JUNE 2010
Vol. 33, No. 6

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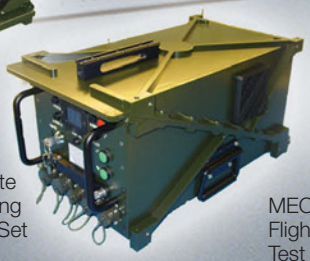

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CHANGING OF THE GUARD

Over the past few years, the electronic warfare (EW) mission area has been undergoing some dynamic changes. Land EW has assumed a position of major importance. Airborne infrared countermeasures have become a critical concern. Senior military leaders in many countries are engaging with the EW community, and they are beginning to perceive EW and spectrum control in a strategic context.

Certainly, the catalyst for many of these and other changes has been ongoing operations in Afghanistan and Iraq and the Global War on Terror, in general. But our community has also been very well served by several key EW leaders (both military and civilian) who have done a remarkable job of shaping and promoting new EW concepts, building organizations and developing human networks to respond to these changes. Along the way, they have defended EW against encroachment from other mission areas, such as Cyber, and ensured that EW won the political knife-fights that are a part of any government bureaucracy. As far as EW is concerned, these were the right people in the right place at the right time. The result is that EW today is on the verge of entering a new era in its history, one in which new organizations may emerge, and one in which EW is pulled together (rather than balkanized) and properly resourced in peacetime, as well as in wartime.

Over the past several months, many of the leaders in our community who helped EW to reach this point have moved on to new jobs and positions, mostly within industry. They should be very proud of what has been achieved, so far. At the same time, I look forward to an emerging group of new EW leaders who must continue to develop EW concepts, engage new military leaders and build EW organizations. They will become the advocates for a highly energized EW community.

As with any community, EW must find ways to consolidate its successes and continue to build on them for the future. Some of that will come from its organizational and operational leaders. But at the same time, all of us in the EW community must be part of that effort by doing what we can to foster informed debate about EW concepts, policies, equipment and organizational structures and to help ensure that EW resourcing is commensurate with its critical importance to US and allied military operations in the future.

– John Knowles

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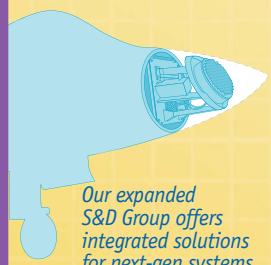

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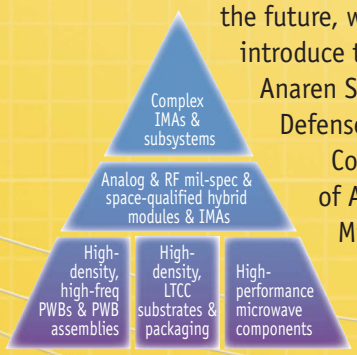

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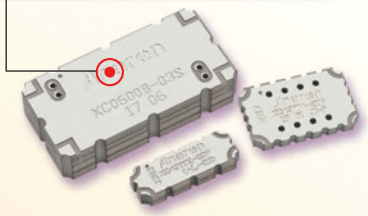

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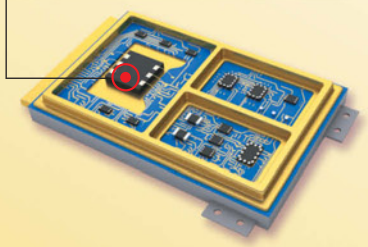

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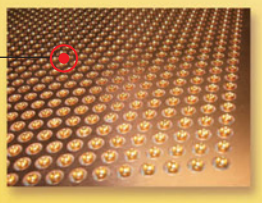

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OCTOBER

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message
from the president

ADVOCATE, INFORM, EDUCATE, QUESTION

I believe the Association of Old Crows (AOC) fulfills several roles as a professional association. It should advocate for the Electronic Warfare (EW) mission area and its professionals; it should inform and educate its members on current and future EW issues and trends; and it should examine and question current operational and technical thought.

To meet these challenges, the AOC is embarking upon a number of strategic initiatives that will address professional development topics through white papers, educational courses and professional certifications within the Electronic Warfare and Information Operations communities. The recent Crane EW Conference was the perfect venue for the AOC to unveil the first of our white papers, *21st Century Electronic Warfare* by Lt Gen Robert Elder (USAF Ret).

21st Century Electronic Warfare is an AOC-sponsored review of EW in the Information Age. In an age of increasing spectrum dependence, it is meant to provide practitioners in all warfighting domains with a fundamental way of thinking about electronic warfare. The white paper presents a common way to understand the electromagnetic spectrum and sets forth a strategic framework that orients and focuses EW activities in the areas of operations, intelligence, acquisition, EW business processes and training.

Within the paper, six tenets of 21st century EW are presented to help guide and stimulate discussion within our community:

1. The electromagnetic spectrum (EMS) provides the maneuver space that allows unified action across all warfighting domains.
2. Electronic warfare creates physical, informational and cognitive effects through the use of electronic systems operating in the Electromagnetic Environment (EME) which create, control, exchange and employ electromagnetic energy across the frequency spectrum.
3. Electronic warfare consists of four elements: electronic attack (EA), electronic protect (EP), electronic warfare support (ES) and EMS control (EMC).
4. Electronic warfare controls and exploits use of the EMS to enable friendly freedom of action in all domains (to include cyberspace) and to deny freedom of action to adversaries.
5. EW and Cyber operations both require use of electronic systems and electromagnetic spectrum but are very different: EW is conducted in the electromagnetic environment, while Cyber ops are conducted in the information environment.
6. Electronic warfare can be employed in support of Information Operations (IO) to influence, disrupt, corrupt or usurp adversarial human and automated decision making while protecting our own.

These six principles represent fundamental beliefs about EW in the 21st century. As you ponder the substance and thought behind these statements, it is important that you craft your own beliefs regarding the role of the EMS and of EW in the Information Age. Let us hear about your thoughts as we continue to address and question subjects of interest. As Old Crows, we need to challenge our community to actively think about and explore our profession. The AOC as an association will strive to assist you in that endeavor.

– Chris "Bulldog" Glaze

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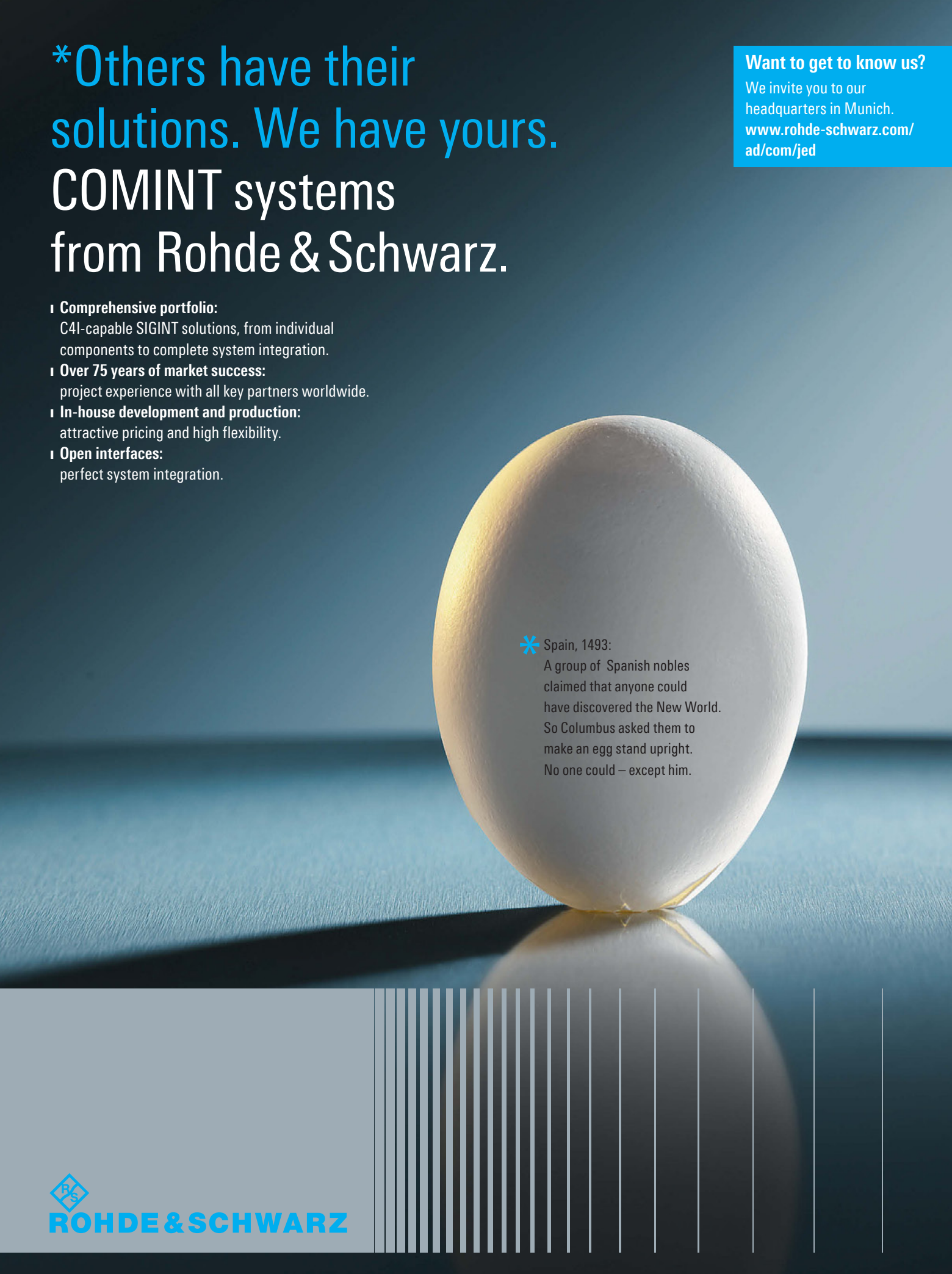

* Spain, 1493:
A group of Spanish nobles claimed that anyone could have discovered the New World. So Columbus asked them to make an egg stand upright. No one could – except him.

ROHDE&SCHWARZ

MARINES GET UPGRADED PROWLERS

The US Marine Corps celebrated the arrival of its first three EA-6B Prowler support jamming aircraft upgraded with the Improved Capability (ICAP) III suite in a May 13 ceremony at MCAS Cherry Point, NC.

The Navy developed ICAP III but procured only 15 Prowlers with the upgrade from 2005 onward after deciding to retire all of its EA-6Bs beginning last year and replace them with new EA-18G Growlers by the end of FY2014. The Corps operates four land-based Marine Tactical Electronic Warfare Squadrons (VMAQ-1 through VMAQ-4), each with five EA-6Bs, at Cherry Point. The service opted to keep flying its Prowlers until 2019 (rather than replace them with Growlers) and to convert its ICAP II EA-6Bs to the ICAP III configuration.

The heart of the Improved ICAP III upgrade, developed by Northrop Grumman, is the ALQ-218 digital wideband receiver, among the first of its kind that can perform selective-reactive surgical (as opposed to preemptive) jamming. The ALQ-218 cues the Prowler's ALQ-99 high- and low-band external jamming pods, enabling the jammer to focus its energy on multiple, specific radar or communications frequencies. The EA-6B ICAP II configuration, by comparison, attempts to jam across larger bandwidths, which disperses the aircraft's jamming power.

A second major advance of the ALQ-218 is its geo-location capability. It can rapidly and accurately pinpoint the location of any radio frequency emitter it detects, improving "spot" jamming as well as cueing the High-speed Anti-Radiation Missiles (HARMs) the Prowler can carry. The ICAP II system, with its ALQ-99 receiver, provides only a "geo-localization" capability – the bearing to an emitter and, at best, its rough location. As a Northrop Grumman description states, "The ALQ-218 utilizes a unique combination of short, medium and long baseline interferometer techniques with a patented passive ranging algorithm to provide geo-location of emitters for cueing jammers and other onboard sensors such as electro-optical/infrared sensors and radar."

Another key addition of the ICAP III suite is the Link 16 Multi-function Information Distribution System (MIDS) tactical data link radio. MIDS terminals automatically exchange situational awareness information with each other in real time and show the locations of enemy air defenses, friendly and enemy aircraft, ships and ground forces on a cockpit display. The combination of the ALQ-218 receiver and Link 16 provides a formidable capability, allowing the exchange of threat warning and attack data among strike and electronic attack aircraft.

The Navy has planned to transfer its 15 ICAP III Prowlers (and one converted test aircraft) to the Marine Corps under a previous agreement. In addition, Congress funded the purchase from Northrop Grumman in 2007-2008 of 16 ICAP III conversion kits for the Marine Corps' ICAP II Prowlers. Those retrofits are being performed by the Naval Aviation Depot-Jacksonville (FL). Thus, the Marine Corps could end up with 32 ICAP III aircraft, potentially enough to stand up a fifth operational squadron in addition to a training squadron, but those options will be determined in the future.

USMC LtCol Marty Moore, the EA-6B ICAP III Fleet Introduction Team Lead with Marine Aircraft Group 14 at Cherry Point, told *JED* that the first two ICAP III aircraft to arrive came from Jacksonville; the third was the first to come from the Navy's inventory. He said that the Marine Corps will outfit its four squadrons with ICAP III aircraft one at a time, beginning with VMAQ-4, which will deploy overseas for the first time with the upgraded Prowlers in the spring of 2011. All four squadrons will have fully transitioned to ICAP III aircraft by the spring of 2012, he said.

The EA-6B has a crew of four – a pilot and an electronic countermeasures officer (ECMO) seated side-by-side up front with the pilot on the left, and two other ECMOs side-by-side behind them in the aft cockpit. Marine EA-6B air crews continue to receive most of their training from VAQ-129, the Navy's Prowler-Growler Fleet Replacement Squadron at NAS Whidbey Island, WA, home base for that service's EA-6B squadrons. Specific training to operate the ICAP III system is being conducted by newly minted Marine instructors at Cherry Point. Lieutenant Colonel Moore and a fellow officer developed a Marine ICAP III training syllabus using Navy courseware and training materials and information gleaned from Navy ICAP III squadron VAQ-140 and Navy Air Test & Evaluation Squadron (VX) 23. The ICAP III training takes 2-3 weeks.

