC-130H Compass Call, and the Air Force EC-37B Compass Call Re-Host. A fourth manned aircraft—the F-35 Joint Strike Fighter—has extensive, integrated EW capabilities. DOD's primary airborne electronic attack payloads include the AN/ALQ-99 electronic attack suite, the Next Generation Jammer, and the Miniature Air Launched Decoy-Jammer.

EW Oversight Issues for Congress

Congress has continually shown interest in EW, and the decisions it makes regarding EW could affect future U.S. military capabilities and funding requirements. In particular, EW programs pose several potential oversight issues for Congress

- Whether DOD is prioritizing appropriately airborne EW programs in its planning and budgeting relative to other U.S. military EW programs (such as those for U.S. ground forces or Navy surface ships) and to other DOD non-EW priorities.
- Whether DOD's proposed mix of airborne EW capabilities and investments is appropriate.
- The evolution of technology and how new technologies can be employed for EW operations.
- The Air Force's planned rate for procuring EC-37Bs and replacing EC-130Hs.

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Introduction[1]

This report focuses on selected U.S. airborne electronic attack programs. Such programs involve developing and procuring both the aircraft whose primary mission is electronic warfare (EW) and the EW systems that are mounted on U.S. aircraft. The President's FY2020 budget request for the Department of Defense (DOD) seeks funding for a number of airborne EW programs.

These programs pose a number of potential oversight issues for Congress, and its decisions on these issues could affect future U.S. military capabilities and funding requirements.

Congress has continually shown interest in EW, and airborne electronic attack in particular. Some Members have formed the EW Working Group, and they routinely discuss improving EW capabilities. The National Defense Authorization Acts over the past several years have included provisions related to EW and electronic attack. Most recently the FY2019 John S. McCain National Defense Authorization Act, discussed the Air Force's acquisition strategy for a new EW attack aircraft as well as a study to catalogue all EW capabilities.

Background

Electronic Warfare

Overview[2]

Electronic warfare (EW)—sometimes also called electromagnetic maneuver warfare (EMW)[3]—is a component of modern warfare, particularly in response to threats posed by technologically sophisticated potential adversaries such as Russia and China. EW generally refers to operations that use the electromagnetic spectrum (i.e., the "airwaves") to detect, listen to, jam, and deceive (or "spoof") enemy radars, radio communication systems and data links, and other electronic systems. It also refers to operations for defending against enemy attempts to do the same. More formally, DOD defines electronic warfare as "military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy."[4]

As shown in **Figure 1**, DOD divides EW into electronic warfare support, electronic protection, and electronic attack. *Electronic warfare support*, sometimes also referred to as electronic support measures (ESM), involves listening to an adversary's radar and radio transmissions in order to detect, locate, and understand how to avoid, jam, or deceive those systems. *Electronic protection* involves limiting the electromagnetic signatures of one's own military equipment and hardening

[1] This report was originally authored by Ray Zuniga, then-Air Force Fellow.

[2] For a brief overview of EW, see CRS In Focus IF11118, *Defense Primer: Electronic Warfare*, by John R. Hoehn.

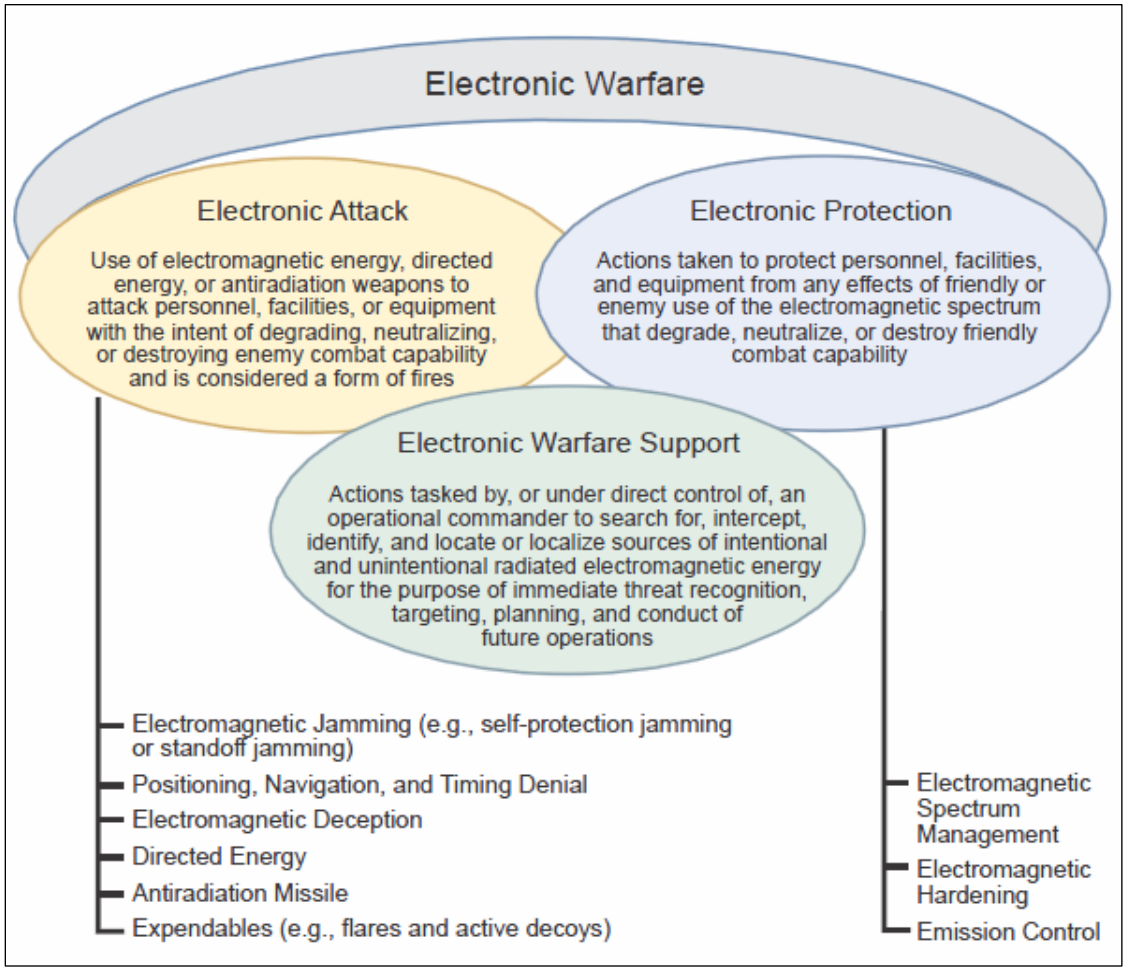
[3] See, for example, John Joyce, "Navy Expands Electromagnetic Maneuver Warfare for 'Victory at Sea,'" *Navy News Service*, November 2, 2017; Robert K. Ackerman, "Electromagnetic Maneuver Warfare Looms as New U.S. Navy Discipline," *Signal*, February 11, 2015.

[4] Department of Defense, *DOD Dictionary of Military and Associated Terms As of February 2019*, p. 78, accessed March 13, 2019, at https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf. See also Department of Defense, *Joint Publication 3-13.1, Electronic Warfare*, February 8, 2012, 144 pp. (including covers), accessed March 13, 2019, at https://www.globalsecurity.org/military/library/policy/dod/joint/jp3_13_1_2012.pdf and https://publicintelligence.net/jcs-ew/.

one's own military equipment against the effects of enemy EW operations. *Electronic attack* (EA) involves jamming and deceiving enemy radars and radio communications and data links.

