ASSOCIATION OF OLD CROWS
Advancing Electromagnetic Warfare TOGETHER
crows.org

November 2022 Vol. 45, No.11

JED

Journal of Electromagnetic Dominance

350th SWW
Changing the EW Game

Also in this Issue:

- News: Royal Navy Selects Ardent Wolf CESM
- EW 101: Side Lobe Jamming EP Techniques

smiths interconnect

Cutting-edge Connectivity

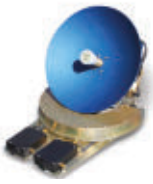
Providing innovative, reliable and customizable solutions that enable our customers to achieve mission success.

We Offer

- Technical excellence and broad market experience
- A comprehensive product portfolio providing customers with a single point of supply for a variety of SATCOM, Ka-Band Antenna Systems and Line of Sight Defense Antenna Systems
- High speed network agnostic connectivity
- High dynamic range block and tuned frequency
- Mobile multi-band capability in a single unit eliminates the need to buy multiple separate systems
- 28V DC input power facilitates operation from vehicles/batteries for maximum portability
- Efficient, high gain directional antenna's (with integrated LNA) support link closure in excess of 100km

Mobile Multi-Band Antenna System

Ground Data Terminal Antenna System



Ka-Broadband Antenna System

more > smithsinterconnect.com

Ultra CHAMELEON,
as flexible as its name implies.

The complete solution for radar target generation and ECM signal generation.

Using a multiple channel, multi-DRFM architecture, CHAMELEON can simultaneously generate complex radar targets together with jamming signals in a unique and highly-programmable way.

The simulator features 3D radar target modelling with true multipoint scatterers, clutter, and ECM signal generation.

The CHAMELEON can be delivered in a variety of form factors, as an indoor rack-mounted system or as a complete self-enclosed system.

For more information about Ultra Specialist RF solutions, visit **ultra.group/intelligence-communications**.

ULTRA

Ultra Intelligence & Communications
sales@ultra-us-gbs.com | www.ultra.group

JED
Journal of Electromagnetic Dominance

CONTENTS

November 2022 • Volume 45, Issue 11

18 Cover Story

350th Spectrum Warfare Wing – Embracing the Future of EMSO
By John Knowles

15 News

- ROYAL NAVY SELECTS ARDENT WOLF CESM
- DARPA SEEKS NEW RECONFIGURABLE RECEIVER PROCESSING TECHNOLOGIES FOR AUTONOMOUS SPECTRUM SENSING
- HENSOLDT, RAFAEL TEAM FOR EUROFIGHTER EK ESCORT JAMMER
- ELBIT SYSTEMS UK TO SUPPLY LASER WARNER FOR CHALLENGER 3 TANKS

Departments

6 The View from Here
8 Conferences Calendar
10 Courses Calendar
12 President's Message
24 EW 101
26 AOC News
28 AOC Members
29 Index of Advertisers
30 *JED* QuickLook

An EC-130J Commando Solo aircraft from the Pennsylvania Air National Guard's 193rd Special Operations Wing (SOW) delivers its last broadcast during a flyover during Community Days at the Lancaster Airport in Lititz, PA, on Sept.17. The event marked the final training flight for the 193rd SOW's three EC-130J aircraft, closing out a 54-year EW history for the wing. The EC-130J Commando Solo III replaced the EC-130E Commando Solo II in 2003. Like its predecessor, the EC-130J performed Military Information Support Operations (MISO) missions in a number of US military operations and could broadcast up to seven simultaneous AM, FM and TV transmissions to a wide civilian audience. In addition, the EC-130J could perform communications electromagnetic attack and collect communications intelligence, as well as perform command and control relay. The 193rd SOW is converting to the MC-130J Commando II mission, providing clandestine infiltration, exfiltration and resupply of special operations forces.

US AIR NATIONAL GUARD PHOTO BY TECH. SGT. TONY HARP

COVER PHOTO STAFF SGT. JAMES A. RICHARDSON JRZ

PROVEN POWER

50 watts

Model BME49189-50 & BME69189-100

4-18 GHz, 50 Watts & 6-18 GHz, 100 Watts
Solid State Power Amplifier Module

- Full Power Across the Entire Bandwith
- Maintains Output Power, Gain, and Efficiency with Real World Load Conditions
- Superior Harmonics *AND* Input /Output VSWR
- Compact, Lightweight, and Usable in the Harshest Environments
- 28 VDC GaN Technology
- High Speed Blanking
- Operating Temperature: -40° C to 55° C

100 watts

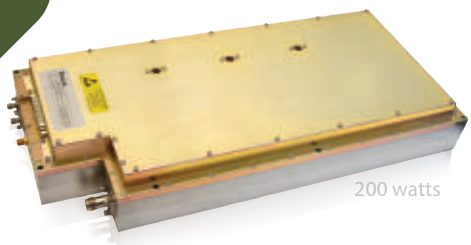
SOLID STATE PERFORMANCE

100 watts

Model BME2969-100 & BME2969-200

2–6GHz, 100 & 200 Watts
Solid State Power Amplifier Module

- High Efficiency Over the Entire Bandwidth
- RF Input/Output Sample Ports
- Internal DC to DC Converters
- External T/R Switch Available
- Maintains Output Power with Real-World Load Conditions
- Operating Temperature: -40° C to 55° C
- Also Available in 300 Watts



200 watts

COMTECH POWER SYSTEMS TECHNOLOGY™

Subsidiary of Comtech Telecommunications Corporation
www.comtechpst.com

Contact our sales & marketing department today to discuss your exact project needs.
Comtech...*meeting needs, exceeding expectations.*

105 Baylis Road, Melville, NY 11747
Tel: (631) 777-8900 • Fax: (631) 777-8877

417 Boston Street, Topsfield, MA 01983
Tel: (978) 887-5754 • Fax: (978) 887-7244

TAKING A NEW APPROACH

I'm very excited about this month's feature story on the US Air Force's 350th Spectrum Warfare Wing (SWW). I truly enjoyed my conversation with 350th SWW commander Col Josh "Mule" Koslov, who assumed command of the wing in late July. He really seems to be picking up right where his equally dynamic predecessor, Col (Ret.) William "Dollar" Young, left off.

The Air Force needs visionary leadership from commanders like Young and Koslov if it wants to dig out of the sizable EW hole it created for itself back in the 1990s. In that decade, it retired EW aircraft, de-activated EW units and dramatically reduced its pipeline of EW experts, which put it in a tough situation as it entered an era of Great Power competition in the early 2010s. Over the past few years, however, the Air Force has been steadily rebuilding its EW enterprise, and activating the 350th SWW in June 2021 has been its most significant move, so far.

The Air Force wants to modernize the way it creates capabilities for the EMS, and it is looking to the 350th SWW to show one way this can be done. By marrying it's EW mission data organization (350th Spectrum Warfare Group) with its growing EW digital services activity (850th SWG), the 350th SWW is in the early stages of building a new organization for the Air Force to quickly field EW capability. The Wing is achieving this in part by developing its own MissionWare – software applications that can provide new capabilities in existing EW systems. There's much more to this digital services strategy, and I'll let the article explain more of that. But the key take-away is that the Air Force is adapting its processes to develop software-based EW capabilities on its own and delivering those capabilities to the warfighter much faster than before. While developing apps for a software-defined system is nothing new – after all, this is how our smart phones work – it's the scope and scale of this digital services strategy that definitely marks a new era for Air Force EW.

Another major aspect of the 350th SWW is its strategic pursuit of integration. For example, the way that the wing is integrating the processes and functions of its various units is fascinating. Its leadership is thinking more like a Silicon Valley tech company than a traditional military organization with a Napoleonic staff structure. This makes a lot of sense, when you consider its focus on providing EW as a digital service. The wing's integration mindset also extends to its personnel. Colonel Koslov mentions how stovepiped (he uses the term "channelized") the Air Force's EW enterprise traditionally has been – especially in its professional ranks. However, the unit commanders (wing, group and squadron levels) of the 350th SWW are drawn from many EW backgrounds. This enables the wing to capture a wider range of perspectives, and it ensures that its solutions consider the entire Air Force EW enterprise. I hope you enjoy our story about the 350th SWW, and I expect you will be hearing more about them in the coming months and years.– *J. Knowles*

JED
Journal of Electromagnetic Dominance

Journal of Electromagnetic Dominance is published for the AOC by
NAYLOR ASSOCIATION SOLUTIONS
550 SW 2nd Avenue
Gainesville, FL 32601
Tel (800) 369-6220
www.naylor.com

COVER PHOTO COURTESY OF
STAFF SGT. JAMES A. RICHARDSON JR

PUBLISHED OCTOBER 2022/JED-M1122/8543

Experience Increased Power & Performance with our New Test Equipment – In Stock & Ready to Ship!

SM435B

A spin on our powerful SM200B, taking the RF tuning range all the way up to 43.5 GHz! With many of the same features as the SM200-series analyzers, the SM435B delivers lightning fast performance at a fraction of the cost of comparable analyzers.

- Benchtop-friendly design
- Readily interfaced, using its local API
- 160 MHz of IBW
- Ultra-low phase noise

BB60D

Now includes a preselector and better dynamic range, better phase noise, lower residual spurious signal levels and also possesses a dedicated 10 MHz input and additional digital output options.