The Naval Surface Warfare Center-Crane (IN) is providing ICAP III support equipment training to Marine maintenance personnel at Cherry Point. – *G. Goodman*

ACC EW CHIEF DETAILS EW RETRANSFORMATION PLANS

Speaking at the AOC/Shephard EW 2010 conference in Berlin last month, Col Joseph Skaja, Chief, EW/IO/DE for the US Air Force Air Combat Command's A8I Division, discussed ACC's plans for investment in various upgraded EW systems, including plans to combine the major components of the ALQ-184 and ALQ-131 pods into one pod.

"We cannot get into the digital age if we keep trying to maintain analog equipment," Skaja said. "We can't give up everything, but what we think the best approach is, we think we can do some IRCM work, we think we can get some better RWRs. We'd like to replace the ALR-69, but that one is probably going to fall by the wayside because of funding. We are doing the pods and we're trying to improve the reliability of some of our systems."

Those plans call for combining the best of the ALQ-184 and ALQ-131 electronic countermeasures pods into one pod, which would be housed in the shell of the ALQ-131 and used on both F-16s and A-10s. Col Skaja said the overall goal is improved capability – through addition of digital RF memory (DRFM technology) – along with bringing total program cost down, by reducing the overall number of pods to be maintained. No timeline for the program was given, though as *JED* reported in March, the EW sustainers at Robins AFB, GA, are currently working on the solution.

With man-portable air defense systems (MANPADS) providing the most significant threat to the A-10, ACC is investing in a new, laser-based infrared jamming system. They are adding the ALISS pod, which jams missiles once they've been launched. The next gener-

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Contact: Stew Taylor, taylor@crows.org

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Session 2 - Military Services Requirements
Session 3 - Agencies' Requirements
Session 4 - International Military Services/Agencies/NATO
Session 5 - Evolving Policy in Regard to EW
Session 6 - Policy in Regard to Cyber Warfare
Session 7 - Policy in Regard to Spectrum Warfare
Session 8 - Policy and Planning in Regard to Special Applications of EW and Spectrum Warfare
Session 9 - Policy and Planning in Regard to Support to LEA's
Session 10 - New Military Service Programs
Session 11 - New Technology Planning and Insertion
Session 12 - Experimentation
Session 13 - International Activities
Session 14 - User Perspective (Recent Military Returning from Iraq or Afghanistan)
Session 15 - New Innovative Approaches to Technology Planning and Quick Turnaround Solutions

AOC 2010

For more information visit the Convention page at www.crows.org.

DOD RELEASES SBIR SOLICITATION

The DOD has released its second FY2010 Small Business Innovative Research (SBIR) solicitation, which includes a number of US Army and US Navy EW and SIGINT research topics.

Under the topic "Novel Directed Energy Propagation Methods for Extended Range Operation" (A10-045), the US Army's Program Executive Office for Missiles and Space is seeking innovative solutions for improving the engagement range of directed energy weapons without simply adding more power and larger antennas to existing DEW systems." It is encouraged that the proposed technologies think outside the realm of current methodologies, i.e., larger antennas or bulkier sources. We do not expect that the laws of physics will be broken, but bending them or tricking them to operate in another regime are exciting possibilities," according to the solicitation. The Topic point of contact is Keith Braun, (973) 724-7072, keith.braun@us.army.mil.

Another Army topic, "Active Closed Loop Infrared Countermeasures (CLIRCM) Sensor for Rotary Wing Aircraft," (Topic A10-082) will investigate methods to improve threat identification and countermeasures selection in DIRCM systems. The topic point of contact is Owen O'Neill, (732) 427-3794, owen.oneill@us.army.mil.

The Army research topic, "Multi-Threat Passive Detection for Aircraft Survivability Equipment (MTD-ASE)" (A10-083), will look at developing a single threat warning sensor head to detect all expected near-IR and mid-IR and UV-based threats. The research would support Army efforts to develop a single EW system to detect IR-guided threats, hostile fire sources, laser threats and laser-guided threats. The topic point of contact is Owen O'Neill, 732-427-3794, owen.oneill@us.army.mil.

Under the topic titled, "Integrated Counter-Mine/Improvised Explosive Device (IED) and Command and Control (C2) Capabilities" (A10-103), the Army will investigate solutions for multifunction RF systems that can perform communications and IED jamming from a single system. "The goal of this proposed effort is to develop a fundamental enabling technology called active interference cancellation, which enables simultaneous Jamming and Communicating capability where the functionality and Jamming-Communicating capability is not impaired by changes in the threat conditions and operating environment," according to the solicitation. The topic point of contact is James Koh, (732) 427-6602, james.koh@us.army.mil.

Under the Joint Non-Lethal Weapons Program, the Navy is soliciting research under the topic, "Cooling/Thermal Management System Development for Active Denial Technology (ADT) and High-Power Radio-Frequency Vehicle Stopper (RF) Systems (N102-110). This work will focus on new thermal management solutions for directed energy systems, in this case high-power RF "vehicle stopper" systems. Program officials want to reduce the size, weight and cost of thermal management systems by a factor of two. The topic point of contact is David Law, (703) 432-0900, dvid.b.law1@usmc.mil.

Another Navy topic is titled, "28GHz-43GHz Nadir/Near-Nadir Low Probability of Intercept Radio Frequency Direction Finding/GeoLocation Capability" (N102-118). Sponsored by the EP-3E program, this program will focus on developing antenna and processor solutions that enable "near instantaneous geolocation" of LPI emitters in the 28- to 43-GHz range using 3-dimensional direction-of-arrival information. The topic point of contact can be reached at (240) 577-3173 or (540) 653-8811.

Details about these and other topics in the SBIR 2010.2 solicitation can be found on the Web at www.acq.osd.mil/osbp/sbir/. Proposals are due by June 23. – *J. Knowles*

ation of that pod, called CMIRCM, Skaja said, will actually jam missile seekers before the missiles are launched.

ACC is also trying to integrate all the EW systems on the F-15Es, eventually upgrading the F-15Cs to the Eagle Passive and Active Warning and Survivability System (EPAWSS). The goal is to bring all the EW data to one location in the aircraft and then use it "to do smart jamming and smart countermeasures," Skaja said, noting that progress may be impeded by funding issues. "It is doing fairly well in the budget process, but we don't know how's it's going to come out in the next cycle."

Col Skaja discussed how ACC views the airborne electronic attack system of systems (AEA SoS) and is working to bring information from multiple sources and platforms together to use across that battlespace. "There is no magic EW system that can bring everything together," he said. "We are trying to populate that with the appropriate equipment, the appropriate upgrades and the appropriate capability enhancements."

Showing an overview of the AEA SoS, Skaja noted that the Air Force is still looking for a stand-off jamming option, while pursuing the jammer variant of the miniature air-launched decoy (MALD) for stand-in jamming. The service is already working on a follow-on to the MALD-J for increased capabilities in this area, Skaja said.

Skaja also said the Air Force is making adjustments to how aircrews are trained. "A lot of the new pilots are not experienced with degradation of their systems," he said, noting that during the Cold War pilots trained to execute missions when systems didn't work. "What we're seeing in today's environment, we aren't degrading our GPS," so aircrews need to be trained how to operate if their more sophisticated systems don't work as planned.

In addition to other planned upgrades, the Air Force has also expedited funding to increase Compass Call capabilities. Plans are to convert another C-130 to the EC-130H Compass Call configuration, adding an aircraft to the fleet to help with the demands placed on it by current operations. Skaja also

noted the addition of two simulators – one a flight deck simulator, the other an additional mission crew simulator – "to help the training problem because of the constant deployment of this aircraft." – *E. Richardson*

JOINT F-35 EW SQUADRON STANDS UP

The 53rd Electronic Warfare Group (Eglin AFB, FL) has stood up the 513th Electronic Warfare Squadron, which will focus on reprogramming the threat libraries for the F-35's planned AN/ASQ-239 electronic warfare system.

The 513th is a joint squadron supporting all three variants of the F-35 Joint Strike Fighter for US forces and international customers. Under the command of Lt Col Tim Welde, the squadron is expected to grow from about 30 engineers and technicians today to about 130 personnel when at full strength. About half of the joint squadron will be Air Force personnel, with the Navy and Marine Corps providing the other 50 percent. The 513th will operate a new $300 million reprogramming laboratory, which is currently under construction at Eglin and should be operational by the middle of 2011.

Command of the 513th is also joint. Colonel Welde is scheduled to lead the squadron for 18 months, after which a US Navy officer will assume command.

F-35 pilots and crew chiefs are also being trained at the 33rd Fighter Wing at Eglin. – *J. Knowles*

IN BRIEF

The US Navy's Space and Naval Warfare Command (San Diego, CA) has awarded a $8.3 million contract to **Raytheon BBN Technologies** (Cambridge, MA) for the Precision Electronic Warfare (PREW) program. Managed by DARPA, the PREW program is an effort to develop a surgical jamming capability covering the 200- to 2,700-MHz frequency range. The PREW concept calls for multiple low-power electronic attack systems on aircraft and ground locations to be formed into an ad hoc communications electronic attack network that can target ground-based emitters.

✪ ✪ ✪

Comtech Telecommunications Corp. (Melville, NY) has announced plans to acquire **CPI International** (Palo Alto, CA) in a deal valued at $472 million. The acquisition would nearly triple the size of Comtech's role in the RF microwave amplifier market, including traveling wave tubes.

✪ ✪ ✪

AAI Corp. (Hunt Valley, MD) has won a contract valued at $43 million from Lockheed Martin as the principal subcontractor for the US Navy's Electronic Consolidated Automatic Support System (eCASS). eCASS is the US Navy's next-generation test set for weapons, avionics, navigation and EW systems. AAI will deliver 49 mission equipment kits to Lockheed Martin.

✪ ✪ ✪

Northrop Grumman's Defensive Systems Division (Rolling Meadows, IL) has won a $79 million contract from Naval Air Systems Command (NAVAIR) for production of Large Aircraft

Infrared Countermeasures (LAIRCM) sensors and processors. Under the contract, the company will supply 99 Next Generation Missile Warning Systems (487 two-color IR sensors and 99 processors) for Navy and Marine Corps helicopters.

✪ ✪ ✪

Kilgore Flares (Toone, TN) has received a second delivery order, valued at $22.5 million, from the US Air Force for ALA-17C IR decoy flares. The flares are used to protect B-52 aircraft from IR threats. This follows a previous $27 million order for the flares awarded in March 2010. Deliveries are scheduled through 2013.

✪ ✪ ✪

Raytheon Missile Systems (Tucson, AZ) has received a $48.9 million contract to begin engineering and manufacturing development of the Miniature Air-Launched Decoy Jammer (MALD-J), the stand-in jammer variant of the MALD. The MALD-J program completed initial testing in December 2009, and the company conducted a second free-flight test in April.

✪ ✪ ✪

NAVAIR has awarded an $11 .5 million contract to **Raytheon** (Fort Wayne, IN) for engineering development models, engineering support and product improvements for ALQ-227 Communications Countermeasures Sets. The ALQ-227 is installed on the US Navy's EA-18G aircraft.

✪ ✪ ✪

NAVAIR has announced plans to award a contract to **Alliant Techsystems** (Clearwater, FL) for production of AAR-47 missile warning sensor upgrades for the US Air Force and US Army. The company will deliver 102 AAR-47A(V)2 sensor upgrades under the contract. The Navy also announced that it will award a separate contract to ATK for delivery of 56 AAR-47(A)V2 flightline test sets.

✪ ✪ ✪

Cobham Sensor and Antenna Systems (Lansdale, PA) has received a $45.9 million contract from NAVAIR for production of 60 ALQ-99 Low-Band Transmitters for the EA-6B and EA-18G. Final deliveries are expected in September 2012.

✪ ✪ ✪

Charles E. Dowdell, founder of **Amherst Systems** (Buffalo, NY), passed away on April 10. Dowdell and his partner, Donald Hess, founded the EW simulation company in 1975. Dowdell retired from Amherst in 1999 after the sale of his company to Comptek Research. Today, the company is operated as part of Northrop Grumman.

✪ ✪ ✪

Ratheon's EW business unit in Goleta, CA, has won an $89.5 million contract from NAVAIR for continued production of its ALR-67(V)3 radar warning receiver for F/A-18E/F Super Hornet aircraft. Deliveries are scheduled for January-December 2012. The contract represents the 12th full-rate production contract for the system. The Navy has ordered a total of 681 systems for Navy and international customers.

washington report

DEFINING FUTURE EW OPERATIONS

Last month, the Association of Old Crows released a new white paper titled "21st Century Electronic Warfare." It was written for the AOC by Lt Gen Robert Elder, (USAF Ret.), former commander of 8th Air Force. The report clarifies the differences between electronic warfare operations and cyberspace operations and how they relate to information operations; identifies shortfalls in policies that pose risks for EW operations in the future; and makes a number of recommendations. It can be downloaded at www.crows.org.

One of the recommendations driven home in the report is the need to develop and maintain an experienced cadre of EW personnel. As the report notes, "There is a critical need to develop strategic and operational leaders with expertise and experience in EW. Insufficient EW leadership capacity exists due to a shortage of workforce development opportunities and a failure to insist on proper technical expertise and experience in critical EW positions. Civilian leaders and military commanders should build the capacity for EW operations by developing a force structure that includes consistently trained personnel, infrastructure and organizational structures. This workforce should work closely with combatant commands to integrate new capacity into existing operations."

As General Elder told *JED*, "We haven't been grooming or developing operational leaders who understand EW and the use of the electromagnetic spectrum. When it comes time to develop operational alternatives for how a campaign might be conducted, we simply don't have anyone who is part of the planning process who is an expert on how control of the electromagnetic spectrum or the use of electronic attack or directed energy could be used to support our maneuver force.

