OCTOBER 2010
Vol. 33, No. 10

The AOC Electronic Warfare Publication
www.crows.org

JED

The Journal of Electronic Defense

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Also in this issue:

EW in the Naval Domain

ELINT Receivers Tackle Dense Signal Environments

A Structural View of EM Spectrum Warfare

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The modular architecture permits tailoring of the capabilities or performance of the system to meet the specifics of the application or mission. Individual module performance can also be scaled/tailored to satisfy any customer. Critical functionality incorporated includes emitter filtering through the separation of multiple emitter signals, and adaptive technique generation to respond to emitter changes, while providing specific responses to a specific emitter signal.

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- Multi-threat signal sorting & routing to assigned RF Converter / μDRFMs
- Characterization / logging support:
  - Post analysis /Verification / Validation

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- Expandable to varying performance and BW

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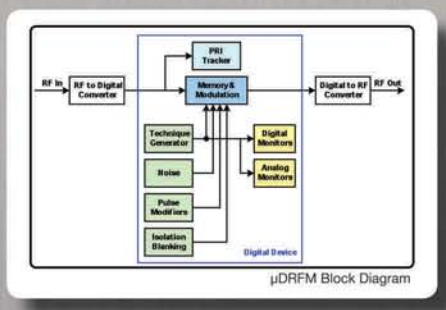
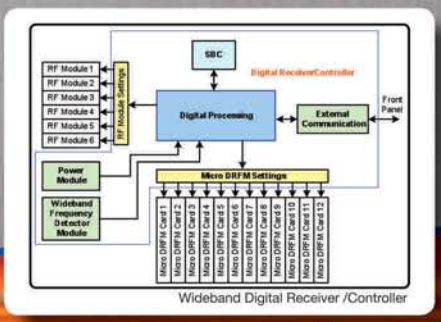


μDRFM Block Diagram



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News

Features

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Departments

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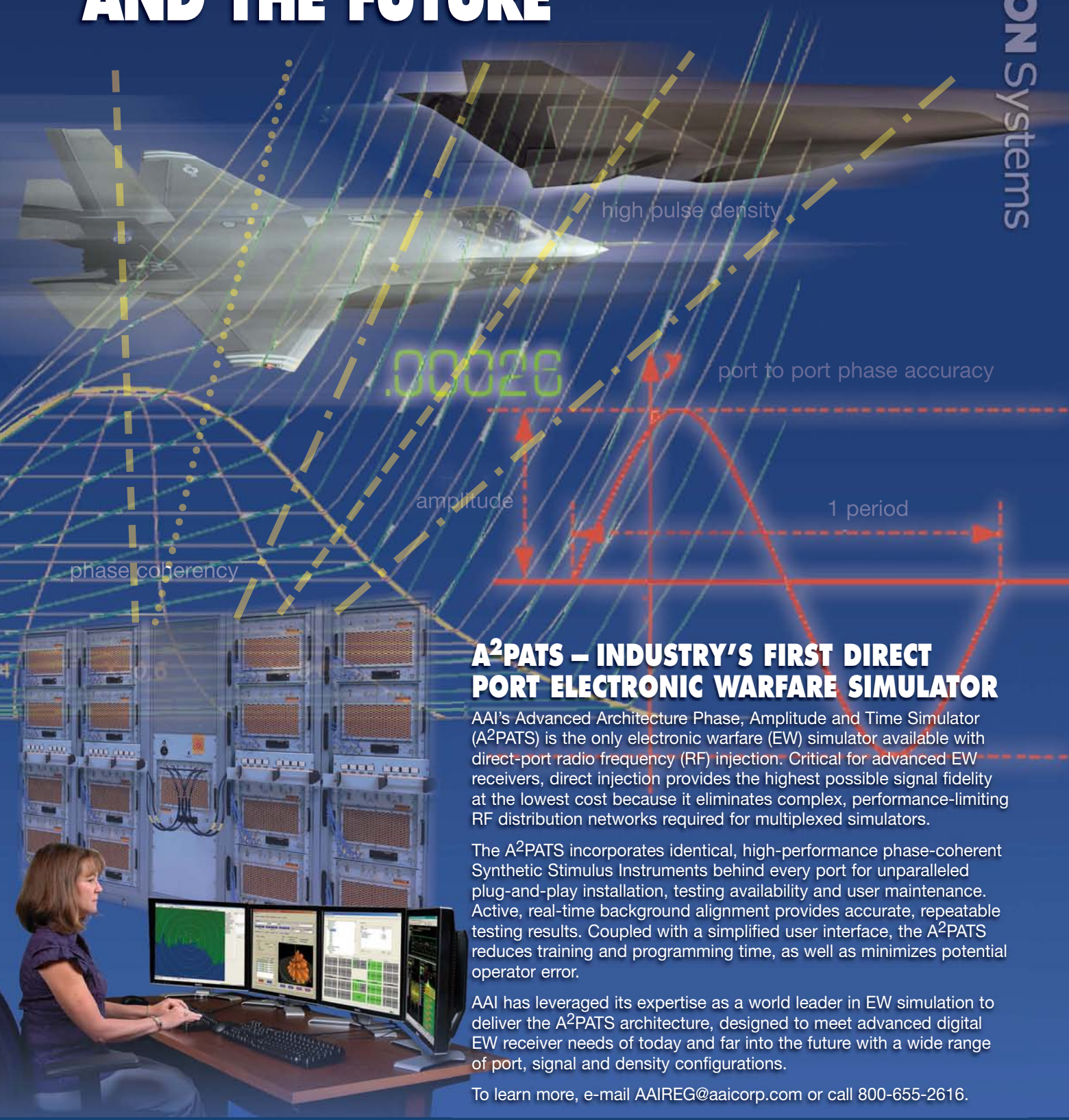

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the view from here

FORGING EW POLICY

We in the Electronic Warfare (EW) Community don't often think in terms of "EW policy" or "EM Spectrum Policy." There are many contributing reasons why this is so, but the main reason is that our community simply has never felt that it needed to develop or articulate policy. We've often thought of ourselves in humble terms – as the folks who jam radars, missiles and radios. Any policy discussions have always appeared too esoteric to serve our practical needs. Or perhaps the members of our community believe that EW is sufficiently articulated and guided by doctrine and operational requirements. After all, EW thinking has always seemed to "evolve" because threat technology moves forward and the warfighter needs EW to counter it. These two facts seem to "take care of" EW.

We can no longer expect to move EW forward by operating under these assumptions.

Ironically, the EW community has been participating in an ongoing policy debate for the past five years, although most of us (me included) probably haven't recognized it as a policy debate. Three major trends have contributed to this *de facto* policy discussion. First, the wars in Afghanistan and Iraq have dramatically changed how the warfighter perceives operational EW and Electromagnetic Spectrum Control. Because of this, EW has (re-)assumed strategic importance for the Combatant Commander. Second, Information Operations (IO) is undergoing major changes, as is the weakening relationship between IO and EW. Third, Cyber organizations are being stood up throughout the DOD. Because of Cyber warfare's dependence on access to the electromagnetic spectrum, some in the Cyber community are mistakenly trying to re-organize EW under Cyber. Most of the EW community, having developed a new vision of the EM Spectrum's strategic role in today's operations, wants no part of this trend.

It is truly amazing that the EW community is successfully transforming itself and at the same time navigating through these difficult issues without any sort of formal policy to guide it. (For me, it conjures an image of a blindfolded man trying to cross a busy highway.) At best, small groups of EW leaders are tackling important policy issues by communicating directly with senior defense leaders. This success has depended on leadership, personal chemistry and good fortune. The stars, however, will not always be so favorably aligned.

EW is becoming too big and too important to manage on an *ad hoc* basis. It was never a good way to manage EW in the first place, but now it simply won't do. When senior leaders need to shape defense strategy in the EMS, they have very little to reach for in terms of understanding how or why EW or Electromagnetic Spectrum Control fit into overarching defense concepts.

Our community needs to take our thinking up a level and articulate EW and EMS policy. If we do not, then someone else (IO, Cyber, etc.) will.

– John Knowles

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October 3-6
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www.crows.org

Influence and Propaganda Conference
October 13-15
Verona, NY
www.crows.org

AUSA Annual Meeting & Exposition
October 25-27
Washington, DC
www.ausa.org

Euronaval 2010
October 25-29
Paris, France
www.euronaval.fr

Airlift/Tanker Association (ATA) Convention
October 28-31
Orlando, FL
www.atalink.org

MILCOM 2010
October 31-November 3
San Jose, CA
www.milcom.org

NOVEMBER

Spectrum Modeling and Simulation Conference
November 2-4
Las Vegas, NV
www.crows.org

Aircraft Survivability Symposium 2010
November 2-5
Monterey, CA
www.ndia.org

Maritime and Systems Technology (MAST) 2011
November 9-11
Rome, Italy
www.mastconfex.com

Aircraft Survivability Equipment Symposium
November 15-17
Nashville, TN
www.quad-a.org

13th Annual Directed Energy Symposium
November 15-19
Bethesda, MD
www.deps.org

I/ITSEC
November 29-December 2
Orlando, FL
www.iitsec.org

Information Operations & Cyber Capabilities in 21st Century Warfare
November 30-December 2
Charleston, SC
www.crows.org

Exponaval 2010
November 30-December 2
Valparaiso, Chile
www.exponaval.cl

DECEMBER

Electronic Warfare Symposium
December 1-2
Swindon, Wiltshire, UK
Clearance: Secret Four Eyes
www.cranfield.ac.uk

International Defence Exhibition and Seminar (IDEAS) 2010
December 6-10
Karachi, Pakistan
www.ideaspakistan.gov.pk

FEBRUARY

Aero India 2011
February 9-13
Bangalore, India
www.aeroindia.in

Low Probability of Intercept Conference
February 15-17
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Atlanta, GA
www.crows.org

Principles of Radar Electronic Protection
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Cyber Warfare – The Weaponry and Strategies of Digital Conflict
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November 16-19
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IR Countermeasures
November 30-December 3
Atlanta, GA
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DECEMBER

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Operational EW Planning Course
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NEW HORIZONS

When I began my Presidency last October, I made a "call to arms" to the Old Crows asking the membership to get engaged throughout your communities to advocate and educate your peers on the importance of Electronic Warfare (EW) and Information Operations (IO). As a result of your actions, the actions of your elected Board of Directors, and the hard work of the AOC Headquarters Staff, I am pleased to tell you that your Association is steadily growing in numbers and in its impact to the national security community.

In the 31 years I have been associated with EW, I can't think of a more exciting time for Electronic Warfare professionals than the one we are in right now. Having traveled throughout the United States and internationally this year, I can tell you that there is a global awareness of the importance of our profession and that awareness is driving doctrinal, materiel and organizational changes that promise new horizons for EW and IO. The expanding criticality of the Electromagnetic Spectrum (EMS) as a global commons in the 21st Century will assure the health of our profession for many decades to come because the expertise and experience resident in our Old Crows will actively be sought after.

As I look back on my year as AOC President, I can say it has been one of great experiences; specifically, meeting and speaking with Old Crows from around the world. I want to thank you for your support and wish you the best, as I hand the baton to Walter Wolf. Our association couldn't be in more capable, experienced hands. Non Videbunt.

– Chris "Bulldog" Glaze

As I begin my AOC presidency this October, my first order of business is to thank Chris for his insightful leadership and to the Board of Directors and AOC staff for their sound stewardship of the AOC over the past year, a year in which the AOC's contribution to global security continued to show increasing relevance. Chris's "call to arms" accelerated a sense of urgency as the global realization became apparent on how important the EMS is and how dependent we are on it.

In 2011, I will continue the "sense of urgency" specifically in three key areas in a way that yields measurable successes in 2011. First, sustain the pace of increasing emphasis on the global perspective of the EMS by engaging the international community, initially in Europe. Second, enhance the AOC Education Foundation's support to the AOC's mission to advocate and educate by creating a sustaining foundation. This foundation will be supported by pillars of EW/IO training, AOC legacy initiatives and a national level scholarship/grant program. Third, revitalize the Senior Advisory Board with a specific 2011 task to perform a deep strategic review of probable EMS challenges in the 2015-plus time frame and how the AOC should posture itself to be a global leader to meet those challenges.

In closing, clearly New Horizons are among us. The profound significance of the global nature of the EMS and the potential for interference demand an AOC that advocates and educates internationally. The AOC will continue to take leadership positions on many key issues dealing with the EMS and I challenge each of you to answer the "call to arms", to be informed, be engaged and be active.

– Walter Wolf

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Raytheon is a leading innovator and supplier of combat-proven electronic warfare systems and technologies — and we bring all of our expertise to bear on the Next Generation Jammer. Raytheon's solution allows the EA-18G platform to seamlessly leverage advanced EW capabilities, even in the most challenging environments. The Raytheon Next Generation Jammer efficiently generates significant power, enabling vast advantages for today's warfighter. Raytheon's experience integrating advanced solutions for the Navy and Marines will yield the most reliable, dependable and affordable way to deny, degrade and disrupt threats while protecting U.S. and coalition forces.

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JED *welcomes and publishes letters to the editor when we're lucky enough to receive them. Please send letters to John Knowles, jknowles@naylor.com or to JEDeditor@naylor.com.*

Special Mission Aircraft Have a Long History

I read with keen interest your article on "SIGINT for Special Mission Aircraft," July 2010.

I worked at Sanders Associates in the early to mid 1980s and we were using Beechcraft B100s and B200s as covert emitter location (EL) platforms – far before any of the programs you mentioned. We only did a few (three I believe) aircraft while I was there, and I believe it was transitioning to an RC-12 program for the military for EL.

The program was primarily code-named "Snowball." I just wanted to provide some information to show we were at the forefront of deploying these aircraft for special missions prior to dates many people think this was taking place.

Thomas L. Ardolf

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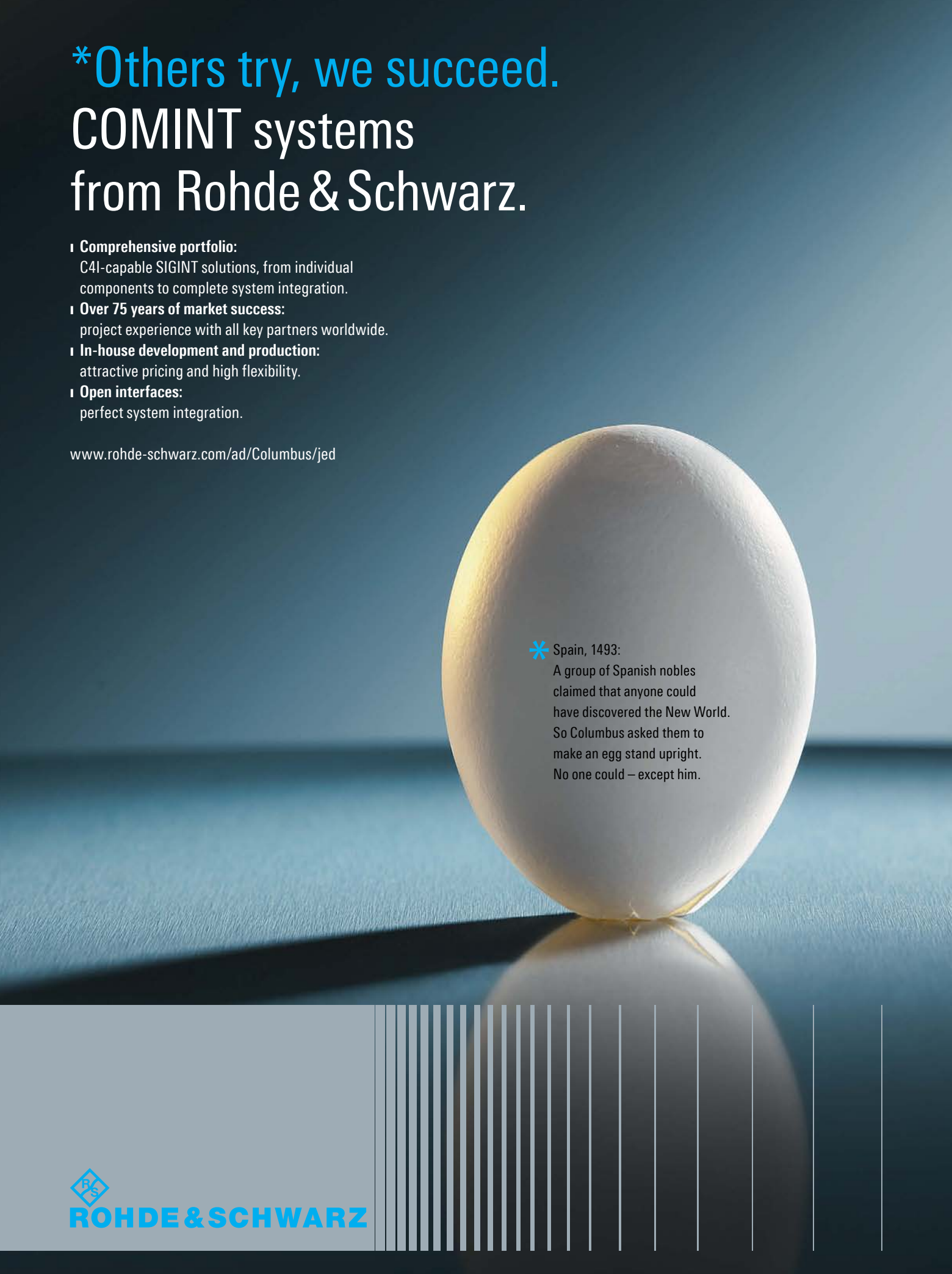

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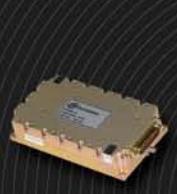
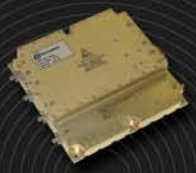


RF Amplifiers



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CIRCM RFP ANTICIPATED

As this issue was going to press, industry teams were waiting for the US Army to release a final request for proposals (RFP) for the 21-month Technology Demonstration phase of the Common Infrared Countermeasures (CIRCM or "ker-kum') program. CIRCM is intended to be a relatively inexpensive, laser-based directed IRCM system that can defeat current and future IR-guided missiles and is light enough to allow installation on Army and Navy/Marine Corps light-to-medium-weight helicopters, particularly AH-64 Apaches, UH-60 Black Hawks, SH-60 Seahawks and AH-1W Super Cobras. The Army plans to award two cost-plus-fixed-fee contracts for the Technology Demonstration phase. Industry teams expected to bid on CIRCM include BAE Systems, Raytheon Missile Systems, ITT Electronic Systems with Lockheed Martin Aculight, and Northrop Grumman with Selex Galileo.

