350th Spectrum Warfare Wing – Embracing the Future of EMSO

By John Knowles

The US Air Force's 350th Spectrum Warfare Wing (SWW) is less than 18 months old, but it is well on its way to making a huge impact in Air Force electromagnetic warfare (EW) in the coming years.

Air Combat Command stood up the Wing at Eglin AFB, FL, in June 2021, with the mission to "deliver adaptive and cutting-edge electromagnetic spectrum capabilities that provide the warfighter a tactical and strategic competitive advantage and freedom to attack, maneuver and defend." Its first commander, Col. William Young, stated at the time, "The competition in the electromagnetic spectrum is more important than ever before. The Joint Force is connected by and delivers effects in and through the EMS. If we lose the fight in the EMS, we will lose the fights in all other domains. We're here to help make sure that doesn't happen."

Col Joshua Koslov, who assumed command of the 350th SWW in July, emphasizes the wing's mission to support the warfighter. "The reason why we need the 350th Spectrum Warfare Wing," he explains, "is that as we transition to this period of global competition, we have to have a single commander who's focused on delivering combat ready EW capability to warfighters – based on warfighters priorities and needs – in order for us to execute the operational plans that they've been tasked to build and potentially have to execute. That's the bottom line. We exist to support the warfighter and to produce combat capability that is required to win our nation's wars." To support this goal, he says, "We're focused on identifying the critical kill chains that we need to attack, in order to make us successful in our operational plans based on our pacing campaign plan."

This approach is different from the way the Air Force supported the warfighter in the past. For the last 50 years or so, the Air Force's EW Enterprise has reflected an industrial age approach organized around its various weapons systems. Its EW professionals were and are stovepiped. Air Force EW Officers (EWOs) have trained with a common curriculum, but after basic EW education, they spend most of their careers operating a specific weapons system, such as the B-52, EC-130H Compass Call or the RC-135V/W Rivet Joint, with little cross training, which creates a stovepiped professional community.

For many decades, the Air Force's EW mission data development process has also been stovepiped. ACC's 53rd EW Group, which formed part of the 350th SWW, was mainly focused on reprogramming and disseminating EW mission data software according to each Combat Air Forces (CAF) weapons system (B-1B, B-52, F-15, F-16, etc.). Koslov describes this is a "channelized" approach to EW, referring to the channelized architectures of many legacy EW systems. While this channelized approach to EW worked in the past, it is no longer viable, he says. "The analogy that I use is, in our hardware, we've gone away from channelized systems, but a lot of our business practices are still channelized," he explains. "And so, the 350th SWW has got to be 'spread spectrum.' Because we're focused on delivering decisive warfighting capability, we have to think this way."

EW MISSION DATA

The 350th SWW comprises two groups: the 350th Spectrum Warfare Group (SWG) and the 850th SWG. The 350th SWG has the equivalent of five squadrons, the 16th Electronic Warfare Squadron (EWS), the 36th EWS, the 68th EWS, the 513th EWS and the F-35 Partner Support Complex (PSC). Its primary responsibility is reprogramming and disseminating EW mission data software for Combat Air Forces (CAF) weapons systems, as well as allies and partners participating in the Foreign Military Sales (FMS) program. This includes utilizing emitter data provided by intelligence organizations, such as the National Air and Space Intelligence Center, to develop EW mission data for CAF EW systems. The Group uses threat simulators to validate EW mission data software updates and performs operational flight tests, as well. The 513th EWS is the sole mission data reprogramming lab for US Air Force, Navy and Marine Corps F-35 aircraft, and the F-35 PSC provides similar support for all international F-35 partners.

Koslov says that developing EW mission data software will remain an important part of what the 350th SWW does, but that how it performs this responsibility needs to change. "As Agile Combat Employment (ACE) leads the Air Force to become a more agile force in the physical space, we have to be able to provide mission data at the speed of need" he says. "And so, waiting on production cycles to update EW systems is not going to help us against our pacing campaign plan challenge. So, we're thinking with that Agile Combat Employment mindset. Anything that can help us to be able to build the architectures and facilities and people that we need to make that loop faster to support achieving warfighter objectives is a really good thing for us to pursue." He said that the F-35 program is showing a lot of promise in achieving this goal, "but the challenge is extrapolating what we're learning from the F-35 to the rest of the enterprise."

Koslov said the way the wing develops EW mission data "needs to be revitalized and brought into the 21st century. We're thinking bigger than just mission data. How do you use mission data to create offensive waveforms as we fight to targets, and what can we re-host that we've learned in mission data on the platforms with longer reaches? And so that's where that our mindset as an integrator comes in. Mission data is our is our bread and butter. But it's got to be revitalized. It has to grow to encompass more of what we need to do in the spectrum."