- Portable, lightweight 6 GHz real-time spectrum analyzer
- Preselector filters from 130 MHz to 6 GHz
- 10dB more dynamic range
- Sweeps up to 24 GHz/sec

Signal Hound®

SignalHound.com Made in the USA

ORDER TODAY AT SIGNALHOUND.COM >

Calendar *Conferences & Trade Shows*

NOVEMBER

Bahrain International Airshow 2022
Nov. 9-11
Sakhir Air Base, Bahrain
www.bahraininternationalairshow.com

2022 Directed Energy Systems Symposium
Nov. 14-18
La Jolla, CA
www.deps.org

I/ITSEC 2022
Nov. 28 – Dec. 2
Orlando, FL
www.ndia.org

Electronic Warfare Conference
Nov. 29-30
Swindon, UK
www.cranfield.ac.uk

EXPONAVAL 2022
Nov. 29 – Dec. 2
Valparaiso, Chile
www.exponaval.cl

MILCOM 2022
Nov. 29 – Dec. 2
Bethesda, MD
https://milcom2022.milcom.org

JANUARY

Surface Navy Association 35th Annual National Symposium
Jan. 10-12
Arlington, VA
www.navysna.org

FEBRUARY

Aero India 2023
Feb. 3-5
Bengaluru, India
www.aeroindia.gov.in

AFCEA West 2023
Feb. 14-16
San Diego, CA
www.westconference.org

IDEX
Feb. 20-24
Abu Dhabi, UAE
www.idexuae.ae

Avalon 2023
Feb. 28 – Mar. 5
Geelong, Victoria, Australia
www.airshow.com.au

MARCH

AFA Air Warfare Symposium
Mar. 6-8
Aurora, CO
www.afa.org

Satellite 2023
Mar. 13-16
Washington, DC
www.satshow.com

Collaborative EW 2023
Mar. 14-16
Point Mugu, CA
www.crows.org

DSEI Japan
Mar. 15-17
Chiba, Japan
www.dsei-japan.com

Dixie Crow Symposium 46
Mar. 20-23
Warner Robins, GA
www.dixiecrowsympsoium.com

*AOC conferences are noted in **red**. For more info or to register, visit crows.org. Items in **blue** denote AOC Chapter events.*

SAVE THE DATES

ASSOCIATION OF OLD CROWS

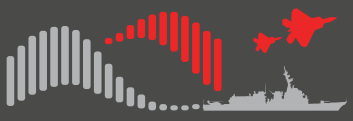
Collaborative Electronic Warfare 2023

MARCH 14–16
Pt. Mugu, CA

ASSOCIATION OF OLD CROWS

Cyber Electromagnetic Activity (CEMA) 2023

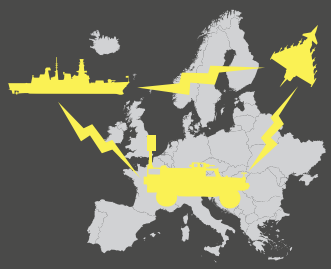
MAY 2-4
Aberdeen Proving Ground, MD



ASSOCIATION OF OLD CROWS

EW Capability Gaps & Enabling Tech 2023

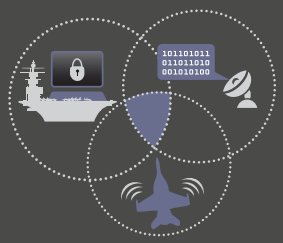
MAY 9–11
Crane, Indiana



ASSOCIATION OF OLD CROWS

AOC EUROPE

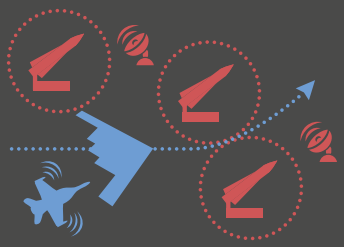
MAY 16–18, 2023
Bonn, Germany



ASSOCIATION OF OLD CROWS

Cyber/Electronic Warfare Convergence 2023

JUNE 6-8
Charleston, SC



ASSOCIATION OF OLD CROWS

Modern Threats: SAM Systems 2023

SEPTEMBER
Huntsville, AL

Find out more at crows.org/conferences

Calendar *Courses & Seminars*

NOVEMBER

AOC Virtual Series Webinar: Testing Your RWR – Accuracy Matters
Nov. 3
2-3 p.m. EDT
www.crows.org

AOC Virtual Series Webinar: Electromagnetic Maneuver: Towards a Theoretical Underpinning
Nov. 10
2-3 p.m. EST
www.crows.org

Cyber Warfare / Electromagnetic Warfare Convergence
Nov. 15-17
Atlanta, GA
www.pe.gatech.edu

RWR System Design and Analysis
Nov. 15-17
Atlanta, GA
www.pe.gatech.edu

Infrared Countermeasures
Nov. 15-18
Atlanta, GA
www.pe.gatech.edu

AOC Virtual Series Webinar: Two-Way Time-Transfer Digital Design for Distributed Array Operations
Nov. 17
2-3 p.m. EDT
www.crows.org

DECEMBER

Electromagnetic Warfare Data Analysis
Dec. 6-7
Atlanta, GA
www.pe.gatech.edu

AOC Virtual Series Webinar: In the Flat Field: Did Russian Army EW Underperform in Ukraine
Dec. 15
2-3 p.m. EDT
www.crows.org

JANUARY

AOC Virtual Series Webinar: Regaining the Spectrum Offensive
Jan. 5
2-3 p.m. EDT
www.crows.org

AOC Virtual Series Webinar: 2023 GPS Spoofing – History and Prevention
Jan. 19
2-3 p.m. EDT
www.crows.org

FEBRUARY

AOC Live Course: 21st Century Electronic Warfare – Systems, Technology and Techniques
Feb. 1 – Mar. 1
8 Session, 3 hrs. each
www.crows.org

AOC Virtual Series Webinar: Joint All-Domain Command and Control (JADC2)
Feb. 23
2-3 p.m. EDT
www.crows.org

Advanced RF Electromagnetic Warfare Principles
Feb. 27 – Mar. 3
Atlanta, GA
www.pe.gatech.edu

MARCH

AOC Virtual Series Webinar: Chinese Thinking on the Establishment of Information Dominance
Mar. 2
2-3 p.m. EDT
www.crows.org

*AOC courses and webinars are noted in **red**. For more info or to register, visit crows.org.*

Collaborative Electronic Warfare 2023

ASSOCIATION OF OLD CROWS

MARCH 14–16 Pt. Mugu, CA

CALL FOR PAPERS

ABSTRACTS DUE BY DECEMBER 14, 2022

THEME: US/AUS approaches to Collaborative EW: Stand-in/Stand-off/Self-Protect jammer collaboration, Sensor collaboration, Man/Machine Collaboration

Classification of Sessions: U.S. Secret, Releasable Australia

Conference Topics:

- Collaborative ES to support dynamic combat operations
- Cooperative electronic attack
- Collaborative electronic attack
- Emerging communications technologies
- Warfighter perspective

VISIT **CROWS.ORG/COLLABORATIVEEW2023** FOR MORE INFORMATION

For Sponsorship Opportunities
Contact Sean Fitzgerald at Fitzgerald@crows.org

EMSO OPPORTUNITIES AND A BRIGHT AOC FUTURE

For anyone who missed it, the AOC Presidency officially changed hands at AOC 2022. Thus, we are writing a joint President's Message to you this month to mark the change.

Every AOC President sets goals at the beginning of their term, pursues them during their term, and reflects on what they have achieved as their term winds down. In the midst of their term, the AOC President must balance the need for continuity with the desire to respond to emerging challenges and opportunities. We are extremely proud of how AOC has been able to adapt and what we have accomplished over the past two years. Those lessons learned have added innovative thought to our Five-Year Strategy for continued growth in advocacy, education and networking for our membership.

All AOC presidents have one tremendous resource they can always rely on – our members. Our diversity adds great strength. Where can you find a Crow? We are everywhere, and there is no single identity within our AOC membership. We represent many different communities and backgrounds; but under the AOC, we work together as one community focused on Electromagnetic Spectrum Operations (EMSO) to gain advantage in maneuvering through an increasingly complex Electromagnetic Operating Environment (EMOE). Our AOC members span the globe and are found in many types of jobs – academia, military service, industry, government, research, etc. We work across countless disciplines and develop a wide range of technologies critical to current and future operations. We operate and support all types of systems and platforms across every warfighting domain. We are the professionals who have and will continue to drive EMS advocacy, visibility, education and prioritization of EMSO-related challenges.

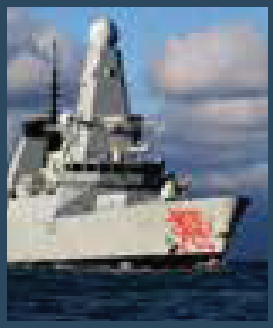
COVID-19 impacted the way AOC did business in 2021 and 2022, but we persevered and we continue to push forward as an even more relevant and visionary organization. AOC staff came together with exceptional initiatives and innovations that enabled us to work successfully in virtual, in-person and hybrid environments, events, webinars and training opportunities. AOC Board of Directors and staff continue to plan and prepare to execute our mission to support you at in-person, virtual, or hybrid events.

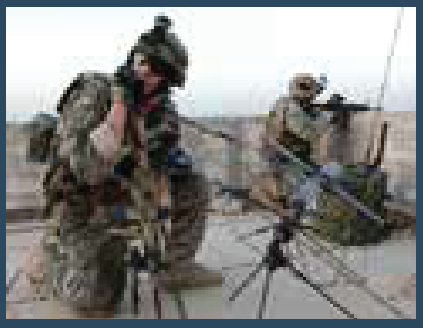
In closing, as we mark this transition from one AOC President to another, the key to the ultimate success of our association remains constant – active member participation. We all have the task to inform, educate, mentor, collaborate, network and, above all, communicate the importance of our endeavors in the EMS. *Together* we will continue to enhance AOC and keep it relevant and vibrant as the premier global professional association advocating across defense industry, government agencies, militaries, and academia for achieving and sustaining a military advantage in the EMS.