Developing ever-better EW systems is a component of the overall competition in military capabilities between major military powers. This issue is not frequently discussed publicly in much detail, because the specifics of EW programs tend to be classified and are closely related to intelligence systems and capabilities.

Figure 1. Overview of Electronic Warfare



Source: Department of Defense, *Joint Publication 3-13.1, Electronic Warfare*, February 8, 2012, Figure I-3 on p. I-5, accessed March 13, 2019, at https://www.globalsecurity.org/military/library/policy/dod/joint/jp3_13_1_2012.pdf and https://publicintelligence.net/jcs-ew/.

EW in an Era of Renewed Great Power Competition

During the Cold War, EW capabilities supported the overall competition in military capabilities between the U.S.-led NATO alliance and the Soviet-led Warsaw Pact alliance. The end of the Cold War and the shift in the early 1990s to the post-Cold War era—a period that featured reduced tensions between major powers and a strong U.S. military emphasis on countering terrorist and insurgent organizations—may have led to a reduced emphasis in U.S. defense plans and programs related to so-called high-end warfare, meaning high-intensity warfare against technologically sophisticated adversaries.

In recent years, the shift in the international security environment from the post-Cold War era to an era of renewed great power competition has increased the focus on EW in U.S. defense planning and programming.[5] In particular, attention has been given to aspects of EW related to high-end warfare and to concerns among some observers that the United States needs to strengthen its efforts in EW as part of its overall effort to preserve U.S. qualitative military superiority over potential adversaries such as Russia and China.

DOD notes Russia has placed an emphasis on EW in its military modernization effort.[6] For example, Russia reportedly has employed EW as part of its military operations in Ukraine and Syria.[7] DOD similarly states that China recognizes the importance of EW in modern military operations and is developing its EW capabilities as an integral part of its broad-based military modernization effort.[8] As China encourages greater integration between its civil and military technological and industrial bases,[9] its EW capabilities may benefit from the sophistication of its extensive civilian electronics industry.[10]

Relationship of EW to Cyberwarfare

EW emerged in the early and middle decades of the 20th century with the invention and spread of radio and radar and their use in military operations. It therefore predates cyberwarfare, which emerged decades later with the invention and spread of computers and the internet. Today, some overlap exists between EW and cyberwarfare, though there is a key difference between the two. EW focuses on military operations that use the electromagnetic spectrum against radars and radio communication and data links, while cyberwarfare activities—which occur on a day-to-day basis, as well as during overt conflicts—target computers and servers, and involve significant use of the wired connections between them. EW and cyberwar activities can support one another.[11]

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[5] For more on this shift, see CRS Report R43838, *A Shift in the International Security Environment: Potential Implications for Defense—Issues for Congress*, by Ronald O'Rourke, and CRS In Focus IF11139, *Evaluating DOD Strategy: Key Findings of the National Defense Strategy Commission*, by Kathleen J. McInnis.

[6] See Department of Defense, Defense Intelligence Agency, *Russia Military Power, Building a Military to Support Great Power Aspirations*, 2017, pp. 32, 42.

[7] See, for example, Yuri Lapaiev, "Ukraine as Clandestine Testing Ground for Russian Electronic Warfare," *Eurasia Daily Monitor*, vol. 15, issue 157, November 5, 2018; "Russia Deploys Electronic Warfare in Syria," *Army Recognition*, October 17, 2018; Tom O'Connor, "Russia's Electronic Warfare System in Syria Will Be Able to Track Planes in Europe and Israel," *Newsweek*, September 28, 2018 Lara Seligman, "Russian Jamming Poses a Growing Threat to U.S. Troops in Syria," *Foreign Policy*, July 30, 2018 Roger N. McDermott, *Russia's Electronic Warfare Capabilities to 2025, Challenging NATO in the Electromagnetic Spectrum*, International Centre for Defence and Security, Tallinn, Estonia, September 2017, p. 39.

[8] See Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2018*, p. 74. For more on China's military modernization effort, see CRS Report R44196, *The Chinese Military: Overview and Issues for Congress*, by Ian E. Rinehart, and CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

[9] For more on these efforts, see Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2018*, pp. 1-2, 81, 84-85, 121.

[10] For an example of these types of activities, see CRS In Focus IF10119, *U.S.-China Relations*, by Susan V. Lawrence, Wayne M. Morrison, and Jonah Langan-Marmur.

[11] DOD states that

> [s]ince cyberspace requires both wired and wireless links to transport information, both offensive and defensive cyberspace operations may require use of the EMS [electromagnetic spectrum] for the enabling of effects in cyberspace. Due to the complementary nature and potential synergistic effects of EW and CNO [computer network operations], they must be coordinated to ensure they are applied to maximize effectiveness. Cyberspace operations may be used to force an adversary

EW as an Element of U.S. Airpower

Although dedicated U.S. EW aircraft are relatively few in number compared with the number of U.S. fighters, strike fighters, and attack aircraft, they play a role in helping to ensure the combat survivability and effectiveness of other aircraft and friendly forces on the ground. EW aircraft detect and jam enemy radars and air defense command-and-control equipment, so that U.S. fighters, strike fighters, attack aircraft, and bombers can more safely penetrate enemy airspace. EA-18G Growlers (discussed below) accompany U.S. fighters, strike fighters, and attack aircraft on missions to penetrate enemy airspace. Other U.S. EW aircraft, such as the EC-130H Compass Call aircraft (discussed below), perform their EW missions from standoff locations in less contested airspace.

Fifth-generation stealthy U.S. aircraft such as the F-22 Raptor and the F-35 Joint Strike Fighter are less dependent on EW support than are less stealthy, earlier-generation U.S. aircraft. Even F-22s and F-35s, however, still benefit from EW support under certain circumstances.[12] EW aircraft support the Navy's Naval Integrated Fires Counter-Air (NIF-CA) concept and help ensure the combat survivability and effectiveness of less stealthy, earlier-generation U.S. aircraft and friendly forces on the ground.

EW Aircraft

Although various U.S. manned and unmanned aircraft perform EW operations, this report focuses on DOD's three primary manned EW electronic attack aircraft: the EA-18G Growler, the EC-130H Compass Call, and the EC-37B Compass Call Re-Host. It also focuses on a fourth manned aircraft, the F-35 Joint Strike Fighter, which has extensive built-in EW capabilities. Each of these four aircraft is discussed briefly below.

Boeing EA-18G Growler

The Boeing EA-18G Growler (**Figure 2**) is a Navy carrier-capable EW aircraft. Its primary mission is to detect and jam enemy radars. Among the 60 or more aircraft in an aircraft carrier's embarked air wing, typically four or five are EA-18Gs. These aircraft are also operated by the Royal Australian Air Force (RAAF).

from wired to wireless networks that are vulnerable to EA [electronic attack]. EW may be used to set favorable conditions for cyberspace operations by stimulating networked sensors, denying wireless networks, or other related actions. In the defensive environment, EW systems may detect and defeat attacks across wireless access points.

(Department of Defense, *Joint Publication 3-13.1, Electronic Warfare*, February 8, 2012, p. I-15, accessed March 13, 2019, at https://www.globalsecurity.org/military/library/policy/dod/joint/jp3_13_1_2012.pdf and https://publicintelligence.net/jcs-ew/.)