EW AS A SERVICE

The 850th SWG is where some of the most dynamic changes are already taking shape under a new concept built around rapidly delivering new software-based capabilities to the warfighter. To achieve this, the group will develop a class of software known as MissionWare, which rides on top of an EW system's operational flight program, much the same way that an app rides on top of an iOS or Android operating system on a smartphone. In fact, the 850th houses its MissionWare apps in a digital distribution service known as the TacApp System. "We're trying to take an 'EW-as-a-service' approach and steal that from the business world," Koslov explains. "So, for example, on our MissionWare side of the house, not every platform needs to continually host a specific weapon systems countermeasure on its OFP. But we can potentially get to a place where we house that information. And so, as a unit is deploying to a specific place or has a specific mission, we are the place that provides that information [for their EW system]. The feedback mechanism for us would be the warfighter saying what the requirements are. And then we feed that down to our digital service folks, who work and crank on developing the capability that we would need in order to host that. And so, we've been successful with that so far."

The wing's goal with its "EW-as-a-service" concept is to move away from developing stovepiped EW capabilities for each weapons system and create software applications that can be used across multiple weapons systems types, regardless of the proprietary software technology residing in the EW system's OFP. For example, an EA technique developed for the EC-130H Compass Call could potentially be used by an EA-18G, even though the Compass Call's mission system (made by L3Harris Technologies and BAE Systems) and the Growler's mission system (made by Boeing and Northrop Grumman) use different OFPs and different (and often proprietary) EA techniques without any standards that would enable them to be shared between the two weapons systems types. "So, where I think the promise of that MissionWare-focused, TacApp System-focused, software-based capability lies is, regardless of whether you have a Compass Call or a Growler in the area, you can share their resources to have a capability against a target set. And that's a warfighter-focused model that I think we need to continue to drive towards adopting."

One way the 350th SWW is achieving this goal is via a data-translation tool, originally developed by Defense Advanced Research Projects Agency (DARPA), known as System-of-systems Technology Integration Tool Chain for Heterogeneous Electronic Systems (STITCHES). More specifically, STITCHES is a "toolchain specifically designed to rapidly integrate heterogeneous systems across any domain by auto-generating extremely low latency and high

throughput middleware between systems without needing to upgrade hardware or breaking into existing system software," according to DARPA. In simpler terms, STITCHES enables two different systems to connect without the need to upgrade either system's hardware or software. When two systems are connected this way, they are being "stitched" together.

In mid-2021, DARPA transitioned the STITCHES program to the 350th SWW, which promptly set up a STITCHES Warfighter Application Team that began identifying opportunities. Koslov explains, "So what we're doing with STITCHES is we've developed a cross functional team across the wing that includes our intel folks, our digital service folks, our MissionWare folks and our mission data folks. And what we're trying to do is reach into the warfighting commands and identify their priorities for capabilities that they need bundled together – stitched together – in order to develop a warfighting capability. And so, we're building a process by which we can rack and stack and prioritize what gets 'stitched' and then test that and field it."

Once a stitch is created between two systems, the connection must be maintained. "How do we sustain that stitch?" Koslov asks, somewhat rhetorically. "Because Technology 1 is operating on [software] version 10.0, and Technology 2 is operating on version 11.0. And we originally stitch them at that level. But when the systems change [implement software updates], we have to revisit that stitch to make sure that the stitch still exists. So how do we maintain the ability to do that and – within our authorities – maintain that combat capability?" That, he says, is one of the challenges they are working to solve.

In some ways, STITCHES is just the beginning – a way to show that two different EW systems that use different software, can be quickly linked to use each other's capabilities. Fundamentally, it represents a way to get around different software standards. By proving the value of linking EW systems in this way, it ultimately places greater emphasis on software standards that can translate into more EW capabilities for the warfighter. "It's about the software as we go forward. And STITCHES is really in its infancy. It's a powerful capability that I think, if we do it right, will deliver capability right now. But we can get exponentially faster if, through collaboration with industry and our Joint and coalition partners, we all operate within an agreed-to set of standards that allow us to be interoperable in the battlespace."

Over the past year, an Air Force team led by members of the 350th SWW showed what can be achieved with its digital service initiative. The effort, known as Project 212, used the STITCHES tool kit combined with newly developed MissionWare to stitch together the Small Adaptive Bank of Electronic Resources (SABER) system on the EC-130H Compass Call and a separate EW capability from the 16th Air Force, known as ARCADE. "The idea was to allow Compass Call to connect with ARCADE in order to make that a closed link," explains Koslov. In July, the Project 212 team conducted in flight verification tests of the stitched systems on a Compass Call at Davis-Monthan AFB, AZ. "It was very successful," says Koslov, "and it demonstrated that a third-party capability can be integrated into a weapon system and deliver combat capability. There's more work needed on the sustainment side to fully realize the vision. But that is now a demonstrated effective capability."

