THE Air Force is getting ready to launch a sweeping analysis of how it conducts electronic warfare, hoping to develop a more integrated and innovative approach to this critical aspect of modern combat around 2018.

That analysis can't come soon enough. Experts charge that the multitude of elements in USAF's electronic warfare portfolio haven't been knitted together in a coherent way; the service is tripping over definitions, can't find a workable distinction between electronic and cyber war, and has taken an ad hoc approach to electronic battle.

The service also lacks an electronic warfare "czar" with visibility into all aspects of its EW efforts—a focal point that experts think is urgently needed.

Retired Gen. Larry D. Welch, USAF Chief of Staff from 1986 to 1990, offered a blunt appraisal of the Air Force's EW enterprise at AFA's Air Warfare Symposium in Orlando, Fla., in February.

"One of the problems with electronic warfare is, we don't know who owns it," Welch said in a panel discussion on future capabilities.

"We don't know where it fits," he said. "It's not cyber, so what is it?"

The Air Force long regarded cyber as endemic to all its missions, and for that reason long postponed recognizing it as a domain separate from air and space and worthy of its own enterprise. After long debate, 24th Air Force, the service's own cyber command, was created in 2010.

"Some people advocate … [that EW] should be considered a separate domain. I don't know that that's the answer," Welch said. "But I do know that the Air Force has been particularly remiss in not doing a lot with electronic warfare compared to … our two principal, probable adversaries," a clear reference to China and Russia.

"Quite frankly," Welch said, USAF has not done nearly as much EW planning "as the Navy has done. So it just needs to have a home somewhere in the Air Force where it … gets the attention it needs."

Reacting to those comments, Gen. Mark A. Welsh III, the current Chief, said electronic warfare has "changed shape over time. And if you ask people in any of the services what that means, you'd get a number of different answers." The Air Force needs to define "clearly what electronic warfare is today and in the future, and then what capabilities are we missing." Some of these may be met by elements "already built into systems that are moving forward," he said.

He continued, "This is one of the areas that we identified a year ago as something for a potential [Enterprise] Capability Collaboration Team in the Air Force"—a cross-domain analysis—as EW "affects a whole bunch of different mission areas … in different ways." But Welsh also said that "using a single broad term to refer to all of it actually confuses things more than it helps. ... We're trying to clearly define the mission area, the requirements within it, and who should have the lead for each of those things."

The Air Force's self-set 12 core functions range from nuclear operations to global attack to mobility and special operations, but don't include EW, though EW is considered a key factor in each.

USAF photo by MSgt. John R. Nimmo Sr.

USAF hopes to develop an innovative, integrated approach to a critical aspect of modern combat: electronic warfare.

LEADING EW OUT OF THE WILDERNESS

By John A. Tirpak, Editorial Director

F-35s such as this one have an inherent EW capability that rivals the EW capabilities of EA-6Bs.

Lt. Gen. James M. "Mike" Holmes, USAF's top strategic planner, told *Air Force Magazine* that an EW deep dive is coming soon, but couldn't get underway until the recent Air Superiority 2030 study was completed. Once the overarching construct was figured out, Holmes said, the pieces—EW being a big one—can be fleshed out in specific detail.

"We are working on it," Holmes said of an EW roadmap. He said there's "a strong feeling that EW will be on the next list" of topics addressed by a Strategic Portfolio Review and an Enterprise Capability Collaboration Team, which will look at ways to address new operational problems in approaches that cut across domains and commands.

"We know that we have to take a soup-to-nuts look at EW across our enterprise," Holmes said.

Asked when it would start, Holmes said Welsh directed that "before we pick the next areas we're going to look at, he wants me to bring in industry and academia and some other people and look at opportunities and think through what our next one should be." Holmes added, "Right now, EW is at the top of the list … we haven't made a final decision." If another topic takes priority, "we're not going to wait, we'll continue to do some work" on it.

The Air Force's EW portfolio has a lot of parts. Its flagship platform is the EC-130H Compass Call, a Hercules transport brimming with racks of electronics gear and bulging with pods and blisters that can detect, locate, and jam transmissions and radars. (The EC-130J Commando Solo, though it has a nearly identical nomenclature, has a completely different mission, as a flying broadcast studio for psychological operations.)