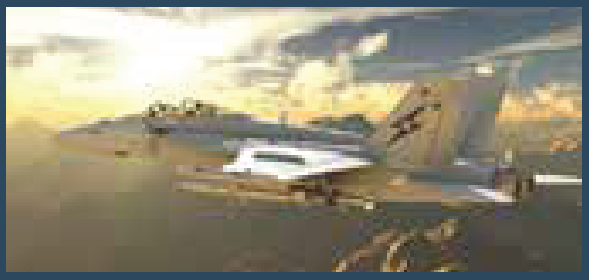
"Thank you for two great years." – *Glenn "Powder" Carlson* (retiring AOC President)

"I am excited and look forward to working with you to grow AOC and support the EMSO profession." – *Brian "Hinks" Hinkley* (incoming AOC President)

ASSOCIATION OF OLD CROWS







ADVANCING ELECTROMAGNETIC WARFARE TOGETHER

AOC SPONSORSHIP OPPORTUNITIES IN 2023

The AOC bridges the gap between Electromagnetic Warfare practitioners, Industry partners, Policymakers, and procurement decision-makers.

AOC Conferences, Webinars, Courses, Career Center, and the Annual AOC International Symposium & Convention are the perfect place to:

- Target a niche audience or reach out to a broad market, depending on event topic and attendee composition
- Develop personal relationships with clients
- Showcase a full product range
- Get immediate feedback and accelerate the buying process
- Launch a new product
- Raise brand awareness

Secure your sponsorship positions TODAY... before your competition does.

Sponsorship Catalog:
crows.org/2023SponsorshipCatalog

Contact Sean Fitzgerald:
fitzgerald@crows.org or 703-549-1600, ext. 222

Help Us Deliver High-Quality Education and Training While Sharing Your Expertise!

Present a Virtual Webinar Today!

Share your expertise and knowledge with the AOC and EMSO community. AOC is seeking presenters for webinars on the following topics:

UPCOMING WEBINAR TOPICS

- Electromagnetic Battle Management (EMBM)
- Joint Electromagnetic Spectrum Information, Analysis, and Fusion (JEMISIAF)
- Test & Evaluation of Electronic Warfare/ EMSO
- Standdown of the Land-Based EA-18G Growler Squadrons; what that means for the Joint Force
- Status of the new EC-37B Compass Call Aircraft for the USAF
- SpaceX, Starlink, and Quick Defeat of Russian Electronic Attack in Ukraine and Other Takeaways
- Joint All-Domain Command and Control (JADC2)
- U.S. Spectrum Auctions and the Future of EMSO/ EW Training in the U.S.
- What's Next After GPS? Time for a new Precision, Navigation and Timing (PNT) Solution
- Clean Energy and EMSO/EW: Do Wind Turbine Farms Really Impact EW Testing?
- Moving EMSO Education "Left of Bang"—The state of civilian undergraduate education in EMSO principles

ARE YOU AN EXPERT?

- Leading researching in a field not mentioned?
- A part of team contributing to the EMSO community?
- Contact AOC's Education Team at education@crows.org

Interested? Contact AOC's Education Team at education@**crows.org**

ASSOCIATION OF OLD CROWS

ROYAL NAVY SELECTS ARDENT WOLF CESM

The UK Ministry of Defence (MoD) has contracted Babcock to deliver, install and support a new maritime communications electronic support measures (CESM) capability on Royal Navy Type 23 frigates. Known as Ardent Wolf, the new CESM suite will replace the existing Hammerhead equipment currently fitted to Type 23 ships. The six-year contract – the value of which has not been disclosed – will involve equipment installation, repair and maintenance, system and design safety, contractor logistics support, training, and all updates.

The MoD commenced procurement activity for Ardent Wolf in mid-2021, outlining plans for a UK-sourced solution founded on a readily available commercial off-the-shelf (COTS) product at a high technical readiness level. The new system is required to utilize the extant CESM infrastructure on the Type 23 frigates, with the contract expected to deliver a minimum of seven COTS-based systems.

Babcock has partnered with a specialist UK-based small/medium enterprise (SME) to deliver the Ardent Wolf program. While the SME concerned has not been identified, *JED* sources suggest that the company concerned is most likely CommsAudit (Cheltenham, UK), which has previously delivered CESM solutions to the RN and offers a small form factor maritime CESM known as Spectra Maritime.

Babcock had previously delivered the Hammerhead CESM system to the Royal Navy in partnership with Boeing subsidiary ArgonST. In April 2021, Babcock received a £1.3 million Hammerhead Life Extension contract from the MoD to sustain the existing equipment in service through to March 2025. – *R. Scott*

DARPA SEEKS NEW RECONFIGURABLE RECEIVER PROCESSING TECHNOLOGIES FOR AUTONOMOUS SPECTRUM SENSING

The Defense Advanced Research Project Agency's (DARPA's) Microsystems Technology Office (MTO) has issued a Broad Agency Announcement (BAA) aimed at developing novel processor hardware and software technologies that can be integrated into a new generation of wideband receivers designed to operate in an increasingly congested electromagnetic operating environment (EMOE). Known as the Processor Reconfiguration for Wideband Spectrum Sensing (PROWESS) program, the effort will develop technologies that "enable 'just-in-time' synthesis of processing pipelines in uncertain environments where pre-programmed solutions are likely to fail," the BAA states.

According to the BAA, "Commercial and military demands on the electromagnetic spectrum (EMS) are driving RF systems to operate in increasingly congested and complex environments. Prior research, including DARPA's Spectrum Collaboration Challenge (SC2), has demonstrated that autonomous software-defined RF systems deliver significant benefits in both spectral capacity and robustness over traditional fixed or rule-based approaches to spectrum usage. The foundation of this type of RF autonomy is spectrum sensing, which enables RF systems to optimize to actual spectrum conditions and react to interference in real-time."

The BAA adds, "Spectrum sensing across wide bandwidths that contain increasingly complex and diverse signals drives the demand for edge processing beyond the capacity of today's devices. This increased demand is rooted in three emerging trends. First, as transmitters become more dynamic and software defined, there is far more uncertainty about potential RF signal operating parameters. Traditional methods to detect and characterize signals are designed for specific waveforms and perform poorly across arbitrary signal modulations and bandwidths. Overcoming these limitations drives receivers to use much more computationally-intensive algorithms. Given the potential rate of signal change, this trend also devalues the use of waveform-specific accelerators. Second, systems are operating across wider frequency ranges, expanding from megahertz (MHz) to gigahertz (GHz) scales. This pushes receivers to sense over wider bandwidths, significantly increasing the amount of digitized data they must continuously process. Third, wideband and narrow beam waveforms reduce peak power presented at the sensor, driving receivers to deliver additional gain through cross correlation and multi-channel spatial processing. These trends, coupled with potential benefits from the widespread use of RF autonomy, motivate innovation in ultra-flexible high-throughput streaming and data processors."

Accordingly, "PROWESS will combine emerging high-density reconfigurable processing arrays with embedded real-time schedulers to expose new architectural tradeoffs that jointly deliver high compute density and fast program switching," the BAA states. Under the PROWESS program, MTO aims to demonstrate three performance goals: 1) runtime reconfigurable processors with 200 giga-operations per second per square millimeter (GOPS/mm^2) compute density and 50 nanosecond program switch time; 2) real-time schedulers that manage 100 parallel programs at 90% processor utilization; and 3) scaling to continuously monitor 40 GHz total input bandwidth for important signals. To address the first two goals, the program will develop new processing architectures that can "jointly maximize compute density while minimizing program switch time." For the third goal, the BAA says, "Emerging cognitive sensors that continuously reassess signal importance present a new opportunity to relax timing constraints and enable schedulers to dynamically drop low-priority data and processing tasks."

To pursue these objectives, PROWESS is structured as a five-year program divided over three phases: Phase 1 (18 months), Phase 2 (24 months) and Phase 3 (18 months). Work under each phase is described as follows: "Phase 1 will focus on the development of device and software designs, using risk reduction experiments to mature these designs to the level of a preliminary design review (PDR). Phase 2 will

further mature designs to the level of a critical design review (CDR) and demonstrate prototype devices and software. Phase 3 will focus on the development of full-scale devices and support software capable of integration with a prototype receiver."

"PROWESS has one technical area that focuses on the development of runtime reconfigurable processing hardware and support software," according to the BAA. "Hardware of interest includes high-throughput streaming data processing arrays and any associated controllers or schedulers. Software of interest includes programming workflow tools, software-based resource managers, and real-time kernels to execute representative sensor processing functions."

The BAA further states, "RTRAs [runtime reconfigurable arrays] present a new opportunity to treat reconfiguration as integral to algorithmic design, rather than just switching among independent programs," the BAA states. "This capability is anticipated to enable the continuous real-time decision-making needed to monitor large swathes of dense and unstructured RF spectrum. PROWESS's overall goal is to combine high-density computational fabric with algorithmic time multiplexing to greatly expand the useful processing capacity in edge sensor systems. Depending on the specific application, this additional processing capacity is expected to improve the performance of receiver systems across the following dimensions: 1) total input bandwidth, (i.e., number of antenna channels × instantaneous bandwidth per channel); 2) diversity of signal types detected and characterized; and 3) probability of detection and correct characterization for signals important to the decision-making of an autonomous RF system."

The PROWESS BAA number is HR001123S0006. Abstracts are due by November 4, and full proposals are due by December 19. Program officials anticipate awarding multiple contracts for Phase 1 work. The technical point of contact is John Davies, DARPA MTO, e-mail HR001123S0006@darpa.mil. – *JED Staff*

HENSOLDT, RAFAEL TEAM FOR EUROFIGHTER EK ESCORT JAMMER

Hensoldt (Taufkirchen, Germany) and Rafael Advanced Defense Systems (Haifa, Israel) have teamed to bid a tailored variant of Rafael's Sky Shield escort jammer pod to equip the Luftwaffe's planned Eurofighter Elektronischer Kampf (EK) electronic combat aircraft. A buy of around 15 Eurofighter EK aircraft is planned to replace the capability currently provided by the Luftwaffe's aging Tornado ECR fleet. An Initial Operating Capability is planned for 2028.