The SABER-ARCADE integration could have been performed without STITCHES, but it would have taken far longer and required more resources to achieve. Koslov explains, "It's called Project 212 because it took 212 days from a bright idea in the fall of 2021 to the successful flight demonstration in July. And so there's a lot of hardcore engineering that the STITCHES Warfighter Application Team had to do to make those systems talk to each other, because there are no standards [between the systems]. So ARCADE software was written without a lot of the normal protocols that would easily be able to be integrated into the SABER software. And so, with really good coordination with the EC-130 SPO and the 16th Air Force, we were able to get the right people talking to each other and allow for this to happen from a policy perspective first. And it was able to go fast because of that coordination – and because of the promise of the capability it provided. In the past, this would have taken a lot longer, because the capability would have had to reach SPO, it would have had to get racked and stacked by SPO for the EC-130 community. That

would have meant something else that they need doesn't get worked on, or it gets pushed down in the rack and stack profile. So, allowing the 350th Spectrum Warfare Wing to be the – for lack of a better term – program manager of this capability, it helped cut through a lot of that red tape. And although it's still in testing, it didn't have to go through that traditional DT/OT, long acquisition process."

WAVELENGTH

Project 212 was a first of its kind demonstration, and it represents only the beginning of what the 350th SWW wants to achieve with its digital services model. In order to continue building this into something larger, the Wing needed to create the organizational structure to grow it.

In August, around the same time that it achieved its success with Project 212, the 850th SWG activated a new unit – formally named Detachment 1, but also known as the Wavelength Digital Service – at Joint Base San Antonio, TX. An ACC news release about the Wavelength activation says, "As opposed to being a software factory, Wavelength drives different areas of software creation. It explores identifying new software solutions, enables the execution of new software, and educates the 350th SWW workforce to make sure their software development principles adhere to modern standards." Koslov explains, "The plan is, they'll work on teams in order to develop capabilities that are requested by warfighters or by higher headquarters. We have a TacApp System today. We have the STITCHES capability today. And so, with Wavelength, we're developing the processes by which we prioritize what we work on and then develop real warfighting capability – not 'it's a cool idea' capability, but capabilities that the warfighter actually needs."

Within the 850th SWG, one of the units that will support Wavelength is the 39th EWS. Activated at Eglin in June 2020, the 39th EWS uses intelligence data on threat systems to support EW operational reprogramming, performs mission data production via the Specialized Electronic Combat Tools and Reprogramming Environment (SPECTRE) software suite and develops EA techniques for EW systems on CAF, search and rescue and FMS partner EW systems. Koslov says, "The cross functional teams for STITCHES and targets set development and those kinds of things reside in the 39th. So, I think about the 39th as the nerve center of the 850th's mission and as a place where the 'EW-as-a-service' mindset resides."

SCALING UP

As mentioned earlier, much of what the 350th SWW is achieving now is in many ways just the beginning – early examples that show what its digital services enterprise can do. In addition to creating new organizations, such as Wavelength, the wing will need to focus on developing the skillsets, as well as building a more sophisticated data infrastructure. Koslov explains, "There's going to be some time where we're going to have to bring in cloud computing infrastructure experts to help us to be able to move this information around the 'Big Data sphere.'" In addition, he says, "The data that we have spans classification levels. And so, we have to develop an infrastructure that can move data and make all data accessible across classification levels, in order to be able to plug our highest-end information into our lowest-end systems and use that information to develop a capability. Those are policy challenges within the DOD right now. And those are also collaboration challenges with industry, in order to set some standards that we can all work from in order to make that interoperability a little bit easier."

In terms of developing the skillsets the wing already has a workforce with deep experience in various types of software engineering, as well as EW test and training. But it will need to develop more people with skills in MissionWare and cloud computing, for example. "We are creating a professional development series for our civilian folks – the wing is right now a majority of civilian personnel," explains Koslov. But another aspect of this is building the mindset the underpins the transformation to an organization that's focused on a growing menu of EW digital services. Toward that end, Koslov says, "We have a very nascent speaker series that we're developing. In August, we had Dr. Karen Haigh, who wrote the leading book on cognitive EW. She talked to the wing and then spoke with our people who are working on AI and ML initiatives. We're also bringing in the folks that own the operational plans, and we're making our people smart – a lot of them are civilians – smart on the adversary and how the adversary thinks. And those were things that some of our engineers may never thought about before, because they saw their job as simply generating mission data files. We're trying to make them talk about and learn about why they're doing it. And then, when we have successes, we can say, 'Here's what your data did for the warfighter. Here's the impact.' Understanding that connection to the warfighter is super important."