Beyond the EC-130H, the Air Force's fourth generation fighters carry self-protection radar warning and jamming pods, electronic countermeasures pods, and onboard EW systems. The Miniature Air Launched Decoy (MALD) missile and its MALD-J jamming variant would be fired in volleys during an air campaign to mask the true location of striking jets. The Air Superiority 2030 plan also suggested that cheap stand-in jamming drones might be built in large numbers to fool enemy air defenses.

STEALTH VS. EW?

The RC-135 electronic spyplane can also be used to characterize, locate, and jam transmissions.

The F-22 and F-35 fighters, as well as a small number of F-15s, possess active electronically scanned array (AESA) radars. These can perform not only search-and-track functions for air combat, but communication, jamming, and deception, too. The F-35 and F-22 also have conformal antennas in their skins which can serve EW functions, but the Air Force won't discuss them.

The F-22, F-35, and B-2 all employ stealth, which relies on aircraft shaping, radar frequency-hopping, some active systems, and a number of tactics and techniques to attenuate their radar signature.

Some have argued that the Air Force put too much reliance on stealth and, in so doing, failed to adequately invest in electronic warfare. Retired Lt. Gen. Robert J. "Bob" Elder Jr., former commander of 8th Air Force, said in an interview that "some people have told me we don't need electronic warfare anymore because we have stealth. Well, stealth *is* electronic warfare. What they meant was, they thought we didn't need active electronic attack."

Until the late 1990s, the Air Force employed large numbers of EW aircraft. The EB-66 Destroyer was a Vietnam-era electronic countermeasures jet that escorted strike aircraft. Also during Vietnam, the F-105G Wild Weasel provoked enemy radars into revealing their positions, which they then attacked with Shrike and Standard Anti-Radiation Missiles. During the 1991 Gulf War, USAF employed F-4Gs in the Wild Weasel role, using the more advanced High-speed Anti-Radiation Missile (HARM) to destroy enemy emitters. The EF-111 Raven, the Air Force's version of a "stand-in" or escort jammer, was also a prominent player in the Gulf War, blanketing the sky with electrons that made the enemy's radar screens light up with thousands of false targets that hid striking USAF jets.

These aircraft collectively performed the suppression of enemy air defenses, or SEAD mission. It is often counted as the kinetic form of electronic warfare.

When the Air Force downsized in the 1990s, the F-4Gs were retired, passing their mission on to F-16Cs equipped with targeting systems for the HARM. The EF-111 retired without a direct successor in hand. The Navy, whose four-seat EA-6B Prowler escort jets carried the same electronics, picked up the jamming

An EA-18G Growler launches from the deck of USS* George Washington. *Some USAF crew members fly with Growler units as exchange officers.

USN photo by Mass Comm. Spc. 3rd Class Bryan Mai

USAF photo by TSgt. Nicholas Rau

SSgt. Gabriel Felix runs through a check of the computer system on an EC-130H at Bagram Airfield, Afghanistan, in February. Compass Call aircraft go through baseline upgrades every 18 to 48 months.

escort mission for both services, and until recently, Air Force electronic warfare officers flew on the Prowlers to improve service integration. Though the Marine Corps still has some Prowlers, the Navy has moved on to the EA-18G Growler, an EW variant of the two-seat F/A-18F Super Hornet. Under an agreement between the services last September, a few Air Force crews will continue to fly with Growler units as exchange officers.

The downsizing over the years, coupled with the growth of stealth, saw USAF neck down to the Compass Call as its main EW platform.

Col. George M. Reynolds, commander of the 55th Wing, which counts the EC-130H and RC-135 fleets in its portfolio, explained that the EC-130 offers several main capabilities. Those are "countercommunications, counterradar, counterdata, and counternavigation," he said in an interview.

"We do a full range of military operations, from supporting small teams on the ground all the way up to the high-end conflicts," he explained. The EC-130 can perform standoff communications or radar jamming of enemy air or surface craft. It can listen for enemy communications, warn troops on the ground that an enemy is nearby, or disrupt the enemy's attack at selective moments by jamming, Reynolds said. The aircraft has a lot of power for emissions, due to its four engines, he noted.

BIG SAFARI

The 55th's aircraft are operating in a constantly shifting electronic environment, as communications evolve from land lines to cellular and satellite modes, and radios morph into software programs on other devices. Many nations that never built land lines are skipping directly to modern wireless systems, Reynolds said, and these are expanding "in an exponential manner." This drives constant fleet updates.