Each contractor will be required to deliver 12 CIRCM B-kits (line-replaceable units and weapons-replaceable assemblies) within 10 months of contract award. The contractors will also deliver an A-kit (platform installation kit including wiring and antennas) for a UH-60 helicopter. Weight is a critical factor in the program. The Army wants each CIRCM B-kit to weigh no more than 85 lbs and each A-kit to weigh no more than 35-70 lbs (depending on the aircraft type).

On 23 September, the Army issued a curious amendment to the CIRCM Draft RFP that stated, "Due to administrative reasons, the Draft RFP due date of September 10 [for industry inputs] has been changed to December 15. However, the actual due date for proposal submissions will be provided in the Final RFP. This solicitation remains in draft form and no proposals are requested at this time." It remained unclear if this meant that the Final RFP would not be released until at least December 15. A *JED* query to the Army's Program Executive Office for Intelligence, Electronic Warfare and Sensors had not been answered by press time. The program point of contact is Ms. Eddie Whitfield, (256) 955-6299, e-mail eddie.whitfield@us.army.mil. The solicitation number is W58RGZ-10-R-0129 and can be accessed at www.fbo.gov. – *G. Goodman and J. Knowles*

USAF ISR TURBOPROPS FULLY FIELDED

The US Air Force accepted its 37th and final Project Liberty MC-12W intelligence, surveillance and reconnaissance (ISR) aircraft on Aug. 31 from L-3 Mission Integration (Greenville, TX). The unarmed, fixed-wing MC-12W is a modified version of the popular small King Air twin-engine turboprop business aircraft built by Hawker Beechcraft and subsequently fitted by L-3 with two onboard ISR sensors, two sensor operator/analyst workstations and communications equipment. The two sensors are a communications-intelligence (COMINT) payload and a down-looking, rotating ball turret with electro-optical and infrared full-motion video cameras.

Defense Secretary Robert Gates, impressed by the Army's successful use of limited numbers of the low-cost King Air turboprops in Iraq in 2006-2007 under Quick-Reaction Capability (QRC) programs, pressed the Air Force to launch a similar effort on an accelerated basis to provide additional overhead intelligence support for US troops on the ground in Iraq and Afghanistan. As a result, last year the Air Force began fielding the first of the Liberty aircraft in that overseas theater.

To expedite fielding, the first seven MC-12Ws to be modified were pre-owned King Air 350s; the remaining 30 were new (extended-range, heavier payload) King Air 350ERs. L-3 modified and delivered the entire fleet of 37 MC-12Ws in less than 24 months after its initial

contract award in September 2008. The Air Force says the aircraft, whose crew of four includes a pilot, co-pilot/mission commander, sensor operator and COMINT specialist, have logged a mission-ready rate exceeding 93 percent. The twin-engine King Air 350ER can stay aloft for 6-8 hours with 5-7 hours of mission on-station time. The Air Force Liberty and Army King Airs have gained praise for the responsive real-time ISR support they have provided US ground combat units engaged in irregular warfare.

The Army has specified the King Air 350ER turboprop as the platform for its planned Enhanced Medium-Altitude Reconnaissance and Surveillance System (EMARSS). Like the Air Force Liberty aircraft, EMARSS will carry a COMINT payload and an E-O/IR ball turret. Competing industry teams submitted their bids for the accelerated EMARSS program in June. The Army plans to award a single 42-month engineering and manufacturing development and low-rate initial production contract very soon. – *G. Goodman*

DARPA TO DEVELOP EP RADIOS

The Defense Advanced Research Projects Agency's (DARPA) Strategic Technology Office solicited industry proposals on September 10 under a Broad Agency Announcement (BAA) relating to the performance of "Communications Under Extreme RF Spectrum Conditions (CommEx)." The CommEX program, the BAA states, is interested in "those technologies and techniques that address communications in severe jamming and in the presence of a wide variety of adaptive jamming and interference sources. CommEx's technical objective is to develop innovative adaptive technologies that make best use of all available domains for adaptive interference suppression." The trend toward increasing spectrum congestion and jamming in the battlespace has driven operational forces to take a fresh look at the electronic protect (EP) capabilities of its radios, as well as radar, GPS and other defense electronics systems.

The BAA encompasses a technology development phase that will establish relevant technologies appropriate for the constraints and typical missions of various platforms.

The CommEX program's overall objective is to enable radio communication networks to operate under extremely severe and complex interference, anticipating traditional interference and communications threats, high-power threats, as well as novel interference resulting from new adaptive threats. The CommEx program "will assess next-generation and beyond jamming threats and then develop advanced interference suppression and avoidance technologies to successfully communicate in the presence of severe, traditional and novel types of interference that are orders of magnitude more severe than what are currently addressed by the most advanced systems," according to the BAA.

DARPA held a CommEX Proposers' Day Conference on September 20. The solicitation number is DARPA-BAA-10-74. Administrative, technical or contractual questions should be sent via e-mail to DARPA-BAA-10-74@darpa.mil. – *JED Staff*

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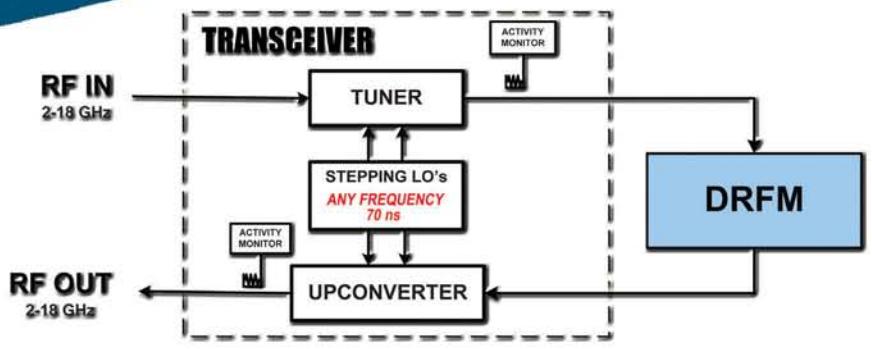

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DARPA TO EXPLORE NEW IC ARCHITECTURES

DARPA's Microsystems Technology Office has released a Broad Agency Announcement (BAA) asking industry to design extremely efficient, monolithic, signal-recognition integrated circuits (ICs) for next-generation military microsystems in areas such as cognitive communications, radar and electronic warfare. The program is called Cognitive radio Low-energy signal Analysis Sensor ICs (CLASIC) and aims to develop new kinds of RF, analog and mixed-signal integrated circuit architectures and design techniques for cognitive radio (i.e., smart communications that are able to sense RF propagation conditions and the needs of users, and adapt their transmit and receive parameters to achieve the best possible quality of service).

The waveform processing requirements of emerging military cognitive radio systems are pushing A/D converter and digital signal processor (DSP) capability, as well as algorithm complexity, beyond the state of the art of today's integrated circuit technology, DARPA explained in the BAA. To fill the gap, the CLASIC program seeks to design new kinds of communications ICs with the capability and energy efficiency to act as a cognitive radio signal sensor on a chip.

The primary aims of the program "include developing energy-efficient analog and/or mixed-signal processing techniques for separating and analyzing mixtures of complex signals. These techniques may require blind-source separation using RF adaptive recursive and transversal filters; analog implementations of fast Fourier and wavelet transforms; and efficient implementations of signal feature extraction and classification algorithms in analog/neuromorphic processing blocks."

Signal parameters of interest for the CLASIC program include modulation schemes, signal constellations, multiple access or hopping schemes, channel use and demodulated symbols.

DARPA seeks technologies that will lead to revolutionary decreases in energy consumption necessary to separate and analyze arbitrary mixtures of signals. Technical areas of interest include low-energy blind signal separation and parameter extraction; and integration with RF front-end.

Proposals are due by December 10. Multiple awards are anticipated. The solicitation number is DARPA-BAA-10-77. Administrative, technical or contractual questions should be sent via e-mail to DARPA-BAA-10-77@darpa.mil. – *JED Staff*

ADVANCED COMINT TECHNIQUES SOUGHT

The US Air Force Research Lab (AFRL) in Rome, NY, issued a Broad Agency Announcement (BAA) on September 21 entitled "Advanced COMINT Collection Techniques & Enablers." The BAA solicited white papers for scientific studies and experiments to increase the laboratory's understanding of the broad range of capabilities required to support advanced COMINT collection techniques. "The overall technical objective of the BAA," it said, "is to develop research into unique and innovative techniques and algorithms that support the identification, collection, processing, exploitation and/or manipulation of electronic communication signals in a moderate to dense co-channel environment." More specifically, AFRL said it is interested in techniques and algorithms for: the detection, identification, characterization and geolocation of emerging communication signals of interest; advancing digital signal processing software methodologies in support of new and existing systems; and integrating these capabilities into information operations and collection systems.

"Due to the proliferation of wireless devices worldwide, there are significant numbers of signals of interest across the spectrum," the BAA noted.

"The ability for identification and collection in dense signal environments, low power signals, low signal to interferer noise ratio (SINR), and power control, etc., is highly desired. Any technologies that will enable SIGINT systems and/or platforms with an improved ability to automatically detect, identify, sort, track, prioritize and reliably classify, and more importantly, geo-locate signals of interest would apply. Specific emitter identification techniques are desired. Technology that can further enable SIGINT platforms to geo-locate threat RF emitters using any method is a critical focus area of research covered by this BAA."

Companies responding to the BAA are required to submit three copies of a 3-to-5 page white paper summarizing their proposed approach/solution. White papers aiming for FY11 funding should be submitted by January 30, 2011; FY12 by January 30, 2012; and FY13 by 30 Jan 2013. Those white papers found to be consistent with the intent of the BAA may be invited to submit a technical and cost proposal. Total funding for the BAA is approximately $24.9 million: $7.7 million in FY11, $8.6 million in FY12 and $8.6 million in FY13. Individual awards are expected to range between $250,000 and $1.5 million per year.

The solicitation number is BAA-11-02-RIKA. The contracting office focal point is Lynn White at 315-330-4996, e-mail Lynn.White@rl.af.mil, and the technical point of contact is Douglas Smith at 315-330-3474, e-mail Douglas.Smith@rl.af.mil. – *JED Staff*

USAF SOLICITS JOINT THREAT EMITTER INTEREST

The US Air Force's Ogden Air Logistics Center (Hill AFB, UT), has issued a request for information (RFI) on 24 September to identify potential industry sources that may meet US Air Force requirements for production of Joint Threat Emitters. The

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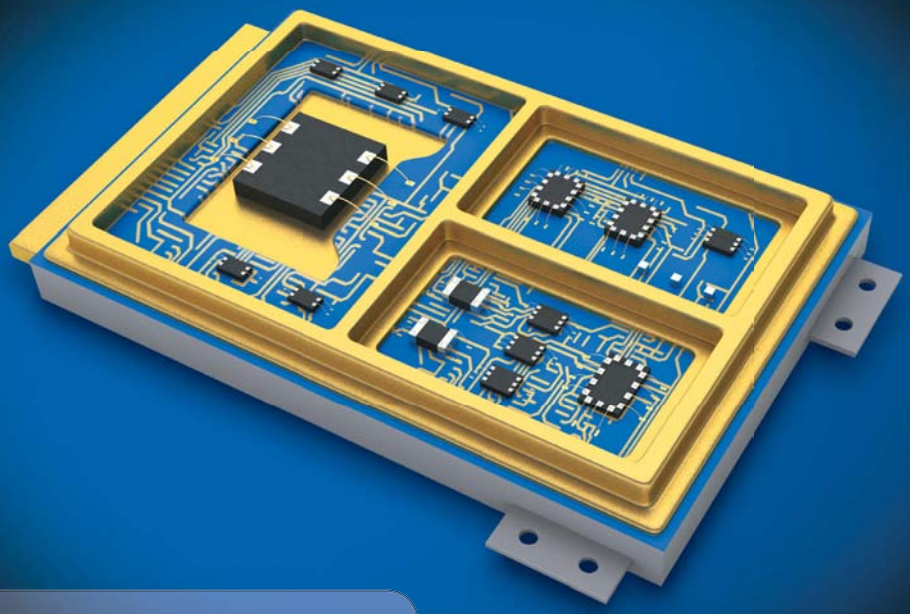

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With marching orders like these driving the war-fighting technologies of tomorrow, today's primes must be more responsive and flexible than ever before.

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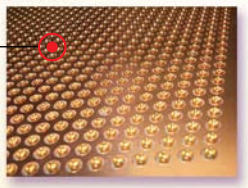

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The Range Threat System Program Office (RTSPO) at Hill AFB intends to generate a purchase request leading to a firm-fixed-price contract award to build, integrate and produce JTE Block 0 Kit 1 units under a five-year indefinite delivery-indefinite quantity contract. Northrop Grumman Amherst Systems (Buffalo, NY) is the incumbent supplier.

The Air Force plans to buy 7-15 Threat Emitter Units (receiver-transmitters groups); up to two Tactical Computer Console units (also known as fixed command and control units or C2Us); up to three Receiver-Transmitter Control Groups (also known as mobile C2Us); and 7-15 infrared cameras. Site surveys are to be accomplished to characterize and document existing range infrastructure required for JTE operation for up to 10 training ranges that will host these JTE production units. The threat training environment must match as closely as possible actual combat conditions in the type, density, deployment and employment of anticipated threats.

The solicitation number is FA8217-10-R-JTE001. The point of contact is Jason Grove at e-mail jason.grove@hill.af.mil), fax 801-586-3366. – *JED Staff*

FIRST US NAVY BAMS UAV BEING BUILT

Northrop Grumman began fabricating the US Navy's first MQ-4 Broad Area Maritime Surveillance (BAMS) unmanned aerial vehicle (UAV) on September 1 at its manufacturing facility in Moss Point, MS. BAMS is a variant of the company's large, high-altitude/long-endurance US Air Force RQ-4 Global Hawk UAV. BAMS will complement the Navy's planned new Boeing 737-based P-8A Poseidon maritime patrol aircraft, performing wide-area, persistent, maritime surveillance and forwarding real-time intelligence, surveillance and reconnaissance (ISR) data in real time. BAMS will be able to provide a continuous on-station presence while monitoring vast areas of open-ocean and littoral regions, providing a reliable picture of surface threats while minimizing the need to use manned aircraft. The combination of the BAMS UAV and the P-8A aircraft will replace the capabilities currently provided by aging P-3C Orion patrol aircraft.