Rafael's Sky Shield escort jammer pod is already in service with a number of air forces. Employing wideband active electronically scanned array technology, the system is claimed to be able to generate simultaneous high effective radiated power jamming and deception transmissions against multiple threats over a wide frequency range.

Under the terms of the partnering agreements, indigenous technology from Hensoldt's own Kalaetron Attack development will be integrated into the Sky Shield pod. According to Hensoldt, Kalaetron Attack combines cognitive software elements, based on artificial intelligence algorithms, with a fully digitized broadband sensor and an electronically-controlled/software-defined jammer.

For Eurofighter EK, the Sky Shield pod is planned to use the same interfaces as those already proven through the integration of Rafael's LITENING targeting pod on Eurofighter. This will simplify integration and certification, the two companies said.

Elektroniksystem-und Logistik (ESG) had previously confirmed its teaming with Elbit Systems' Elisra business to bid the Tactical Electronic Attack System ESG/Elisra (TEASE^2) pod for the Eurofighter EK escort jammer requirement. Saab and Elettronica are also understood to be considering bids.

The Eurofighter EK represents one strand of the Luftwaffe's wider Luftgestützte Wirkung im elektromagnetischen Spektrum (luWES) program. Other projected luWES elements include large airborne stand-off jammers, and expendable stand-in jammers. – *R. Scott*

ELBIT SYSTEMS UK TO SUPPLY LASER WARNER FOR CHALLENGER 3 TANKS

Elbit Systems UK has been selected by Rheinmetall BAE Systems Land (RBSL) to provide its Elbit Laser Warning System (ELAWS) for the British Army's Challenger 3 (CR3) main battle tank (MBT) upgrade program.

Designed to provide accurate and timely alerts to laser-guided threats, ELAWS provides 360° coverage for the detection, characterization and pinpointing of laser sources, such as range finders, anti-tank guided weapons, target designators and infrared illuminators. ELAWS has also been designed to integrate with a wide range of countermeasures systems.

Elbit Systems UK will supply 150 ELAWS units to the CR3 program. Rafael Advanced Defense Systems has previously been selected to provide its Trophy active protection system for the Challenger upgrade.

RBSL was selected in May 2021 to lead the program to upgrade 148 Challenger 2 MBTs to the improved CR3 standard. The upgraded tanks are expected to enter service with the British Army in 2027. – *R. Scott*

IN BRIEF

The US Army's Product Manager Electronic Warfare Integration (PdM EWI) and Project Manager Electronic Warfare & Cyber (PM EW&C), will host an industry day on November 10 at Aberdeen Proving Ground, MD, to discuss the planned request for proposal (RFP) for the Army's **Electronic Warfare**

Planning and Management Tool (EWPMT) requirement. Several operational units have been equipped with early versions of EWPMT and received associated training to support current operations. The initial release (Version 1) of EWPMT to all Army units became available in FY2022. The selected contractor will provide a range of services necessary for the continued design, build, integration, testing, delivery, fielding, maintenance, configuration management, and sustainment of EWPMT. The deadline for registering for the Industry Day is usarmy.apg.peo-iews.mbx.pmewc-pdmewi-industry@army.mil. PdM EWI expects to release a final RFP in early 2023.

The National Reconnaissance Office (NRO) (Chantilly, VA) awarded study contracts to six companies to explore commercial RF remote sensing under its Strategic Commercial Enhancement's (SCE) Broad Agency Announcement (BAA) Framework. The awardees are **Aurora Insight** (Denver, CO), **HawkEye 360** (Herndon, VA), **Kleos Space** (Luxembourg), **PredaSAR** (Boca Raton FL), **Spire Global** (Vienna, VA), and **Umbra Lab** (Santa Barbara, CA). According to the NRO, "This new BAA focus area will help the NRO better understand the capabilities of multiple commercial RF providers to address new intelligence challenges. This is the second focus area awarded under the NRO's new SCE BAA framework, designed to streamline the assessment and operationalization of emerging commercial capabilities. The SCE BAA Framework and first focus area for commercial radar were released in October 2021, followed by awards in January 2022 to five commercial radar providers."

The **Air Force Research Lab's Information Directorate (AFRL/RI)** has issued a Broad Agency Announcement (BAA Number FA8750-22-S-7006) soliciting white papers for its Adaptive Waveform Generation for Extreme RF (AWGER) program. The AWGER effort will explore "innovative research in cognitive waveform generation and network control and analysis within a unified scenario evaluation environment," according to the BAA. Managed by the Information Directorate's Communication Technology and Systems Branch, Communication Networking Section (AFRL/RITGB), the cognitive waveform generation aspect of the AWGER program will focus on machine learning techniques for building waveforms from fundamental digital processing blocks; adjustments to waveforms based on varying RF environments and interference; RF environment / physical layer simulation and designed waveform evaluation; and resiliency to adversary attacks. Network control analysis research will look at network throughput analysis and control within varying RF environments; coordination/handshaking of physical layer changes between nodes in a network/neighborhood; and network layer simulation and network control evaluation. Funding for the AWGER program is estimated at $49.9 million over five years. Multiple contracts, valued at $300,000 to $3 million, will cover early phases of research over the first three years. The technical point of contact is Gerard Wohlrab, AFRL/RITGB, (315) 330-4663, e-mail gerard.wohlrab@us.af.mil. White papers for FY2023 proposals are due by November 4.

The DOD's Test Resources Management Center (TRMC) Test and Evaluation (T&E)/Science and Technology (S&T) Program, acting via the Training and Readiness Accelerator (TReX) consortium, has awarded a $3.1 million contract to **Northrop Grumman Amherst Systems** (Buffalo, NY) for the Electronic Warfare Test (EWT) Topic: Digital Generation "C" (DGEN-C) prototype project. TRMC's overarching strategy is to create a new translation technology capability through an iterative technology research and demonstration approach. According to the contract announcement, "The Next-generation Electronic Warfare Environment Generation (NEWEG) system utilizes National Air and Space Intelligence Center (NASIC) Electronic Warfare Integrated Reprogramming Database (EWIRDB) emitter models and data directly to support signal generation to support both direct injection and free-space testing configurations. EW threat simulators utilize signal generation systems as core processes to synthesize threat signals for testing sensors installed on modern EW platforms. These signal generation systems require different types of inputs depending on the nature of the EW threat simulator; however, these inputs all trace back to common textual file structures commonly called Waveform Descriptor Words (WDWs). The WDWs must be translated into Pulse Descriptor Words (PDWs) thru the NASIC Real-Time Keystone tool and into usable waveforms formatted for efficient use by the real-time signal generation system. Baseband signal generation sampling rates may also be different from EWIRDB data sampling rates." The DGEN-C prototype effort will "create new translation technology to optimize usage of the different levels of EWIRDB information and signals to support existing and future signal generators." Following successful DGEN-C development, TRMC anticipates awarding a sole-source contract for a follow-on production phase.

Australia's Department of Defence announced officially opened its new **Pitt-Johnston Electromagnetic Warfare Research Centre** in Adelaide last month. The facility, a collaboration between the Defence Science and Technology Group and Joint Capabilities Group, "boasts a highly secure environment with first-class laboratories, workspaces and high-end information technology to test the survivability of Defence platforms on the electromagnetic spectrum," according to a Department of Defence news release about the opening. The center is named after WCdr Mark Pitt and Gp Capt Wayne Johnston in recognition of their contributions to the development of Joint EW in Australia.

350th Spectrum Embracing the F

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

Warfare Wing – uture of EMSO

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

The 350th SWW leadership team: Col Eric C. Paulson, 350th Spectrum Warfare Wing vice commander, left, Col Josh Koslov, 350th SWW commander, center, and CMSgt David S. Southall, 350th SWW command chief. USAF PHOTO BY SSGT ERICKA A. WOOLEVER

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.

The 350th SWW develops and maintains EW mission data files for CAF, search and rescue weapons systems, as well as allies and security partners via the Foreign Military Sales program. The F-35 Lightning II Norway Italy Reprograming Laboratory (above) provides F-35 mission data files for two important F-35 partners. USAF PHOTO BY STAFF SGT. ERICKA A. WOOLEVER

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 Applica-

tion 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."

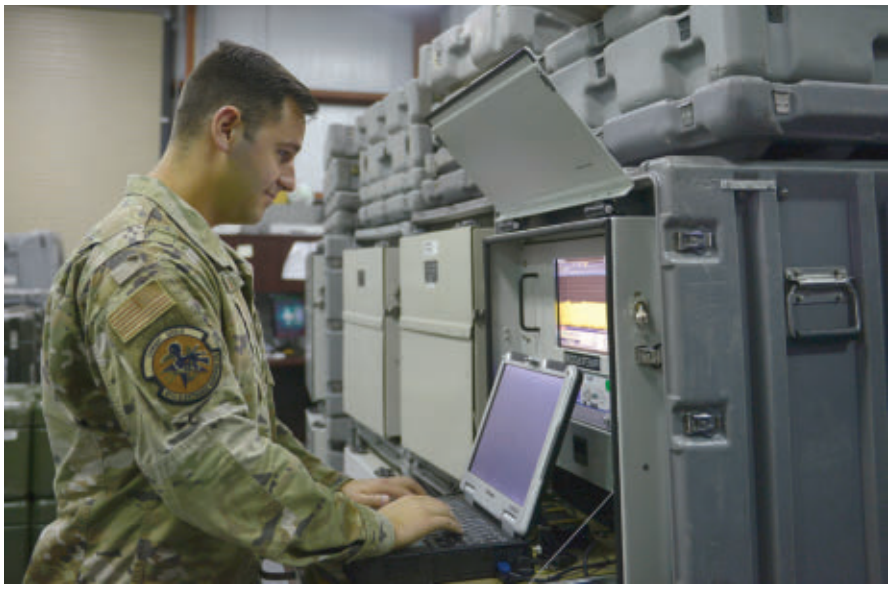
SCALING UP

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



SSgt Preston B. Leeling, 87th Electronic Warfare Combat Shield technician performs a software verification on a USM-642 Raven Test set. The USM-642 is used to evaluate RWRs installed on US Air Force aircraft. USAF PHOTO BY STAFF SGT. ERICKA A. WOOLEVER

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."