"The capabilities on the aircraft actually get updated very rapidly. … In the case of the EC-130, we go through baseline upgrades … every 18 to 48 months," Reynolds said. The older aircraft are now largely up to speed with digital avionics, doing away with the old "round dial" cockpit displays, he said. Those upgrades have provided "significant" new capabilities.

In between the major refits, there are "Quick Reaction Capabilities," which are interim installs of new mission gear. It's all done under an Air Force program/office called Big Safari, which does quick acquisition and maintenance of aircraft in key missions.

"One of our combatant commanders may want us to look at a communication system that we had never seen used by a military," Reynolds explained. "And that could be a terrorist organization, a country … that's using something they bought from [another] country we never anticipated." Big Safari has to "provide that capability on the aircraft because nobody five years ago had thought about that capability being used."

Likewise, the specialists that use the equipment need constant, on-the-fly training. If they suggested it, though, they have a pretty good sense of how it's supposed to work.

The pace of programmed depot maintenance is also faster for the 55th Wing

Unarmed EB-66 EW aircraft escorted strike aircraft during the Vietnam War, detecting and jamming enemy air defense radars.

USAF photo

An EC-130H Compass Call on the flight line at Bagram. The EC-130 is the Air Force's flagship EW aircraft, brimming with electronic equipment, pods, and blisters to detect, locate, and jam enemy communications and radar.

airplanes than for most others. After a total stripdown of the aircraft to inspect, repair, and reinforce anything necessary, "it's really not even the same airplane" anymore, Reynolds said.

In the case of the EC-130s, the key life-limiting item was the center wingbox, which holds the wings and central fuselage together. Those have been replaced, and that mod "extends the life of the platform by decades," he said.

Reynolds said that to meet demand for machines and crews alike, the wing rethought all its upgrade schedules and training programs to increase aircraft availability, with the same number of aircraft. Such is the demand that sometimes aircraft are hot-turned, where one crew gets off and another gets on.

To get even further value out of the aircraft, Reynolds said that participation in a Red Flag or similar exercise is an opportunity to experiment with new tactics, techniques, and procedures and "support test and evaluation while we're there." The wing is increasing its participation in Virtual Flag and simulations, and doing more "reachback" by making use of stateside analysts and operators as backup for deployed people and assets.

All of which made it puzzling that the Air Force proposed retiring seven of the 15 EC-130 Compass Call aircraft in its Fiscal 2016 budget request. The decision to retire those airplanes "was one not made lightly," the Air Force told Congress at the time, "but was driven by financial constraints and the needs of the Air Force to modernize in other areas."

The reason was certainly not lack of need. Reynolds said that, since 9/11, the EC-130 has been "continuously deployed to the Middle East" among 13 locations worldwide.

Operating tempo has been unrelentingly high during those years. "We've been doing this for so long, that's kind of become the standard," he said. For some specialties associated with the mission, such as linguists, the optempo has been even higher, as it has been for maintainers, who are in short supply.

Congress declined USAF's request to reduce the EC-130 fleet.

Service sources said the Air Force was willing to absorb some loss of EC-130s because its new F-35s have an inherent EW capability that will match or exceed what the EC-130s offer. Lockheed Martin, maker of the F-35, frequently points out that the Marine Corps plans to use a standard F-35, without any external jamming pods, as its EA-6B replacement.

THE BLACK WORLD

The Navy, however, has focused on the EA-18G Growler as its principal EW platform. In mid-April, it awarded Raytheon a $1 billion contract to complete development of the Next Generation Jammer pod, which will replace the ALQ-99 pods that were largely a legacy of the Prowler.

Elder said a lot of EW projects "are in the black world" which means that US advances in EW may not be obvious. He said USAF's air operations centers do a good job of coordinating the disparate EW efforts and are moving toward achieving even better synergies between them.

"Where they are now is just in the basics, but they're getting better and better," he said, speculating that this may be one of the reasons "why the Air Force hasn't seen a need to go for a [new] dedicated" EW platform.

The Air Force asked industry last fall to pitch ideas for militarizing business jets to take on electronics-heavy missions the service didn't identify. Industry experts speculated that such aircraft might be intended for EW.

Elder suggested that the US hurts its own efforts by distinguishing signals intelligence missions from electronic warfare, largely because of laws affecting how the military can conduct reconnaissance. "That distinction complicates our approach," he said.