The BAMS program is managed by the Navy's Persistent Maritime Unmanned Aircraft Systems Program Office (PMA-262), headed by CAPT Bob Dishman, which falls under the Program Executive Office for Unmanned Aviation and Strike Weapons (PEO U&W) at NAS Patuxent River, MD. – *JED Staff*

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Raytheon GE NORTHROP GRUMMAN BOEING

IN BRIEF

AAI Corp. (Hunt Valley, MD) has delivered its new Advanced Architecture Phase, Amplitude and Time Simulator (A2PATS) to the U.S. Naval Air Warfare Center, Weapons Division (NAWCWD) at China Lake, Calif., under a subcontract from Applied Geo Technologies, Inc. (Choctaw, MS).

✪ ✪ ✪

Sierra Nevada Corp. (Sparks, NV) has received a $49.8 million award from Naval Sea Systems Command for production of 587 dismounted Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) systems. Deliveries are scheduled to run through July 2011.

✪ ✪ ✪

Southwest Research Institute (San Antonio, TX) has received an $8.9 million contract from the US Navy's Space and Naval Warfare Systems Center Atlantic (Charleston, SC) for engineering and technical services for cryptologic systems and antennas. The base contract runs through September 2011 and will extend through 2015 is all options are exercised.

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Crane Aerospace & Electronics (Redmond, WA) has appointed Bob Tavares as vice president of its Microwave Solutions business, which includes sites in Beverly, MA; Chandler, AZ; West Caldwell, NJ; and San Jose, Costa Rica. He comes to Crane after many years at M/A-COM.

✪ ✪ ✪

Boeing has won a $3.5 million contract from the US Air Force to manufacture 19 Group A kits to support installation of the ALR-69A(V) radar warning receiver on C-130H aircraft.

✪ ✪ ✪

Integrated Business Solutions was awarded a $1.2 million contract by the US Air Force for engineering services in support of the AN/USM-464A test program set (TPS) development. The company will provide TPS block cycle testing and documentation. The USM-464 is used to test EW systems, such as the ALQ-172, ALQ-155, ALQ-111, ALQ-196 and the ALR-69.

✪ ✪ ✪

The US Navy has awarded a $66 million contract to **Alliant Techsystems** (Clearwater, FL) to procure up to 4,600 weapons replaceable assemblies, including computer processors, optical sensors and control indicators and related to the AAR-47 missile warning system. Deliveries will run through August 2013. The AAR-47s will be used on US Navy, US Air Force and Indian Air Force aircraft.

✪ ✪ ✪

OEWaves (Pasadena, CA) has received a contract from the Defense Advanced Research Projects Agency (DARPA) to develop and demonstrate a RF photonic receiver for the Agency's Electro-Magnetic Pulse (EMP) Tolerant Microwave Receiver Front End (EMPiRe) program. As part of the program, the company

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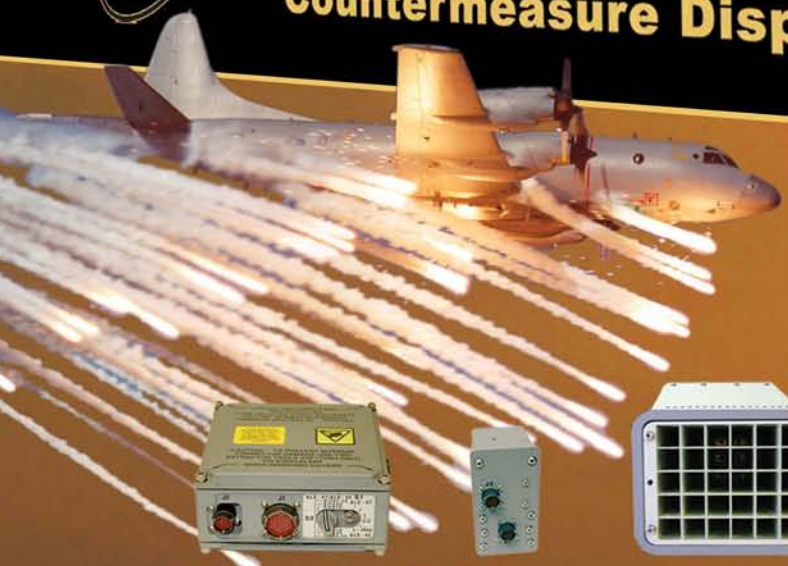

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✪ ✪ ✪

Boeing has reorganized its Military Aircraft business, consolidating from six divisions to four. The four new divisions are Global Strike, based in St. Louis, MO, to be led by Shelley Lavender; Mobility, based in Ridley Park, PA, to be led by Jean Chamberlin; Surveillance and Engagement, based in Seattle, WA, to be led by Bob Feldmann; and Missiles and Unmanned Airborne Systems, based in St. Charles, MO, to be led by Debbie Rub. The changes took effect October 1.

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The last US Air Force EC-130H Compass Call assigned to the **386th Air Expeditionary Wing** departed it's base in Southwest Asia on Aug. 29 for deployment to another US Central Command base, capping a 6.5 year tour of duty in which Compass Call crews flew some 23,300 combat hours in direct support of Operation Iraqi Freedom. The 43rd Expeditionary Electronic Combat Squadron has been part of the wing since June 24, 2004. During that time, its crews flew more than 3,300 combat sorties totaling 23,300 hours of flight time.

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NIITEK Inc., part of the Chemring Group, opened a new Engineering Center of Excellence at its Dulles, VA, headquarters last month. The company develops and manufactures countermine ground penetrating radars that are currently used in counter-IED operations in Afghanistan.

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The **Naval Surface Warfare Center** (Crane, IN) has announced plans to acquire a low cost Multi-domain EW Test and Evaluation system (METES) for testing the Navy's SLQ-32 Surface EW Improvement Program configuration. Last month, it solicited technicial information from companies in advance of a formal solicitation to be released in the coming months. The technical point of contact for this effort is Mr. Jayesh Naik, WXMN Branch, (812) 854-4962, jayesh.nail@navy.mil.

✪ ✪ ✪

Comtech and **CPI International** have terminated plans to merge, according to a statement from Comtech. In May the two companies announced plans to merge, but the deal was called off by mutual agreement.

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The first US Air Force **RQ-4 Global Hawk** unmanned aerial vehicle (UAV) to deploy to US Pacific Command on a permanent basis arrived at Andersen AFB, Guam, on September 1 following an 18-hour flight from its main operating base at Beale AFB, CA. The high-altitude long-endurance UAV also is being forward-deployed to US European Command in Sigonella, Italy, where a Global Hawk arrived on September 15. The UAVs will be based at both Sigonella and Andersen and will be operational there in early 2011.

✪ ✪ ✪


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The US Army conducted testing last month at Lakehurst, NJ, of **Northrop Grumman's** Common Signals Intelligence (SIGINT) System 1500. The CSS-1500 is a small-scale, lightweight SIGINT payload. The company said the testing validated "several key functions of the system, including instantaneous geo-location, irregular warfare signal exploitation and SIGINT battlespace situational awareness." The testing was conducted as part of a Cooperative Research and Development Agreement (CRADA) between Northrop Grumman and the Army, and was used by the service to gather data on the payload's capability to evaluate it against other SIGINT payloads.

ADDENDUM

In *JED*'s September survey on power sources for IED and communications jammers (p. 47), the article omitted L-3 Electron Devices. The following information should have been included in the survey:

L-3 Electron Devices
San Carlos, CA
+650-591-8411
www.L-3com.com/edd/mpm/

Product Name: M1201 Microwave Power Module
Applications: Communications Jammers, IED Jammers
Operating Frequency: 2-6 GHz
Technology: Conventional MPM
Power Out: 2.0 - 2.5 GHz……50 - 80 W min.
2.5 - 3.5 GHz……80 W min.
3.5 - 6.0 GHz ….80 - 65 W min.
Harmonic and Spurious levels (dBc): Harmonic-7dBc, Spurious -45dBc
Efficiency: 40%
Reliability: >12,000 hrs
Power Dissipated in Watts: 375 W
Size (HxWxL): 1.25 x 6 x 11
Weight: 8 lb (max)
Applicable Platforms: airborne, ground, shipboard, submarine
Additional Features: Include any power-up cycle required, amplifier class, special cooling requirements and breakdown voltage. Production released item, multiple packaging/power options available including active cooling heat exchanger system. Consult factory for special power or frequency requirements.

Product Name: M1225 Microwave Power Module
Applications: Communications Jammers, IED Jammers
Operating Frequency: 6-18 GHz
Technology: Conventional MPM
Power Out: 100-125 Watts
Harmonic and Spurious levels (dBc): Harmonic-4dBc, Spurious -45dBc
Efficiency: 30%
Reliability: >12,000 hrs
Power Dissipated in Watts: 475 W
Size (HxWxL): 1.4 x 7.5 x 8
Weight: <6.5 lb
Applicable Platforms: airborne, ground, shipboard, submarine
Additional Features: See Model 1201 features (above).

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SENATE APPROPRIATIONS BILL SUPPORTS EW PROGRAMS

US Senate and House leaders put off further action on the FY2011 Defense Appropriations and Authorization bills until after the November 2 mid-term elections, partly as a result of social policy differences, including amendments to repeal the Pentagon's "Don't Ask, Don't Tell" policy regarding gays in the military. At the time that *JED* went to press, this meant that the DOD's FY2011 budget wouldn't be approved in time for the October 1 start of the new fiscal year. Congress passed a continuing resolution that, in the meantime, allows the US military to continue spending at the same rate as FY2010.

The authorization bill sets policy and is normally supposed to precede passage of the appropriations bill. However, it does not provide funding, so is not as critical as the appropriations bill to keeping the US military operating.

The latest action on the defense appropriations bills had occurred on September 16, when the Senate version was approved by the full Defense Appropriations Committee and introduced on the Senate floor by Committee Chairman Sen. Daniel Inouye. The full House Appropriations Committee had not yet taken action on the House version as this issue went to press. Differences between the two versions will ultimately have to be reconciled by a House-Senate Conference Committee, and then a single defense appropriations bill will be voted on by both Houses of Congress and sent to the President to sign.

The Senate appropriations bill funds a number of electronic warfare (EW) and signals intelligence (SIGINT) procurement and research and development programs, largely without reductions. Highlights by service include the following, with full funding except where noted:

ARMY

- $211.5 million for development of the new Enhanced Medium-Altitude Reconnaissance and Surveillance System (EMARSS) aircraft.
- $71.5 million for additional Prophet wheeled vehicle-mounted COMINT systems.
- $16.1 million for Warlock IED jammer procurement, representing a decrease of $8 million.
- $25.8 million for continuing Guardrail SIGINT aircraft upgrade modifications (including a $4.1 million decrease in the area of Airborne Precision Geo-location).
- $80.4 million for MQ-1 Sky Warrior (Predator) unmanned aerial vehicle (UAV) payload procurement, a $20 million cut due to "Tactical SIGINT Payload (TSP) schedule adjustment."
- $163.7 million for aircraft survivability equipment infrared countermeasures (IRCM). This includes a cut of $10.5 million deemed "excess to requirement."
- $3 million, unrequested, for an "Advanced EW and SIGINT System."
- $4 million, unrequested, for Hostile Fire Indication technology for Army and Navy/Marine Corps helicopters.

NAVY/MARINE CORPS

- $982.9 million for procurement of 12 additional EA-18G Growler support jamming aircraft. This reflects a decrease of $45.9 million from the original Navy request resulting from multi-year F-A-18E/F and EA-18G production contract savings.
- $90.3 million for EP-3E ARIES II SIGINT aircraft modifications.
- $90.6 million for Next-Generation Jammer development, a cut of $30 million, apparently due to schedule changes resulting from the Navy's decision to stretch out the technology maturation phase of the program.
- $56.5 million for continuing Joint Counter-Radio Controlled Improvised Explosive Device EW (JCREW) 3.3 system development.
- $51.7 million for Tactical Aircraft Directional IRCM (TADIRCM) development.
- $26.7 million for SLQ-32 shipboard Electronic Support Measures/Electronic Attack systems procurement, a $23 million decrease attributed to Block 1B3 upgrades (a $6.1 million cut) and Block 2 receivers (a $16.9 million cut) being "ahead of need."
- $53.5 million for High-Speed Anti-Radiation Missile (HARM) modifications.

AIR FORCE

- $176.6 million for EC-130H Compass Call communications jamming aircraft modifications and $20.7 million for further Compass Call development.
- $39.5 million for RC-135 Rivet Joint SIGINT aircraft modifications, a $4.7 million decrease primarily the result of a "delay in the Block 45 upgrade program."
- $17.2 million for Large Aircraft IRCM (LAIRCM) operational systems development.
- $90 million for EW Development (EMD);
- $25.9 million for Airborne Electronic Attack;
- $143.3 million, a decrease of $5 million, for the Airborne SIGINT Enterprise.
- $13 million for manned destructive suppression development.
- $15.6 million for multi-platform EW equipment operational systems development.
- $199 million for development of a Next-Generation Bomber.

The Senate appropriators had one complaint aimed at DOD's stewardship of its Joint Improvised Explosive Device Defeat Organization (JIEDDO), noting, "Appropriations for activities such as the JIEDDO are being used to cover unrequested and unjustified items which either are of interest to senior leaders or make up for shortfalls in amounts requested by the services. The mission of JIEDDO is too critical for the program to serve as a blank check book for projects which might not be able to warrant funding on their own merits." – *G. Goodman*

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world report

AUSTRALIA APPROVED FOR GROWLERS

According to Australian press reports last month, the US government approved export of the US Navy's EA-18G Growler support jamming aircraft, a derivative of that service's two-seat F/A-18F Super Hornet fighter, to Australia in late August. That would mark the first US foreign military sale of the Growler. The EA-18G is in full-rate production by Boeing for the US Navy and is replacing that service's venerable 4-seat EA-6B Prowler jamming aircraft.

In February 2009, the Australian government requested that 12 F/A-18F Super Hornets – half of the country's $6 billion 24-plane order – be wired for potential EA-18G electronic attack capabilities while they were still on Boeing's St. Louis production line. This would now allow those Super Hornets to be upgraded to the US Navy's EA-18G Growler configuration in light of the reported US government export approval. – *G. Goodman*

IRAQ TO BUY F-16 FIGHTERS

The Iraqi Government has requested the sale of 18 F-16 Block 50/52 aircraft from the US via Foreign Military Sale (FMS) channels.

The proposed sale includes the Advanced Countermeasures Electronic System (ACES) from Raytheon (comprising the ALR-93 radar warning receiver from Northrop Grumman and Raytheon's ALQ-187 jammer) and the ALE-47 countermeasures dispenser from Symetrics. The package also includes APG-68(V) radars, AN/APX-113Advanced IFF systems, AIM-9L/M-8/9 Sidewinder Missiles, AIM-7M-F1/H Sparrow Missiles, AGM-65 Maverick air-to-ground missiles and Paveway II laser-guided bombs. The Iraqi Air Force is being offered two targeting system options: Lockheed Martin's AAQ-33 Sniper or Northrop Grumman's AAQ-28 Litening.

The aircraft have been given the F-16IQ designation. – *JED Staff*

CANADA TO BUY DIRCM SYSTEMS FOR HELOS

Canada has selected the AN/AAQ-24(V) Directional Infrared Countermeasures (DIRCM) System manufactured by Northrop Grumman for its CH-47F Chinook helicopters. The government plans to buy eight AAQ-24 systems, each of which will include six AAR-54 missile warning sensors, two Small Laser Transmitter Assemblies (SLTAs), processor units, control indicator units and smart cards. The estimated value of the sale is $72 million.

In late 2009, Canada ordered 15 of the Boeing-built helicopters, but it did not name the electronic warfare equipment to be installed on the aircraft. The helicopters are slated for delivery in 2013 and 2014 and are expected to be deployed in support of Afghanistan operations.

Canada also flies four Boeing/USAF C-17 Globemaster aircraft fitted with AAQ-24 DIRCM systems. – *J. Knowles*

EUROFIGHTER EW SUITE PRODUCTION

BAE Systems awarded SELEX Galileo, a Finmeccanica company, a contract worth about £400M to supply the Praetorian Defensive Aids Sub System (DASS) in support of the Tranche 3A production lot of Eurofighter Typhoon aircraft. SELEX has already delivered more than 200 Praetorian systems to date. Designed specifically for the Typhoon, the Praetorian DASS includes electronic countermeasures (ECM), electronic support measures (ESM) and missile approach warning (MAW) elements, which SELEX says provide an unmatched level of situational awareness and protection for Typhoon crews.