[12] The F-35 includes inherent EW capabilities, as discussed below.

Figure 2. EA-18G Growler

Source: Photo accompanying Megan Eckstein, "Electronic Warfare Executive Committee to Focus on Strategy, Acquisition," *USNI News*, March 18, 2015.

The EA-18G is the successor to the carrier-capable EA-6B Prowler, which was operated by both the Navy and Marine Corps. The EA-18G achieved initial operational capability (IOC) in September 2009,[13] and EA-18Gs have gradually replaced EA-6Bs. The final operational EA-6Bs, operated by the Marine Corps, were retired in March 2019.[14]

Unlike the EA-6B, which was a four-seat aircraft, the EA-18G has a crew of two. The EA-6B was an EW variant of the Navy and Marine Corps carrier-capable A-6 Intruder attack plane; similarly, the EA-18G is an EW variant of the Navy and Marine Corps carrier-capable F/A-18F Super Hornet strike fighter.

The EA-18G is equipped with an airborne electronic attack (AEA) avionics suite that has evolved from the EA-6B's Improved Capability III (ICAP III) AEA system. As discussed below, the EA-18G carries AN/ALQ-99 jamming pods, which are to be replaced by Next Generation Jammer jamming pods. The Navy states that "the EA-18G's electronic attack upgrades meet or exceed EA-6B Airborne… Electronic Attack capability to detect, identify, locate and suppress hostile [electromagnetic] emitters; provide enhanced connectivity to National, Theater and strike assets; and provide organic precision emitter targeting for employment of onboard suppression weapons to fulfill operational requirements."[15] The Navy further states that

[13] Department of the Navy, *U.S. Navy Program Guide 2017*, p. 11.

[14] See, for example, Shawn Snow, "EA-6B Prowler, One of the Saltiest Warfighters in the Marine Corps, Retires," *Marine Corps Times*, March 8, 2019; Justin Katz, "Marine Corps to Complete Prowler Retirement in March," Inside Defense, November 1, 2018.

[15] *Department of Defense, Fiscal Year (FY) 2018 Budget Estimates, Navy, Justification Book Volume 1 of 4, Aircraft Procurement, Navy, Budget Activity 01−04*, May 2017, p. 1 (PDF page 69 of 242).

> [t]he EA-18G provides full-spectrum airborne electronic attack (AEA) capabilities to counter enemy air defenses and communication networks, most notably anti-radiation missiles. These capabilities continue to be in high demand in overseas contingency operations, where Growler operations protect coalition forces and disrupt critical command and control links.[16]

The Air Force does not operate an aircraft directly analogous to the EA-18G. The last such Air Force aircraft was the EF-111 Raven, an EW variant of the F-111 fighter. The Air Force retired the last of its EF-111s in 1998.

The Navy states that "the [EA-18G] inventory objective of 160 aircraft will support ten carrier-based squadrons, five active expeditionary squadrons, and one reserve squadron."[17] A total of 163 EA-18Gs were procured through FY2016, including a final procurement of 10 in FY2016. The Department of the Navy does not plan further procurement of EA-18Gs. EA-18Gs, like F/A-18E/Fs, currently are receiving funding for a service life extension; [18] the Growler is expected to be replaced starting in the 2030s.[19]

Lockheed Martin EC-130H Compass Call[20]

The EC-130H Compass Call (**Figure 3**) is an EW aircraft based on a modified version of the C-130 Hercules cargo aircraft. The EW system on the aircraft is called the Compass Call system. The Air Force states that the EC-130H "disrupts enemy command and control communications and limits adversary coordination essential for enemy force management." The Compass Call system employs offensive counter-information and electronic attack (or EA) capabilities in support of U.S. and Coalition tactical air, surface, and special operations forces.

[16] Department of the Navy, *U.S. Navy Program Guide 2017*, p. 10.

[17] Department of the Navy, *U.S. Navy Program Guide 2017*, p. 11.

[18] Research and development efforts to improve the capabilities of EA-18Gs in coming years are funded in Program Element (PE) 0604269N, EA-18 Squadrons—a line item in the Navy's research and development account. In the Navy's proposed FY2020 budget, this PE is line 112 in the Navy's research and development account.

[19] Department of Defense *Annual Aviation Inventory and Funding Plan: Fiscal Years (FY) 2019-2048*, p. 10. Accessed at: https://apps.dtic.mil/dtic/tr/fulltext/u2/1062648.pdf

[20] Unless otherwise indicated, information in this section is taken from U.S. Air Force fact sheet, "EC-130H Compass Call," September 23, 2015, accessed March 15, 2019. Although this fact sheet is dated September 23, 2019, the Air Force states that its online fact sheets contain up-to-date information and statistics.

Figure 3. EC-130H Compass Call

Source: U.S. Air Force official website, EC-130H Compass Call Fact Sheet, September 23, 2015, accessed April 1, 2019, at http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104550/ec-130h-compass-call.aspx.

The EC-130H is operated by a crew of 14, most of whom are assigned to operate the aircraft's EW systems. The EC-130H can be considered a so-called "low-density, high-demand asset," meaning a specialized asset that exists in DOD in relatively low numbers but that DOD uses extensively. A February 2018 press report states that

> [t]he small, 14-aircraft EC-130H fleet has been flying since 1981—and near-constantly in the Afghanistan, Iraq, and Syrian conflicts, because of the unique capability it offers in communications jamming and electronic attack. It has been a key element in the fight against ISIS, an adversary that has adapted high technology to its tactics and strategy….
>
> EC-130Hs there have been deployed nonstop since 2002, the longest continuously deployed Air Force unit in the Afghanistan war.[21]

The EC-130H achieved IOC in 1983. EC-130Hs are being replaced over time by new EC-37B Compass Call Re-Host aircraft (see next section). The Air Force projects in its FY2020 budget submission that it will have 13 EC-130Hs and no EC-37Bs in service at the end of FY2019, and 12 EC-130Hs and one EC-37B in service at the end of FY2020. While EC-130Hs remain in service, the Air Force plans to modernize them to improve their capabilities and reduce their maintenance costs, which have been rising as the aircraft have aged.[22]

[21] Brian W. Everstine, "Electronic Warfare Isn't Going Away—But EC-130Hs Will," *Air Force Magazine*, February 2018.

[22] Modernization of EW systems on EC-130Hs is funded through a line item in the Modification of In-service Aircraft (i.e., Budget Activity 05) part of the Air Force's aircraft procurement account, in a line item entitled "Compass Call." In the Air Force's FY2020 budget submission, this is line item 53.

EC-37B Compass Call Re-Host Aircraft

Air Force plans call for replacing the service's EC-130Hs over time with a total of 10 new EC-37B Compass Call Re-Host aircraft (**Figure 4**).

Figure 4. EC-37B Compass Call Re-Host Aircraft

(Artist's rendering)

Source: Artist rendering accompanying Brian W. Everstine, "Electronic Warfare Isn't Going Away—But EC-130Hs Will," *Air Force Magazine*, February 2018.

The first EC-37B was procured in FY2018, two more were procured in FY2019, and the Air Force's proposed FY2020 budget requests $114.1 million for the procurement of a fourth in FY2020. Air Force plans call for procuring additional EC-37Bs at a rate of one per year until the planned total of 10 is reached.