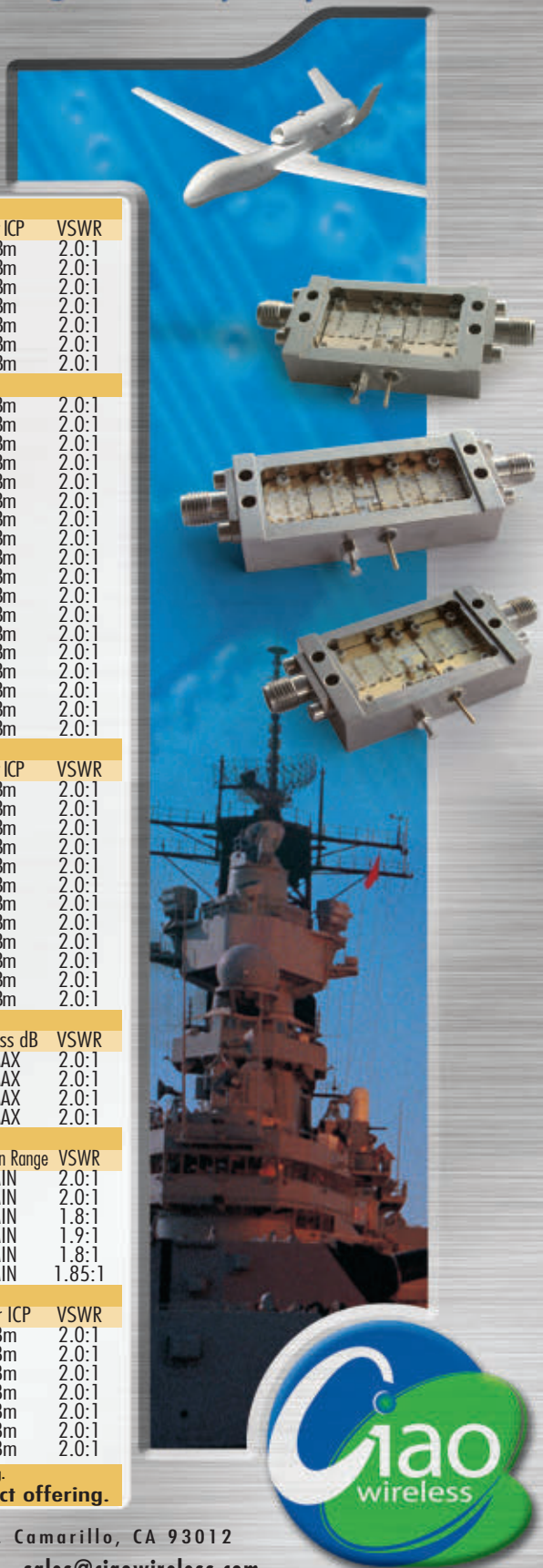
Ultimately, Koslov says, "The promise of this wing is the ability to look at the adversary's kill chain in its entirety and be able to develop ways to mitigate it for the warfighter. The 350th Spectrum Warfare Wing represents a significant corporate reinvestment in the future of the Spectrum, and it's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

RF Amplifiers and Sub-Assemblies for Every Application

Delivery from Stock to 2 Weeks ARO from the catalog or built to your specifications!

- Competitive Pricing & Fast Delivery
- Military Reliability & Qualification
- Various Options: Temperature Compensation, Input Limiter Protection, Detectors/TTL & More
- Unconditionally Stable (100% tested)

ISO 9001:2000 and AS9100B CERTIFIED



OCTAVE BAND LOW NOISE AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA01-2110	0.5-1.0	28	1.0 MAX, 0.7 TYP	+10 MIN	+20 dBm	2.0:1
CA12-2110	1.0-2.0	30	1.0 MAX, 0.7 TYP	+10 MIN	+20 dBm	2.0:1
CA24-2111	2.0-4.0	29	1.1 MAX, 0.95 TYP	+10 MIN	+20 dBm	2.0:1
CA48-2111	4.0-8.0	29	1.3 MAX, 1.0 TYP	+10 MIN	+20 dBm	2.0:1
CA812-3111	8.0-12.0	27	1.6 MAX, 1.4 TYP	+10 MIN	+20 dBm	2.0:1
CA1218-4111	12.0-18.0	25	1.9 MAX, 1.7 TYP	+10 MIN	+20 dBm	2.0:1
CA1826-2110	18.0-26.5	32	3.0 MAX, 2.5 TYP	+10 MIN	+20 dBm	2.0:1

NARROW BAND LOW NOISE AND MEDIUM POWER AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA01-2111	0.4 - 0.5	28	0.6 MAX, 0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA01-2113	0.8 - 1.0	28	0.6 MAX, 0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA12-3117	1.2 - 1.6	25	0.6 MAX, 0.4 TYP	+10 MIN	+20 dBm	2.0:1
CA23-3111	2.2 - 2.4	30	0.6 MAX, 0.45 TYP	+10 MIN	+20 dBm	2.0:1
CA23-3116	2.7 - 2.9	29	0.7 MAX, 0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA34-2110	3.7 - 4.2	28	1.0 MAX, 0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA56-3110	5.4 - 5.9	40	1.0 MAX, 0.5 TYP	+10 MIN	+20 dBm	2.0:1
CA78-4110	7.25 - 7.75	32	1.2 MAX, 1.0 TYP	+10 MIN	+20 dBm	2.0:1
CA910-3110	9.0 - 10.6	25	1.4 MAX, 1.2 TYP	+10 MIN	+20 dBm	2.0:1
CA1315-3110	13.75 - 15.4	25	1.6 MAX, 1.4 TYP	+10 MIN	+20 dBm	2.0:1
CA12-3114	1.35 - 1.85	30	4.0 MAX, 3.0 TYP	+33 MIN	+41 dBm	2.0:1
CA34-6116	3.1 - 3.5	40	4.5 MAX, 3.5 TYP	+35 MIN	+43 dBm	2.0:1
CA56-5114	5.9 - 6.4	30	5.0 MAX, 4.0 TYP	+30 MIN	+40 dBm	2.0:1
CA812-6115	8.0 - 12.0	30	4.5 MAX, 3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA812-6116	8.0 - 12.0	30	5.0 MAX, 4.0 TYP	+33 MIN	+41 dBm	2.0:1
CA1213-7110	12.2 - 13.25	28	6.0 MAX, 5.5 TYP	+33 MIN	+42 dBm	2.0:1
CA1415-7110	14.0 - 15.0	30	5.0 MAX, 4.0 TYP	+30 MIN	+40 dBm	2.0:1
CA1722-4110	17.0 - 22.0	25	3.5 MAX, 2.8 TYP	+21 MIN	+31 dBm	2.0:1

ULTRA-BROADBAND & MULTI-OCTAVE BAND AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure (dB)	Power-out @ P1-dB	3rd Order ICP	VSWR
CA0102-3111	0.1-2.0	28	1.6 Max, 1.2 TYP	+10 MIN	+20 dBm	2.0:1
CA0106-3111	0.1-6.0	28	1.9 Max, 1.5 TYP	+10 MIN	+20 dBm	2.0:1
CA0108-3110	0.1-8.0	26	2.2 Max, 1.8 TYP	+10 MIN	+20 dBm	2.0:1
CA0108-4112	0.1-8.0	32	3.0 MAX, 1.8 TYP	+22 MIN	+32 dBm	2.0:1
CA02-3112	0.5-2.0	36	4.5 MAX, 2.5 TYP	+30 MIN	+40 dBm	2.0:1
CA26-3110	2.0-6.0	26	2.0 MAX, 1.5 TYP	+10 MIN	+20 dBm	2.0:1
CA26-4114	2.0-6.0	22	5.0 MAX, 3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA618-4112	6.0-18.0	25	5.0 MAX, 3.5 TYP	+23 MIN	+33 dBm	2.0:1
CA618-6114	6.0-18.0	35	5.0 MAX, 3.5 TYP	+30 MIN	+40 dBm	2.0:1
CA218-4116	2.0-18.0	30	3.5 MAX, 2.8 TYP	+10 MIN	+20 dBm	2.0:1
CA218-4110	2.0-18.0	30	5.0 MAX, 3.5 TYP	+20 MIN	+30 dBm	2.0:1
CA218-4112	2.0-18.0	29	5.0 MAX, 3.5 TYP	+24 MIN	+34 dBm	2.0:1

LIMITING AMPLIFIERS

Model No.	Freq (GHz)	Input Dynamic Range	Output Power Range Psat	Power Flatness dB	VSWR
CLA24-4001	2.0 - 4.0	-28 to +10 dBm	+7 to +11 dBm	+/- 1.5 MAX	2.0:1
CLA26-8001	2.0 - 6.0	-50 to +20 dBm	+14 to +18 dBm	+/- 1.5 MAX	2.0:1
CLA712-5001	7.0 - 12.4	-21 to +10 dBm	+14 to +19 dBm	+/- 1.5 MAX	2.0:1
CLA618-1201	6.0 - 18.0	-50 to +20 dBm	+14 to +19 dBm	+/- 1.5 MAX	2.0:1