SELEX Galileo is Praetorian's lead contractor and system design authority. The company leads the EuroDASS consortium, which includes Elettronica, Indra Sistemas, EADS and SELEX Galileo. The EuroDASS partners share the production of more than 20 major line-replaceable items that make up the Praetorian system. The first Praetorian delivery under the new contract is scheduled in mid-2012. The systems will be supplied to all four Eurofighter Typhoon partner nations: the UK, Italy, Spain and Germany.

With SELEX Galileo's activities, Finmeccanica of Italy's share in the avionics on the Eurofighter Typhoon exceeds 60 percent. Finmeccanica's participation in the program includes development and production carried out at SELEX Galileo's sites in Luton, Edinburgh, Milan, Pomezia and Caselle. – *JED Staff*

IN BRIEF

- **Systematic Software Engineering Ltd.** (Camberley, Surrey, UK) has received a contract extension from the UK Ministry of Defence to continue providing data analysis services to the Air Warfare Center at RAF Waddington, Lincolnshire. Systematic's electronic warfare specialists provide analytical resources and product support under the contract, which was originally awarded in 1999. Systematic is a core member of one of the final two consortiums (the other being a Logica/MASS team) competing for the UK's Defence EW Center Improvement Program (DEWC IP) contract, which is expected to be awarded in December 2010.
- **PLATH GmbH** (Hamburg, Germany) has partnered with the Shephard Group to provide an additional communications intelligence (COMINT) day at the 16th annual AOC/Shephard Electronic Warfare conference, to be held May 25-27, 2011, in Berlin, Germany. PLATH will back up the COMINT day, which will be an international event focusing on COMINT.

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interview

DOMITILLA BENIGNI
Chief Operating Officer
Elettronic S.p.A.

By Luca Peruzzi

Elettronica S.p.A. (ELT) has established itself as a leading EW company serving the Italian military, European customers and, more recently, the Middle East and Asia-Pacific markets. Over the past few years, it has established partnerships that have enabled the company to branch out from RF EW into the IR countermeasures and COMINT markets. Earlier this year, the company announced that it was also pursuing Cyber-related opportunities. *JED* recently sat down with ELT's new Chief Operating Officer, Domitilla Benigni, who provided an insightful look into the company's strategy and market prospects.

Elettronica (ELT) has earned a position among the EW market's leaders based on its Radio Frequency (RF) EW product line. What are the company's strategies to strengthen its worldwide presence and to cope with demanding customer requirements?

ELT has six decades of EW specialization in this sector, and it is enlarging its production portfolio to cope with new threats and address customer requirements. In 2011, ELT will celebrate the company's 60th anniversary. In addition to the RF EW core business, ELT is introducing new IR countermeasures and communications intelligence capability solutions, and is approaching the new frontier of technologies in the Cyber warfare domain. In the last decade, our company's labor force has dropped from around 2,000 personnel to almost 800, while in the meantime we have established a strong relationship with our subcontractors, outsourcing most of the component production. We decided to concentrate on design, development and integration activities, in addition to very specific components and subassembly production, such as solid-state amplifier technology.

In the last decade company revenues have doubled, reaching €193 million in 2009 with a constant growth in the last five years; we are forecasting similar results for 2010. With a healthy backlog of around €1 billion, mostly coming from domestic, European programs, and their spin offs, it is important to quickly adjust and respond to newer market needs. In addition to our subsidiary in Germany and participation in LNX (a high-tech company in the US), we have established joint-ventures in the UAE and India to adapt to the technology transfer and offset package requests. More agreements are to come, according to market opportunities.

How is Elettronica coping with new systems design, development, integration and production requirements as well as export needs?

We are focusing and strengthening our R&D laboratory capabilities, providing adequate funding, as well as implementing new development methodologies. In addition to a roughly constant € 10 million R&D yearly funding flow, we are already implementing risk-reduction development methodologies in order to have new products ready for the market in three years time. In parallel, LNX is providing fast prototyping and hi-tech components for surveillance and acquisition, while our subsidiary in Germany is focusing on homeland security R&D in order to strengthen its position in this specific market sector. Elettronica has grown and is still strongly involved in important European programs, such as the Eurofighter, the FREMM multi-purpose frigates, the ESM equipment for the NH90 helicopter and derived programs. Today, however, and mainly due to military budget reductions and newer asymmetrical threats, we observe that except for specific areas, the global market is focusing on smaller-size procurements, where solutions that can be quickly and easily adapted to new requirements are becoming paramount.

El-Op of Israel and ELT co-developed the ELT/572 or MUSIC directional infrared countermeasures (DIRCM) system, which uses fiber laser technology. The ELT/572 is completing development testing and performance validation ahead of initial deliveries in 2012. Can you give some insight about anticipated contracts?

Elettronica has very recently been informed by the Italian Ministry of Defense (MOD) that it has been selected to receive a contract for ELT/572 installation design, test and validation activities on board the Italian Air Force's C-27J and C-130J

continued on page 38

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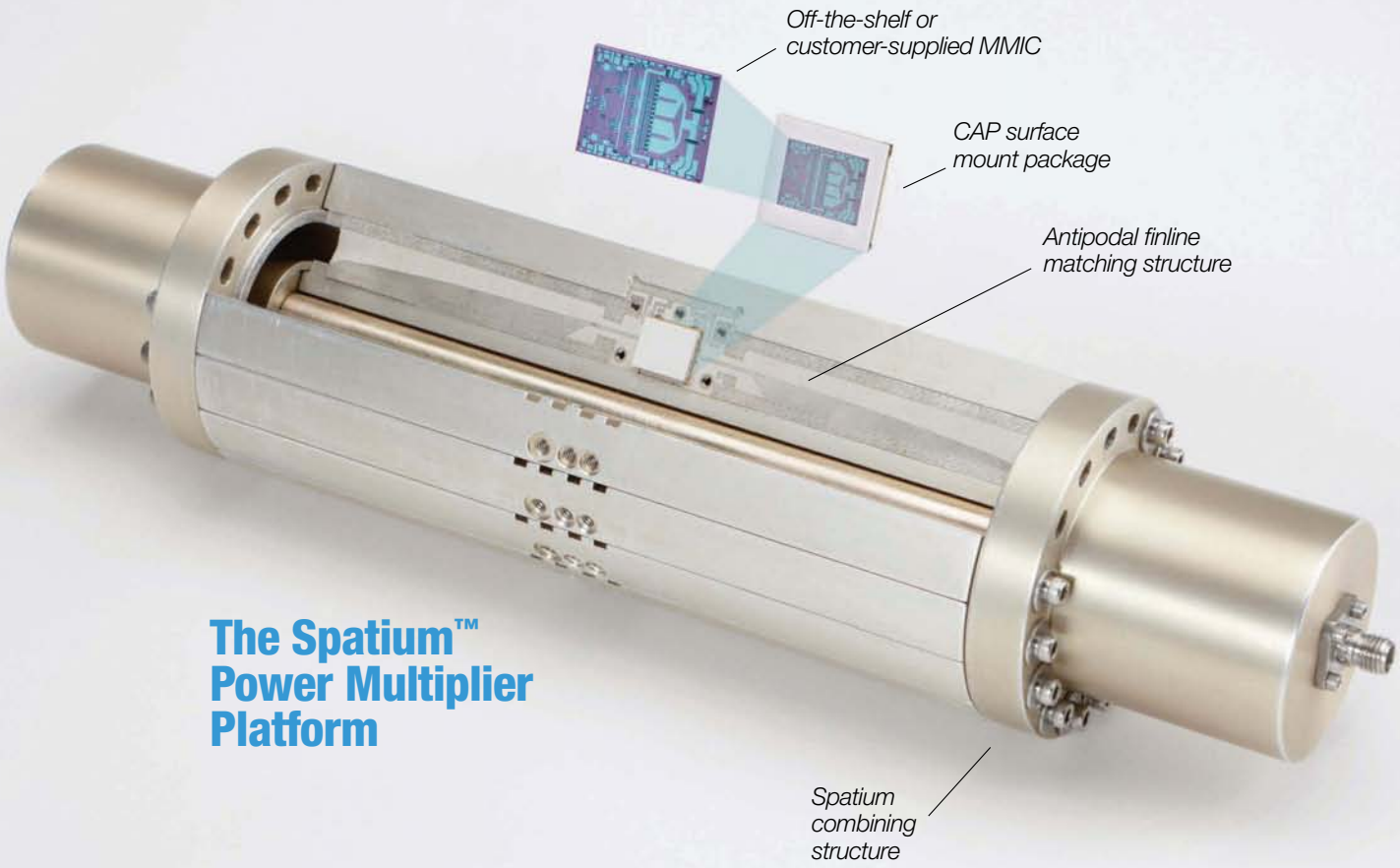

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transport aircraft. By the end of the year, the Air Force will also place an order with ELT and El-Op for production of the first batch of 6 ELT/572 DIRCM systems. This represents an important market achievement, as the Italian MOD is looking forward to equip a range of fixed- and rotary-wing platforms with the ELT/572, potentially including the new Alenia Aeronautica ATR-72MP (Maritime Patrol), the Boeing KC-767A tanker, the in-service Airbus A-319CJ VIP aircraft, together with the future Boeing/AgustaWestland CH-47F tactical transport and AgustaWestland AW101 Combat SAR helicopter types. We are also expecting to acquire the first contract with an international customer within the same timeframe.

The Italian MoD's Land Armaments General Directorate has recently assigned, to a large industrial team headed by Finmeccanica company's Selex Sistemi Integrati, an important contract within the Forza NEC program. This will provide the Italian armed forces a distributed network-enabled capability (NEC), ranging from single soldier to higher commands. What are Elettronica's responsibilities within this project?

Elettronica has been appointed the EW component Design Authority, participating from the earliest phases of this very important spiral-based evolutionary program, which should satisfy the Italian armed forces NEC requirements for decades to come. ELT has also developed a new family of communications intelligence and jamming products for ground and naval applications and is exploring the Counter-Improvised Explosive Device (C-IED) warfare segment. Concurrently, we are developing an EW net-centric C2 capability with company funds, allowing us to develop dedicated solutions not only for national but also for international market requirements.

At the Farnborough Air Show in July, Elettronica unveiled the company's new technology frontier: cyber warfare. Can you briefly elaborate on this topic and discuss the company's first application?

We are all aware that adversary cyber warfare attack capabilities can disrupt the sophisticated IP protocol-based combat, intelligence, C2 and communications layers on which present and future net-centric capable forces are and will be equipped. Such a threat implies that the deployed forces in a wide range of national and international operations must be ready to counter it, especially in those contexts where, though under attack, it is not possible to respond with physical neutralization of it. We are therefore developing, with company funding, a cyber warfare net-centric based C2 system, capable of monitoring, identification and self-protection functions against such a threat. In parallel, we are working on a multi-platform networked self-protection suite, to provide cyber warfare attack capabilities, which is planned to be completed in 2012.

In the last decade, Elettronica has consolidated its position as a leading electronic warfare company in the Middle East, providing systems for all United Arab Emirates (UAE) armed forces. What are ongoing and future procurement prospects in this area?

Elettronica has already provided more than 100 operational systems to the UAE armed forces. Thanks to the ELT local established office and the ELBAT joint-venture with Baynunah Aviation Technology, we were able to provide product support and business development, which has key importance for customer confidence in the demanding EW market. In 2009, contracts have been announced to provide an ESM/ELINT suite for maritime patrol aircraft and the new *Abu Dhabi*-Class ASW corvette. In the meantime, we are upgrading the Navy's in-service vessels. Earlier this year, we received a contract to provide additional ESM systems for new Falaj-2-Class stealth patrol vessels (to be provided by Fincantieri). This is in addition to the Dassault Mirage 2000 EW suite procurement and on-going logistics support, which is part of an earlier contract. We are currently participating in new procurement tenders in the country, and following other Middle East opportunities, such as in Saudi Arabia with the Eurofighter program.

In recent years, India has become one of the most promising markets in the defense and homeland security sector. How is Elettronica fulfilling the country's defense procurement requirements for domestic industry participation?

Besides a mature relationship of technical cooperation with the Bangalore-based DARE (Defence Avionics Research Establishment), we have signed a teaming agreement with Alpha Design Technologies in 2007, which has evolved into the AEDS joint venture, the latter preparing to be operational this year. With an Elettronica share of 26 percent, AEDS will be responsible for local EW system design and production, becoming a vehicle to satisfy the necessary technology transfer requirements requested by Indian defense procurement laws. Elettronica has a wide range of EW products, which are being proposed for major defense tenders, particularly in the airborne and naval domains.

The agreement signed between Italian Prime Minister Silvio Berlusconi and Brazilian President Luiz Inácio Lula da Silva, followed by respective ministries of defence and navy agreements, offers new market prospects for the Italian defense industries in the leading South American market. What are some of Elettronica's opportunities in this context?

Brazil's growing economy and the country's leading position within the South America continent make its national defense and homeland security sector one of the most promising markets in the world at present. Thanks to the mentioned government and MOD agreements, we are currently involved, together with other Finmeccanica group companies, in a Fincantieri shipbuilding group-led industrial package offer, submitted this summer, for a range of fully-equipped naval platforms. These include frigates, offshore patrol and logistic support vessels, in addition to local construction and technology transfer. Concurrently, we are also evaluating different prospects on the local market, with the foreseen establishment of a local ELT office and/or joint activities with Brazilian companies, if business opportunities will arise.

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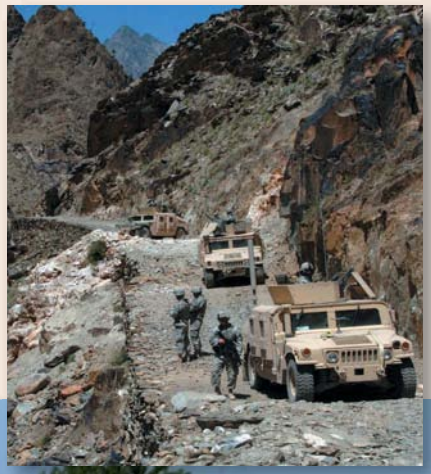
What's Next in IED



US Army and Navy Follow

By Glenn Goodman

Jammers?

Distinct Development Paths

Over the past six years, the US Department of Defense and military services have fielded tens of thousands of electronic jammers of different types in Iraq and Afghanistan to protect US and coalition forces from remote-controlled improvised explosive devices (RCIEDs), the deadly roadside bombs used by insurgents to attack convoys and foot patrols. Called Counter Radio-Controlled IED Electronic Warfare (CREW) systems, the predominantly vehicle-mounted jammers automatically detect and block radio-frequency signals emitted by triggering devices, such as mobile phones or garage door openers that are used to remotely detonate the bombs.

The Navy's Explosive Ordnance Disposal/Joint CREW Program Office (PMS 408) at Naval Sea Systems Command (NAVSEA) in Washington, DC, has been the DOD's executive agent for acquiring common ground-based CREW systems for the military services since 2006, using emergency wartime supplemental funding from the Joint IED Defeat Organization. The largest CREW users are the Army and Marine Corps.

PMS 408 is developing a next-generation JCREW 3.3 family of mounted, dismounted and fixed-site jammers intended to replace existing DOD CREW systems beginning in 2012. The Army, however, does not plan to procure JCREW 3.3 systems to replace its existing CREW jammers. Intent on moving beyond single-mission (force protection) CREW "boxes" to ground-based EW systems with broader capabilities, the Army is set to kick-start a new acquisition program in the coming months called the Integrated EW System (IEWS). This plan is in step with the greater emphasis being placed on EW capabilities across the Army that grew out of the counter-IED fight in Iraq.

CURRENT CREW SYSTEMS

PMS 408 has fielded more than 20,000 CREW systems since 2008, including in excess of 16,000 vehicle-mounted CREW 2.1 jammers. The CREW 2.1 systems, produced by ITT Force Protection Systems (Thousand Oaks, CA), consist of the CREW Vehicle Receiver Jammer (CVRJ) and the less numerous Mobile Multi-Band Jammer (MMBJ) used by Special Operations Forces.

PMS 408 has also supplied the Symphony CREW system, the only one approved for Foreign Military Sales, to US allies and coalition partners since 2007. Produced by Lockheed Martin MS2 (Manassas, VA) and comparable to the 2.1 series, Symphony has been fielded for PMS 408 by the Naval Surface Warfare Center-Crane (IN) since 2007, initially to Iraqi forces. Lockheed Martin deliv-

ered its 1,500th Symphony system in late June.