The Air Force's FY2020 budget submission projects that the first new EC-37B will enter the Air Force's inventory by the end of FY2020. The first two EC-37Bs are scheduled to achieve Initial Operational Capability (IOC) in 2023.[23]

L3 Technologies, a U.S. defense contractor involved in EW programs, is the prime contractor for the EC-37B. The EC-37B is based on the Gulfstream G550 commercial business jet, an aircraft

[23] Procurement of EC-37Bs is funded through the Other Aircraft (i.e., Budget Activity 04) part of the Air Force's aircraft procurement account, in a line item entitled "Compass Call." In the Air Force's FY2020 budget submission, this is line item 15. This line item is not to be confused with the previously discussed line item 53 in the Air Force's FY2020 aircraft procurement account, which is also called Compass Call. Line item 15 is for the procurement of new EC-37B aircraft, while line item 53 is for the procurement of Compass Call EW systems for both existing EC-130H aircraft and new EC-37B aircraft.

that the Air Force also uses as the basis for its C-37B VIP transport aircraft. The Air Force states that EC-37Bs

> will receive Prime Mission Equipment (PME) from legacy donor EC-130H aircraft, as well as new, upgraded PME…. The re-hosted COMPASS CALL platform will utilize 70% of the PME off of the current airframe without modification; the remaining 30% of PME will be new or modified (repackaged) for the re-host. [Compared to the EC-130H,] the re-hosted COMPASS CALL aircraft will provide increased range, speed, endurance and operating altitude for better stand-off range and survivability. This will enable the USAF to effectively conduct Electronic Attack (EA) in an Anti-Access/Area Denial (A2AD) environment.[24]

The Air Force's acquisition strategy of replacing the EC-130H fleet by re-hosting their EW systems on new Gulfstream G550 aircraft was a subject of debate in Congress and contract-award protests.[25]

F-35 Joint Strike Fighter

The Lockheed Martin F-35 Joint Strike Fighter (**Figure 5**) is being procured in three versions for the Air Force (F-35A), Marine Corps (F-35B), and Navy (F-35C). Another CRS report provides an overview of the F-35 program, which is DOD's largest single acquisition program.[26]

While the F-35's primary missions are air-to-ground combat (i.e., strike operations) and air-to-air combat (i.e., fighter operations), the F-35 has a built-in EW capability that is claimed by Lockheed Martin officials—the prime contractor manufacturing the aircraft—to be significantly greater than that of previous U.S. fighters and attack aircraft. Lockheed officials state that the F-35's EW system, designated AN/ASQ-239 serves as a signals collector system which provides: radar warning, identifies the geolocation of electronic emitters, tracks multiple aircraft simultaneously, provides high-gain (i.e., a highly focused radio antenna), high gain counter measures, and high gain electronic attack through the radar. [27] According to Lockheed officials these EW capabilities are designed to provide: wide-frequency coverage,[28] quick reaction time, high sensitivity and probability of intercept, accurate direction finding, track multiple aircraft, and provide self-protection countermeasures and jamming.

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[24] *Department of Defense, Fiscal Year (FY) 2020 Budget Estimates, Air Force, Justification Book Volume 1 of 2 Aircraft Procurement, Air Force, Vol-1*, March 2019, p. 113.

[25] For press articles providing a review of the debate over the Compass Call replacement acquisition strategy, see Brian W. Everstine, "Electronic Warfare Isn't Going Away—But EC-130Hs Will," *Air Force Magazine*, February 2018; Rachel Cohen, "Congress Tells Air Force Not to Replicate EC-X Strategy for Other Programs," Inside Defense, November 17, 2017; Valerie Insinna, "L3 Gets Compass Call Contract, Names Gulfstrem As Airframe Provider," *Defense News*, September 8, 2017.

[26] CRS Report RL30563, *F-35 Joint Strike Fighter (JSF) Program*, by Jeremiah Gertler.

[27] Greg Lemons, Karen Carrington, Dr. Thomas Frey, and John Ledyard, Lockheed Martin Aeronautics Company, "F-35 Mission Systems Design, Development, and Verification," AIAA Aviation Forum, June 25-29, Atlanta, GA, 2018 Aviation Technology, Integration, and Operations Conference, approved for public release 5/1/18, JSF18-502, p. 6, accessed April 2, 2019, at https://www.lockheedmartin.com/content/dam/lockheed-martin/eo/documents/webt/F-35_Mission_Systems_Design_Development_and_Verification.pdf. Lockheed officials state on page 7 that "the EW system is common among the three F-35 variants, except for the forward Band 3/4 arrays, which employ longer elements for the F-35C Carrier Variant (CV). Also differing, the distance between the inboard and outboard arrays is less on the CV variant due to the wing fold. In addition to the EW Band 3/4 apertures, the radar MFA [multifunction] is employed to support EW functions."

[28] LtGen Steven Rudder has stated to the Senate Armed Services Committee that the F-35 can providing jamming across most frequencies, however there are deficiencies which can only be provided by the EA-18G. Statement of Lieutenant General Steven Rudder before the Senate Armed Services Committee Subcommittee on Seapower [hearing] on Navy and Marine Corps Aviation Programs in Review, March 6, 2018, pp. 57-58.

Figure 5. F-35 Joint Strike Fighter

Source: Defense Visual Information Distribution Service (DVIDS), "National Cherry Festival Air Show 2018 [Image 2 of 12]," accessed April 1, 2019.

Lockheed Martin claims that due to the inherent, built-in electronic warfare capabilities the F-35 does not require a dedicated electronic attack aircraft to support it;[29] this would potentially free up other aircraft to perform electronic attack missions to protect less stealthy aircraft. To provide its organic jamming capability the F-35uses its active electronically scanned array (AESA) radar which teamed with advanced jamming algorithm packages, can potentially provide 10 times the jamming power of legacy aircraft. [30]

Figure 6 shows the location of EW system-related equipment on the F-35. During a 2018 hearing on the Navy and Marine Corps aviation program review, Lieutenant General Steven Rudder stated that although the Marine Corps was retiring the EA-6B, the Marine Corps' new F-35Bs would have sufficient EW capability for most Marine Corps contingencies.[31]

[29] Lockheed Martin, "Unprecedented Battlefield Access," accessed April 1, 2019. See also BAE Systems, "AN/ASQ-239 F-35 electronic warfare / countermeasure system," accessed April 2, 2019, at https://www.baesystems.com/en-us/product/an-asq-239-f-35-ew-countermeasure-system.

[30] Tyler Rogoway, "Could the F-35 Become the Biggest Electronic Intelligence Collection System Ever Devised?" *The Drive*, July 6, 2016.

[31] Statement of Lieutenant General Steven Rudder before the Senate Armed Services Committee Subcommittee on Seapower [hearing] on Navy and Marine Corps Aviation Programs in Review, March 6, 2018, pp. 57-58.

Figure 6. F-35 EW System-Related Equipment

Source: Greg Lemons, Karen Carrington, Dr. Thomas Frey, and John Ledyard, Lockheed Martin Aeronautics Company, "F-35 Mission Systems Design, Development, and Verification," AIAA Aviation Forum, June 25-29, Atlanta, Georgia, 2018 Aviation Technology, Integration, and Operations Conference, approved for public release 5/1/18, JSF18-502, Figur 8 on page 7, accessed April 2, 2019, at https://www.lockheedmartin.com/content/dam/lockheed-martin/eo/documents/webt/F-35_Mission_Systems_Design_Development_and_Verification.pdf.