"It's not only about developing technical expertise – it's about developing operational leader expertise among our officers. We would like to see people getting into senior positions who have grown up in the EW business, so it can be injected into our overall operational planning." – *G. Goodman*

HOUSE PANEL MARKS FY2011 AUTHORIZATION

The House Armed Services Committee released its version of the FY2011 Defense Authorization Bill on May 21. The HASC funded the 12 new EA-18G Growler support jamming aircraft requested by the Navy in FY2011 for $1 billion. The service had planned to buy the final 10 of 88 aircraft in FY2011, but added two more in FY2011 and 24 in FY2012 at the behest of DOD officials to allow the Navy's three land-based expeditionary squadrons to remain in service. The panel fully funded virtually all of the DOD's EW- and SIGINT-related requests. The following are highlights:

Army Procurement:

- $88.5 million for the Enhanced Medium-Altitude Reconnaissance and Surveillance System (EMARSS), a new manned SIGINT/ISR aircraft for which release of a request for proposals for engineering and manufacturing development is imminent.
- $71.5 million for Prophet Enhanced signals-intelligence (SIGINT) vehicles.
- $24.5 million for Army Aircraft Survivability Equipment (ASE).
- $174.2 million for Army ASE Infrared Countermeasures (IRCM).
- $29.9 million for Guardrail SIGINT aircraft modernization.

Navy Procurement:

- $90.3 million for EP-3E SIGINT aircraft modifications.
- $33.8 million for Airborne Electronic Attack (AEA) systems.
- $21.9 million for Common Electronic Countermeasures Equipment.
- $53.5 million for High-Speed Anti-Radiation Missile (HARM) modifications.
- $49.7 million for SLQ-32 shipboard EW improvements.

Air Force Procurement:

- $176.6 million for EC-130H Compass Call communications-jamming aircraft modifications.
- $44.2 million for RC-135 Rivet Joint SIGINT aircraft modifications.

Army RDT&E:

- $211.5 million for EMARSS.
- $17.3 million for EW Technology (ET) applied research; $21.4 million for EW advanced technology development (including $3 million not requested by the Army for an "Advanced Ground EW System" or AGES); $172.3 million for EW Development and another $21.6 million also for EW Development, both for system development and demonstration (SDD) activities.

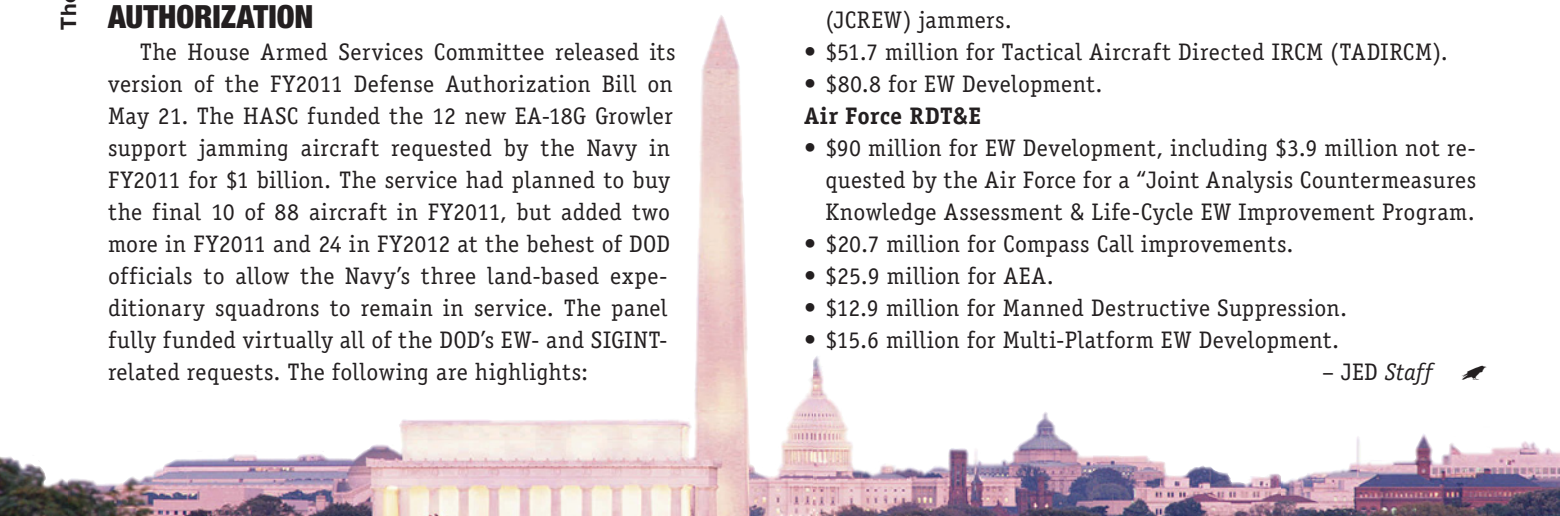
Navy RDT&E:

- $120.6 million for the Next-Generation Jammer (NGJ), soon to enter a pre-SDD Technology Maturation phase with multiple contractors.
- $84.5 million for Ship Self-Defense (Soft Kill/EW).
- $56.5 million for Joint Counter Radio-Controlled IED EW (JCREW) jammers.
- $51.7 million for Tactical Aircraft Directed IRCM (TADIRCM).
- $80.8 for EW Development.

Air Force RDT&E

- $90 million for EW Development, including $3.9 million not requested by the Air Force for a "Joint Analysis Countermeasures Knowledge Assessment & Life-Cycle EW Improvement Program.
- $20.7 million for Compass Call improvements.
- $25.9 million for AEA.
- $12.9 million for Manned Destructive Suppression.
- $15.6 million for Multi-Platform EW Development.

– JED *Staff*



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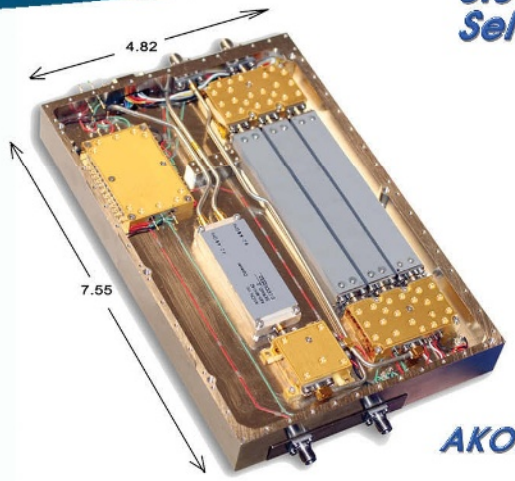

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RAF NIMROD R1 AIRCRAFT DEPLOYED TO AFGHANISTAN

The UK's remaining two Nimrod R1 signals-intelligence (SIGINT) aircraft are undertaking their last major deployment – in Afghanistan – before being retired in 2011. They belong to the 51st Squadron, part of the Royal Air Force's Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) component, based at RAF Waddington, Lincolnshire.

Speaking at the AOC/Shephard EW 2010 conference in Berlin last month, Air Commodore N.J. "Flash" Gordon, AO ISTAR & SAR, noted recent successful operational activities of the RAF's ISTAR component – including the tripling of UK signal-collection figures over the last year – and anticipated the Nimrod R1 SIGINT platforms' contribution to coalition operations in Afghanistan, "with deployment expected to last until the type platform retirement in March 2011."

The RAF retired its third Nimrod R1 in October 2009. The remaining two aircraft recently received unspecified upgrades directed toward their communications intelligence (COMINT) suite, according to Gordon.

The UK Ministry of Defence revealed recently that its Nimrod R1s will be replaced by a fleet of three Boeing 707-based RC-135 Rivet Joint platforms equipped with the same mission suite employed by the US Air Force, with the first aircraft to be inducted into UK service in 2014. In the meantime, RAF crews are to be trained on the USAF aircraft.

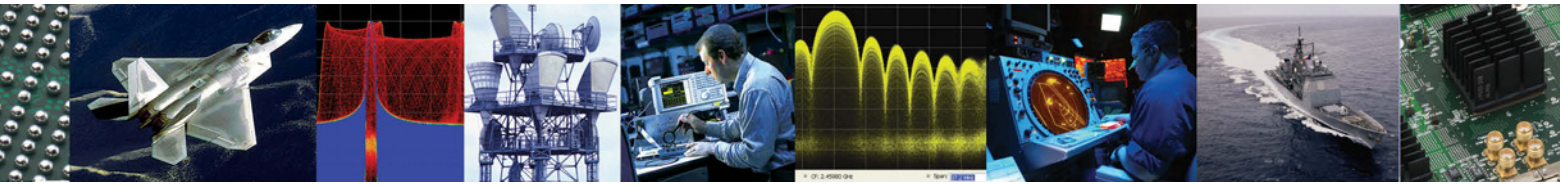
UK SIGINT activities in support of coalition operations in the Afghanistan theater also are being provided by the USAF-developed MQ-9 Reaper unmanned aerial vehicle (UAV) and the Shadow R1 turboprop aircraft (a specially modified Hawker Beechcraft King Air 350ER), which are equipped with dedicated equipment similar to USAF platforms. Gordon pointed to an improved procurement process in which the UK's MQ-9 Reapers were procured and fielded in 15 months and entered service only one week after the USAF version.

Speaking from the operational perspective at EW 2010, Maj Jonny Hill, Commanding Officer of the Royal Marines' Y Squadron, noted that an electronic support payload is planned for the UK's new Watchkeeper UAV from Thales. However, he added, "There's a debate raging in the UK at the moment about whether additional SIGINT/EW capabilities ought to be loaded onto UAVs." This may limit the expanded options for EW and SIGINT payloads for UK UAVs moving ahead.
– L. Peruzzi and S. Grant

NATO PLANS EW TRAINING SYSTEM UPGRADES

NATO is preparing for a major upgrade of its electronic warfare training equipment, including 20 new airborne RF jamming simulator pods, four new EW cabins to be used in land/maritime EW training and four anti-missile ship defense "smart" pods.

Briefing attendees at AOC/Shephard EW 2010 conference last month in Berlin, Capt Peter Kenward, director of the NATO Joint EW Core Staff (JEWCS), laid out an ambitious plan for modernization, which would move toward first stage authorization in third quarter of



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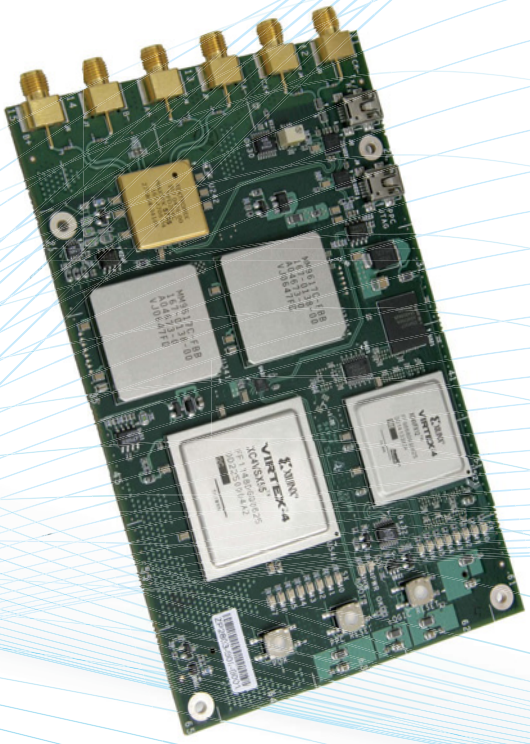

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2010 with initial bids going out in the fourth quarter of this year.

Kenward said the modernization program would bring NATO capabilities up to date with modern EW. However, he noted that the originally approved price tag of €150 million was developed a couple of years ago, and though NATO is proceeding, the undertaking might have to be adjusted based on the current availability of NATO funding.

If the program is able to proceed as intended, contracts would be awarded in 2012 with design, procurement and initial operational capability (IOC) of the land/maritime pieces scheduled for 2014. Airborne upgrades are scheduled to follow in 2015.

"Quite often our equipment fails in an exercise or fails in what a user wants, and they're much less likely to invite us back when that happens," Kenward said, noting that the joint training mission is essential to ensuring a prepared allied force.

NATO's training budget has seen significant cutbacks, and this modernization effort will likely face serious budgetary issues as it moves ahead. Kenward lobbied for support from governments and industry to ensure that the organization's work in joint training – NATO's 2010 training schedule has already seen several planned exercises canceled – can continue. – *E. Richardson*

REAL-TIME RETASKING USING... FACEBOOK?

The continuing integration between land and air EW assets was a key topic during the AOC/Shephard EW 2010 conference in Berlin last month, and Air Commodore Gordon noted an instance where Facebook was used to enable real-time activity.

Part of the issue, Gordon said, could be related to the differences in planning. "Land forces tend to be quite decentralized in terms of their execution and planning and air forces really tend to be far more sanctified in their planning," he said, noting that in Afghanistan what happens is that decentralized ground forces can end up bypassing the operational planning process.

To improve their overall ability to coordinate tasking, forces need a tactical level of understanding of what EW assets bring to an operation. "We need to be able to connect considerably better," Gordon said. "One of things that struck me was the power of the Internet."

Visiting central operations, Gordon said he saw a small group of those involved in intelligence, combined with subject-matter experts and people operating platforms who put themselves in a room to track real-time coordination and synergies across the current operation.

"One of the ways they were doing that was that they were challenging their mates in theater on Facebook," Gordon said. "What they were trying to build was a real-time, synchronized picture so that they could re-task and flexibly employ strategic assets."

To re-task an asset in real time, "that's very powerful," Gordon said. "That is changing the whole way we do business." – *E. Richardson*

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By Glenn Goodman

COMINT

US Marines and Special Operations Command Pursue Lightweight Eavesdropping Gear

Mobile signals-intelligence (SIGINT) systems, particularly man-portable communications-intelligence (COMINT) equipment for ground troops, have come into demand today among major militaries thanks to the force-protection requirements of irregular warfare. The shrinking size of SIGINT receivers, the growing power of signal processors and new antenna designs have reduced the technological challenges of developing man-portable systems that provide sufficient frequency coverage even in the face of an expanding COMINT target set. Lightweight direction-finding (DF) and COMINT systems for dismounted applications of conventional and special operations forces (SOF) are desired to detect and locate enemy activity in forward areas. Although many systems are man-portable or team-portable, the ideal remains a man-pack system light enough to be carried and operated by a single soldier.