The Army's current inventory of vehicle-mounted CREW systems consists of about 32,000 Duke V2 CREW 2.0 jammers, which the service acquired on its own beginning in late 2005, and about 13,000 CREW 2.1 CVRJ systems supplied by PMS 408, according to LTC Bruce Ryba, Product Manager for CREW within the Program Executive Office for Intelligence, EW & Sensors (PEO IEW&S) at Ft. Monmouth, NJ (which is relocating to Aberdeen Proving Ground, MD). The Army also has about 1,300 MMBJs, which are being replaced with either Dukes or CVRJs, he said.

The Duke V2 is comparable to the CREW 2.1 in terms of frequency coverage and jamming range. The Duke manufacturer is SRCTec (Syracuse, NY), which is upgrading the Army's Duke V2s to a V3 configuration. The V3 configuration adds more frequency coverage via an additional unit that is connected to the primary Duke unit. Ryba told JED that the Army has procured about 27,000 V3 upgrade kits to date.

An SRCTec spokesperson said the Duke V3 upgrade improves the jammer's capability to the level of the CREW 3.2 system. The latter is the newest vehicle-mounted CREW device being procured by PMS 408. In August, ITT edged out Northrop Grumman Space and Mission Systems (San Diego, CA) to win the CREW 3.2 production contract, under which it will supply up to 5,000 of the jammers.

In June 2009, Sierra Nevada Corp. (Sparks, NV) won the NAVSEA production contract for CREW 3.1 dismounted backpack jammers with its Thor III system and will produce up to 2,500. The Army has received about 1,300 of those, Ryba said. The Marine Corps also is fielding Thor IIIs. They are replacing larger and heavier Guardian backpack systems, more than 1,000 of which were deployed by the two services in 2006-2007. The Marines predominantly use the vehicle-mounted CVRJs.

Following the drawdown of US forces in Iraq and the surge in Afghanistan, Ryba said, the Army will have about 45 percent fewer CREW systems deployed in the overseas theater. "So part of our strategy," he said, "is to re-set the systems that we pull out. We are developing a storage plan to ensure that those systems are available for any future contingency operations."

JCREW 3.3

PMS 408 selected ITT and Northrop Grumman in October 2009 to competitively develop the next-generation JCREW 3.3 family of IED jammers. Key features of JCREW 3.3 are its open-architecture interface standards, which will facilitate incorporating advanced software applications from different vendors over time, and an emphasis on incremental software rather than hardware upgrades to keep pace with changes in the threat.

Navy CAPT John Neagley, who heads PMS 408, told *JED*, "Both companies are providing unique technological solutions to meet the JCREW 3.3 performance specification."

Paul Mueller, ITT's vice president and general manager of Force Protection Systems, told *JED*, "JCREW 3.3 is a very challenging program. If you look at the

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specification, there is a much broader spectrum that we have to handle simultaneously, which implies a broader bandwidth that we have to be able to process in real time. Another key aspect of 3.3 is that it really stretches us, not just on the IED jamming side, but also in all of the other EW and RF spectrum management types of capabilities. One of the big departures is that we are really talking about a multi-functional EW capability and no longer an independent CREW box on a particular platform.

"The 3.3 system has to interact not only with other jamming systems but with communications systems that might be collocated. It's not just about how we jam the device but how do we collect information about it, how do we process that to raise the situational awareness of the commanders in the field, how do we collect germane data and send it back for post-mission analysis? How do we exercise some level of command and control over the jamming functions so that we can do more cooperative types of things and be more efficient in the use of the spectrum? So there is a plethora of new capabilities that are being implemented in 3.3. Not only does the effectiveness of the jamming present challenges, but also the implementation of the rest of the EW and RF spectrum management capabilities required by 3.3."

ITT and Northrop Grumman completed their Preliminary Design Reviews last March and were each undergoing a Critical Design Review (CDR) as this issue went to press last month. Following the CDRs, Neagley said, the Navy plans to select one of the two companies to build prototype JCREW 3.3 systems for testing. He added, "Both contractors will deliver a technical data package that represents their final system design and potentially supports future competition."

"The open-architecture aspects of JCREW 3.3," Neagley noted, "will allow us to pace the evolving threat. As commercial technology, networks, and tactics, techniques and procedures change, CREW systems must be able to adapt rapidly. JCREW 3.3 provides that flexibility."

Compatibility between US forces' IED jammers and communications systems allowing simultaneous operation remains a significant technical challenge. The various Army and Navy EW research labs continue to address techniques and technologies to mitigate or eliminate interference and fratricide issues. Software-defined radio solutions that integrate the generation of EW waveforms and communications waveforms are said to be of particular interest.

Neagley told *JED*, "PMS 408 and the DOD have focused on maximizing the interoperability and compatibility of current and future CREW systems," noting, "JCREW 3.3 will improve our capabilities in this area."

The projected initial operational capability milestone for JCREW 3.3 is late FY12. Neagley said the Marine Corps plans to begin acquiring JCREW 3.3 systems in FY2013.

ARMY IEWS

The Army has chosen to go down a different path than JCREW 3.3. COL Rod Mentzer, the Project Manager for EW within PEO IEW&S and Ryba's boss, told JED, "The Army is undertaking an incre-


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mental strategy to move beyond narrowband CREW jammers to multi-function, broader-spectrum EW systems."

In September 2009, the Joint Requirements Oversight Council (JROC), chaired by Joint Chiefs of Staff Vice Chairman Gen James Cartwright, approved a Joint EW Initial Capabilities Document. It has an Army IEWS Annex spelling out that service's unique requirements. "The Navy is moving forward with a solution set [JCREW 3.3] that will provide the next iteration of CREW-type capability," Mentzer said. "The Army leadership has come back and said that the Navy solution, being CREW-centric, does not address our broader EW requirements." He added, "The Navy's 3.3 system design could potentially be a subset of our solution meeting future CREW requirements, but its scope is not big enough to be our answer for the next version of ground-based EW we want to pursue."

Mentzer noted, "The joint EW requirement approved by the JROC gives us the authority to proceed, and now we have [full] funding allocated for IEWS in the Army's FY12-17 Program Objective Memorandum

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[spending plan]." The next step involves identifying a Material Development Authority, expected to be PEO-IEW&S, which will initially conduct an Analysis of Alternatives (AoA) study, required by the DOD prior to a formal new program start.

The Army is still sorting out the technically feasible capabilities it hopes to include in the first increment of IEWS. "Right now," Mentzer said, "it looks like Increment 1 will be more focused on an offensive electronic attack capability of counter-communications, as opposed to a jammer that only does vehicle protection." This will require wider frequency coverage and greater jamming power and range.

An essential initial task involves networking the IEWS boxes with a secure wireless link, Mentzer said, so they can share information and coordinate jamming. A dedicated communications link would not be required, an industry source told *JED*; Tactical Internet Protocols could be leveraged to pass information over available radios, such as SINCGARS, EPLRS or TACSAT.

An Office of Naval Research solicitation from this past year pertaining to the development of future upgrades to JCREW 3.3 describes the potential benefits of networking: "The ability for CREW systems to communicate with one another and transfer pertinent information would provide a networked approach that maximizes protection capabilities and resources. Networked operations could be used to geo-locate all systems, or to easily change CREW system operating parameters. Networked operations could be used to develop a self-forming network topology or networked-based jamming algorithms. Analysis of the topology could be used to recommend placements of JCREW hardware over a wide area for optimized operations… Techniques for cross-platform allocation and coordination of JCREW resources to maximize effectiveness and efficiency are desired."

Anthony Lisuzzo, head of the Intelligence and Information Warfare Directorate (I2WD) at Ft. Monmouth, the key Army research lab involved in IEWS, gave a simple example of how networking the boxes would allow more efficient, distributed, cooperative jamming. "Let's say you have a convoy, and the IEWS box on every vehicle detects the same threat. If the boxes are networked, we'll know which one is picking up the strongest threat signal and can dedicate that jammer to it, rather than having several boxes indiscriminately jamming the same threat in an uncoordinated fashion. The other boxes, conserving power, can be looking for other threats, mapping the RF environment and reporting real-time situational awareness data over the network." The RF sensor data could be fused with data collected by electro-optical/infrared and other non-RF intelligence, surveillance and reconnaissance sensors.

In some cases, an industry source told *JED*, it might be advantageous not to jam a threat emitter – such as a command-and-control node – but to keep monitoring its signals and let it stay on the air.

IEWS Increment 1 is expected to offer threat direction-finding and geo-location capabilities. These will allow IEWS boxes to more effectively focus their jamming energy, thereby increasing protection range.

Mentzer identified another desired IEWS Increment 1 capability – "battle

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management software for an EW officer that would provide him the flexibility to reprogram or lift and shift [jamming] efforts among the networked boxes."

IEWS Increment 2, he said, would "bring the airborne layer into the IEWS network, whether it be manned or unmanned aircraft." Increment 3, not yet defined, could incorporate advanced jamming techniques or directed energy systems.

Like JCREW 3.3, IEWS will use an open architecture with industry interface standards allowing "plug-and-play" capabilities and mission-specific modules, Lisuzzo said.

Lt Col Ryba noted, "It's probably going to be 2015 or later before the Army begins fielding IEWS and several more years to achieve a full operational capability. So we will need to apply technology insertion and technology refresh efforts to the CREW systems we have today to keep them effective against new and emerging threats until they can be replaced."

The Army expects to award a contract in the third quarter of FY11 for technology insertion upgrades to its Duke V3 systems. Separate Navy/Marine Corps and Army upgrade efforts for CREW 2.1 CVRJs, all involving contractor ITT, are underway and are being coordinated. (The CVRJ is a software-programmable jammer.) PMS 408 has viewed its CREW 3.1 and 3.2 programs as technology bridges that also maintain a production capability until the next-generation JCREW 3.3 can be fielded. The Naval Surface Warfare Center at Indian Head, MD, released a request for information this past summer on behalf of PMS 408 concerning potential near-term performance improvements to the CREW 3.1 dismounted jammer. PMS 408 says it continues to upgrade the Symphony IED jammers it provides to US allies and coalition partners. The Naval Surface Warfare Center-Crane plays a key role in sustaining the CREW systems procured by PMS 408.

EMBRACING THE FUTURE OF LAND EW

It is important to acknowledge that future programs, such as IEWS and JCREW 3.3 upgrades, will face significant challenges, even though they build on an operational and technological legacy that has been well established over the past five years. For instance, no one knows how much these new systems will cost. Today's CREW systems are fairly simple compared with the frequency coverage and functionality that IEWS and future CREW systems must feature.

In addition, the Army today views EW in a largely intelligence-oriented context rather than from an operational perspective. This perception will eventually change, as the Army has started to develop a new corps of EW operators. In the meantime, IEWS will lack some of the broad advocacy that could help the program navigate future Army budget deliberations.

Finally, the EW industry must focus on developing carefully thought out land EW solutions that will be capable and affordable for ground forces.

None of these challenges are insurmountable. But they must be addressed and overcome. In the end, the Army will acquire a capability that provides ground units unprecedented levels of organic EW capability.

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COMMANDER BENOIT SALMON
Electronic Warfare Armament Program Manager
Marine Nationale

By Tom Withington

The *Marine Nationale* (French Navy) is currently undergoing an extensive modernization, with the introduction of several new classes of ships and submarines. The fleet has recently received new frigates in the form of two Horizon class air-defence ships, the *Forbin* and *Chevalier Paul*, which were commissioned in 2008 and 2009, respectively. The navy will also receive nine FREMM (*Frégate Multi-Mission*) multi-role frigates, the first of which, the *Aquitiatine,* is scheduled to be commissioned in 2012. Other new surface combatants to join the French Navy in the next few years include the third Mistral class amphibious support vessel, named *Dixmude*, which is expected to also be commissioned in 2012, while discussions are continuing at the governmental level as to whether France will collaborate with the United Kingdom in the design and production of a second aircraft carrier to join the *Charles De Gaulle*.

Beneath the waves, the navy recently received the last of its *Triomphant*-Class ballistic missile submarines that carry the country's nuclear deterrent, and will obtain up to six *Barracuda*-Class nuclear-powered attack submarines the first of which, *Suffren*, is expected to be commissioned in 2017. Similarly, deliveries of new naval aircraft are continuing. The *Aeronavale* (French Naval Aviation) is acquiring the Dassault Rafale multi-role combat aircraft for service on the navy's sole aircraft carrier, *Charles De Gaulle*, with 28 jets delivered to date to replace the force's 41 Dassault Super Etendard fighter-bombers. Meanwhile, in terms of rotary aviation, the navy will get up to 27 NH Industries NFH-90 helicopters and possibly a fourth Northrop Grumman E-2C Hawkeye early-warning aircraft.

As regards operational commitments, French naval shipping continues to support national and international deployments around the world, assisting in counter-terrorism and counter-piracy activities in the Indian Ocean, and also providing humanitarian assistance in the wake of natural disasters such as the Haiti Earthquake earlier this year.

Commander Benoit Salmon is the Marine Nationale's Electronic Warfare (EW) Armament Program Manager, and he took some time prior to the forthcoming Euronaval exhibition hosted in Paris between 25-29 October to give the *Journal of Electronic Defense* an insight into the force's current EW posture. He explains how this supports France's naval doctrines and operations, the navy's EW training and modernization, and the force's EW plans for the future:

Biography

Commander Benoit Salmon entered the French Naval Academy in 1988 and subsequently began his career in the Operations branch. From 1997 until 1999 he was embarked onboard the anti-submarine frigate *Jean de Vienne*, during which time he participated in the test of this ship's self-defense equipment. Between 2004 and 2006, he was the electronic warfare planning officer for NATO's Joint Electronic Warfare Core Staff (JEWCS). He served as planning officer of the JEWCS from 2004 through 2006. In 2006, he studied at the Interarmées College of Defense (French staff college), before taking up his current assignment as the Marine Nationale's Electronic Warfare Armament Program Manager.

What is the French Navy's current EW doctrine?

EW in the French Navy relies on three basic doctrines that are similar to those practiced in the French Air Force and the

continued on page 56

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French Army. Its main domains are electronic surveillance, electronic defence and electronic attack. These three pillars influence all of the tactics in use with French Navy EW systems. Electronic surveillance can be performed on any French Navy platform, although it is essentially concerned with listening and trying to build a picture of the tactical EW situation. Electronic defence is practiced by fewer ships in the fleet, notably platforms such as the *Horizon*-Class anti-air warfare frigates. Such ships are equipped with electronic jamming systems that can provide an enlarged defence for other naval combatants. Other surface combatants are equipped with passive self-defence systems to protect themselves and other accompanying ships. The French Navy also practices electronic attack, for which we use very specific jamming systems that are installed on certain ships, although I cannot disclose precisely which ones.

How important is EW currently to French Navy operations around the world?

It is difficult to say regarding a specific operation, but broadly speaking EW is bringing some value by helping to elaborate on tactical information that naval forces are receiving from their other sensors and from other platforms. This helps commanders to make the right decision and, as EW is covering all of the electronic spectrum, it can help to bring missing information to the commanding officers' attention to help them achieve their mission.

Do you expect in the future for the navy to perform any upgrades or modifications of its existing ship EW systems?

There are some ongoing projects. For example, the *Georges Leygues* F-70 class frigates, which are used for anti-submarine operations, have undergone a program to upgrade these vessel's electronic and physical countermeasures. The same upgrade will also be performed on the *La Fayette*-Class light multi-mission frigates [These vessels are outfitted with a SAIGON ARBG-1 VHF/UHF detector, ARBR-21 radar detector and Dagaile Mk.2 chaff launcher.] We also have a program with Etienne-Lacroix, based in southwest France, to fit a new generation of countermeasures to the *Horizon*-Class frigates. This program may be extended to the FREMM class frigates over the next few years. At present, these countermeasures are still undergoing qualification. We hope for this qualification to be completed by the end of the year, or in the worst case, at the beginning of next year. By the end of next year all of the modernizations of these vessels' countermeasures will have been completed.

Can EW information be shared among vessels across the Marine Nationale's new SIC-21 Battle Management System (BMS)?

The goal for the new generation of warships like the *Horizon*- and FREMM-Class frigates is for them to be able to easily share their EW information between themselves and other ships across their battle management systems. For FREMM-Class ships, the EW operator will work from the Combat Management Center with the electronic warfare systems integrated with the ships' other weapons and command and control systems. This will allow the easy sharing of tactical EW information with other vessels.

How does the French Navy perform its electronic warfare training?