The Defense Science Board, in a report released late last year, offered what it called a "sobering" assessment of electronic warfare capabilities across the military services. Though the US "relies on information superiority," this is "jeopardized by serious deficiencies" in EW. The DSB urged the Pentagon to spend more on EW, devote more manpower and other resources to it, shift "more to offense," and create "governance" for the EW enterprise appropriate to 21st century warfare.

The DSB estimated it would cost "$2.3 billion per year for at least five years" to implement its recommendations regarding electronic warfare.

Deputy Defense Secretary Robert O. Work, responding to the DSB, launched the EW Executive Committee, which he touted as a cross-service look at integrating electronic warfare—not just at the tactical or operational level, but across entire theaters. The so-called "ExCom"

Raytheon photo

Miniature Air Launched Decoy (MALD) units mounted on a B-52. They can be fired in volleys during combat to mask the real location of striking aircraft.

is co-chaired by Pentagon acquisition chief Frank Kendall and Joint Chiefs vice chairman Air Force Gen. Paul J. Selva.

Work explained that EW—like space, cyber, and nuclear weapons—is a "cross-cutting" area where "we don't have a kind of 'head'" and consequently "got in trouble." There was no way for Work to know "whether, as a Department of Defense, as a joint force, [if] we have enough electronic warfare effectors in our joint battle networks."

The ExCom has given him more insight into the EW portfolio, he said, but "we have a lot of work to do in both cyber and EW. Our adversaries have really … poured a lot of money into it because they know the power of our battle networks" and want to counter them.

Work said he created a "Cyber Investment Board" as a result of analysis done on that domain, "and … my intent" is to do something similar with EW. More should be done in both areas, he said, but "what we give up to get it is always the question."

In a paper called "Winning the Airwaves," published last fall by the Center for Strategic and Budgetary Assessments, authors Bryan Clark and Mark A. Gunzinger suggested the Pentagon consolidate the terminology for electronic warfare, electronic attack, cyber, and electronic support under the blanket domain name "electromagnetic spectrum." The Defense Department, they said, should also take advantage of new technologies that will "dramatically change" EMS to leapfrog the nation's adversaries in this domain.

Much as smartphones and the internet are changing "how the world shares, shops, learns, and works," new sensors and networking technologies will give some militaries "significant new advantages over competitors that fail to keep pace," the authors warned, charging that " 'failed to keep pace' is an appropriate description" of the Pentagon's investments in EMS for a generation.

COUNTERDETECTION

This "pause," Clark and Gunzinger charged, gave Russia, China, and other rivals a chance to target "vulnerabilities" in US communications and sensor networks. The "once significant" American military advantage in the EMS domain "is eroding and may in fact no longer exist," they wrote.

To fix the situation, the authors recommended the US obtain a "leap ahead" in EMS capability. This could come through "low-power countermeasures" to defeat enemy sensors and low probability of intercept/low probability of detection sensors and communications to reduce the likelihood that US forces will be "counterdetected."

The authors pushed a shift toward passive or "multistatic" methods: using "ambient electromagnetic energy"—such as comms traffic, TV and radio emissions, and even sunlight—to spot enemy forces without emitting and using new emissions controls and "low-power countermeasures" to stay quiet in enemy airspace.

Such a transition demands ever-more sophisticated (and hack-resistant) networking of systems; the ability to agilely "maneuver" in the EMS with regard to power, frequency, space, and time; investing in "multifunctional" systems like AESAs that can perform a variety of all-in-one tasks; investing in smaller, cheaper systems that can be widely deployed among US forces; and investing in systems that can rapidly and automatically "characterize the EMS," finding "previously unknown emitters" and exploiting opportunities.

Asked who is the quarterback for the EW enterprise in combat, Elder said, "There are a number of different programs looking … now" to designate just such a player—and they're secret—but "there's a need to be able to coordinate these things" such that whenever the leader "drops out, someone else can pop in and take over."

David Hime, president of the Association of Old Crows, an EW organization, said though the terms "convergence" and "integration" have become common themes in debates over EW strategy, "it seems we still keep having this debate. … Some people argue" that EW, Sigint, electronic attack, and cyber "are the same thing," but what should guide the discussion from now on is, "the effect you're trying to have in the battlespace."

Hime and Elder agree that a central office for EW acquisition would create a useful, clear focal point.

There should be "a clear go-to person that has [a] broader portfolio than just the requirements," bringing in training and operations as well, Elder said.

Whether that EW overseer should be at the deputy chief of staff level—much as the Air Force created a deputy chief of staff for ISR in 2006—might be an "interesting discussion," he said. ✪