USMC SIGINT SYSTEMS

The ground-based SIGINT and electronic attack operations of the US Marine Corps are conducted by elements of its three Radio Battalions (RadBns). Each division-size Marine Expeditionary Force has one RadBn, which dispatches SIGINT tactical collection teams or larger detachments to support operational units of different sizes, even down to company level and below. Some RadBn teams also support units of USMC Forces Special Operations Command (MARSOC). Each team or detachment is "task-organized" to support the required mission, including, for example, taking along the right type of COMINT linguists.

Dan Fitzgerald, the Acting Program Manager for Intelligence Systems at Marine Corps Systems Command (MCSC), told *JED* that the Marine Corps' goal is to push ground-mobile SIGINT support as far forward as possible and to the lowest tactical echelon.

Each RadBn uses a combination of vehicle-mounted and dismounted SIGINT equipment to conduct its assigned missions. The two primary sets of equipment are the Team-Portable Collection System (TPCS) and the man-portable Radio Reconnaissance Equipment Program (RREP). Both passively intercept enemy communications signals and provide their line of bearing using direction-finding equipment; the larger TPCS set of equipment can also locate the source of the emissions.

TPCS-Multi-Platform-Capable (TPCS-MPC) is a modular, scalable, carry-on/carry-off set of equipment that can be operated from a non-dedicated organic wheeled ground vehicle such as an armored Humvee or Mine-Resistant Ambush Protected (MRAP) vehicle or set up at a fixed site. (TPCS is fully integrated into a dedicated USMC Light Armored Vehicle called the Mobile EW Support System or MEWSS, which combines it with a communications jammer for on-the-move or stationary operations.)

As a description on the MCSC website states, "The TPCS-MPC will provide the Operating Forces with the capability of intercepting, processing, locating and degrading threat communications, to include advanced modulations and complex low probability of intercept (LPI) signals. TPCS-MPC will process both data and information (signals intercept, signals intelligence and electronic reconnaissance) from sources internal and external to the Marine Air-Ground Task Force. The system will analyze collected data to produce usable information such as traffic analysis, crypto analysis, transcription and translation. TPCS-MPC will be interoperable with other fielded USMC SIGINT/EW assets, functioning as either a stand-alone system or as an integral part of a larger SIGINT architecture."

SIGINT data from RadBn teams using TPCS and RREP equipment are fed via radio link to a Technical Control Analysis Center (TCAC), which fuses data from multiple sources, including Marine EA-6B Prowler aircraft.

The TPCS-MPC Block 0 system entered service in 2007. Fitzgerald said a total of 58 have been fielded. The Marine Corps has a requirement for 72 systems.

The Navy's Space and Naval Warfare (SPAWAR) Systems Center-Atlantic (N. Charleston, SC) produced the Block 0 systems. A Block 1 replacement entered system development and demonstration in December 2008; it is slated to become operational in FY2011-2012.

A true man-pack capability would give the battlefield commander more flexibility and a reduced footprint, particularly in mountain environments.

Fitzgerald said one of the major aims of the TPCS-MPC Block 1 development effort is greater equipment portability through enhanced modularity and scalability. As he explained, "We want a RadBn unit, if a mission requirement calls for it, to be able to use smaller portions of the TPCS equipment, for instance, for a man-pack mission of limited duration, while continuing to support vehicle-mounted missions." A true man-pack capability would give the battlefield commander more flexibility and a reduced footprint, particularly in mountain environments, he added.

Fitzgerald noted that pre-planned product improvements to TPCS are being achieved through insertions of commercial-off-the-shelf (COTS) and non-developmental-item (NDI) technologies.

The man-portable RREP SIGINT equipment – consisting of eight components of various sizes – is carried by dismounted RadBn teams. The latest version is SIGINT Suite 3 (SS-3), which entered service in 2005. The Marine Corps has fielded a total of 38 SS-3 systems.

Gunnery Sergeant Joseph Denton, the RREP project manager at MCSC, told *JED*, "The weight of the SS-3's equipment is spread across the six Marines of a typical Radio Reconnaissance Team."

The foot-mobile, special operations-capable RRTs deploy in conjunction with Marine Force Reconnaissance elements and other advance force units, providing SIGINT support to a deployed Marine Expeditionary Unit and indications & warning support to other adjacent advance force units. The forward RRT's proximity to enemy emitters helps it collect LPI communications signals.

Denton said the SS-3 is continually refreshed with new software and COTS/NDI hardware to maintain its performance capabilities vis-à-vis evolving threat signals. "Using an incremental approach, we are able to integrate new or improved capabilities into the system without having to redesign it,"

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he said. Development of an SS-4 replacement for the SS-3 has not been initiated, he noted.

A continuing SIGINT-related MCSC development program is called Radio Battalion Modernization and Concept Exploration (RadBn Mods). It aims to respond rapidly to urgent SIGINT tactical operational requirements by introducing limited quantities of new equipment to deployed RadBn Marines for the purpose of conducting field-user evaluations and gaining feedback. The evaluations last 6-24 months, and the results determine if a piece of equipment or software transitions to a SIGINT acquisition program of record.

As noted on the MCSC website, "The RadBn Mods program provides the only means of rapidly introducing focused SIGINT technologies to the Operating Forces. Without this program, the Marine Corps would lose its ability to stay relevant and capable of SIGINT collection against new emerging technologies and targets of interest."

Fitzgerald said a number of RadBn Mods efforts have become programs of record, including the TCAC as well as niche software packages for RREP.

The RadBn Mods description on the website also states, "The program has been effective in rapidly providing solutions ranging from Humvee-mounted to hand-held systems capable of exploiting relevant target communications systems." (Fitzgerald and Denton declined to elaborate on the nature of the "hand-held systems" for classification reasons.)

JOINT THREAT WARNING SYSTEM

US Special Operations Command (USSOCOM) has been developing mobile ground SIGINT systems – as well as aircraft and maritime variants – for at least a decade under the Joint Threat Warning System (JTWS) program.

JTWS, as stated in FY2011 DOD budget documents, "is an evolutionary acquisition program that provides threat warning, force protection, enhanced situational awareness and target identification/acquisition information to Special Operations Forces (SOF) via signals intercept, direction finding and SIGINT."

The two JTWS land systems are the lightweight man-packable Ground SIGINT Kit (GSK) Body-Worn/Mobile, which can be operated by a single SOF SIGINT operator, and the Team-Transportable GSK Static. The latter can be carried by four or five team members or on a Humvee.

Little information about the two ground-mobile variants has been released by USSOCOM or its development agent, the SPAWAR Systems Center (SSC)-Atlantic. As with other man-portable/man-packable SIGINT systems, reducing size, weight and required power undoubtedly has been one of the key JTWS technical challenges. The GSK Body-Worn/Mobile variant likely is limited to a basic signal intercept and direction-finding capability.

One of the design objectives of the JTWS family is common core software across the variants and an open software architecture called the JTWS Component Architecture and Framework (JCAF). As described in an SSC-Atlantic briefing from last July, "JCAF is a Government-owned and controlled, standards-based, open software architecture that encourages reuse and discourages proprietary, stove-piped solutions. JCAF allows disparate capabilities from competing vendors to co-exist within a trusted environment." The architecture facilitates continuing technology updates to address evolving threat signals. SRC (Atlanta, GA) has worked as a contractor for SSC-Atlantic on facilitating JCAF conformance for third-party hardware and software components.

The FY2011 budget documents note that the JTWS program completed test and evaluation of the GSK Body-Worn/Mobile and Static systems in FY2009; the FY2010 budget funds integration of a networking solution for the two GSK variants and the purchase of two engineering development models.

A key technology insertion effort for the GSK variants designed to reduce their size, weight and power involves integrating the small Picoceptor and Picoprocessor into them. Both are built by Finmeccanica's DRS Signal Solutions (Gaithersburg, MD). The Picoceptor is a miniature low-power receiver and software-defined radio designed for portable SIGINT applications. Combined with the Picoprocessor miniature signal processor, the Picoceptor can be worn by a soldier or integrated into small platforms and used for signal intercept and threat warning. Covering the 2 MHz to 3 GHz frequency range, the single-channel Picoceptor weighs less than a pound and measures only 3x5x0.9 inches. The dual-channel version weighs less than 1.6 pounds and measures 3x5x1.5 inches.

During FY2010, SSC-Atlantic is completing Picoceptor prototype development and testing the receiver's integration into the JTWS GSK Body-Worn/Mobile and Static systems.

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Manpack COMINT/DF Manufacturers

Companies from Europe, Israel and the US supply some of the most advanced man-portable COMINT/DF systems on the market. The following is a sampling of what's available.

Thales Land and Joint Systems (Colombes Cedex, France) offers the TRC 6200 digital direction finder, which covers 30-3,000 MHz range. Another manpack system from Thales is the Esmerelda XE, a 15 kg monitoring, analysis, measurement and DF system that covers the 9-kHz to 3,000 MHz range, with frequency extension options for SHF and EHF. Both the Esmerelda equipment and the TRC 6200 can be used with the company's Nomad portable DF antenna.

In Germany, Munich-based Rohde and Schwarz makes the TMSR200, a manpack detection, identification, DF and recording system. Signals are captured by the operator with the handheld HE300 directional antenna and sent to the system's EB200 MiniPort comms ES receiver (covering 10 kHz through 3,000 MHz) and the DDF195 direction finder, which covers 0.5-3,000 MHz. The system uses the company's RAMON software for receiver control, display and signal evaluation. Plath, another German company based in Hamburg, manufactures the Signal Monitoring Subsystem (SMS) 2010 for man-portable COMINT applications. The SMS 2010 comprises the SSR 2400 receiver, which operates over the 20-MHz to 3,000-MHz range with a 24-MHz coherent bandwidth, and the company's MAN 4122 antenna.

Persides (Willsbridge, Bristol, UK) is one of the newest companies in the market with its Chili man-pack comms ES system. The system covers HF-3,000 MHz and can output to the company's VEEcam display for "on the march" use or to a laptop computer for more detailed analysis of signals and mission planning. Chili was part of the Team Harken bid for the UK's Project SEER man-pack comms ES and EA program last year. The winner of the Team SEER competition was Roke Manor Research (Romsey, Hampshire, UK), which is supplying its Resolve suite, including a comms ES system. Last month, the company introduced its Tri-Quad man-pack DF system, which provides coverage from 2 MHz to 3,000 MHz.

Synetic Systems Group is another UK defense manufacturer focused on the tactical COMINT/DF systems market. Over the past decade, the company's Surveillance Technology Center in Tewkesbury, Gloucestershire, has supplied UK forces with its Lightweight Emitter Acquisition Recording and Analysis System (LEARAS), a man-portable system covering the 2- to 2,000-MHz frequency range. The system is fed by three antennas: the MA1316 (2-250 MHz), the MA1310 (200-1,200 MHz) and the MA1310G (1,200-1,900 MHz).

The DF4400S receiver acts as the DF operator and control unit. The Wideband Acquisition Signal Processor (WASP) enables intercept of short-duration, frequency-agile emitters. The system's software suite, hosted on a laptop PC, includes the Visual Radio System controller, mission planning and a recording function.

L-3 TRL Technology, also located in Tewkesbury, Gloucestershire, makes the SMARTSCAN family of man-portable COMINT/DF and EA systems. This includes the Man-Portable EW System (MEWS), a tripod-mounted receiver and jammer that uses a laptop PC for control and display. The MEWS can be integrated with the company's Compact EW System for Electronic Attack (CES EA) or the Modular Countermeasures Suite for Electronic Attack (MCS EA).

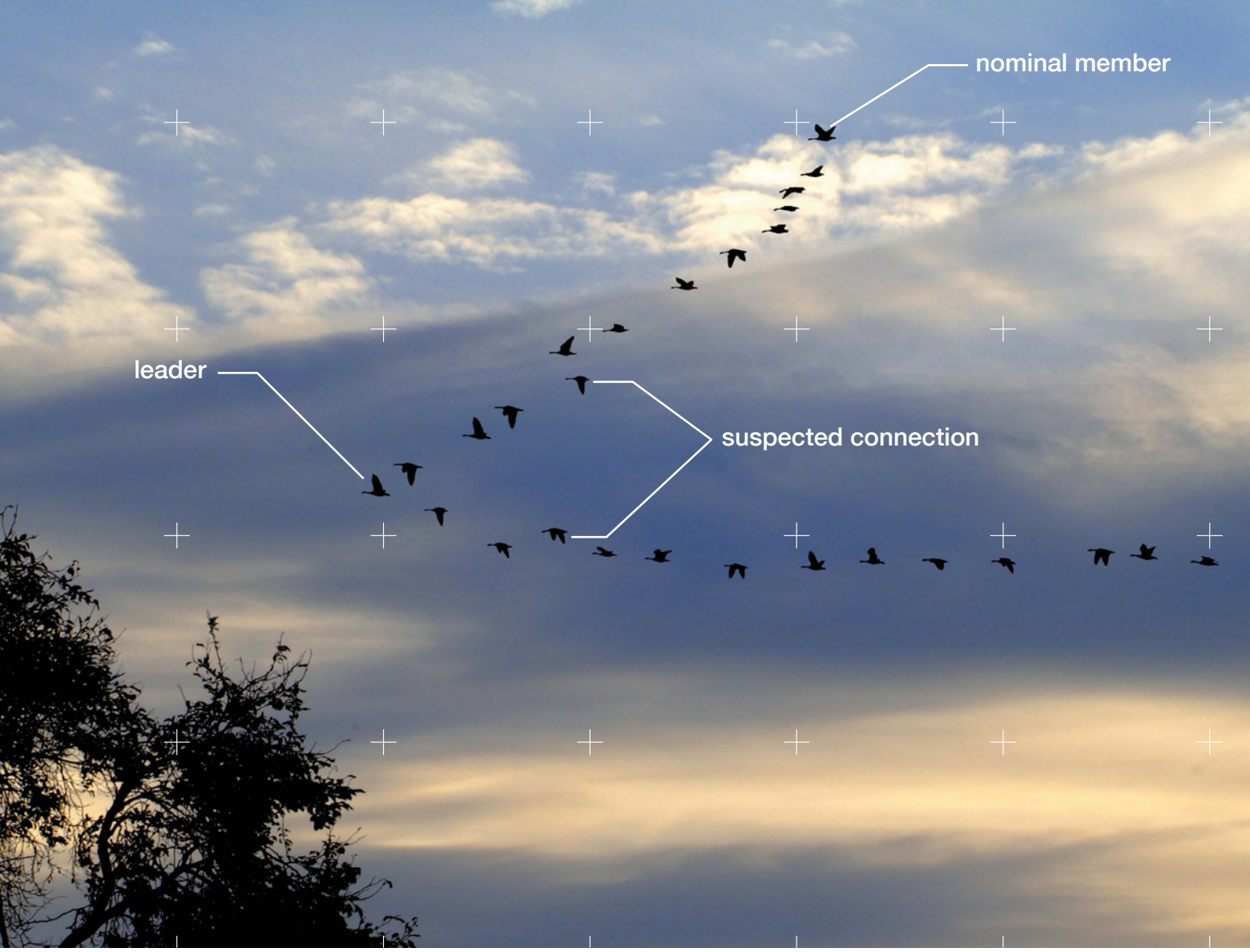
Turkey's Aselsan makes the DFINT-3T2, a man-portable DF system, which provides intercept and DF coverage against emitters in the VHF and UHF bands. It can be networked with other DFINT-3X systems and used to geolocate detected emitters.