AMPLIFIERS WITH INTEGRATED GAIN ATTENUATION

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure (dB)	Power-out @ P1-dB	Gain Attenuation Range	VSWR
CA001-2511A	0.025-0.150	21	5.0 MAX, 3.5 TYP	+12 MIN	30 dB MIN	2.0:1
CA05-3110A	0.5-5.5	23	2.5 MAX, 1.5 TYP	+18 MIN	20 dB MIN	2.0:1
CA56-3110A	5.85-6.425	28	2.5 MAX, 1.5 TYP	+16 MIN	22 dB MIN	1.8:1
CA612-4110A	6.0-12.0	24	2.5 MAX, 1.5 TYP	+12 MIN	15 dB MIN	1.9:1
CA1315-4110A	13.75-15.4	25	2.2 MAX, 1.6 TYP	+16 MIN	20 dB MIN	1.8:1
CA1518-4110A	15.0-18.0	30	3.0 MAX, 2.0 TYP	+18 MIN	20 dB MIN	1.85:1

LOW FREQUENCY AMPLIFIERS

Model No.	Freq (GHz)	Gain (dB) MIN	Noise Figure dB	Power-out @ P1-dB	3rd Order ICP	VSWR
CA001-2110	0.01-0.10	18	4.0 MAX, 2.2 TYP	+10 MIN	+20 dBm	2.0:1
CA001-2211	0.04-0.15	24	3.5 MAX, 2.2 TYP	+13 MIN	+23 dBm	2.0:1
CA001-2215	0.04-0.15	23	4.0 MAX, 2.2 TYP	+23 MIN	+33 dBm	2.0:1
CA001-3113	0.01-1.0	28	4.0 MAX, 2.8 TYP	+17 MIN	+27 dBm	2.0:1
CA002-3114	0.01-2.0	27	4.0 MAX, 2.8 TYP	+20 MIN	+30 dBm	2.0:1
CA003-3116	0.01-3.0	18	4.0 MAX, 2.8 TYP	+25 MIN	+35 dBm	2.0:1
CA004-3112	0.01-4.0	32	4.0 MAX, 2.8 TYP	+15 MIN	+25 dBm	2.0:1

CIAO Wireless can easily modify any of its standard models to meet your "exact" requirements at the Catalog Pricing.

Visit our web site at www.ciaowireless.com for our complete product offering.

Ciao Wireless, Inc. 4000 Via Pescador, Camarillo, CA 93012

Tel (805) 389-3224 Fax (805) 389-3629 sales@ciaowireless.com

Electromagnetic Protection (Part 7)

More Side Lobe Jamming EP Techniques

By Dave Adamy

An auxiliary antenna with more gain in any side lobe direction than the side lobe gain of the main antenna can be used in electromagnetic protection (EP) to detect and counter side lobe jamming. The coherent side lobe canceller (CSLC) defends against narrowband jamming signals, such as FM noise, and the side lobe blanker (SLB) defends against pulsed side lobe jamming.

COHERENT SIDE LOBE CANCELLING

The coherent side lobe canceller employs an auxiliary antenna, as shown in Figure 1. The auxiliary antenna is shown as having significant gain in a side lobe direction.

Figure 2 compares the actual beam shapes of these two antennas. Since the auxiliary antenna has less diameter than the main antenna, its beam is wider and its boresight gain is less. The side lobes of the main antenna are reduced as their angle from the bore sight increases.

The auxiliary antenna is designed so that its gain at any angle is greater than that of the main antenna side lobe at that angle. When the signal strength from the auxiliary antenna is greater than the signal strength from the main antenna, the radar is being jammed by a jammer in a side lobe direction. The output of the auxiliary antenna is phase locked to the jamming signal and then delayed by 180 degrees. When this 180-degree-shifted signal is added to the main beam antenna output, the jamming signal is cancelled and thus absent from the signal returned to the radar receiver. Note that this is practical for narrow band signals, such as FM noise.

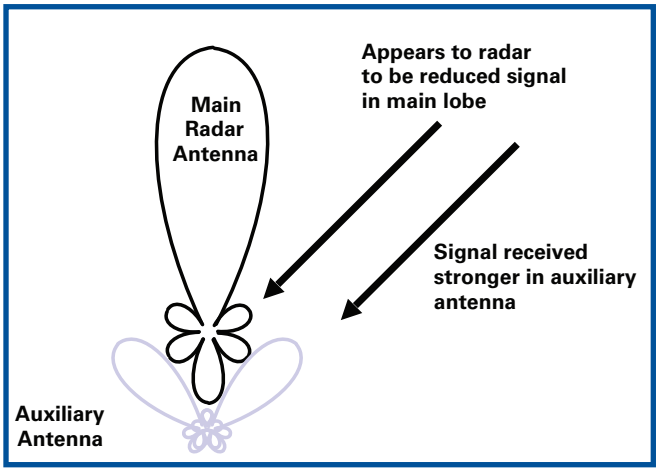


Fig. 1: *A coherent sidelobe canceller has an auxiliary antenna with more gain in side lobe directions than the gain of the side lobes. It is effective against narrow-band jamming, such as FM noise.*

If there are multiple side lobe jammers, each jammer must be handled by a separate auxiliary antenna. There must be as many auxiliary antennas as the number of jammers countered. Figure 3 shows three auxiliary antennas removing three jamming signals.

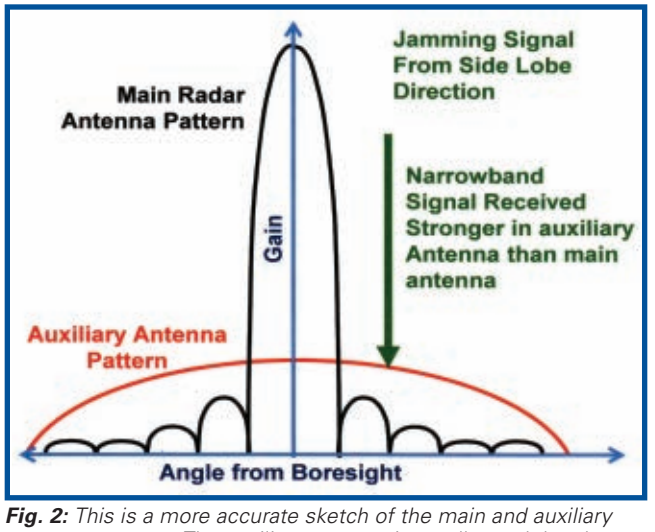


Fig. 2: *This is a more accurate sketch of the main and auxiliary antenna patterns. The auxiliary antenna is smaller and thus has a wider beam and less boresight gain. It is designed to provide more gain in the directions of the side lobes than the side lobe gains.*

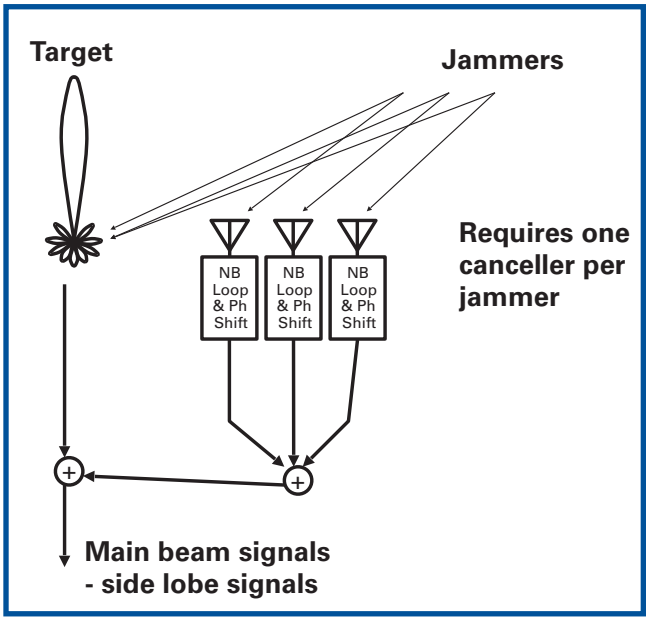


Fig. 3: *There is an auxiliary antenna for each side lobe jammer. Its output is phase locked to that jamming signal, and the output is shifted 180 degrees, so that when added to the main antenna output it will cancel the side lobe jamming signal.*

COUNTERING CSLC ELECTROMAGNETIC PROTECTION

Since there must be one auxiliary antenna per countered jamming frequency, a signal with many different continuous wave (CW) frequency components would overload the number of auxiliary antennas and would thus allow jamming signals to enter the radar receiver. As shown in Figure 4, a pulsed signal has a frequency spectrum with many CW components spaced by the pulse repetition frequency. This means that the addition of a strong pulsed signal to an FM noise jamming signal can overload the EP technique and will thus allow the narrowband FM noise jamming to be effective. This means that a pulsed signal is often added to FM noise jamming.

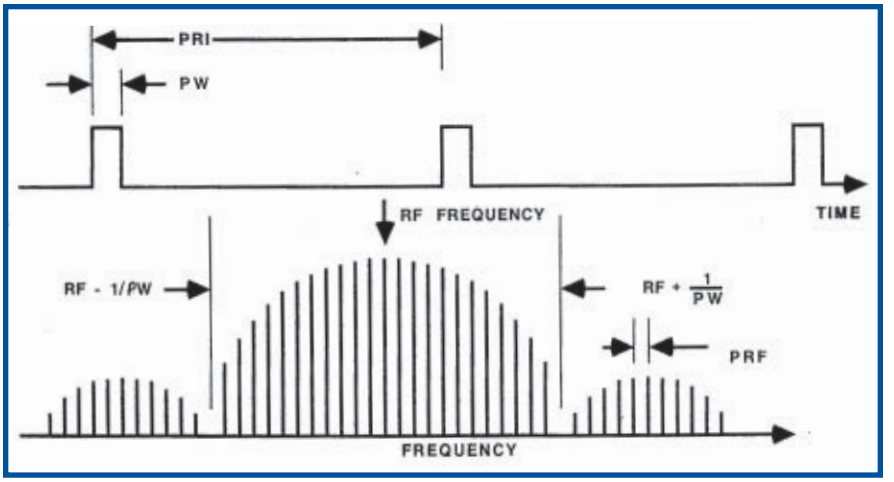


Fig. 4: *The frequency spectrum of a pulsed signal has spectral lines separated by the pulse repetition frequency (PRF). The main lobe of the spectrum extends over a frequency range twice the frequency of the inverse of the pulse width (PW).*

SIDE LOBE BLANKING

Figure 5 shows a single pulsed jamming signal arriving from an off-boresight direction. (This antenna figure is the same as that used for side lobe cancelling (Figure 1), but here it is used in a different way. Because the jamming signal is received in the auxiliary antenna at a higher level than it is received in the side lobe of the main antenna, it can be identified as an off-boresight jamming signal. Since the pulse jamming signal is very short, it is not practical to phase lock the antenna output to that signal. However, if the auxiliary antenna output is greater than the main antenna output, an electronic switch can turn the main antenna output off during the short duration of that pulse, thus removing the jamming signal from the radar receiver, as shown in Figure 6. Multiple pulse jammers can be cancelled using a single auxiliary antenna.