Airborne EW Payloads

DOD's primary airborne electronic attack payloads include the AN/ALQ-99 electronic attack suite, the Next Generation Jammer, and the Miniature Air Launched Decoy-Jammer. Each of these systems is discussed briefly below.

AN/ALQ-99 Tactical Jamming System (TJS)

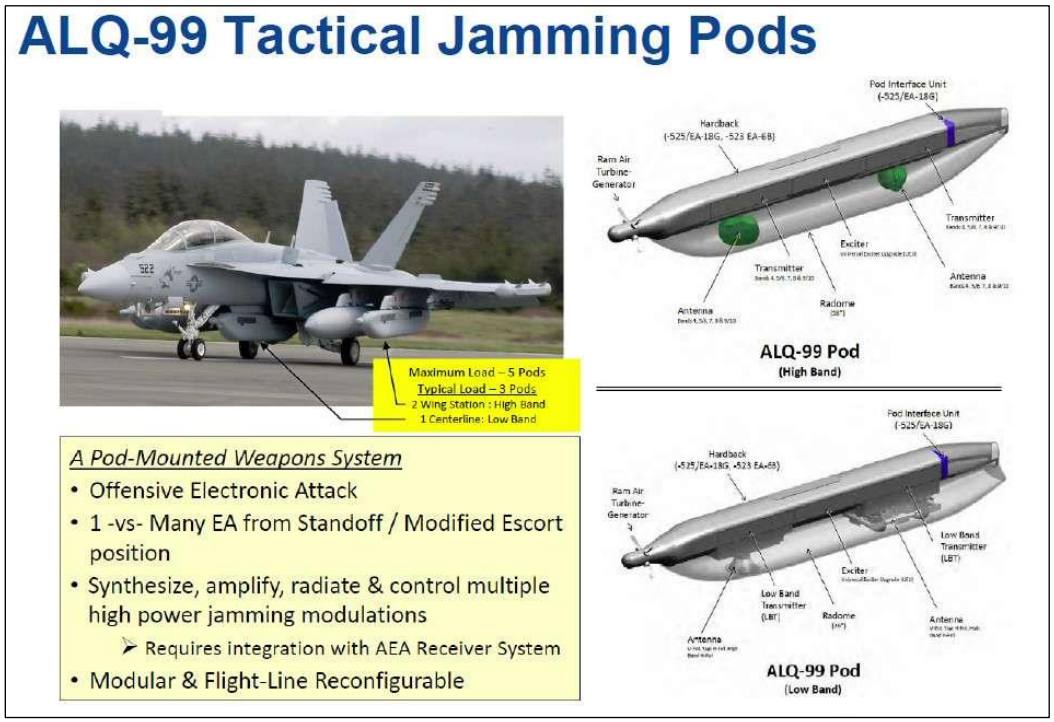
The AN/ALQ-99 tactical jamming system (**Figure 7** and **Figure 8**; see also **Figure 2**) consists of a series of electronic jamming pods. The system was originally developed in the 1970s for the EA-6B, and it was also used by the EF-111A. The system has been updated over time and is currently carried by EA/18Gs. The current version of the system, called the ALQ-99F(V), achieved IOC in 1999. Navy plans call for replacing the ALQ-99 with the Next Generation Jammer (see next section). The Navy states that the ALQ-99 "is the only airborne tactical jamming system in the Department of Defense inventory. [The] ALQ-99 [system] is facing material and technological obsolescence and cannot counter all current, much less future, threats."[32]

[32] Department of the Navy, *U.S. Navy Program Guide 2017*, p. 27. The Navy's use of the word "tactical" refers to how the system is carried on a tactical fighter aircraft, as opposed to an aircraft like the EC-130H Compass Call.

Figure 7. EA-18G Growler Equipped with AN/ALQ-99F Tactical Jamming System

Source: Annotated U.S. Navy photo as printed in Government Accountability Office, *Next Generation Jammer[:] DOD Should Continue to Assess Potential Duplication and Overlap As Program Moves Forward*, GAO-13-642, August 2013, p. 5.

Figure 8. ALQ-99 Tactical Jamming Pods



Source: Briefing slide accompanying Joseph Trevithick and Tyler Rogoway, "Navy's Next Gen Jammer Is Three Pods, Not One, And Competition For One Of Them Just Heated Up," *The Drive*, October 25, 2018. In this press report, the caption for the briefing slide states: "An RAAF [Royal Australian Air Force] briefing slide showing the interior layout of the two types of AN/ALQ-99 pod."

Next Generation Jammer (NGJ)

As mentioned above, Navy plans call for replacing the ALQ-99 with a new EW system called the Next Generation Jammer (NGJ) (**Figure 9**, **Figure 10**, and **Figure 11**).

Figure 9. Next Generation Jammer—Mid Band (NGJ-MB)

(Artist's rendering)

Source: Photo accompanying Sam LaGrone, "L3, Northrop Selected for Next Generation Jammer Work; Program Stalled After Raytheon Protest," *USNI News*, August 21, 2018.

The NGJ is being developed in three increments designed to jam across three radio frequency bands to prevent adversaries from using their communications and radar systems.[33] The first increment, which is to provide EW capability in mid-band frequencies, was previously referred to as Increment 1, but is now called the AN/ALQ-249 system or the Next Generation Jammer—Mid Band (NGJ-MB). The next increment, which is to provide EW capability in low-band frequencies, was previously referred to as Increment 2, is now called the Next Generation Jammer—Low Band (NGJ-LB). The remaining increment, currently called Increment 3, is to provide EW capability in high-band frequencies. DOD states that "the order of development [of the increments] was determined by the assessed capabilities of the developing threat and shortfalls of the legacy system to counter those capabilities, with Inc 1 [the Increment 1 system] covering the most critical threats."[34]

[33] Radars and radios operate at different frequencies depending on what mission they are trying to accomplish. Lower frequencies (i.e., "low-band") provide a longer range picture of the airspace, but cannot be used to launch a missile. Middle-band radars can provide target quality pictures for missiles, however do not have as long of a range. High-band radars can provide high-fidelity pictures, however they shorter ranges and the radio frequencies can be disrupted by objects and even water molecules. For more information see CRS In Focus IF11155, *Defense Primer: Military Use of the Electromagnetic Spectrum*, by John R. Hoehn.

[34] Department of the Navy, *U.S. Navy Program Guide 2017*, p. 27 and Department of Defense, *Director, Operational Test & Evaluation, FY 2016 Annual Report*, December 2016, p. 303.

Figure 10. Next Generation Jammer—Mid Band (NGJ-MB)

(Artist's rendering)

Source: Department of Defense, *Director, Operational Test & Evaluation, FY 2016 Annual Report*, December 2016, p. 303.

Raytheon was awarded the contract for developing NGJ-MB. L3 Systems, Northrop Grumman, and Harris were awarded the contract for developing NGJ-LB.[35] The Navy's FY2020 budget submission states that NGJ-MB is scheduled to achieve IOC in the fourth quarter of FY2022.[36]

The NGJ program has been a subject of congressional oversight for several years.[37] An August 2018 press report states the Navy stalled in its development of the NGJ, however with the renewed focus of "great power competition," particularly with Russia and China, the NGJ has been given increased importance and priority. [38] Frank Kendall, when he served as the Undersecretary of Acquisition, Technology and Logistics decided to accelerate the program.