Israel's Elsira's Tadiran Electronic Systems in Holon manufactures the MP-DF 100, a 14 man-pack COMINT/DF system covering the 25- to 3,000-MHz range. The system can be operated with a handheld 90-degree front-sector antenna and a hand-strapped PDA or via a 360-degree tripod-mounted antenna featuring Bluetooth networking.

In the US, Southwest Research Institute (San Antonio, TX) has developed a manpack comms ES and DF system that distributes the antennas and system components throughout a soldier's vest or clothing. Earlier this year, SwRI also introduced its AP-460, a man-portable 20-ft telescoping DF antenna that covers from 20 MHz to 3 GHz.

Also in the US, Applied Signal Technology (Annapolis Junction, MD) manufactures the Model 650 Rogue manpack COMINT system. It covers the 20- to 3,000 MHz range and can receive up to 24 channels simultaneously. L-3 ASIT (Linthicum Heights, MD) makes the RDF-110, a 14-lb self-contained remotely operated DF sensor covering the VHF and UHF bands. Operating autonomously or as part of a network, the system can be used as a man-portable system or attached to a vehicle. Another L-3 division, Linkabit (San Diego, CA) makes the PRD-13, a COMINT/DF system which is used in both mounted and dismounted configurations by the US Army.

Other US companies in the manpack COMINT/DF market include Syndetix (Las Cruces, NM), which manufactures the Hostile Emitter Angle Tracker Revised (HEATR); DRT (Germantown, MD); Radio Reconnaissance Technologies (Fredricksburg, VA) and Cubic (San Diego, CA). – *J. Knowles*



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EW Systems Add More Fiber to Their Diet

By Barry Manz

Here's a chilling thought: If coaxial cables had not been able to achieve lower loss, greater shielding effectiveness and higher dissipation factors at increasingly higher frequencies, microwave and millimeter-wave subsystems "as we know them" would be connected by waveguide. Instead of today's rat's nest of semi-rigid coax, threat warning systems, jammers and essentially every other type of high-frequency defense electronic system would be replete with conduits of "microwave plumbing." Fortunately, coaxial cable, whether semi-rigid, hand-formable or flexible, has become the glue that binds together the subsystems that form the world's defense subsystems. However, a competitor in the form of RF over fiber (also known as Fiber over Glass or RFoG) is rapidly gaining momentum and is already replacing coax in some of its historically dominant domains.

The key words in the last sentence are "some applications," because while RFoG offers unchallenged advantages, they are principally achieved in applications that require long cable runs, for reasons that should become obvious later in this discussion. Before launching into how RFoG is making inroads into what has traditionally been a copper-dominated world, it helps to look at the problem of distributing high-frequency signals in general.

For those who contemplate such things, all types of electrical wiring are a paradox. That is, without wiring, little or nothing electrical could be interconnected. However, they severely restrict what can be done, how well, and over what distances. Thus the feverish development of wireless technologies dedicated to "untethering" those remaining consumer products has not yet been unshackled by the ether via Bluetooth, Zigbee, WiFi and other standards.

Hidden away from all this commercial excitement are the microwave and millimeter-wave EW, radar and communications subsystems that make up the bulk of defense electronic systems in ground, air and sea-based applications. Distributing RF and microwave signals in such systems requires well-matched coaxial transmission lines that must deal with stringent electromagnetic characteristics. These challenges are irrelevant at lower frequencies and thus have been ignored by digital designers until recently, as processor and bus speeds work their way up into the microwave region.

Although largely unheralded, advances in coaxial cable technology have continuously been made over the years through efforts by companies such as W. L. Gore, Micro-Coax, Andrew, Times Microwave Systems, Radio Frequency Systems, M/A-COM, Huber & Suhner, and others. Loss, phase and amplitude stability, shielding effectiveness, and other important characteristics have been markedly improved thanks

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to advances in materials and manufacturing technologies. New cable variants have also appeared, such as so-called "hand-formable" cables that look more or less "semi-rigid" but are actually bendable and stay in the shape to which they are formed. Smaller-diameter versions of the "hard-line" spline-dielectric cables used in high-power radio and television broadcast applications are also found in EW and other systems.

In addition to advances in electrical performance, physical improvements to microwave cables have taken place as well. Parameters such as bend radius, crush resistance, flex life, and resistance to assorted hostile environmental conditions have been addressed in order to satisfy assorted requirements, which, not surprisingly, are driven mostly by the military.

Flightline testing in particular connotes visions of test systems being pulled around by their test cables, which although looking much like high-quality garden hose are actually precision microwave components and sensitive to handling. Coaxial cable manufacturers have addressed this problem with protective materials surrounding the critical center conductor, dielectric and shielding layers of the cable.

Spaceflight applications have their own esoteric requirements, such as resistance to a phenomenon called multipaction (in which the components of electrical systems are eaten away by the actions of electrons within their structures). In short, the development of microwave coaxial transmission line has not remained stagnant, but has simply taken a back seat to active components that get more attention.

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However, coaxial cable is heavy, susceptible (even in its heavily-shielded variants) to interference, can be "tapped," and has significant loss. Fiber-optic cable in comparison is very light, largely impervious to interference, does not leak EM energy, and has immense bandwidth. It also has only a fraction of the loss of coaxial cable, which makes it very appealing for use in applications where data from remote sensors must be delivered to a distant central point. Of course, fiber optic transmission is inherently limited to small-signal conditions and thus is not a form-fit-replacement for a broad swath of coaxial cable applications such as the transmission of RF power.

The concept of using fiber optic cable to bring RF signals to and from various points is decades old and the obvious benefits of doing so have been the sustaining factor for firms such as Microwave Photonics, 3 Phoenix, Linear Photonics, Pharad, Pulse Power & Measurements, Syntonics, and many others that make either components or complete systems for defense applications.

Immense improvements to fiber-optic communications capabilities have been made over the years thanks to the replacement of multi-mode fiber with the single-mode variety and advances in semiconductor and other technologies. These have brought costs down to reasonable levels while improving performance and reliability over a variety of environmental conditions. The ability of Verizon to economically provide reliable fiber-based television, telephony, and broadband service to millions of homes via its FiOS network is testament to just how far lightwave technology has come.

Of course, fiber is hardly a newcomer to defense systems and is already used in large quantities in the F-22 and soon the F-35, for example. However, fiber is principally used to communicate digital rather than RF signals (think Ethernet and the cable industry), and RF signals create significant challenges that have been overcome only within the last decade or so. Adding RF to the mix has also been a long time in coming because of factors ranging from the high cost of the optical components to middling RF performance, and the typically glacial pace at which DOD adopts new technologies. "The feeling is typically that coax may be bulky and big, but it works," says Joshua Korson, who heads up Microwave Photonic Systems' business development. The company was founded in 1995 by former DOD engineers to pursue RF-over-fiber applications and today does 60 percent of its business in the defense sector.

A combination of factors is accelerating uptake of RFoG by DOD, and together these factors are making the use of RF-over-fiber rapid and widespread. For example:

- In the air: Lighter, smaller, power-critical platforms such as UAVs make increased SWaP performance essential and even incremental reductions in size and weight are extremely desirable.
- At sea: Shipboard electrical and electronic systems cover virtually every frequency in the electromagnetic spectrum from DC well into the millimeter-wave region, making EMI an enormous problem. As a dielectric medium, fiber is impervious to interference. In addition, simply replacing coax with fiber throughout a ship can save meaningful amounts of weight, while replacing heavier RF and microwave components such as switches with fiber-based devices as well. For example, a typical shipboard radar system uses roughly 750 ft. of coaxial cable that weighs 14,000 lb. The same radar employing RFoG would reduce the cable weight to 40 lb., which reduces the weight of the ship above the water line.
- On the ground: Distributed networks of EW, satcom, and other sensors can be remotely operated from the host electronics and the massive amounts of information they capture can be sent over many miles without repeaters with immunity from interference and interception.

There are also more esoteric factors, such as reduced maintenance cost, materials based on ubiquitous silica rather than increasingly-depleted copper, and the ability to transmit more data at higher data rates using a single, thin fiber using fewer repeaters. Fiber is also largely impervious to environmental conditions such as corrosion.

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PEERING THROUGH THE RFOG

At a very basic level, an RFoG system accepts an RF signal source in an optical detector and the RF signal is converted to one in the lightwave region of the spectrum using one of several type optical modulators, transmits it using a laser diode through the fiber, and performs the reverse at the receiving end. Fiber provides the same benefits in RFoG applications as it does in every lightwave application whether military or commercial. For example, consider a ground-based EW system that incorporates transmitters and receivers as well as an array of antennas mounted on a hill or some other advantageous (but highly visible) location. The enormous amount of information captured by this system must be delivered to a command center by either wired or wireless means at either its original frequencies or after downconversion to a lower frequency.

If the distribution system is based on coaxial cable it will incur huge losses, making the use of amplifiers necessary at points over its length. It will also produce an electromagnetic signature that can be received and located by enemy forces, and once found it can be intercepted either over the air or at its source. Large rolls of coaxial cable are also very heavy and must be carried to the site or air-dropped in place rather than carried by soldiers in the field.

In contrast, an RFoG distribution system can be laid over long distances, which provides significant protection for personnel, who may be miles from the visually and electromagnetically visible RF and microwave transmit and receive site. Fiber's immense bandwidth allows signals from all points to be delivered either at their original frequencies or at lower-microwave frequencies after downconversion. The distribution network is also largely undetectable as signals travel through the fiber, optical switches and other components at lightwave frequencies in a dielectric rather than electrical medium. Short distribution networks up to perhaps 500 ft. are man-portable and can be set up quickly as well. Disturbances along the network are instantly recognizable as either reduced signal strength or complete signal loss, which, while destroying the link (at least in this particular path in the network), eliminates the possibility of interception.

THE END OF THE COAXIAL CABLE?

With all of these advantages, it might seem that fiber could easily replace coaxial cable in most of applications that it has so venerably served, but this is not likely any time soon. Fiber's greatest strengths for RF applications are realized over distances greater than those found in an equipment enclosure, especially in terms of spurious-free dynamic range (SFDR) and noise figure. Fiber comes into its own when the application must be remotely operated and transfer large amounts of information from one or more points to a central location. Its overall form factor is smaller, cable routing is simplified because the cable itself is lighter, thinner and easier to work with, issues of crosstalk, EMI, EMP and signal isolation are eliminated, and personnel can be located miles from the RF and microwave equipment. "Red and black" signals can be easily isolated within the system as well.

As a result, some specific applications in which fiber is desirable become obvious. EW systems, air traffic management, mobile communications and satellite communications terminals can be networked with much higher levels of security for both people and data. A command center can be networked to an almost unlimited number of antenna sites as can communications within the center itself. Test ranges, which typically employ multiple antennas spaced at relatively long distances can be networked with a single fiber to a central site, and air traffic management systems can gain a level of security as well.

Other applications of coaxial cable such as connecting RF and microwave modules within enclosures and transmission of RF power are beyond the reach of fiber, and these applications make up a significant portion of the interconnection content within EW and most other RF and microwave defense systems. Coaxial cable will probably never compete with fiber where fiber's advantages are most pronounced, but the reverse is true as well.

As for RFoG, the next big leap will be the Photonic Integrated Circuit (PIC), which should reduce the size of optical systems, deliver higher performance than is achievable using discrete components and potentially integrate electronic circuits that further increase functional integration. "The challenge here is form factor," says Korson. "Everyone wants to reduce size. However, current technology is mature and no longer just magic as it was 10 years ago. Today, complete system solutions are available."

So in the foreseeable future, the development of coaxial cable and RFoG will no doubt continue along separate paths but each will contribute to coming generations of EW and other defense systems, each in its own unique way.

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EW Against Modern Radars – Part 8

Side-Lobe Cancellation and Blanking

Side-lobe jamming is an important EW function because a single jammer, for example an EA-6B's ALQ-99 pod, can jam a number of radars. This month, we discuss two electronic protect (EP) techniques to reduce the J/S produced by a side-lobe jammer. One works against CW side-lobe jamming and the other against pulsed side-lobe jamming.