Most of the EW training takes place onshore at the French Navy's various bases. We have a new generation of simulators to take into account the needs of new ships, such as the FREMM vessels. The training system at the bases will be able to imitate the display of that system. Regarding training at sea, we still have a dedicated EW training vessel. We have also the training facility at the *Centre d'Essais de Lancement de Missiles* missile test center on the Mediteranean island of Levant off the southern coast of France to perform very specific trials. The new simulators will be deployed at the naval base in Toulon on the French Mediterranean coast, and also at the French Navy base in Brittany on the Atlantic coast. We expect these simulators to be operational in the next three years, although the contract has not yet been awarded for their construction.

What role does the Aeronavale play in collecting and distributing EW information to the rest of the fleet?

The role of the Aeronavale is connected with the electronic surveillance doctrine. If you have a platform that is able to collect tactical information, then all of this information will have an important value in deepening the tactical picture. The Dassault Rafale is equipped with Thales' SPECTRA but the Dassault ATL 2 Atlantique maritime patrol aircraft is definitely the suitable platform to significantly increase the range of the fleet's electronic surveillance collection. Such information can then be provided to other naval platforms.

What do you believe will be the major challenges that the French Navy's EW posture will face in the future?

Operations in littoral regions are of great concern to naval EW practitioners. This is because of the dense electronic environment generated by GSM [Global System for Mobile Communications] civilian mobile phones and coastal radar, for example. Because of this, you need to have systems that are able to listen through this entire polluted spectrum. So sensitivity is essential. You must be able to operate with filters specifically calibrated to that littoral environment. I think that the other main EW challenge for the French Navy in the future is to be able to manage a very accurate database that can contain all the necessary identifying details of increasingly complex naval radars. The complexity of modern naval radars means that the quantity of information that must be added to this database increases very fast. Managing all the information and ensuring its accuracy is a difficult challenge, because if you have do not have good, accurate and timely information, the target radar won't be detected and relevant information won't be obtained. We have developed this database, but at the same time its management is an endless challenge as it is something that needs to be verified and updated continuously.

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Electronic War and the Surface

Is the United States Navy making sound investments in surface ship electronic warfare (EW)? Several pieces of evidence have recently shown that the US Navy over the past two decades may have not made the best decisions with regard to sustaining and maximizing the in-service life of its surface fleet, including neglecting improvements in shipboard EW.

FUNDING PRIORITIES

Over the past several years, most of the Congressional support for the surface fleet has focused on the highly technical Ballistic Missile Defense (BMD) capability and how this system plays into future roles of protecting Europe, Japan, South Korea, Taiwan and other key US allies around the world. Yet this is a good example of not making the best investments for the surface navy. The key element of BMD is the SPY-1 radar, which has statistically been degrading over the past few years. The funding needed to maintain the SPY radar and other AEGIS combat system components has not been available to the commanding officers of our surface combatants. In addition, manning is down in technically specific rates, such as CT's and FC's, which greatly impacts the ship's ability to perform key missions, and training has been reduced or eliminated for many of our sailors. The way ahead is to upgrade all of the Navy's shipboard combat systems, not just AEGIS or BMD. Other Navies have found ways to balance their layered defense to include more technologically advanced EW suites, more capable trainable launchers and modern decoys.

As a retired US Navy Surface Warfare Officer, my point is not to demean or downplay AEGIS or BMD. In fact, my goal is just the opposite – to promote a robust and maintained layered defense capability, of which, AEGIS and BMD are absolutely crucial elements. In addition to AEGIS and BMD, an overall improved EW system, which at a minimum includes more capable decoys and a trainable launcher, is essential to ensure a robust defense capability for our surface combatants.

THE LITTORAL ENVIRONMENT

While the Navy has consistently devoted defense dollars to BMD and its associated technologies, it has invested relatively little funding in recent years to improve ship self-defense or, more importantly, Carrier Strike Group Defense. Unfortunately, the millions of dollars invested in BMD do nothing for the self-defense of the ship or strike group operating today. In fact, ship self-defense is arguably as important as BMD from a holistic perspective. If a specific ship conducting a BMD mission suffers battle damage, that ship's ability to conduct BMD (or any other mission for that matter) is most certainly lost or at a minimum degraded.

As we look at ship self-defense, today's ships and sailors find themselves in a much different role than in the past. The Navy is now operating more often in "brown water" or littoral environments. While the new Littoral Combat Ships (LCSs) are designed for these missions, our CG's, DDG's and FFG's were not. Yet

fare Today Navy

By Matt Eberhardt

these are the platforms being used today for littoral missions. While operating in the littoral environment, ships are much more vulnerable to shore based threats with little or no warning and have much less reaction time for threat evaluation, engagement, and countermeasures. In addition, ships operating close to the shore are more susceptible to radar clutter, electromagnetic interference, (EMI), or other types of shore-based jamming or interference. When these issues are combined with the challenges posed by operations in close proximity to land (i.e., near shore-based anti-ship missile threats, the limited ability to maneuver the ship based on depth of water, background shipping/traffic, etc.) one must conclude that self-defense and a need for multiple layered defensive options are even more critical to today's Navy.

SEWIP

Furthermore, in these operating environments, EW plays a vital role in the overall combined layered defense concept. To the Navy's credit, it has recently invested in the Surface Electronic Warfare Improvement Program (SEWIP), Phase I and II, which have targeted key upgrades to the SLQ-32 suite hardware and software components that were designed in the 1970's and based on 1960s technology. SEWIP Block 1A, already completed, added improved displays and a modern interface, along with some hardware changes to incorporate commercial-off-the-shelf (COTS) technologies. Block 1B1 made more changes to replace obsolete electronics (some of which are no longer manufactured) and increased the ability to identify the

source of incoming radar signals. SEWIP Block 1B2 provided signal processing and display upgrades. SEWIP Block 1B3 added additional display upgrades, and a High-Gain High-Sensitivity (HGHS) subsystem, to better process modern missiles seekers. Block 2, which is currently in engineering and manufacturing development, replaces the SLQ-32 receivers and antennas with modern technologies designed to handle the dense signal environments that are part of littoral operations.

NAVAL DECOYS

As a result of the SEWIP improvements, the "receive" side of our SLQ-32s is gaining significant advantages over the older version of the system. The Navy has also invested in the Nulka decoy, an active RF decoy that can seduce incoming missiles away from their intended targets. Over the past 20 years, very little funding has been allocated to the development or acquisition of passive RF and IR decoys, which ultimately can improve the performance of the self-defense system against newer more advanced threats, such as those with dual-mode seekers. Additionally, no funding has been allocated or invested in new decoy launching system designs or concepts. For example, newer trainable decoy launching systems are now available that significantly reduce the decoy launch time. More specifically, when transiting through the Straits of Hormuz, or operating in the littoral with limited maneuverability, ships are at a disadvantage as a result of being so close to shore-based anti-ship missile sites which are virtually undetectable until after they are launched. In some cases, for example, a ship may be operating near the coast, and if an enemy missile were launched at it, the crew could quite likely have less than a few minutes to react and engage the threat. With a fixed decoy launcher, the ship must first maneuver in order to deploy the decoy payloads in the proper pattern relative to the wind. If that ship could eliminate the need to maneuver in order to launch expendable countermeasures – as would be the case if the ship had a trainable launcher – that ship would save valuable time and gain critical effectiveness for the decoys. As a reminder of how confusing littoral operations can be and how quickly an attack can occur, it is important to recall the INS Hanit incident.

INS HANIT

In July of 2006 the *INS Hanit,* an Israeli SAAR 5 Class Corvette operating approximately 10 nautical miles off the Lebanese Coast, was attacked by Hezbollah. A shore-launched C-802 missile was confirmed as the attacking threat. The Hanit was in a relaxed weapons posture and her crew was unaware of the threat. But the real question is, "If they had their weapons system up and operating, would hard kill have saved the ship?" Modeling and simulation studies show that a combined approach of hard-kill (missile engagement or other physical defense) and soft-kill (the use of decoys in conjunction with other EW methods) have proven to have a much higher defensive success rate. Some of the most recent real-world naval EW encounters occurred during the Falklands War,

when Royal Navy combatants benefitted from chaff in several missile encounters launched by Argentinian aircraft. As a result of these successful engagements, the Royal Navy has been adamant about maintaining the latest technologically advanced decoys on their ships. Some naval experts may argue that during the Falklands War, the Argentinian forces used an older version of the Exocet and that chaff is very effective against these older threats. They might say that chaff is less effective against

newer threats with more discriminating seekers, thus there is no longer a need for chaff or other decoys. I believe the opposite is true. We must outfit our Navy with newer more advanced decoys to combat today's threats. We must continue to incorporate EW and decoys as part of a layered defense capability.

ADVANCED DECOYS

Over the past two decades the EW industry has developed significant performance improvements for ship decoys and launchers. By comparison, the US Navy uses a much older generation of decoys, such as the MK 214 chaff seduction round, MK 216 chaff distraction round and MK 245 IR round. These rounds have been in circulation for more than a decade in some cases, although a more common shelf life is closer to 7-10 years at best. Because the current inventory of decoy rounds is so old, I wonder if ships are even allowed to use these old rounds for training? If in fact ships are not allowed to train and fire their weapons systems, which includes Mk 36 launcher and chaff rounds, sailors are likely to become less efficient and less knowledgeable about how the decoy system works. As a result, will they become less capable of accurately performing key duties, such as reloading the rounds, in the heat of battle?

Replacement rounds for both seduction and distraction are much more capable today, and in some cases can be incorporated with insensitive munitions technologies, thus adding another key safety feature to the round. In addition to newer more capable versions of seduction and distraction rounds, studies

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and trials are being conducted on corner reflector technology and variable range rounds, which have better capabilities against more sensitive shorter-range gate seekers and sea-skimming missiles. Other advanced rounds include multi-purpose decoys, which incorporate IR and RF features to defeat advanced missile threats that use dual-mode seekers.

THINKING PROACTIVELY

My greatest concern is that in recent years the Navy has been thinking and planning in more of a "reactive" mode versus a "proactive" mode. For instance, if we rewind back to 1999 and review the Force Protection Posture for ships in overseas ports during that time frame, we would see that procedures, methods and training were much more relaxed and there was little concern for threats to a warship while in port. Then on October 12, 2000, the *USS Cole* was attacked while pier-side in Aden, Yemen. A brief stop for fuel (BSF) that was to take merely a few hours turned into a tragedy in which 17 sailors were killed and 39 injured – not to mention repair costs of approximately $250 million to the destroyer. Could this attack have been prevented? Could the US Navy have allocated funding and training for Force Protection upgrades sooner (hence proactive versus reactive) and saved the millions in repair costs and the lives of those 17 sailors lost that tragic day? With a previous failed attack in the port of Aden in which another US ship was targeted, one could argue there was a good probability we could have prevented the *USS Cole* attack or minimized the damage and loss of lives. Based on this

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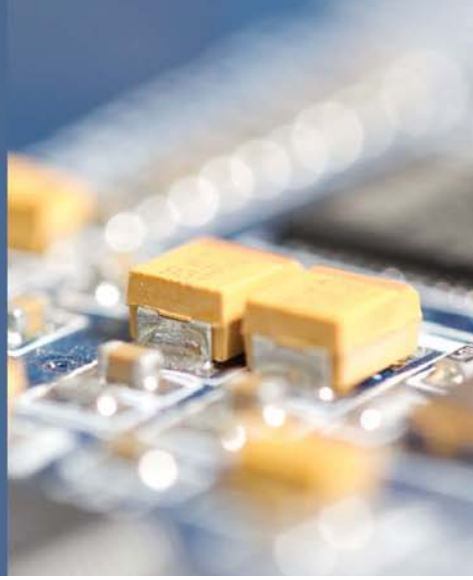

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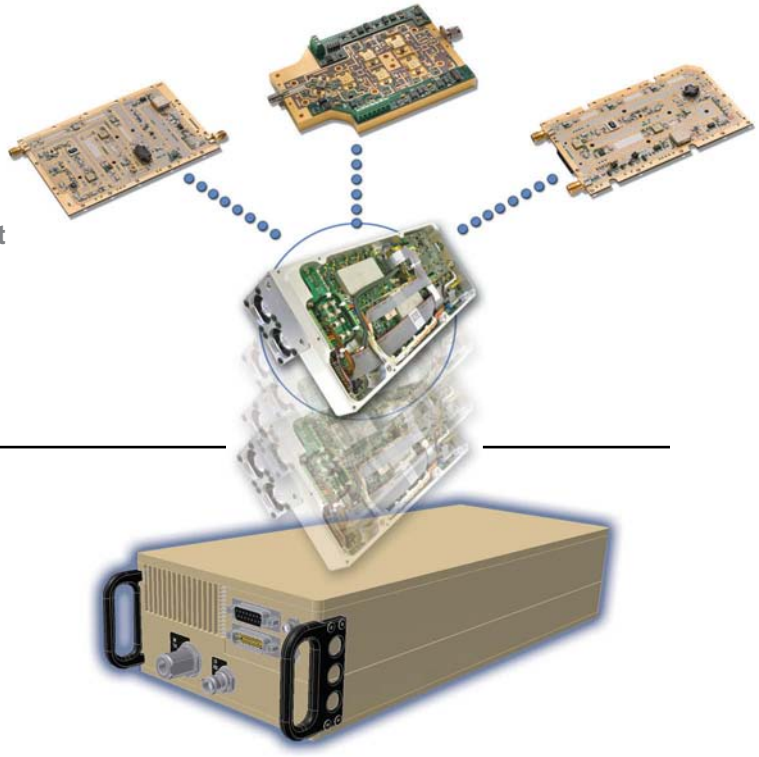

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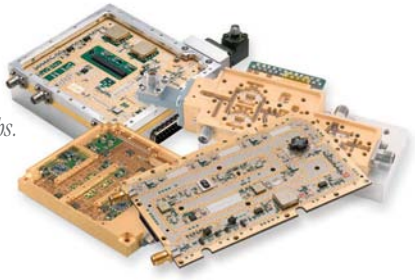

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example and the evidence shown in the *Hanit* attack, mobile shore-based missile launchers exist, and they have the ability to reach our ships. As a result, more EW research from the labs and a greater EW focus by senior US Navy leaders is needed to ensure that our ships can operate effectively and project naval power in the littoral environment.

A COMPREHENSIVE SHIP DEFENSE STRATEGY

EW must be an integral part of the US Navy's Defense-in-Depth strategic plan. The anti-ship missile threat faced by our Navy has evolved and our leaders should now be focused on the ship self-defense requirements of the littoral environment, where EW plays an even more important role. This layered defense plan should not only incorporate all of the significant improvements to the surface combatant EW suite, such as those covered under the SEWIP improvements, but it should also add newer more capable countermeasure launchers and modern decoys. This combined layered defense or Defense-in-Depth concept is a necessity in today's naval operations.

Matthew Eberhardt is a retired lieutenant commander and a Surface Warfare Officer with 21 years of service in the US Navy. Before retiring in early 2010, he served tours as Operations Officer on USS Leyte Gulf and Operations Officer on USS The Sullivans. He was Fire Control Officer and Navigator on USS Vicksburg and Navigator on USS Camden. In his current position, he is Director, Naval Countermeasure Marketing, for Kilgore Flares Company – part of The Chemring Group.

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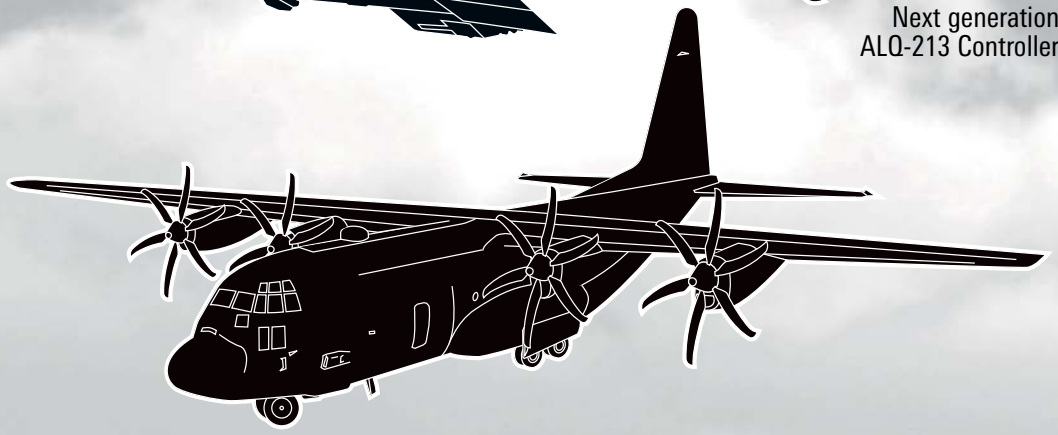

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By Barry Manz

Electronic intelligence (ELINT) has been an essential military tool since World War II, when the Allies used it to find Axis radars. Today, almost every nation that maintains a modern air force or navy also collects or obtains ELINT data, which is most commonly defined as intelligence collected from non-communications electromagnetic radiation. ELINT primarily focuses on signals and non-intentional emissions collected from radars.