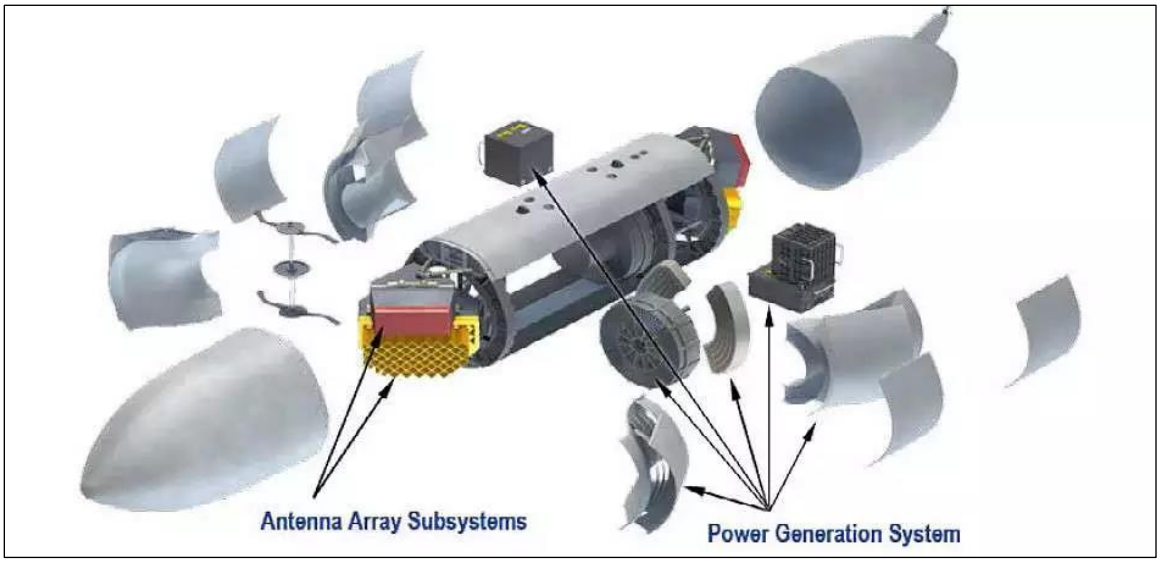
[35] See, for example, Joseph Trevithick and Tyler Rogoway, "Navy's Next Gen Jammer Is Three Pods, Not One, And Competition For One Of Them Just Heated Up," *The Drive*, October 25, 2018; Sam LaGrone, "L3, Northrop Selected for Next Generation Jammer Work; Program Stalled After Raytheon Protest," *USNI News*, August 21, 2018.

[36] See also Julian Kerr, "Avalon [Airshow] 2019: Next Generation Jammer on Track for US Navy IOC in 2022," *Jane's Defence Weekly*, February 28, 2019; Paul McLeary, "Navy's New EW Jammer to be Ready in 2022, *Breaking Defense*, July 17, 2018.

[37] See, for example, Government Account Ability Office, *Weapon Systems Annual Assessment[:] Knowledge Gaps Pose Risks to Sustaining Recent Positive Trends*, GAO-18-360SP, April 2018, pp. 102-103; Department of Defense, *Director, Operational Test & Evaluation, FY 2016 Annual Report*, December 2016, pp. 303-304; Government Accountability Office, *Next Generation Jammer[:] DOD Should Continue to Assess Potential Duplication and Overlap As Program Moves Forward*, GAO-13-642, August 2013, 27 pp.

[38] Sam LaGrone, "L3, Northrop Selected for Next Generation Jammer Work; Program Stalled After Raytheon Protest," *USNI News*, August 21, 2018.

Figure 11. Next Generation Jammer—Mid Band (NGJ-MB)



Source: Illustration accompanying Joseph Trevithick, "The Navy's New Jammers For Its EA-18G Growlers Cut Back Their Range More Than The Old Pods," *The Drive*, November 28, 2018.

The Navy's FY2020 budget submission requests $524.3 million for PE 0604274N in FY2020. The budget submission projects annual funding to decline in subsequent years, to $178.4 million in FY2022 and zero funding thereafter as research and development work on NGJ-MB is completed and NGJ-MB transitions from research and development to procurement.[39] The budget submission estimates the total research and development cost of NGJ-MB at $3,985.0 million (i.e., about $4.0 billion), of which $2,848.2 million (i.e., about $2.8 billion) has been received through FY2019.

The Navy's FY2020 budget submission requests $6.2 million for PE0604274N—the first procurement funding requested for NGJ-MB.[40] The submission projects that in subsequent years, as procurement of NGJ-MB ramps up, annual funding for this line item would increase to $144.7 million in FY2021 and $534.1 million by FY2024. The submission estimates the total procurement cost of NGJ-MB at $4,830.9 million (i.e., about $4.8 billion).

The Navy's FY2020 budget submission requests $111.1 million for this PE in FY2020 and projects annual funding to increase in subsequent years, to $241.5 million in FY2024.[41] The submission estimates the total research and development cost of NGJ-LB at $3,499.1 (i.e., about $3.5 billion), of which $178.3 million has been received through FY2019.

[39] Research and development work on NGJ-MB is funded in Program Element (PE) 0604274N, Next Generation Jammer (NGJ)—a line item in the Navy's research and development account. In the Navy's FY2020 budget submission, PE 0604274N is line 116 in the account.

[40] Procurement of NGJ-MB is funded through a line item called Next Generation Jammer (NGJ) in the Modification of Aircraft (i.e., Budget Activity 05) part of the Navy's aircraft procurement account. In the Navy's FY2020 budget submission, it is line 59 in the account.

[41] Research and development work on NGJ-LB is funded in PE 0604282N, Next Generation Jammer (NGJ) Increment II, another line item in the Navy's research and development account. In the Navy's FY2020 budget submission, this PE is line 118 in the account.

Impact of Next Generation Jammer on Range of EA-18G

Because the NGJ reportedly produces more drag on the EA-18G according to the Navy the Next Generation Jammer has the potential of reducing the operational range of the EA-18G. A November 28, 2018, press report states that the NGJ Mid-band pod produces more drag than the current ALQ-99.[42] Raytheon's proposal for the low-band pod was partially rejected as a result of increased drag over competing designs. These increases in drag have been reported to reduce the operational range of the EA-18G. The specific impact on range is classified.[43]

Miniature Air-Launched Decoy (MALD) and Jammer (MALD-J)

DOD states that the Miniature Air Launched Decoy (MALD) and Jammer (MALD-J), also designated ADM-160 (**Figure 12** and **Figure 13**), is designed as a low-cost, expendable vehicle that can replicate the flight and radar signatures of manned aircraft. The MALD-J adds an electronic attack component. According to the DOD "MALD-J is designed to support an airborne strike force to achieve mission success by jamming enemy radars and air-defense systems by degrading/denying detection of friendly aircraft or munitions."[44]

MALD has a reported range of about 500 nautical miles.[45] It was first developed in the mid-1990s, and more than 2,000 have been produced. A new version, designated MALD-X, is now being developed. An August 2018 press report states that

> MALD-X enhances the modular nature of the mini cruise missile with the ability to accommodate different electronic warfare payloads that are more advanced than those found on MALD-J. What is planned to come out of MALD-X is a networked decoy that can use its adaptive electronic warfare payload to deliver electronic attacks on air defense nodes autonomously or at the direction of operators from a afar in a semi-autonomous fashion.[46]

A derivative of MALD-J and MALD-X, designated MALD-N, is being developed for use on Navy F/A-18E/F strike fighters.[47]

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[42] Joseph Trevithick, "The Navy's New Jammers For Its EA-18G Growlers Cut Back Their Range More Than The Old Pods," *The Drive*, November 28, 2018.