Side-Lobe Cancellation

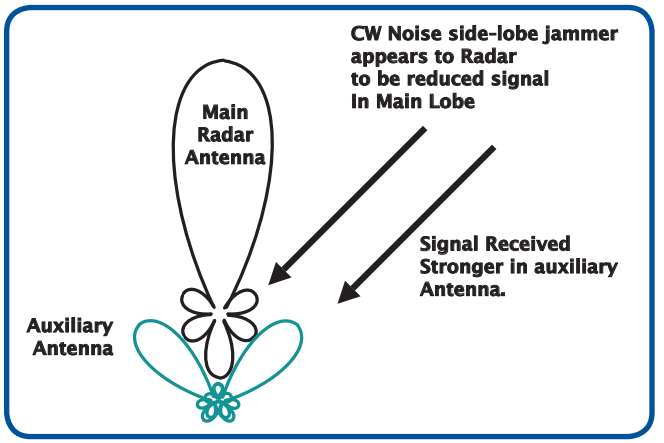

Figure 1: A coherent side-lobe canceller removes CW signals, which are stronger in the side lobes than in the main beam of the radar antenna.

As shown in **Figure 1**, the side-lobe canceller (SLC) requires an auxiliary antenna, which receives signals from the direction of the main radar antenna's important side lobes. These are the side lobes close to the main beam. The auxiliary antenna has greater gain in the side-lobe direction than the side lobes of the main antenna beam. Thus, the radar can determine that the signal arrives from the side-lobe direction and can discriminate against it.

This technique is also called "Coherent Side-Lobe Cancellation" (CSLC) because the (jamming) signal is reduced in the input to the radar's receiver by coherently canceling it. As shown in **Figure 2**, the jamming signal from the auxiliary antenna is used to generate a copy, which is shifted by 180 electrical degrees. The process of making a phase shifted copy of a signal requires some sort of a phase-locked-loop circuit, and in order to have high quality phase control (i.e., very close to 180

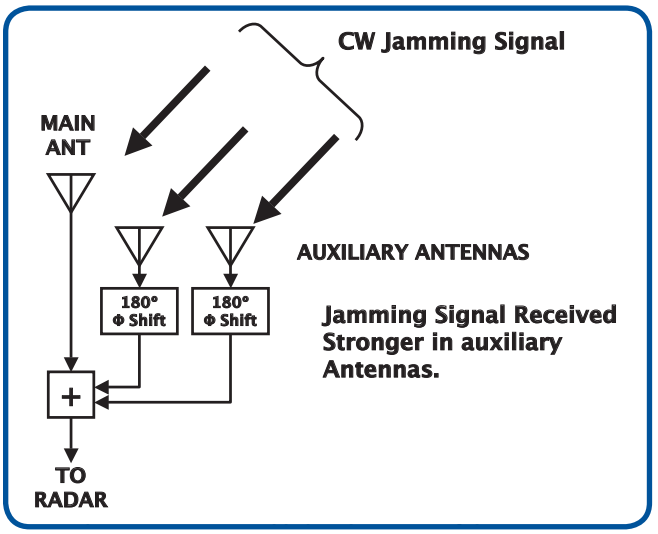

Figure 2: Inputs from auxiliary antennas are added to the output of the main antenna 180 degrees out of phase.

degrees) this must have a narrow-loop bandwidth. Note that a wide-loop bandwidth allows fast response, but a high quality lock requires a narrow loop – hence a slower response. The narrow loop requires a continuous signal, for example a noise-modulated CW signal, such as used in a standoff noise jammer. It is important to understand that the closer the phase shifted signal is to exactly 180 degrees out of phase with the jamming signal, the greater the reduction of the jamming signal into the radar receiver will be.

Each jamming signal that is cancelled requires a separate antenna and phase-shift circuit. Because there are two auxiliary antennas in **Figure 2**, this radar would be able to cancel two CW side-lobe jammers.

It is interesting to note that the Fourier transform of a pulse signal (i.e., the pulse signal viewed in the frequency domain) has a large number of distinct spectral lines, as shown in **Figure 3**. The top part of the figure shows a pulse signal in the time domain (as it would be viewed on an oscilloscope) and the bottom part of the figure shows the same signal in the frequency domain (as it would be viewed on a spectrum analyzer). Note that the main lobe of the frequency response is 1/PW wide, where PW is the pulse width in the time domain. Also note that the spectral lines are separated by the pulse-

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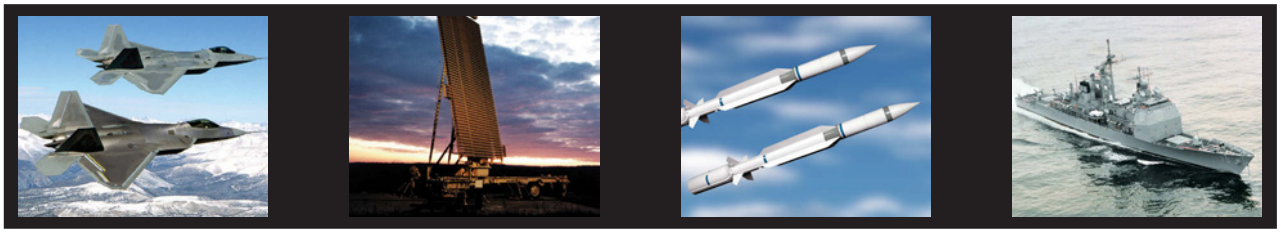

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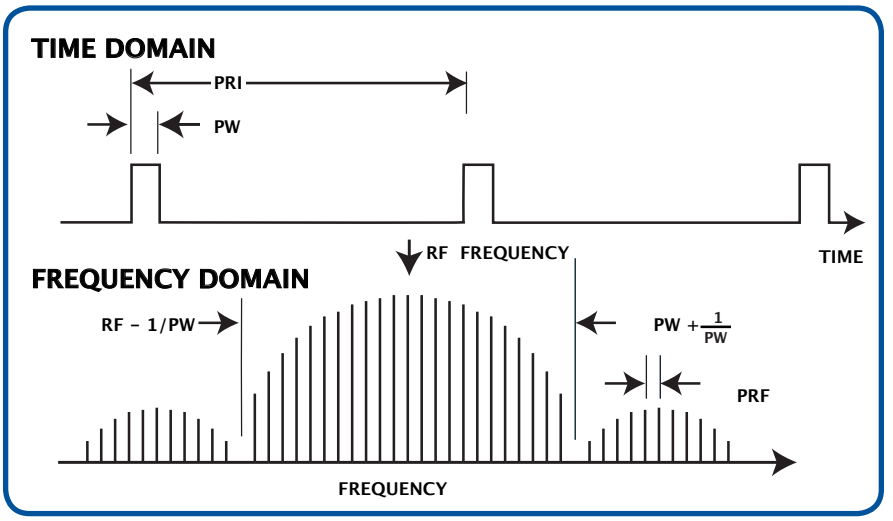

Figure 3: A pulse signal has many spectral lines when viewed in the frequency domain.

repetition frequency (PRF). PRF = 1/PRI, where PRI is the pulse-repetition interval in the time response. Thus a single pulse signal broadcast into the side lobes of a radar protected by a side-lobe canceller can capture several coherent side-lobe cancellation circuits, making the CSLC ineffective against noise jamming. That is why it is sometimes appropriate to add pulsed signals to side-lobe jamming noise.

Side-Lobe Blanking

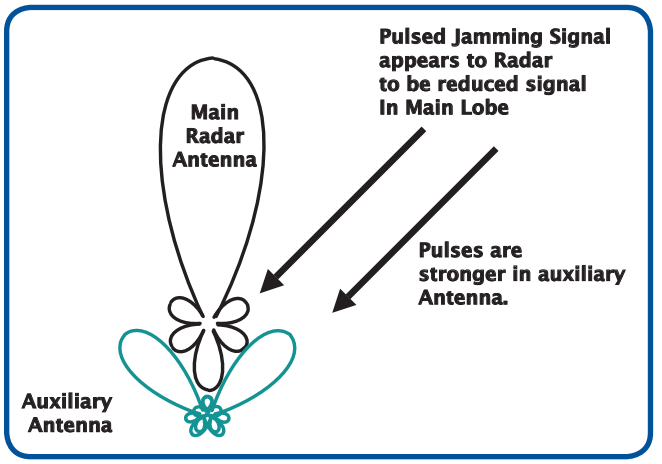

Figure 4: A side-lobe blanker removes pulsed signals that are stronger in the side lobes than they are in the main beam.

The side-lobe blanker (SLB) is similar to the side-lobe canceller in that it uses an auxiliary antenna that covers the angular area of major side lobes as shown in **Figure 4**. The difference is that it is intended to diminish the effect of side-lobe pulse jamming. If a pulsed signal is received in the auxiliary antenna at a higher level than it is received by the main radar antenna, the radar knows it is a side-lobe jamming signal, rather than a skin return from the radar's transmitted signal. The radar then blanks the input to its receiver during the jamming pulse with the circuit shown in **Figure 5**.

This type of EP is also useful in any type of pulse-signal receiver. For example some control links and some types of identification friend or foe (IFF) systems receive pulses. These systems can be jammed with false pulses – which would be removed by the SLB.

The problem that this technique gives the radar is that it cannot receive its own return signal during the time that any pulse is present in its side lobes. Thus a jammer can disable the radar (or data link or IFF) by use of cover pulses – which blank the radar just when it needs to be looking for a return pulse. Because a side-lobe jammer (e.g., a stand-off jammer) is not at the target, it does not know the timing of enemy pulses to microsecond accuracy. Therefore, it cannot place pulses directly over enemy skin-return pulses. This will require that side-lobe cover pulses be long enough to include this time uncertainty

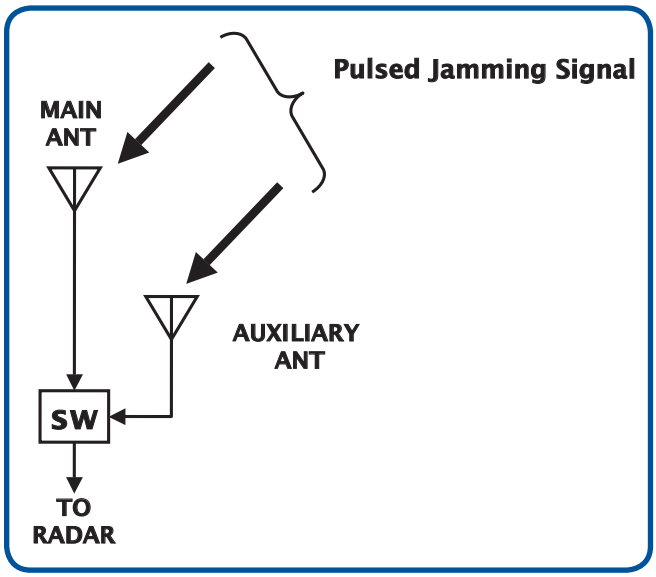

Figure 5: The output of the main radar antenna is blanked during a pulse that is stronger in the auxiliary antenna.

What's Next

Next month, we will continue our discussion with Monopulse Radar and Anti-Crosspol EP. For your comments and suggestions, Dave Adamy can be reached at dave@lynxpub.com.

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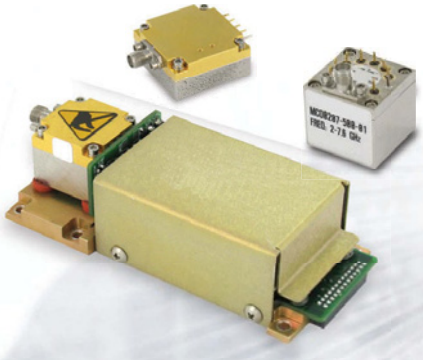
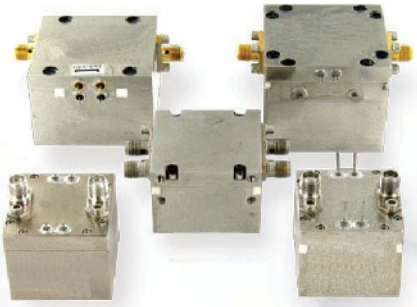
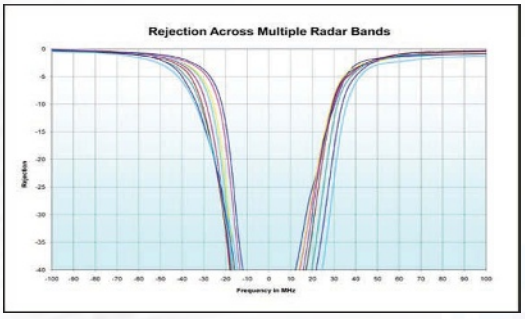
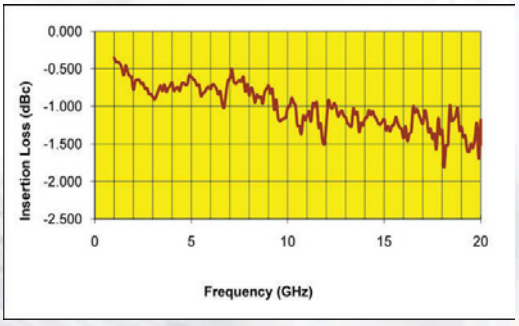


Filters

- Band reject filters for EW and ECM use
- Band pass filters for pre-selectors
- Fast tune driver circuitry







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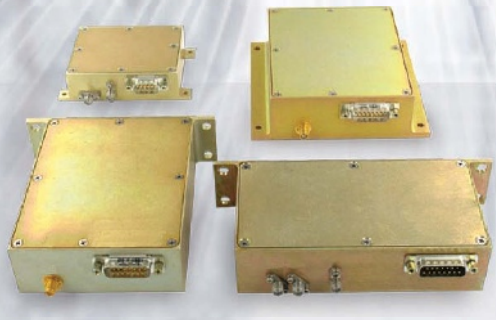