In EW applications, ELINT data is used to develop threat radar databases, which can be used to program the threat libraries in radar warning receivers (RWRs) and electronic support measures (ESM) systems. ELINT data is also used to help develop effective jamming techniques in electronic attack systems. But EW represents just one of ELINT's many uses. For example, ELINT often provides situational awareness to military commanders by offering a wide, real-time view of the enemy's electronic order of battle. ELINT can also reveal subtle patterns of enemy behavior or provide details about the readiness of an enemy's air defense system. Few nations would ever attempt to fight an adversary without the information and insight that ELINT can offer.

From the perspective of receiver design, the line of demarcation between ELINT and COMINT has started to blur, since it is usually desirable to develop a single platform from which both ELINT and COMINT subsystems can be built. So, while ELINT deals with deriving information from signals that do not contain voice or data communications and COMINT does, the challenges remain largely the same. One of their prime differentiators has been the frequencies in which ELINT and COMINT systems operate. Until the past decade, most COMINT systems covered the communications bands from the kilohertz region up to 1 or 2 GHz, while most ELINT systems covered the "typical" radar bands between 500 MHz and 40 GHz. But even this is changing, as COMINT is tasked in part with mirroring the frequencies used by commercial communications and entertainment systems, which now span from tens of kilohertz to about 6 GHz, with higher frequencies (even high millimeter-wave frequencies) in the wings. Many ELINT have moved coverage down below 500 MHz and slowly upward from 40 MHz, keeping in step with millimeter-wave radars, which are used in many missile systems.

Although ELINT systems collect non-communications signals, defining an ELINT system is not simple because the term, "electronic intelligence," does not refer to any sort of technical specification. Today, for example, it is very common to see an ESM system described as an ESM/ELINT system. This means the ESM receiver performs its ESM function (rapid threat detection, identification, geolocation and possibly precision targeting), and it also collects and stores emitter data that is useful for later analysis (an ELINT function), for purposes such as developing emitter databases. In the nuanced language of EW and SIGINT, the term "ELINT system" is typically used to describe a system that is designed primarily for the purposes of ELINT collection. The ELINT receivers inside these systems typically are more capable (and more expensive) than the receiver(s) used in a tactical ESM system.

REDUCING SWAP

The credit for ELINT system performance is largely the result of the engineers who design the receivers that form its core, and their job is increasing in complexity as military user demands better performance in less space, with lower power consumption, and of course, for less money. In short, ELINT is a poster technology for SWaP – reductions in size, weight and power.

Cobham Defense Systems has decades of experience in the design of ELINT receivers – "and we're not done yet", said Andy Humen, vice president of Cobham Sensor Systems. "New challenges from threats of interest require subportions of traditional bands of interest to be developed and integrated into very small packages for use on platforms not accustomed to carrying larger receivers and tuners," said Humen. "The trend we see from our customers is for smaller, lighter, more stand-alone products that push the state of the art." For example, Humen cited wider IF bandwidth requirements beyond current JASA-compliant tuners with an IF output at 1 GHz and

500 MHz of bandwidth or 160 MHz MHz with 80 or 100 MHz of bandwidth. "Processing speeds are going up with ADCs that achieve 10 GB/sec and even 50 GB/sec in the lab. You can get commercial 20-bit samplers or even higher. This means processing in the tens of GHz per second, which in turn drives up bandwidth requirements."

Humen noted that the typical Joint Airborne SIGINT Architecture (JASA) requirement once was a 1-GHz IF downconverted from up to 40 GHz and 500 MHz of bandwidth. "Now customers are saying they need 1 or 2 GHz of BW," explained Humen, "which moves the IF above 1 GHz, so processing is driving RF front-end performance. We're getting closer to the antenna in terms of bandwidth, but we still have to perform conversion, preselection, amplifier and gain control, and maintain very good linearity and phase noise and group delay, while tuning faster as well."

MERCURY RISING

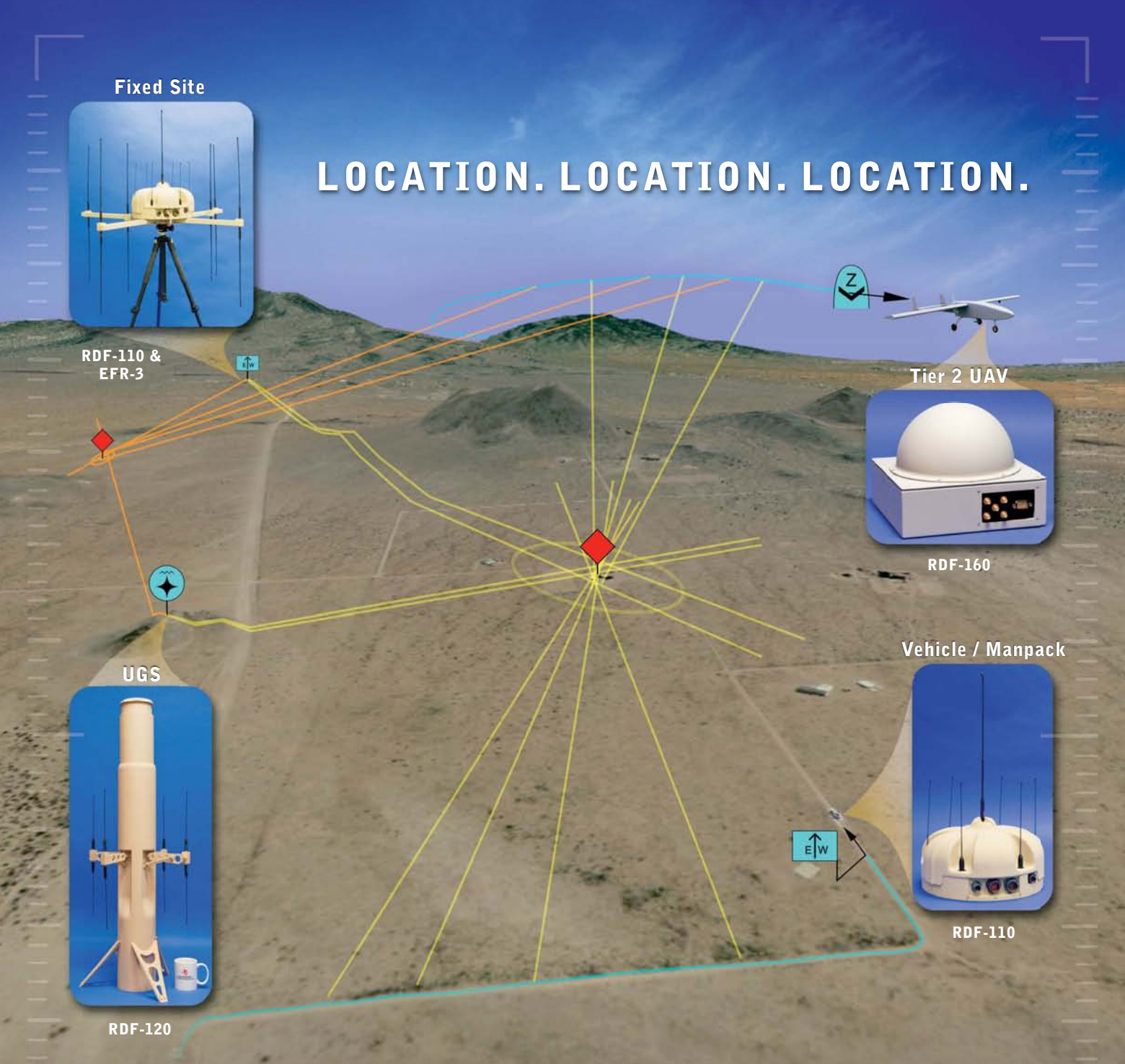
Mercury Computer Systems, an embedded processor developer and manufacturer that for all but the last few years of its history did not address RF subsystems, has dramatically changed that paradigm with its acquisition of Echotek and Advanced Radio Systems. "When we were looking for acquisitions, we came to a consensus that we should get closer to the sensor," said Bill Ceccherini, general manager of the Echotek Product Group. "One reason we have been so successful with this is because we can now help customers solve system-level issues – adding a 'secret sauce' to derive extra capabilities. This stems from getting closer to the sensor, which gives us a holistic view of the data input chain."

The company sees several trends in the ELINT area, including applications that provide the dividing line between coherence and noncoherence. That is, large multichannel systems that are phase coherent from the antenna through the ADC versus a single radio and tuner performing just a search function. Each one has different SWaP requirements and search applications require a single-slot approach and a smaller chassis.

"We also find a greater interest in placing these systems in more rugged spaces," said Ceccherini, "as well as insertions versus 'system forklift upgrades,' which means we will have to focus more on the VME and VXS space. From a pure technology standpoint, higher bandwidths are where the market is going."

The company's approach to ELINT receiver design differs from more traditional methods, in which a PLL synthesizer is used. The Model 1802 microwave receiver instead uses a direct digital synthesizer (DDS), which delivers inherently fast tuning speed but "without help" suffers from higher phase noise than the PLL approach. However, the company developed and patented a technique that allows its DDS to be comparable to or better than a PLL-based approach. The Model 1802 covers 500 MHz to 18 GHz and has high channel density, with two channels per slot.

"There are a couple of ways to deal with SWaP, said Charlie Hudnall, director of engineering for the Echotek Product Group. "The traditional approach is to



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place all LO generation and RF downconversion in a single slot with one channel and LO generation in a 6U card. However, as the primary market for our products is multi-element antennas, we approach the problem differently. We use a single slot for LO generation, and we created a unique way to distribute the LOs, putting two RF tuners in a 6U slot. So, for a two-slot slot system our density is the same as our competitors', but with three slots or higher we have a higher channel density. Our advantage is tuning speed because of the DDS-based LO generator that eliminates the settling time problems of PLL-based synthesizers. We can tune a high-channel coherent ELINT collector in less than 1 µs, including all radios and LO generators."

However, with increasing bandwidth requirements the company is evaluating other approaches for generating LOs in order to maintain high tuning rates while achieving lower phase noise. "The sensitivity requirements are so high that we may have to use older techniques to achieve them. The trade-off is coarser tuning versus a DDS, but many ELINT systems do not need this granularity.

MR. DIGITAL, MEET MR. MICROWAVE…

For someone working in the digital domain with devices such as ADCs and FPGAs, an ideal ELINT receiver solution would be an antenna whose output goes directly to an ADC, completely eliminating those nasty, hard-to-work-with microwave RF and microwave components. The benefits of transforming analog signals into the digital domain are obvious, and the remarkable increases in ADC sampling rates and bits of resolution are allowing these devices to move inexorably toward that goal. In addition, the immense capabilities of FPGAs have guaranteed them a place in every type of EW system.

"The FPGA has created an immense transformation," said Cobham's Humen, and this applies to previous digital components as well. "In the past, ASICs would be created for specific applications, and they are expensive and inflexible. An ASIC costs $500,000 to tens of millions of dollars to create," he said. "With FPGAs, you can work in high-level VHDL and load everything into an FPGA to get the control features you need."

"There has been a paradigm shift in terms of what is needed in an ELINT receiver," explained Ken Eagen, manager of domestic program, sales and marketing, at Cobham Sensor Systems, "especially as it concerns high-speed ADCs. In our Hunt Valley [Maryland] facility, we have three times as many digital designers as RF designers now versus two years ago, and integrating RF and digital is critical." However, as his colleague Bob Liechty, manager of business development, pointed out, "You still need a good linear front end." In addition, it is likely that ELINT receiver designers will be waiting a while before an ADC will be able to digitize a 40 GHz signal. Nevertheless, based on the pace of ADC performance improvements, that day is likely to arrive sooner rather than later.

Mercury's Hudnall agreed about the role of ADCs and bringing digital and RF designers together. "Having IF and RF engineers working side by side is a great advantage," he said, "and in fact

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is now a necessity. While L-band is typically considered an 'RF band', it's now a direct-digitized band both up and down with 10 bits or more of resolution, so it's becoming more an IF band every day.

"It's commonplace now to digitize the 30-MHz HF band, and now you can do some fairly effective direct digitization in VHF and UHF bands and satcom bands that would have been considered an RF rather than IF band before," he continued. "You can do that with 10- or 12-bit converters. Every day the line gets blurrier and blurrier. Materials you would have used in an RF system you have to entertain in the IF side on the front end of your digitizer."

However, whether or not the "all digital receiver" is the Holy Grail mimics the days when consumer and professional audio industries moved from analog to digital signal and storage techniques and when digital technology moved in on film. Even after more than two decades and massive improvements in digital technology, there is still a dedicated group of purists who remain convinced that the "analog sound" or "look of film" have not yet been achieved in digital formats. For these people, they may never be. However, in some ELINT (and COMINT) situations and for some analysts, working with signals in their original form is preferable to a digitized version, and sometimes still requested.

SOME HEARTY ELINT RECEIVER EXAMPLES

While the receivers in an ELINT system represent only a part of an entire system, most manufacturers focus on the receivers themselves sometimes with accompanying RF and microwave components such as downconverters, switched filter banks, antennas, and much more.

For example, Applied Signal Technology offers its PEGASUS family, designed to serve ESM and electronic intelligence ELINT requirements. It incorporates monopulse direction finding, geolocation, parametric measurement analysis, and reporting of both conventional and modern emitters in real time. The systems are fully automated and are designed in modular fashion to satisfy airborne, ground-based, shipboard and submarine applications and environments. The systems can be configured for operation from UHF frequencies through Ka-band and use a wideband digital channelized receiver, along with interferometry to provide ELINT information. Its capabilities include azimuth or azimuth/elevation mono-pulse DF arrays, selectable channelized processing bandwidths over wide IF frequencies, high probability of intercept with fine grain parameter measurement accuracy, and can be specified for manned, unmanned, remote, and autonomous operation.

Cobham has a wide array of products designed for ELINT (and COMINT) applications, including the SMR-7500 microwave digitizing tuner within its LiteRail family that is a very small, portable, intercept and surveillance subsystem receiver designed for narrowband and wideband signal targets. It can operate in an analog-only mode (RF-to-IF) with 70, 140, or 160 MHz IF outputs and up to 1 GHz of instantaneous bandwidth. It can also incorporate a digitizer for


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advanced signal processing, and it is housed in a rugged chassis to operate in demanding remote payloads in which size, weight, and power are critical.

Other Cobham "ELINT-centric" products include its Spectra Scout family of small, lightweight, low-power receiver systems designed for UAS and ground-portable applications. They provide priority-based spectral survey with mission planning and actionable energy alarms based on signal criteria and combine spectral search and detection with emitter location using T/FDOA techniques, proprietary signal algorithms and antennas designed and manufactured by Cobham. The Spectra Scout I and II covers 30 MHz to 6 GHz with 20 MHz bandwidth and a 400-MHz/sec scan rate.

They perform spectral stare, scan and priority-based search; measurement of frequency, amplitude, bandwidth, signal-to-noise ratio, and time; environmental threshold detection; and I/Q recording with AM and FM demodulation capability. They can be configured with up to 24 user-defined software channels, have GPS and time-tagging for geolocation T/FDOA, LPI algorithms for FMCW and pulsed FMCW signals, and 800- to 1000-MHz circular direction finding and reporting. The Spectra Scout III includes phased interferometer DF techniques, covers 200 MHz to 6 GHz, and has a dual-channel coherent digital receiver or dual coherent digital independently programmable digital receiver.

Zeta Associates offers the Model Z0609 compact general-purpose block downconverter, which is well suited for the ELINT environment and is based on high-performance mixers and synthesizers with high dynamic range, high third-order intercept, low noise figure, and an instantaneous bandwidth of 72 MHz. It tunes from 10 MHz to 3 GHz with resolution of 200 kHz. Four IF filters can be accommodated and are available from 6- to 72-MHz bandwidth, all with sharp cutoff and low passband ripple. When used in DF applications in which coherent operation is required, multiple tuners act as slaves and use the local oscillator from a master unit. The company also offers a companion six-band preselector when filters are not employed, which is controlled by the tuner, and built-in-test functions are integrated within. It is available in standard, high-gain and wideband versions.