COUNTERING SIDE LOBE BLANKING

If a jamming pulse is used, it may be possible to synchronize it with the radar's own received return pulse. Thus the EP measure would eliminate the desired return signal pulses from the input to the radar receiver, making the radar ineffective. The timing of this pulse would require calculating the distances (and thus the propagation delays) between the radar, the jammer and the target. It should be understood that this would be very difficult to do in a dynamic engagement, since range from the jammer to the jammed radar and the range from a maneuvering target to the radar will be changing rapidly.

WHAT'S NEXT

Next month, we will continue our radar EP discussion by the consideration of EP against cross polarization jamming.

Dave Adamy can be reached at dave@lynxpub.com.

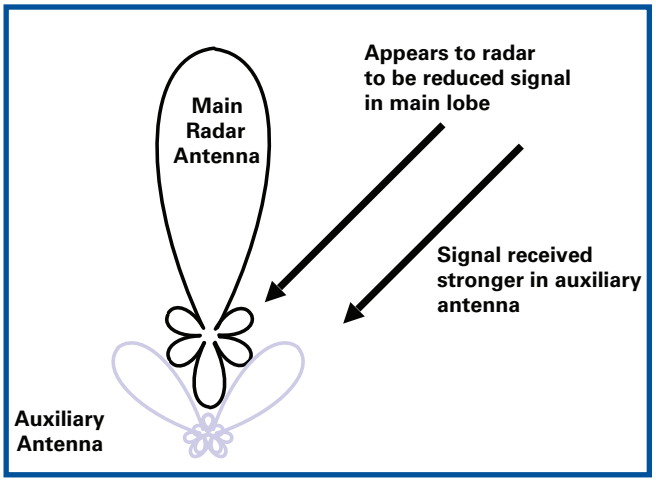


Fig. 5: *A side lobe blanker has an auxiliary antenna with more gain in side lobe directions than the gain of the main antenna side lobes. It is effective against side lobe pulse jamming. The same antenna applies to the side lobe cancelling and side lobe blanking EP functions, but it is used in a different way.*

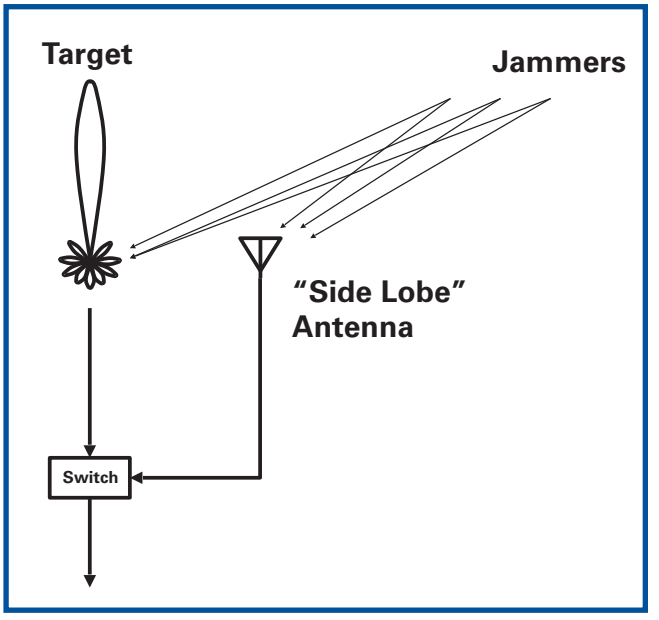
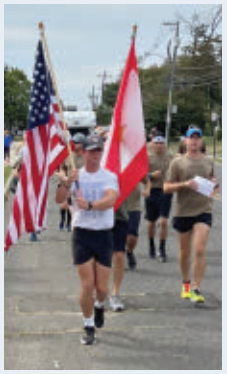


Fig. 6: *When the side lobe blanker detects a pulse signal in a side lobe that is larger than the same signal received by the main antenna, the main antenna output is blanked during that pulse.*

2022 NEW JERSEY RUN FOR THE FALLEN – AOC GSC PARTICIPATION

By AOC North Eastern Regional Director Myles Patrick Murphy



As the long dog days of summer wind down and the shorter, cooler days of Fall fast approach, the Association of the United States Army (AUSA) Monmouth Chapter, the Association of Old Crows (AOC) Garden State Chapter (GSC) and Army Aviation Association of America (AAAA) Jersey Chapter gather each September to honor the New Jersey families of our fallen military brothers and sisters who paid the ultimate price so we can enjoy our freedoms every day.

The New Jersey Run for the Fallen is an amazing event where a team of military runners from Joint Base McGuire-Dix-Lakehurst and other locations across the United States unite to run more than 190 miles to honor every New Jersey service member that has died in support of Operation Iraqi Freedom, Enduring Freedom, Operation New Dawn and other conflicts. Each mile marker along the way is dedicated to a fallen hero and their Gold Star family. The runners start in Cape May and finish four days later at the Vietnam Veterans Memorial in Holmdel.

AUSA Monmouth Chapter, AOC GSC and AAAA organizations have gathered each September since 2014 to honor heroes and mile markers along the course.

This year 15 heroes were honored with 15 mile markers by all three organizations. Each year, the number of markers and those honored increases as the organizations honor more heroes and families.

This year, the three organizations met at Long Branch High School on Sunday, Sept. 25 to present two Gold Star Honor Remember Flags to the family of two brothers: US Marines Staff Sergeant Christopher R. Goski and US Army Sergeant First Class Michael J. Goski.

From left to right, T.R. Russell (AUSA Monmouth Member), Bruce Ryba (AUSA Monmouth Vice President), AOC Northeast Regional Director Myles Murphy, Jan Moren (AOC GSC BoD and AUSA BoD), Carolyn Young (AOC Member), Kit Roache (AUSA Monmouth BoD), AUSA Monmouth Chapter President Ed Thomas, CSM (Ret) Jack Chlapowski (AUSA Monmouth BoD), Ellie Smith (AUSA Monmouth BoD) and Charles Seal

AUSA MONMOUTH BOD).

US Marines SSgt. Christopher Goski was honored first as a team of military runners stopped at Hero Marker 437 for a small ceremony and to remind everyone present that he will never be forgotten. Christopher served six tours of duty and was training for his seventh deployment at the time of his death. He served in both Iraq and Afghanistan in support of Operations Iraqi Freedom and Enduring Freedom, fighting the enemy in close combat on every deployment. Christopher's personal decorations include two Navy-Marine Corps Achievement Medals, three Combat Action Ribbons and three Good Conduct Medals.

Military runners honored Sergeant First Class Michael Goski next at Hero Marker 437.1, just a few feet away. Michael, a United States Army Green Beret Special Forces veteran of 12 years, served five tours of duty in Iraq and Afghanistan. He was serving in the US National Guard at the time of his death. He was awarded many decorations including: the Bronze Star, Iraq Campaign Medal with three Campaign Stars, Afghanistan Commendation Medal with two Campaign Stars, Parachutist Badge, Combat Infantryman Badge, Expert Infantryman Badge, Special Forces Tab, Army Commendation Medal (third award), Army Service Ribbon, Meritorious Unit Commendation, Air Assault Badge, Global War On Terrorism Service Medal, Overseas Service Ribbon, National Defense Service Medal, NATO Medal, NCO Professional Development Ribbon (three awards) and Army Good Conduct Medal (third award).

For more information on next year's event, please visit www.njrunforthefallen.org.

AOC Members

SUSTAINING

AT&T Corp.
BAE Systems
Bharat Electronics Ltd.
CACI International Inc.
Chemring Group PLC
General Atomics Aeronautical
General Dynamics
Keysight Technologies
L-3 Harris
Leonardo
Perspecta
Raytheon Intelligence & Space
Rohde & Schwarz USA
Saab Sensor Systems Germany GmbH
SRC, Inc.
The Boeing Company

MILITARY UNITS

57 IS/DOD
293 EWS
Centro de Guerra Eletrónica – PTAF
Japan Air Self-Defense Force
VMU-3

INSTITUTES/ UNIVERSITIES

Georgia Tech Research Institute
Mercer Engineering Research Center
Riverside Research Institute
RVJ Institute

GOVERNMENT GROUPS

Australia Department of Defence DIO
DE&S
Defence Science & Technology Agency
DOD
New Zealand Defence Technology Agency
NLR
NLR – Royal Netherlands Aerospace Centre
Technology Agency