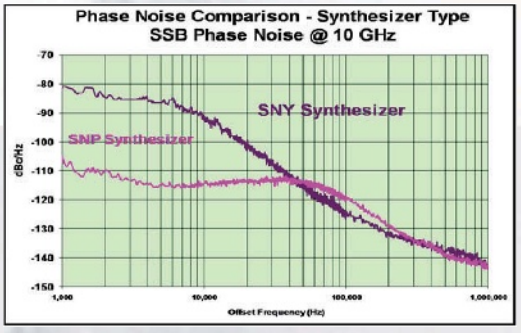

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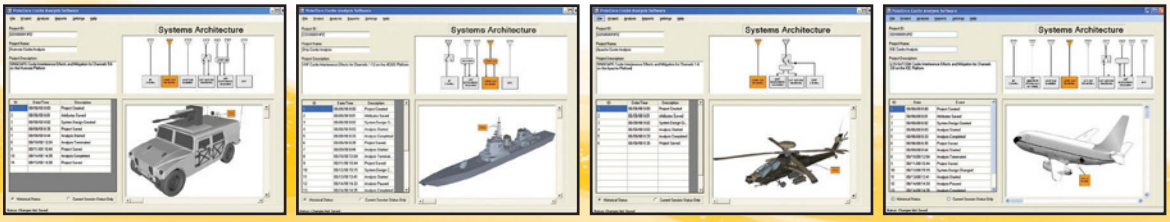

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2010 AOC Election Guide

President
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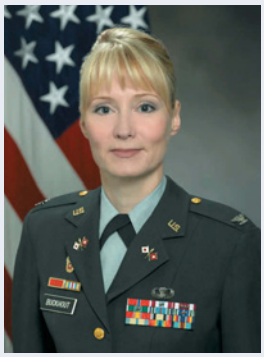

COL Laurie G. Moe Buckhout, USA

COL Laurie G. Moe Buckhout, US Army, has led the US Army's EW Division in the Pentagon for the past four years. She was commissioned in 1984 after graduating from James Madison University and has served literally from the foxhole to the White House, completing several tours in Germany, in tactical units from Division to Corps echelons, from a platoon leader in Stuttgart to Ops officer in the 3rd Infantry Division. After years of engineering tactical communications networks for the warfighter, she was selected to serve with the White House Communications Agency as a Presidential communications officer before attending the Command and General Staff College at Fort Leavenworth, KS.

Colonel Buckhout eventually returned to Germany to command the 32d Signal Battalion, deploying more than 600 of her unit's soldiers to Iraq from 2003 to 2004. There, Colonel Buckhout commanded an 800-soldier task force spread throughout Iraq. While in command, she was cited for extraordinary bravery, logging thousands of miles in her vehicle throughout the ground war and the year following as she supported Generals Petraeus and Wallace during their attacks into Baghdad and northern Iraq.

Following command, Colonel Buckhout was assigned to the Joint Staff, J6, working current ops, spectrum and cyber issues. In 2006, after leading spectrum and EW integration efforts in the newly created Joint IED Defeat Organization, she was selected by the Vice Chief of Staff of the Army to lead the stand-up of the Army's electronic warfare capability. Over the last four years, she has been a determined advocate for the EW community at large, focusing on defining and building 21st century EW concepts.

Colonel Buckhout holds a master's degree in information systems management and in military arts and sciences. Her awards include the Bronze Star, Defense Meritorious Service Medal (twice), the Army MSM (four times), the Joint Commendation Medal and multiple service and Joint medals.

Colonel Buckhout is a respected and energetic leader within the EW community. She has been a proud advocate for EW and the AOC and she has regularly addressed senior military and government leaders at service, joint, and international forums. From these experiences, she has developed a strategic understanding of the expanding role that EW and the AOC will play in the future. This summer, she will be retiring from the Army and taking a position in the EW industry. She recognizes the importance of building stronger bonds between our industry partners and key defense leaders, creating opportunities to allow frank discussion of service requirements.

Colonel Buckhout represents the newest generation of the joint warfighter – well-schooled in the current and future fights and the encompassing capabilities of EW, IO and Cyber. If elected as your next AOC President, she will use her experience and insight to help the AOC continue its outstanding support of our soldiers, warfighters and national leaders.

CAPT Kenneth "Kilo" Parks, (USN Ret.)

CAPT Kenneth "Kilo" Parks, (USN Ret.) has been actively engaged in the electronic warfare and information operations communities for more than 33 years and is well qualified for the position of President. He is a recognized leader both in and out of uniform. He attended the University of Mississippi, where he earned a bachelor's degree in public administration in 1976 and received his master's degree from the Naval War College in 1999.

After graduating, he was commissioned as an Ensign in the US Navy and reported for flight school training, earning his

Wings of Gold in 1977. He is a retired naval officer with more than 26 years of military operational experience. He has served in the EW/IO arena at the highest levels of leadership.

Ken has led three EW/IO military commands: Commanding the Fleet Information Warfare Center, Electronic Attack Squadron 129 (VAQ 129) and Electronic Attack Squadron 139 (VAQ 139). Additionally, he has worked numerous EW/IO issues at the OPNAV, SYSCOM and TYCOM levels.

Ken is a recognized leader in EW and Integrated Air Defense Systems (IADS). As an instructor at the Naval Strike Warfare Center (NSWC), he was the Red Force Commander for Carrier Airwing training. He also occupied a Red Force position at the Nellis AFB, NV, complex during the same period.

His awards include the David R. Dillon Inspirational Leadership Award, EA-6B Instructor of the Year for the Fleet Replacement Squadron (VAQ 129), Tailhooker of the Year and Top Hook (Top Recruiter) for the Tailhook Association.

Ken has worked at various levels within local roosts, from roost member in the Prowler Roost to chairman of committees to Tidewater Chapter president. His accomplishments included increasing membership in the Tidewater Chapter into re-engaging various EW/IO commands locally and on the national scene.

At the national level, he has served as an AOC National At-Large Board Director and currently serves as the treasurer of the AOC nationally.

As president, he will continue to focus on the financial stability of the AOC, increase the AOC's ability to enhance membership status at the local level and expand the visibility of the AOC worldwide. Additionally, he is working to broaden the membership base of IO and specifically EW within the various services. Recognition of those whose efforts deserve special attention also is his goal. If elected, he will work to increase and broaden membership in the AOC, much like he has achieved at the local level and in other associations.

Ken currently is a business development manager in industry specializing in EW and C4I issues and programs. He has worked or led numerous programs, including Counter Improvised Explosive Device (CIED), FORCEnet Requirements and Assessments, Joint Force Maritime Component Commander (JFMCC) and Concept of Operations (CONOPS) for numerous EW and IO systems.

William R. Clemons

William "Buck" Clemons was re-elected to his second term as a member of the Board of Directors in 2008. He wishes to continue his service to the Association through these exciting times as President. As the AOC adapts to a changing EW environment, he has both championed and supported the necessary adaptations to stop the fall in membership and has worked with the entire team to turn around the Association.

He has actively participated in Capitol Hill Awareness Day for the last four years and led the revitalization of the Redstone Rebel Roost. He has served on many committees and actively participated in all Board activities. He chaired the Nominations and Election Committee in 2007, successfully recruiting the essential number of candidates. Currently, he is the chairman of the Membership Committee and working on 16 initiatives to improve member and chapter support provided by the National Headquarters.

This study will affect every chapter and touch every member in a positive way. This assignment has shown him the importance of the International Chapters and imparted on him the special considerations needed by an internationally relevant association. It has also taught him to recognize the volunteer nature of the Chapter and National Boards. As President, he hopes to advance the development of the certification/education program and the Information Operations Institute. He will also work with the Services and OSD to plot the proper course of EW as a warfighting domain.

Buck is the founder and president of Clausewitz Technology, a service-disabled veteran-owned small business. There he works as a consultant doing business development for companies in the Huntsville/Redstone Arsenal community. He has helped them develop and market missile warning systems, hostile fire indication systems and chaff/flare dispenser systems, and has completed several requirements analyses for EW systems. Most recently, he has won work with the Aviation/Missile Research, Development, and Engineering Center to iterate DOD architecture framework documents derived from OSD's Future Vertical Lift Initiative Concept of Operations, which includes the US Army Aircraft Survivability Initial Capabilities Document. He is actively involved in the local chapter and community events.

Prior to this, Buck served 20 years in the US Army as an AH-64 Attack Helicopter Pilot and a Tactical Operations (TACOPS) Officer. As such, he was the Commander's subject matter expert on EW. He attended the US Army Electronic Warfare Officer Course in 1998, and was tracked into TACOPS after he attended the Air Force's Joint Air Operations Command and Control Course in mid-2000. After that he served tours as a TACOPS Officer in Korea and Fort Stewart, GA, where he retired. He currently lives in Huntsville, AL, with his wife Hea-Suk, and their three children.

The hard jobs throughout his career and his Board service during tumultuous times has prepared him for the leadership position which he seeks. As President of our Association he will lead by example, preserve the fraternal nature of our organization, and move out on advanced initiatives that will continue to make the AOC relevant to the Pentagon, Congress, industry and the warfighter.

At Large Directors
Vote for three

Lt Gen Robert J. Elder, Jr., USAF, (Ret.)

Lt Gen Robert Elder (USAF, Ret.) joined the Old Crows in 1982 as an Air Force engineer working electronic counter-countermeasures for the F-15, when military leaders across the globe clearly recognized the importance of EW. Today, our leaders see value in spectrum control, cyber connectivity and information ops but don't understand that EW is the foundation for these critical elements of modern military operations. AOC is uniquely positioned to advocate the critical role for EW, including the need for experienced people and modern systems, to educate others about its relationships to (and differences from) cyber and information operations and to help industry provide for the military's EW needs. As an AOC Director, General Elder will promote expansion of these valuable elements of the AOC mission.

Anthony Lisuzzo

As Director of the US Army Intelligence and Information Warfare Directorate (I2WD), Fort Monmouth, NJ, since 2000, Tony Lisuzzo has worked to create a state-of-the-art S&T organization with a world-class reputation for the rapid fielding of ISR and EW solutions for the Global War on Terror.

The AOC has always been an integral part of the Ft Monmouth area and he has been a member since 1984. Tony has served the Garden Gate Chapter as secretary, treasurer, vice president and president; along with running the Northeast conference and participating in numerous technology panels during symposiums. He was honored to be the 2009 AOC National Gold Medal recipient.

The increased convergence and ubiquity of cyber capabilities represents a significant change in the way our national forces address their operational environment. The next-generation systems are beginning to emerge, forming a global, hybrid and adaptive network that seamlessly merges commercial/military wired, wireless, optical, satellite communications (SATCOM) and other systems into one network. The Department Of Defense's ability to leverage cyber and electromagnetic capabilities will be increasingly critical to its future operational success. More than ever, this EW/Cyber challenge is a combined responsibility. Specifically working with other countries and teaming together is a must for success. Tony wants to assist AOC and the community to identify areas for combined operations so the strengths of all are maximized. The future leaders in this area will require mentorship. Tony has the experience and communication skills to help AOC meet that challenge of inspiring and focusing the future leaders of EW and Cyber.

Sam Neal

Sam Neal is director, Electronic Combat Support Facility, Robins AFB, GA. The organization is a field operating agency of Air Force Special Operations Command, providing electronic warfare mission data reprogramming and EW engineering for combat and airlift aircraft in Special Operations Command, Air Mobility Command, Air National Guard and Air Force Reserve.

He is a retired electronic warfare officer with prior experience as a special operations test director on various aircraft and was an instructor and the director of operations at the 453rd Flying Training Squadron, Mather AFB, CA, where he trained EW officers and developed the Electronic Combat Coordinator Course. He was the command EWO for Air Training Command, commander of AFSOC's reprogramming unit, and deputy director, Special Operations Liaison Element at the Combined Air Operations Center for Operation Enduring Freedom. His flight experience includes combat missions on the AC-130 Gunship and Instructor Navigator time on the T-43. In his 30-plus years of EW experience, he has participated in the writing of AF EW Doctrine, AF and AFSOC EW roadmaps, the EW Operations Shortfall Study, numerous EW handbooks and was a member of several AF EW steering groups.

He served as the AOC Southern Region Director and on the Dixie Crow Board of Directors. He has been the guest speaker for several chapters and has worked various positions on the Dixie Crow Symposium Committee. Sam received the AOC's Life Achievement Award in 2008 and the Management Award in 1999.

David Hime

Dave Hime brings his career's breadth of EW S&T experiences and perspectives of more than 36 years to the AOC. Coming up through the EW ranks of the old Avionics Laboratory (now the AFRL Sensors Directorate), Dave is currently the Senior Division Technical Advisor, providing leadership guidance for the Directorate's broad-spectrum, proactive EW/IO program across USAF, tri-service and international

forums. Dave holds senior EW S&T appointments, including US National Representative to The Technical Cooperation Panel, AF Principal to the Technology Panel for EW, and AF Principal to the recent DDR&E EW Technology Task Force.

Mr. Hime is a life-member of the AOC since 1979. He's been active in many Kittyhawk Chapter efforts, including scholarship, elections and awards, running its "Kittyhawk Week" regional symposium for several years, election to its Board of Directors in 2000 and Chapter President from 2001-2005. Dave was honored in 2003 with the AOC's Executive Management Award and in 2007 with the AOC's Lifetime Achievement Award. He currently is in his fourth year on the National Board of Directors and many will recognize his dedicated contributions as the AOC's Convention Chairman for tremendously successful 2007, 2008 and 2009 symposiums in Orlando, Reno and Washington, DC.

Dave is known and respected as a leader and team player in AF, service and international circles on technology issues requiring collaboration, cooperation and commitment. His fundamental tenets of communication and teamwork will help the AOC navigate through the new paradigm of EMS warfare and the future relevance, direction, growth and reinvigoration of EW/IO.

Wayne Shaw

Wayne Shaw knows there are three requirements to be successful on any board: be an expert, be passionate about the cause and be able to work well with others.