[43] The Raytheon Company, File B-416578.1, October 22, 2018. Accessed at: https://www.gao.gov/docket/B-416578.1

[44] Department of Defense, *Director, Operational Test and Evaluation, FY 2017 Annual Report*, January 2018, p. 265.

[45] See, for example, Raytheon, "MALD Decoy, Disrupting Enemy Air Defense Systems," undated, accessed April 4, 2019.

[46] Tyler Rogoway, "Recent MALD-X Advanced Air Launched Decoy Test Is A Much Bigger Deal Than It Sounds Like," *The Drive*, August 24, 2018. See also Colin Clark, "Did We Put This Bug In SCO's Ear? MALD-X Tested For Swarm EW," *Breaking Defense*, August 23, 2018; Kimberly Underwood, "U.S. Military Takes MALD-X Outfitted with Electronic Warfare to the Air," *Signal*, August 24, 2018.

[47] Matthew Nelson, "Raytheon to Develop Miniature Aerial Decoy Tech for Navy," *Executive Biz*, January 31, 2019; Richard Scott, "MALD-N Programme Transitions into TMRR Phase, Splits off Jammer Payload," *Jane's Missiles & Rockets*, October 2, 2018; Jason Sherman, "Navy Taps Raytheon to Launch Next-Generation EW Decoy: the MALD-N," *Inside Defense*, September 26, 2018; Tamir Eshel, "US Navy to Field a Networked Decoy/Jammer," *Defense Update*, August 26, 2018; Tyler Rogoway, "Recent MALD-X Advanced Air Launched Decoy Test Is A Much Bigger Deal Than It Sounds Like," *The Drive*, August 24, 2018.

Figure 12. Miniature Air-Launched Decoy (MALD)

(Shown fitted to a B-52H bomber)

Source: Photo accompanying Tyler Rogoway, "Recent MALD-X Advanced Air Launched Decoy Test Is A Much Bigger Deal Than It Sounds Like," *The Drive*, August 24, 2018. The caption to the photo states: "MALDs loaded up on a B-52H."

Figure 13. Miniature Air-Launched Decoy (MALD)

Source: Photo accompanying Tyler Rogoway, "Recent MALD-X Advanced Air Launched Decoy Test Is A Much Bigger Deal Than It Sounds Like," The Drive, August 24, 2018.

Potential Issues for Congress

Congressional EW Working Group (EWWG)

Given their interest in, and concerns about, U.S. EW capabilities in the era of renewed great power competition, some Members of Congress have met in recent years through the Electronic Warfare Working Group (EWWG).[48] In the 115th Congress, Representative Bacon introduced the Joint Electromagnetic Spectrum Operations Readiness Act of 2018 (H.R. 5522). This bill would have asked the DOD to

- develop a joint campaign modeling capability to model electromagnetic spectrum effect on operations,
- assess capabilities and capacities of EW platforms associated with operational plans, and
- develop an interim and annual report on programs and personnel assigned to EW missions.[49]

An identical bill in the Senate was referred to the Senate Armed Services Committee.[50]

Airborne EW as a DOD Priority

One potential oversight issue for Congress is whether DOD is giving too little, too much, or the right amount of priority to airborne EW programs in its planning and budgeting relative to other U.S. military EW programs (such as those for U.S. ground forces or Navy surface ships) and to other DOD non-EW priorities, particularly in the context of renewed great power competition and improvements in air defense and EW capabilities by Russia, China, and other potential adversaries.

Congress may consider developments such as Russia's deployment and sales to other countries of advanced air defense systems. Some observers have expressed concern about Russia's ability to use its advanced air defense systems, such as its S-400 surface-to-air (SAM) missile system, to establish hard-to-penetrate anti-access/area-denial (A2/AD) zones around defended areas in Europe and Middle East, and for countries that purchase Russian-made air defense systems, such as China, to do something similar in other regions.[51] Other observers state that the capabilities of

[48] See, for example, "EWWG Briefing: "Electronic Warfare & Electromagnetic Spectrum Operations," concerning a briefing scheduled for October 3, 2017, accessed March 11, 2019, at http://dearcolleague.us/2017/09/ewwg-briefing-electronic-warfare-electromagnetic-spectrum-operations/; "AOC [Association of Old Crows] Advocacy: EW Working Group Hosts EW/EMSO Educational Briefing Series for Congress," March 29, 2017, accessed March 11, 2019, at http://www.ecrow.org/articles/index-v4.asp?aid=432979&issueID=52139; Association of Old Crows, invitation to panel discussion on the electromagnetic spectrum scheduled for June 21, 2016, accessed March 11, 2019, at http://www.ecrow.org/pdf/EWWG_invitation_6.21.pdf; Association of Old Crows, photo of June 21, 2016, meeting, accessed March 11, 1019, at https://www.facebook.com/aocrows/photos/electronic-warfare-working-group-ewwg-hosts-electromagnetic-spectrum-ems-panel-w/1056968031018192/. The Association of Old Crows (AOC) is a professional association for those with an interest in EW. For more on the AOC, see Association of Old Crows, "Mission & History," accessed March 11, 2019, at https://www.crows.org/page/missionandhistory.

[49] H.R. 5522.

[50] S. 2949.

[51] See, for example, Michael Cecire, "NATO Is Focusing on the Wrong Russian Threat in Eastern Europe," *World Politics Review*, October 26, 2018; "China's Anti-Access Area Denial," Missile Defense Advocacy Alliance, August 24, 2018; Dominik Jankowski, "Six Ways NATO Can Address the Russian Challenge," Atlantic Council, July 4, 2018;

Russia's A2/AD air defense systems have been overrated.[52] The Defense Intelligence Agency states that Russian air defense are among the best in the world, and they continue to develop highly-capable systems which they export to countries like China interested in acquiring long range defensive systems.[53]

DOD states that China's air force has one of the largest air defense forces, with a series of advanced long-range surface-to-air missiles. These consist of the Russian S-300PMU, the domestically produced CSA-9, and the recently fielded Russian S-400 system.[54]

An April 2018 press report stated (emphasis added):

> One of the "wicked problems" [U.S.] commandos are facing now is in Syria, which [U.S. Army General Tony] Thomas called the "most aggressive electronic warfare environment on the planet from our adversaries. They are testing us every day, knocking our communications down, **disabling our EC-130s**, etc."[55]

Another factor Congress may consider is how, in a situation of finite DOD funding, devoting more funding to airborne EW programs would affect funding for other EW priorities, or DOD non-EW priorities, and what the resulting net change would be in overall U.S. military capabilities.

Mix of Airborne EW Capabilities and Investments

Another potential oversight issue for Congress is whether DOD's proposed mix of airborne EW capabilities and investments is appropriate given the current and projected capabilities of potential adversaries such as Russia and China. Specifically, what is DOD's vision by combining specialized tactical EW aircraft such as the EA-18G, standoff EW aircraft such as the EC-130H and EC-37B, strike fighters with embedded EW capabilities such as the F-35, and air-launched decoys and jammers with growing numbers of stealthy fifth-generation F-35s? What evolutions are occurring in U.S. military operational concepts? Is it appropriate, for example, that the Air Force and Marine Corps no longer operate their own specialized tactical EW aircraft, while the Navy continues to operate and invest in the EA-18G and its Next Generation Jammer EW pods? More generally, to what degree do the airborne EW capabilities of the Air Force, Navy, and Marine Corps overlap, and is that overlap appropriate?