GROUPS

3dB Labs Inc.
Abaco Systems
Advanced Test Equipment Rentals
Aeronix, Inc.
ALARIS Antennas
Algoptimal
Allen-Vanguard
Amentum
Analog Devices
Annapolis Micro Systems Inc.
Anritsu
API Technologies
ApisSys SAS
Apogee Engineering
Armtec Defense Technologies
ARS Products
Aselsan A.S.
AssuredTek
Atkinson Aeronautics & Technology, Inc.
Atrenne, a Celestia Group Company
Avix
Azure Summit Technology, Inc.
Babcock International Group
Beca Applied Technologies Ltd.
Black Horse Solutions, Inc.
Blue Ridge Envisioneering, Inc.
Cablex PTY Ltd.
CEA Technologies, Inc.
Centauri
Cobham Advanced Electronic Solutions
Communications & Power Industries LLC
Comtech PST Corp.
Consunet Pty Ltd.
Crescend Technologies, LLC
CRFS Inc.
CRFS Ltd.
CSIR DPSS
Cubic Defense
CyberOps
Daqscribe
Dayton Development Coalition
dB Control
DCS Corp.
Decodio AG
Defense Research Associates Inc.
Digital Receiver Technology (DRT)
Droneshield
Eagle Sales Corp.
Elbit Systems of America
Elbit Systems of EW & SIGINT
ELDES S.r.l.
Electro-Metrics, Corp.
Elettronica GMBH
Elite RF
Elmtek Pty Ltd.
ELTA Systems Ltd.
Empower RF Systems
Epiq Solutions
Epirus
ESG GmbH
ESROE Ltd.
Galleon Embedded Computing
GFD GmbH
Giga-Tronics, Inc.
Government Business Development
Hammer Defense Technologies LLC
Hasco
HawkEye360
Helsing GmbH
Hensoldt Australia
Hensoldt Sensors GmbH
HII
Hughes
IAI North America
Interface Concept
IW Microwave Products Division
JT4, LLC
KBR
Kratos General Microwave Corp.
L3Harris Intelligence & Cyber International
L3Harris TRL Technology
LCR Embedded Systems
Leonardo DRS
Leonardo Electronics – US-N/A
Liteye Systems, Inc.
Lockheed Martin Co.
MarServices GmbH
Mass Consultants Ltd.
Maxar-Ypsi-EW
MBDA France
MC Countermeasures, Inc.
MDA
Meggitt Baltimore
Meggitt Defense Systems
Microwave Products Group
Milpower Source, Inc.
Milso AB
Mission Microwave Technologies
Motorola Solutions
MTSI
Nask, Inc.
Northrop Grumman Defense Systems Advanced Weapons
NSI-MI Technologies
Orolia Defense & Security
Parsons
PCTEL, Inc.
Peraton/Perspecta
Phasor Innovation
Photonis Defense Inc.
Predata
Procitec GmbH
RADA Technologies LLC
RADX Technologies
Research Associates of Syracuse, Inc.
Revolution Aerospace
Rincon Research Corp.
Rohde & Schwarz GmbH & Co. KG
Roschi Rohde & Schwarz AG
Ruag
S2 Corp.
Sciens Innovations
Scientific Research Corp.
SEA Corp.
Serpikom
Sierra Nevada Corp.
Signal Hound
Silver Palm Technologies
SimVentions
SMAG Mobile Antenna Masts GmbH
Smiths Interconnect – Tampa
SOIO
Spectranetix, Inc.
Spherea GmbH
Steatit
Stellant Systems
Swisscom Broadcast AG Systems & Processes
Sypaq Systems
T2S
TCI International, Inc.
TCOM, L.P.
Tech Resources, Inc.
Tektronix Inc.
Teledyne Technologies, Inc.
Teleplan Globe Defence
Tevet LLC
Textron Systems
Textron Systems Electronic
The Mitre Corp.
ThinKom Solutions
Tinex AS
Transformational Security LLC
Transhield Inc.
Trideum
Ultra Electronics – EWST
Ultra Electronics Avalon Systems
Unival Group GmbH
Vadum Inc.
Valkyrie Enterprises LLC
Vectrus Systems Corp.
Viavi Solutions
Vic Myers Associates
WGS Systems, Inc.
work Microwave
X-COM Systems
Xolaris Civil Security

ASSOCIATION OF OLD CROWS

JED, Journal of Electromagnetic Dominance (ISSN 0192-429X), is published monthly by Naylor, LLC, for the Association of Old Crows, 1001 N. Fairfax St., Suite 300, Alexandria, VA 22314.

Periodicals postage paid at Alexandria, VA, and additional mailing offices. Subscriptions: *JED, Journal of Electromagnetic Dominance,* is sent to AOC members and subscribers only. Subscription rates for paid subscribers are $160 per year in the US, $240 per year elsewhere; single copies and back issues (if available) $12 each in the US; $25 elsewhere.

POSTMASTER:
Send address changes to
JED, Journal of Electromagnetic Dominance
c/o Association of Old Crows
1001 N. Fairfax St., Suite 300
Alexandria, VA 22314

Subscription Information:
Glorianne O'Neilin
(703) 549-1600
oneilin@crows.org

JED Sales Offices

NAYLOR
ASSOCIATION SOLUTIONS
550 SW 2nd Avenue
Gainesville, FL 32601
800-369-6220
Naylor.com

Project Manager:
Kira Krewson
Direct: +1 (770) 810-6982
kkrewson@naylor.com

Project Coordinator:
Alexandra Lewis
Direct: +1 (352) 333-3409
alewis@naylor.com

Advertising Sales Representatives:
Shaun Greyling
Direct: +1 (352) 333-3385
sgreyling@naylor.com

Robert Shafer
Direct: +1 (770) 810-6986
rshafer@naylor.com

Chris Zabel
Direct: +1 (352) 333-3420
czabel@naylor.com

NAYLOR (Canada) Inc.
200 - 1200 Portage Ave.
Winnipeg, MB R3G OT5 Canada
Toll Free (US): (800) 665-2456
Fax: +1 (204) 947-2047

Index of Advertisers

ARS Products	www.arsproducts.com	29
Atrenne	www.atrenne.com	Outside Back Cover
Ciao Wireless, Inc.	www.ciaowireless.com	23
Comtech PST Corp	www.comtechpst.com/	5
D-TA Systems Inc	www.d-ta.com/	8
Norden Millimeter, Inc.	www.nordengroup.com	10
Philpott Ball & Werner	www.pbandw.com	30
Photonis USA PA, Inc	www.PhotonisDefense.com	Inside Back Cover
Signal Hound	www.signalhound.com	7
Smiths Interconnect	www.smithsinterconnect.com	Inside Front Cover
Ultra Electronics Limited – EWST	www.ultra.group	3

Details	Page #
350th Spectrum Warfare Group	18
350th Spectrum Warfare Wing	18
39th EW Squadron, Specialized Electronic Combat Tools and Reprogramming Environment (SPECTRE)	21
850th Spectrum Warfare Group	18
87th EW Squadron, Combat Shield EW assessment program	21
950th Spectrum Warfare Group, 350th SWW	22
AFRL, Adaptive Waveform Generation for Extreme RF (AWGER) BAA	17
Agile combat Employment	18
AOC Garden State Chapter, 2022 New Jersey Run for the Fallen	26
Ardent Wolf CESM, Royal Navy Type 23 frigates	15
Aurora Insight, NRO RF emissions monitoring study contract	17
Australian Department of Defence, Pitt-Johnston Electromagnetic Warfare Research Centre	17
Coherent side lobe canceller (CSLC), EW 101	24
Col Joshua Koslov, 350th SWW	18
CommsAudit, Ardent Wolf CESM	15
DARPA Processor Reconfiguration for Wideband Spectrum Sensing (PROWESS) BAA	15
Elbit Systems UK, ELAWS for British Army Challenger Tank 3	16
HAwkEye360, NRO RF emissions monitoring study contract	17
Hensoldt, teaming partnership for Eurofighter EK	16
Kleos Space, NRO RF emissions monitoring study contract	17
MissionWare, 350th SWW	19
Northrop Grumman Amherst Systems, contract from DOD Test Resource Management Center (TRMC)	17
PredaSAR, NRO RF emissions monitoring study contract	17
Project 212, 350th SWW	20
Rafael, teaming partnership for Eurofighter EK	16
Sidelobe jamming EP techniques, EW 101	24
Spire Global, NRO RF emissions monitoring study contract	17
System-of-systems Technology Integration Tool Chain for Heterogeneous Electronic Systems (STITCHES), 350th SWW	20
TacApp System, 350th SWW	19
Umbra Lab, NRO RF emissions monitoring study contract	17
US Army, planned RFP for EW Planning and Management Tool (EWPMT)	16
Wavelength Digital Service, 30th SWW	21

MORE JAM FOR LESS BREAD ...

THE WORLD'S MOST COST EFFECTIVE TWT BASED MICROWAVE POWER MODULES

HIGHER POWER - 200W minimum CW power 2 - 8 GHz and 6 - 18GHz
HIGHER EFFICIENCY THAN SOLID STATE - >35% vs.<10%
HIGHEST RELIABILITY - (*Comparison study E.Nicol et al)
LOWEST SWaP-C - Better than 1W/Cu in (including cooling)
WIDEST RANGE OF OPTIONS - Pulsed and CW, Broadband and Narrow Band

LEARN MORE AT: PhotonisDefense.com/power-and-microwave

PHOTONIS DEFENSE
Power and Microwave

*Nicol, E. F., Mangus, B. J., Grebliunas, J. R., Woolrich, K., & Schirmer, J. R. (2013). TWTA versus SSPA: A Comparison Update of the Boeing Satellite Fleet On-Orbit Reliability (pp. 1-2, Tech.). Los Angeles, CA: Space & Intelligence Systems, Boeing Corporation.W

MADE IN USA

1000 New Holland Ave., Lancaster, PA 17601 | 717-291-6000
info@photonisdefense.com | photonisdefense.com

atrenne.com

When failure is not an option.

OpenVPX *[configured and ready to ship]*

- *Enclosures*
- *Backplane systems*
- *Integration*
- *Custom solutions*
- *VME*
- *VPX™ CompactPCI*
- *SOSA™*
- *OpenVPX™...*

Atrenne®
A Celestica Company

Atrenne Computing Solutions | sales@atrenne.com | 508-588-6110