950th SPECTRUM WARFARE GROUP

One of the 850th SWG's primary activities is the Combat Shield EW assessment program, performed by the group's 87th EWS. The Combat Shield unit, which was created in 1990 and was an essential part of preparing US Air Force units for deployment for the 1991 Gulf War, comprises several teams that perform on-site EW weapons systems evaluations for aircraft squadrons, similar to Combat Archer (for air-to-air weapons) and Combat Hammer (for air-to-ground weapons). The squadron's EW readiness assessments help Air Force squadrons to identify shortfalls and improve their EW systems' performance. This information also helps major commands and Air Force leadership understand the EW operational readiness levels of their various squadrons.

Like many units in the 350th SWW, the Combat Shield program will expand its mission under a new organization, the 950th SWG, that will be located at Robins AFB, GA, says Koslov. "Our plan right now is to grow the 87th and make the 87th assessment mission the core of what the 950th Spectrum Warfare Group does at Robins, but at a much larger scale. Not just RAW gear [self-protection EW], but the warfighting capabilities of the Air Force in the spectrum." Koslov said the wing chose Robins for the 950th's location because it is the primary location for the Air Force's EW sustainment efforts, and some of their work is focused on fixing EW deficiencies identified by the Combat Shield program. "There's a footprint of folks [at Robins] that works on EW programs on the development side, and that will be crucial to us," he explained. "If you pair your assessment folks with the folks that are deeper development folks, it should be a golden circle. We're assessing and talking to developers at the same time. There's, 'this is not good; We need to develop a capability against it.' So, I think there's some synergies with the organizations that exist at Robins and with the growth of what the analysis mission can be. I think there's some natural synergy between the capabilities that exist there today. And obviously Robins is a historic EW base that will support the 950th amazingly."

WHAT DOES THE CROW THINK?

While the 350th SWW is focused on re-organizing and evolving its mission to support the Air Force in the EMS, it is also focused on establishing itself as the Air Force's "go-to" resource for all things Spectrum. Koslov likens this to the role of the 8th Fighter Wing and Kunsan Air Base in the Republic of Korea. "The 8th FW in Kunsan Air Base, Korea – that Wing Commander is always the Wolf," explains Koslov. "And that goes back to Robin Olds [call sign Wolf 01], and Vietnam and the Wolfpack. Everyone knows that the Wolf's job is to take the fight north, receive follow-on forces and keep fighting. That's what that wing does for the nation. And so, we're the Crows down here at the 350th Spectrum Warfare Wing. The wing commander position here is Crow 01. What I'm trying to do is to get the Air Force to say, 'you know, when a spectrum issue arises within the Air Force, they ask, what does the Crow and the Crows think?' And that's not me personalizing it to Josh Kozlov. That's me personalizing it to the wing. What do the Crows think? And we're the place where they come to get those answers."

Koslov cites an example of China's latest wave of incursions into Taiwan's airspace following the visit by a US congressional delegation in August. "What I care about and where I want to get to is that somebody says, 'What does the Crow know? What does the Crow think about what they [PLAAF] just did? And what are we learning from that?' And then, how am I pumping all that information that we collected back into my enterprise to develop capability against what they just showed us? I want our organization to be thinking, when Red does something like that, we realize, 'Oh, we're going get a whole bunch of good information. We can't wait to get this information, because it's going make us much more lethal and enable us to deliver decisive capability that much better.'"

As Crow 01, Koslov's career has prepared him for the task ahead, which has the twin demands of continuing to build the wing and integrate its functions while simultaneously integrating the wing into the larger Air Force. "My warfighting approach is based on the career that the Air Force has given me, and I wasn't purposely developed for this job. In my last job, I was the AOC commander, and my job there was as an integrator. I've spent a lot of my career in the Compass Call, which by nature is an integrating platform. I feel like I'm uniquely qualified for this job, and I think my heritage as an electronic attack EWO helps me in this role, because I've been offensive my whole career. I haven't been channelized. I've been about effects and asking things like, 'how do I take this Compass Call system that was designed for to attack the former Soviet Union in the Fulda Gap, and apply it to a GWOT fight?' And that's a small tactical problem compared to what we're facing today."

Ultimately, Koslov says, "The promise of this wing is the ability to look at the adversary's kill chain in its entirety and be able to develop ways to mitigate it for the warfighter. The 350th Spectrum Warfare Wing represents a significant corporate reinvestment in the future of the Spectrum, and it's just one of many steps that we're going to take as a Service to overcome our operational challenges in the Spectrum."