"The Baltic Dilemma: NATO Security in the Russian Anti-Access Bubble," Royal Danish Defence College, May 3, 2018 (announcement for a conference scheduled for May 29, 2018); Ian Williams, The Russia – NATO A2AD Environment," Center for Strategic and International Studies (Missile Threat, CSIS Missile Defense Project), January 3, 2017.

[52] See, for example, Robert Dalsjö, Christofer Berglund, and Michael Jonsson, *Bursting the Bubble, Russian A2/AD in the Baltic Sea Region: Capabilities, Countermeasures, and Implications*, FOI, Swedish Defence Research Agency, March 2019, 114 pp.; David Axe, "A New Report Claims Russia's Mighty Missiles Might Not Be So Mighty After-all," National Interest, March 7, 2019. See also Jyri Raitasalo, "It Is Time to Burst the Western A2/AD Bubble," Kungl Krigsvetenskapsakademien (Royal Swedish Academy of War Sciences), June 16, 2017.

[53] Defense Intelligence Agency, *Russia Military Power, Building a Military to Support Great Power Aspirations*, 2017, p. 79.

[54] Department of Defense, Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2018, pp. 34-35.

[55] Howard Altman, "SOCom Leader Wanted to Toss Google Exec from Car. Because He Was Right." *Tampa Bay Times*, April 26 (updated April 27), 2018.

Role of Emerging Technologies

A third potential issue for Congress is how DOD uses advances in technology. Electronic attack platforms have evolved from the manned platforms with relatively large crew sizes, such as the EA-6B Prowler and the EC-130H Compass Call, to the EA-8G Growler with a crew of two and the MALD-J, which does not have crew and is a standoff weapon. Evolving A2/AD environments potentially make traditional stand-in jamming too dangerous for manned aircraft. Therefore, Congress may consider policy for DOD regarding developing platforms that are capable of operating in A2/AD environments. What unmanned EW programs does DOD currently fund? Does DOD plan to develop additional stand-in jamming systems?

EC-37B Compass Call Re-Host Aircraft Procurement

Another oversight issue for Congress concerns the Air Force's planned quantity and rate for procuring EC-37Bs and replacing EC-130Hs. The Air Force plans to replace 14 EC-130H aircraft with 10 EC-37Bs. The Air Force currently maintains 10 EC-130H Compass Calls for operations, with one aircraft devoted to testing and three additional aircraft in back-up inventory. How does the Air Force plan to use a smaller fleet of aircraft? Would 10 EC-37B aircraft be able to meet operational demands?

Some Members of Congress have expressed an interest in procuring EC-37Bs more quickly than the Air Force plans, so as to accelerate the replacement of EC-130Hs with EC-37Bs. The committee and conference report language bearing on this issue for the John S. McCain National Defense Authorization Act for Fiscal Year 2019 and the FY2019 DOD appropriations act appear below.

Appendix. Recent Congressional Action

John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/S. 2987 /P.L. 115-232)

The House Armed Services Committee, in its report (H.Rept. 115-676 of May 15, 2018) on H.R. 5515, the FY2019 National Defense Authorization Act, stated that

> [t]he committee supports the Air Force's efforts to recapitalize the aging EC–130H Compass Call fleet with the more capable EC–37 type aircraft. The committee notes that the Air Force must first comply with the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328) and the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91) before it can carry on with the transition plan. The Air Force requested $108.1 million for fiscal year 2019 for one EC–37. The committee is concerned that the Air Force plan to procure one aircraft per year over 10 years in order to recapitalize this fleet is not the most efficient way to move the capability to the field quickly, and may put the Compass Call mission at unacceptable risk of mission failure. Therefore, the committee directs the Secretary of the Air Force to provide a briefing to the House Committee on Armed Services by February 1, 2019, on the Compass Call transition plan. This plan should include:
>
> (1) courses of action to accelerate the recapitalization of the EC–130H fleet and Baseline 4 development and deployment for incoming EC–37 aircraft;
>
> (2) attendant timelines for each course of action;
>
> (3) cost estimates for each course of action;
>
> (4) recommended course of action and a plan to manage both fleets while supporting combatant commander requirements; and
>
> (5) an assessment of the potential for future cooperative development and procurement of EC–37B Compass Call aircraft by the Royal Air Force of the United Kingdom and the Royal Australian Air Force in a way the leverages the best practices of the RC–135 cooperative program arrangement with the Royal Air Force of the United Kingdom. (Pages 23-24)

The Senate Armed Services Committee, in its report (S.Rept. 115-262 of June 5, 2018) on S. 2987, the John S. McCain National Defense Authorization Act for Fiscal Year 2019, stated the following:

> The committee supports the Air Force's efforts to recapitalize the aging EC–130H Compass Call fleet with the EC–37 type aircraft. The committee notes that before it can carry on with the transition plan, the Department of Defense must first comply with the related provisions in the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328) and the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91). While the committee notes that Department has submitted the certification required by the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91), delays in satisfying the requirement has led to a work stoppage on the program lasting at least six weeks. The committee is concerned about the potential for further work stoppages should the Secretary of the Air Force fail to make a timely determination that the EC–37B has a high likelihood of meeting combatant requirements, as required by the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328). The committee encourages the Secretary of the Air Force to make a timely determination for this requirement to avoid further program delays and cost overruns.

> Therefore, the committee directs the Secretary of the Air Force, not more than 60 days after the determination required by the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328) is made, to provide a briefing to the congressional defense committees on the Compass Call transition plan. This plan should include:
>
> (1) Courses of action to accelerate the recapitalization of the EC–130H fleet and Baseline 4 development and deployment for incoming EC–37 aircraft;
>
> (a) attendant timelines for each course of action;
>
> (b) cost estimates for each course of action; and
>
> (2) Recommended course of action and a plan to manage both fleets while supporting combatant commander requirements. (Pages 40-41)

FY2019 DOD Appropriations Act (Division A of H.R. 6157/P.L. 115-245)

The House Appropriations Committee, in its report (H.Rept. 115-769 of June 20, 2018) on the FY2019 DOD appropriations act (H.R. 6157), stated the following:

> The [committee's] recommendation [of FY2019 procurement funding for the program] includes an increase of $194,000,000 above the budget request to procure and modify one additional EC–37B Compass Call aircraft, with the expectation that such funds will allow the Air Force to accelerate the fielding of the fourth such aircraft to meet combatant commander needs and mitigate performance concerns regarding the legacy EC–130H fleet. The Committee recommends that the Secretary of the Air Force consider increasing the procurement of EC–37B aircraft to two per year if such a pace of recapitalization can be achieved without unduly disrupting the operational availability of Compass Call capability for the combatant commanders. (Page 188)

In final action on the FY2019 DOD Appropriations Act (Division A of H.R. 6157/P.L. 115-245 of September 28, 2018), Congress increased the requested amount for procurement of new EC-37Bs by $108 million for "Program increase - accelerate fourth EC-37B aircraft."[56]

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[56] Joint Explanatory Statement for H.R. 6157, PDF page 203 of 559, line 15.