Expertise: Wayne was a qualified EWO in the B-52, B-1B, EF-111, and an EA-6B ECMO. He was a department head of a Navy fleet squadron and then an instructor at the Navy's EA-6B Weapons School. On the Air Staff, he was the programmer for most USAF EW programs. As chief of CENTCOM's EW shop in the Middle East for a year, he supervised members from all US military services as well as coalition partners and worked operational EW and RF spectrum issues from all domains for the wars in Iraq and Afghanistan. At the Joint EW Center, he worked on the "EW Functional Solutions Analysis" before retiring from the Air Force in May 2009. Now at Booz Allen Hamilton, working in the JEWC for JFCOM on the IO Range, he is injecting more EW into IOR events.

Passion: Wayne has grass roots experience in AOC as President of the Robert Lynn Chapter in the late 1980s when it won "Chapter of the Year." He was also President of the Red River Chapter in the early 1990s. He has received multiple awards for contributions to EW to include being the USAF recipient of the AOC Joint EW award in 2009, and he was voted by his fellow chapter BoD members as the 2009 Billy Mitchell Chapter "Director of the Year." He has contributed articles to *JED* in 2007 and 2008.

Working with others: see the above.

William C. DeBoe, Jr.

William "Chuck" DeBoe has 28 years with the EW community. He graduated from the US Air Force Electronic Warfare School and has more than 2,800 hours of flight time as an electronic warfare officer in the RC-135V/W, MC-130E, and MC-130H.

He participated in Operation Eldorado Canyon and was the senior EW officer supporting Air Force Special Operations Command during Operation Just Cause. Chuck deployed as the senior electronic warfare officer for the 1st Special Operations Wing during Operations Desert Shield and Desert Storm. He also supported the Naval Special Warfare Task Group during Operation Desert Storm. He served twice as the Special Operations Liaison Element commander in support of Operation Southern Watch and was later selected as the Deputy Commanding Officer for a Joint Special Operations Task Force during Operation Enduring Freedom.

Along with numerous military awards, Chuck is the recipient of the Association of Old Crows Gold Certificate of Merit for his efforts to improve the training capabilities of the 8th Special Operations Squadron.

Since retiring from active duty with the US Air Force in 2003, Chuck has spent the past six years with ITT Electronic Systems, serving as manager, business development. He supports the company's efforts with Robins AFB and the Air Force Special Operations Command.

Chuck serves on the Dixie Crow Chapter Board of Directors as the Dixie Crow Symposium 35 Chairman. Chuck's efforts at the national level will be focused on growing the organization.

Richard Morgan

Richard "Rick" Morgan has been a Crow since 1979, when he joined VAQ-33 in Key West, FL. Between then and his 1994 retirement from the Navy he flew 2,300 hours as an electronic countermeasures officer in EA-6B, EA-4F and ERA-3B type aircraft. Rick flew 41 combat missions with VAQ-141 during Operation Desert Storm and has 447 carrier arrested landings as well.

Between 1994 and 2004, he worked as a direct support contractor conducting EW-related research for the Air Force Studies and Analysis Agency and Joint Chiefs of Staff (JCS) in Washington, DC. He is currently the head of business development for the Boeing EA-18G Growler program in St. Louis, MO.

Rick has a BA in Political Science and an MBA from the University of Missouri system. He is an author with more than 50 articles published on EW, aviation and railroad history, as well as two books on naval aviation. Rick currently resides in

O'Fallon, MO, with his wife of 29 years, Julie. They have two children, Katy, a meteorologist with WMBF-TV in Myrtle Beach, SC and Scott, a corporal with the Marines in North Carolina.

Bennett Hart

Bennett Hart works across all of QinetiQ North America (QNA) business groups to enhance the company's end-to-end technology solutions to the Department of Defense and intelligence agencies. He joined QNA in 2007, and has more than 40 years of defense and intelligence experience with 17-plus years in the United States Senior Executive Service.

He retired from government service, where he served in the Joint IED Defeat Organization (JIEDDO) as Acting Director of Intelligence and special advisor to the Director of the Counter IED Operations Integration Center (COIC). He served as the NRO deputy director and chief engineer of the Advanced Systems and Technology Directorate, responsible for development and operational testing of new capabilities and as the NRO Chief Architect. While serving at the Defense Intelligence Agency, he was the associate deputy director responsible for classified Operations/Science and Technology assigned to the Technical Collection and MASINT Directorate.

Mr. Hart is a graduate of the National Security Agency's Cryptologic Career Course, the Defense System Management College's Program Management Course, the Federal Executive Institute and both the Senior Managers in Government and Senior Executives in National and International Security Programs at Harvard University. He received his bachelor's degree and a reserve commission from the University of Illinois as a distinguished military graduate. He commanded at the company, battalion and brigade levels in the US Army Reserves. He was a scoutmaster and served as a vice president of the National Capital Area Council. He is an Eagle Scout and a holder of the Silver Beaver.

Douglas Lamb

Douglas "Chopper" Lamb is a 28-year Air Force veteran. Since his retirement in 1997 "Chopper" has become a senior manager for General Dynamics Advanced Information Systems and remains actively involved in EW-related work. During his Air Force career, while logging more than 3,000 hours in fighters, he was actively involved in EW requirements definition, development, and testing of fighter EW capabilities.

Chopper's EW experience includes engineering and flight testing in the 422nd Fighter Weapons Squadron at Nellis AFB, NV, where he was the F-15 Tactical Electronic Warfare System (TEWS) flight test manager. While in HQ USAF in both Requirements and Special Programs Divisions, Chopper was actively involved in funding approval for new EW capabilities and managed test range programs for key facilities used for development and operational testing.

Before retiring from the Defense Intelligence Agency, he was responsible for developing the IC's country-specific Integrated Air Defense System (IADS) studies, was DIA's validation official threat documents supporting EW systems acquisition and testing, and managed the DOD's Foreign Materiel Acquisition/Exploitation activities.

Chopper is an active member of the National Capitol Chapter, holding numerous positions the last 12 years including President. He led his BoD team in winning the AOC Outstanding Large Chapter for 2008-2009. Chopper is seeking an At-Large National Board of Director position to continue evolving the Chapter Support Program. He plans to focus on stimulating membership participation and interest by offering lessons learned during his Chapter's two-year quest to win the Outstanding Chapter Award.

Steven Kochman

A native of South Windsor, Connecticut, CAPT Steve Kochman (USN Ret.) is a 1983 graduate of the Worcester Polytechnic Institute with a bachelor's degree in chemical engineering. Captain Kochman served three sea tours in EA-6B squadrons. His shore tours include the Naval Postgraduate School/Test Pilot School (NPS/TPS) Cooperative program, Commander Electronic Attack Wing, US Pacific Fleet, Requirements Officer and the Naval War College, Newport, RI. Captain Kochman earned master's degrees in aeronautical engineering, foreign policy and strategic studies. He took command of the VAQ-140 Patriots during Operation Enduring Freedom in April 2002, while deployed in USS John F. Kennedy (CV 67).

In August 2003, Captain Kochman reported to Naval Aviation Systems Command to serve as PMA-234 Advanced Systems and Jammer Management IPT Lead. In October 2005, Captain Kochman reported to PMA-265 to serve as deputy program manager for EA-18G. Captain Kochman served as EA-6B and Airborne Electronic Attack Systems (PMA-234) Program Manager from November 2006 through November 2009. Captain Kochman retired from active duty in March 2010.

Captain Kochman has logged more than 2,900 flight hours in over 30 different aircraft. His decorations include the Legion of Merit, Bronze Star, Meritorious Service Medal, Air Medal (strike flight), Navy Commendation Medal, Navy Achievement Medal and various unit awards.

Dennis Fandrei

Dennis Fandrei has been a Crow for more than 25 years, and is still involved in every aspect of EW today.

His entire Navy career was devoted to EW, from his first squadron in the EA-3B; an EW Instructor; to more than seven cruises in the EA-6B; command of EW Training at the Naval Air Systems Command (PMA-212); command of an EW squadron (VAQ-33); and finally, command of Navy EW acquisition (PMA-253) at NAVAIRSYSCOM.

Dennis has been active in the Association of Old Crows Capitol Club for more than 15 years, has received numerous awards, the latest of which was the "Distinguished Service Award" presented in December 2009.

He has been in the Washington, DC, area since 1988, and has been involved in many community and professional associations, all of which were EW and IO related.

His goal is to be elected to the National Board, thereby utilizing his experience in both the US Navy and industry to support the goals and initiatives of the National AOC, as well as the chapters.

International Region I

Vote for one

Johannes Naumann, Dipl.-Ing.,

LtCol Johannes Naumann (German Air Force Ret.) is from Bonn and joined the German Forces in 1972. He earned a master's degree in electronics and communications from University of the German Armed Forces, Munich and served as an EW officer in the EW/SIGINT-Branch at C&E Command, helping to improve and design the EW suites of fighter aircraft.

He joined the AOC in 1978. During his early career, he designed the Electronic Warfare Operations Support Center (GEWOSC) in TRIER and the EW module for the Flight and Tactics Simulator for the Tornado.

In 1984 Johannes served as director of SIGINT Operations in Bavaria, and then in 1986 he became commander of GEWOSC in TRIER. From 1989 to 1995 he was stationed at GAFCOM, Cologne, where he managed EW requirements, development oversight, operational testing and HARM integration support. Next, he moved to Washington, DC, where he served as head of the Air Force Section, German Armed Forces Command US/CA, in Reston, VA.

He was the first non-US board member of the AOC Capitol Club. As such, he fought for better AOC services for international members. He established the Capitol Club's Multinational Forum (MNF) and was its first chairman. He received the AOC's Special Electronic Warfare Service in the International Arena Award.

Upon returning to Germany, he was named Section Leader for Electronic Systems, Airborne at the Armed Forces Intelligence Office, Gelsdorf. In 2002 he gained responsibility of the Capability Analysis Section for ISR and EW Systems (joint) at the Federal Armed Forces Office in Bonn. Today, Johannes is a Director of the Red Baron Roost, Bonn, Germany.

Dr Robert S. Andrews

Dr. Robert S. Andrews has been involved in EW for more than 30 years, with extensive experience in ESM and ECM systems, DRFM technologies and EW threat simulator systems. He received his B.Sc (Eng) from the University of Manitoba, Canada, on the Dean's Honor List.

After completing his PhD in Underwater Spread Spectrum Data Communications at Imperial College London as an Athlone Fellow, he had a short post-doctoral career as a lecturer in microwave transmission line theory. He joined Decca EW Division (later Racal), Hersham, UK in 1977 as a principal systems engineer involved in ESM and ECM system design, and in 1981 he moved to Anaren Microwave Ltd as Technical Director specializing in ESM receivers, ESM signal processing, DRFM technologies and later in EW simulation techniques and systems. He was promoted to Managing Director in 1986 and in 1996, he made a director buy-out of this business from Anaren Inc. and formed EW Simulation Technology Ltd (EWST), where he is currently the commercial director.

Dr. Andrews has authored more than 20 technical papers in learned journals and has presented at EW conferences around the world since 1978.

He is the past chairman of the SME Working Group in the UK EW Tower of Excellence and was the president of the AOC UK Chapter from 2004-2009. He has been on the board of the UK Chapter since 1999 and is currently in the role of past president. He is a Fellow of the Institute of Engineering and Technology (IET) in the UK and is a Chartered Engineer (CEng).

International Region II
Vote for one

Gerry Whitford

Gerry is the future programs manager for the BAE Systems Australia Joint Business Unit, a strategic business development position with a specific focus on future defense programs across the Information & C4ISREW domains. He moved into this role in November 2009, transitioning from his former role as the general manager, electronic warfare (EW); a position he has held since 2005.

As general manager EW, Gerry was responsible for a range of complex defense EW programs, from advanced R&T activities through to large capability acquisition and through life support programs. He also oversaw the integration of the BAE Systems Australia and Tenix EW capabilities following the merger of the two organizations in July 2008, creating a dedicated EW business with more than 200 professional engineering staff engaged in a wide spectrum of EW development activity, including sophisticated signal intercept and identification systems, microwave jamming systems and advanced laser systems.

Gerry graduated from the South Australian Institute of Technology with an electronics engineering (Hons) degree in 1978. After advancing his career internationally with Marconi Avionics (UK) and locally with Hawker De Havilland and Philips Electronic Systems, Gerry joined BAE Systems (then Thorn EMI) in 1983, being lured by the prospect of working in the company's newly formed EW group, the first Australian company to establish a business focused specifically on EW. Gerry has remained with the EW group since its early inception, holding several engineering and program management positions, both within Australia and overseas, leading to his appointment as general manager, EW in 2005.

2010 On-line Voting Instructions

Beginning July 1, you can visit the AOC homepage, **www.crows.org**, where you will see election information and a link to electionsonline.us, the independent vendor that will conduct the on-line election. Once into the electionsonline.us website, type in your AOC member number and password.

The website will direct you to your ballot, where you can make your selections. If you have not registered on the AOC website, you need to use your membership number and "crows" as the password. Your membership number can be found on the mailing label of your copy of *JED*, your membership card or you may call AOC headquarters for assistance. Your dues must be current as of May 15 to vote. If your membership has lapsed, you may call the AOC to have your access to the election activated once your dues are paid. As with past AOC elections, your ballot is secret. No one at the AOC (members, directors or headquarters staff) will be able to access completed ballots during or after the elections. Electionsonline.us will hold all completed ballots, tabulate them and send the results to the AOC when the election is complete. Once you have cast your on-line vote, electionsonline.us will send you an e-mail confirming that they have received your completed ballot. Providing your e-mail address is not essential for voting, but it is necessary in order to receive e-mail confirmation that your vote was processed.

PAPER BALLOTS

For those AOC members who do not want to vote on-line, the AOC will provide paper ballots and election guides upon request. Members who prefer to vote via paper ballot may request to do so by submitting a Ballot Request Form no later than June 25, 2010. The AOC will then send out paper ballots to those members July 1. As the election authenticator, electionsonline.us will open your ballot and enter your votes into the computer. To avoid any chance of a member being able to vote more than one time, you may not vote on-line after you have requested and have been sent a paper ballot.

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