Zeta has also recently introduced the Model Z0823 wideband acquisition module to accompany the Model Z0609 or other radios and tuners. It can be used as a 190-MHz, 14-bit ADC, digitizing two wideband channels and continuously forwarding them over its 1-Gb/sec data link for processing. It can also be used as a self-contained signal processor, using its FPGAs to filter and decimate or demodulate complex waveforms and forward the results via Gigabit Ethernet for archiving or spatial processing. The Model WAQ can be used with various hosts and can store three Virtex 5 FPGA loads. It has a 1-s DRAM time delay buffer to enable first-symbol demodulation of transient communication signals.

There are dozens of other companies across the world that are developing and manufacturing advanced ELINT receivers. In North America, this includes Rockwell Collins, Northrop Grumman,

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ITT, Ultra Electronics Telemus, Sierra Nevada Corp., and Argon ST. European ELINT receiver developers include Thales, EADS, Patria, QinetiQ and EONIC. In Israel, Elta and Elisra are the major ELINT companies. There are, of course, many more – too many to cover here.

A PROMISING FUTURE

The continuous expansion of the commercial wireless communications market and demands for RF and microwave devices with higher performance in smaller packages will play a role in allowing ELINT receiver designers to meet these challenges, at lower cost. "We'll be able to increase the performance of tuners because of the availability of parts we didn't have even five years ago," said Cobham's Andy Humen. "We need to be quick to incorporate these products. When bandwidth is increased, so is the amount of signal content, so instantaneous dynamic range will be a key factor. We'll need to handle signals with high instantaneous dynamic range that can appear as you're tuning around while retaining linearity to ensure the ADC can do its job."

High on the list of challenges for ELINT designers at Cobham are antennas in front ends in which phase matching, phase calibrating and close-spaced centers require extensive modeling and testing in chambers. Another challenge lies in getting the heat out of the system. "As you become more involved in the digital world, the more you ask of processing components, the hotter they run. So, getting the heat out is essential for reliability and ensuring the system performs as expected for its lifetime," said Humen.

Cobham also designs wideband spiral antennas and apertures for ELINT systems, and it is working on designs with applications well into the millimeter-wave region. The work includes direction-finding array apertures and is using some apertures for geolocation and ELINT. The company has built antennas into a UAV fuselage, where it is embedded in the winglet to provide an omnidirectional pattern and broad bandwidths.

Looking out to the technology horizon, DARPA has been tackling SIGINT system SWAP challenges under its "Channelized SIGINT/ELINT Receiver for UAV Apps (CHaSER)" program. This effort, completed in 2009, focused on developing a photonic RF receiver that can significantly reduce the SWAP while dramatically improving performance. In 2008, DARPA awarded the CHaSER development contract to OEWaves, a photonics company that has developed two core technologies, the optoelectronic oscillator (OEO) and whispering gallery mode (WGM) optical resonators. According to the company, the phase noise performance of the OEO surpasses that of conventional microwave oscillators "by at least three orders of magnitude." In addition, the company believes that WGM optical resonators with crystalline material enable ultra-high quality factor (Q) microwave and optical filters, and novel photonic microwave receiver architectures. Both of these technologies could yield significant SWaP advantages in future SIGINT and (eventually) EW systems. With CHaSER now completed, the company is continuing this development work for DARPA under a follow-on contract awarded last year. Assuming DARPA achieves its goal, an EW system based on this technology would be well suited for small platforms, such as UAVs and unattended ground sensors, providing wideband signal collection and processing capabilities that were once only possible on larger platforms.

The future will continue to bring newer more sophisticated radars featuring new waveforms and techniques and operating across more frequencies. These types of developments will demand new approaches to ELINT receiver design, beginning at the component level. As ELINT receiver designs shrink, while at the same time providing more capability, these trends will enable powerful ELINT systems to be widely fielded on a variety of small, tactical platforms that can operate close to enemy radars and other emitters rather than collecting signals from large platforms operating at stand-off distances. That day is much closer than we may think.

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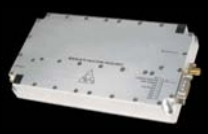

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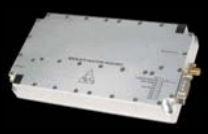

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A Structural View of E

Editor's Note

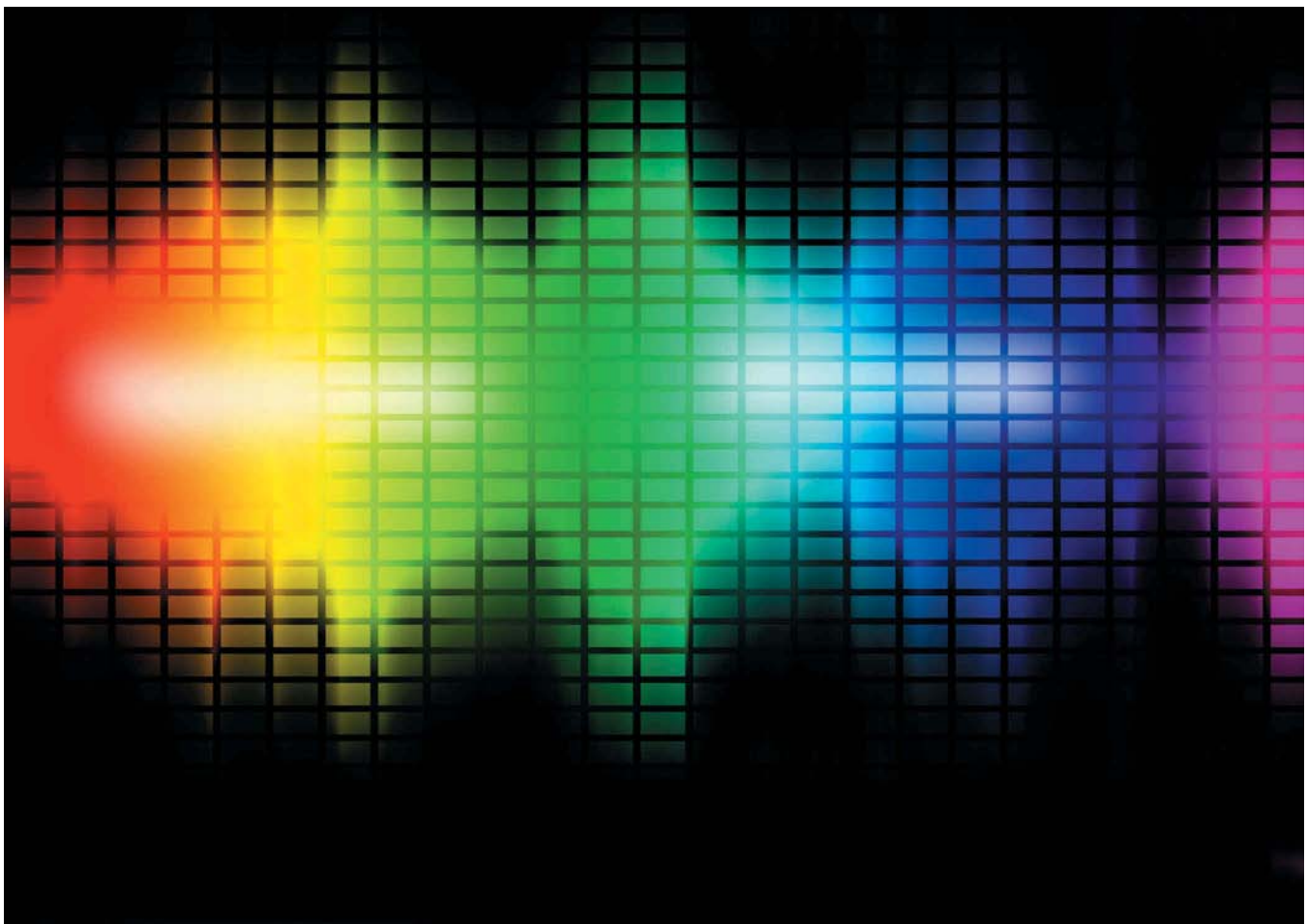
For the past year, US Strategic Command has been developing a new concept known informally as Electromagnetic Spectrum Warfare (EMSW). EMSW differs from electronic warfare (EW) as described in joint doctrine. It builds on the foundation of EW (electronic support, electronic attack and electronic protect) and adds more EMS-related roles and functions. For example, EMSW addresses the role of frequency management or EM Spectrum Management (EMSM), and it introduces the role of EM Battle Control (EMBC).

One of the major factors driving the DOD's push into establishing EMSW is the growing concern among combatant commanders that the DOD as a whole needs to recognize the importance of the EM Spectrum in today's operations. The US and other countries are creating net-centric fighting forces, but they continue to treat the medium upon which those forces depend – the EMS – as a freely available and unlimited resource. This is an incorrect and outdated assumption that will lead to serious mission failures in future military operations.

The DOD leadership has recognized this problem and it is exploring how to better organize, train and equip to achieve EMS Control in the battlespace via the fused efforts of EMSW and EMSM, under direct operational leadership. DOD leaders have made it clear that current EW terminology is not sufficient to describe the concepts, functions, and *requirements* of EMSW. Gen James Cartwright, Vice Chairman of the Joint Chiefs of Staff and Chairman of the Joint Requirements Oversight Council, has stated quite clearly that he wants a lexicon change to be part of the DOD's push into warfare for control of the Spectrum. The following article concisely discusses the foundation and structure of EMSW and recommends a set of working terms from which we can begin to develop a new lexicon that works both within the EW community and communicates EMSW effectively to leaders and organizations outside the community.

It is essential, when reading the following article, to avoid focusing too much on the proposed terms of EMSW, because these terms may change. It is far more important to understand and digest the concepts and intentions behind those terms. These are the ideas that are driving EW into the larger more strategic arena of EMSW, and these are the enduring concepts and *realizations* defining the future of our EW, or should I say *Spectrum Warfare*, community.

– John Knowles



M Spectrum Warfare

By Jesse Bourque

The EMS is all radiated analog electromagnetic energy. Five of our warfighting domains – Land, Air, Sea, Space and Cyberspace – can be categorized as physical or physics-based continua, within, from, and through which decisive attack, deception, concealment, maneuver, and effects delivery can be conducted and measured by military forces. This "shared essence" applies also to another physical *maneuver space*, the electromagnetic spectrum. Thus, the EMS exists as our newest warfighting domain.

We have grown comfortable with a tactical, reactive, capability-centric view of electronic warfare, which has driven a raft of other detrimental behaviors, over time. The term "EW" itself is arguably dead language despite its majestic legacy, because it distracts us from the essential understanding that Warfare in the Spectrum isn't a group of things or *electronics*, or even the fixation on information many want it to be. It is instead the critical range of "top-down" *operations* and *responsibilities* centered on controlling the energy of the EM spectrum for operational use, or achieving EM

The term "EW" itself is arguably dead language despite its majestic legacy, because it distracts us from the essential understanding that warfare in the spectrum isn't a group of things or electronics, or even the fixation on information many want it to be.

GLOSSARY OF EMS WARFARE TERMS

Electromagnetic Spectrum Domain (EMSD): A global domain consisting of the range of frequencies of freely radiated analog electromagnetic (photonic) energy, from zero to infinity.

Electromagnetic Spectrum Control (EMSC): The condition of durable advantage in an electromagnetic operating environment for the times, locations and durations necessary to achieve campaign objectives at minimum possible risk to friendly forces.

Electromagnetic Operating Environment (EMOE): A region within the EMSD in which friendly military, adversary, commercial or civilian activities occur or could conceivably occur, including energy radiated from other sources; unintentionally radiated energy; and naturally occurring background emissions; as well as any electromagnetically-compatible aperture that may be invoked to transmit or receive EM energy.

Electromagnetic Spectrum Warfare (EMSW): A mission area including any action involving the use of radiant electromagnetic energy to control the electromagnetic operating environment, to protect friendly personnel, facilities, equipment, and or to attack the enemy. The *subdivisions* of electromagnetic warfare are electromagnetic spectrum attack (EMSA), electromagnetic spectrum exploit (EMSE) and electromagnetic spectrum protect (EMSP).

Electromagnetic Battle Control (EMBC): An interrelated system of systems/processes for cross-Domain EMS operational synchronization via adaptive awareness, planning, visualization, force allocation, mission execution and assessment.

Electromagnetic Spectrum Attack (EMSA): A subdivision of the EMSW mission area involving the use of electromagnetic energy, directed energy, or anti-radiation weapons to attack personnel, facilities or equipment with the intent of degrading, neutralizing or destroying enemy combat capability, that is considered a form of Fires.

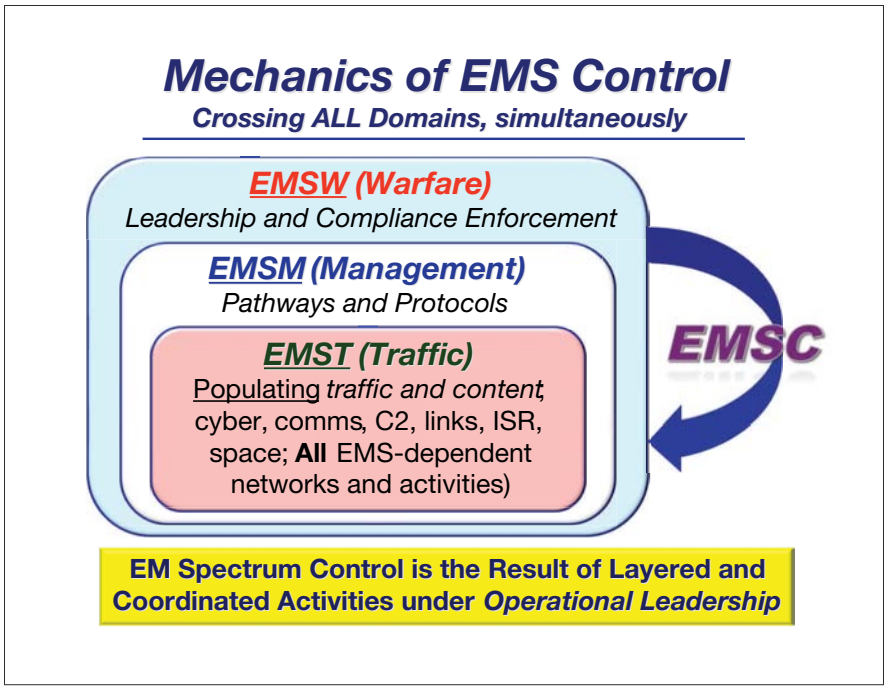
Electromagnetic Spectrum Exploit (EMSE): A subdivision of the EMSW mission area involving actions taken to search for, intercept, identify and locate or localize sources of intentionally and unintentionally radiated EM energy for the purpose of immediate threat recognition, EM interference (EMI) remediation, targeting, planning and conduct of future operations. EMSE is operational collection performed for immediate operational use and not for subsequent analysis.

Electromagnetic Warfare Protect (EMSP): A subdivision of the EMSW mission area involving technology or process *attributes* intended to protect personnel, facilities, and equipment from any effects of any uses or incidences of EM energy that degrade, neutralize or destroy friendly combat capability.

Electromagnetic Spectrum Operations (EMSO): The total military contribution to the EM energy within an EMOE, including Energy anticipated for passive reception or collection for operational purposes.

Electromagnetic Spectrum Management (EMSM): An *essential enabler* of EMS Control involving actions taken to provide and administrate a robust, adaptable, and responsive framework for EMS Traffic.

Electromagnetic Spectrum Traffic (EMST): Routine non-adversary spectral content or planned frequency usage within an EMOE, requiring the management and protection of EMSM and EMSW, respectively.



spectrum control. The term EMS warfare, or *spectrum warfare*, logically follows from that understanding. This understanding will compel us to pursue meaningful, effective solutions, by providing a system to develop and acquire capabilities coherently, solve our shared problems more durably, anticipate and address the genesis of threats and not just their symptomatic effects, spend scarce resources more efficiently and negotiate conflict more quickly.

THE EMS DOMAIN

Previous thorough and well-informed discussion in *JED* has provided ample justification for acceptance of a Spectral Domain, so justification will not be visited again here and a description will suffice. The "EMS Domain" (EMSD), like the Space Domain, is essentially infinite and its contents are un-fixed in time and geo-space. It is analogous to the whole Land Domain, the whole Sea Domain, the whole Air Domain, etc, in that much more of it exists than could ever be used or experienced all at once. But uniquely among the domains, the EM Energy of the EMS Domain maintains three simultaneous forms, or *states*: as a medium, a transport layer and a weapon.

An EM Environment (EME) or EM Operating Environment (EMOE) is one of many subsets of the EMS Domain that we could be expected to create, populate, or withstand during military operations. (The concepts of EME and EMOE are functionally synonymous. As such, EMOE will be used here to represent both concepts, as it obligates

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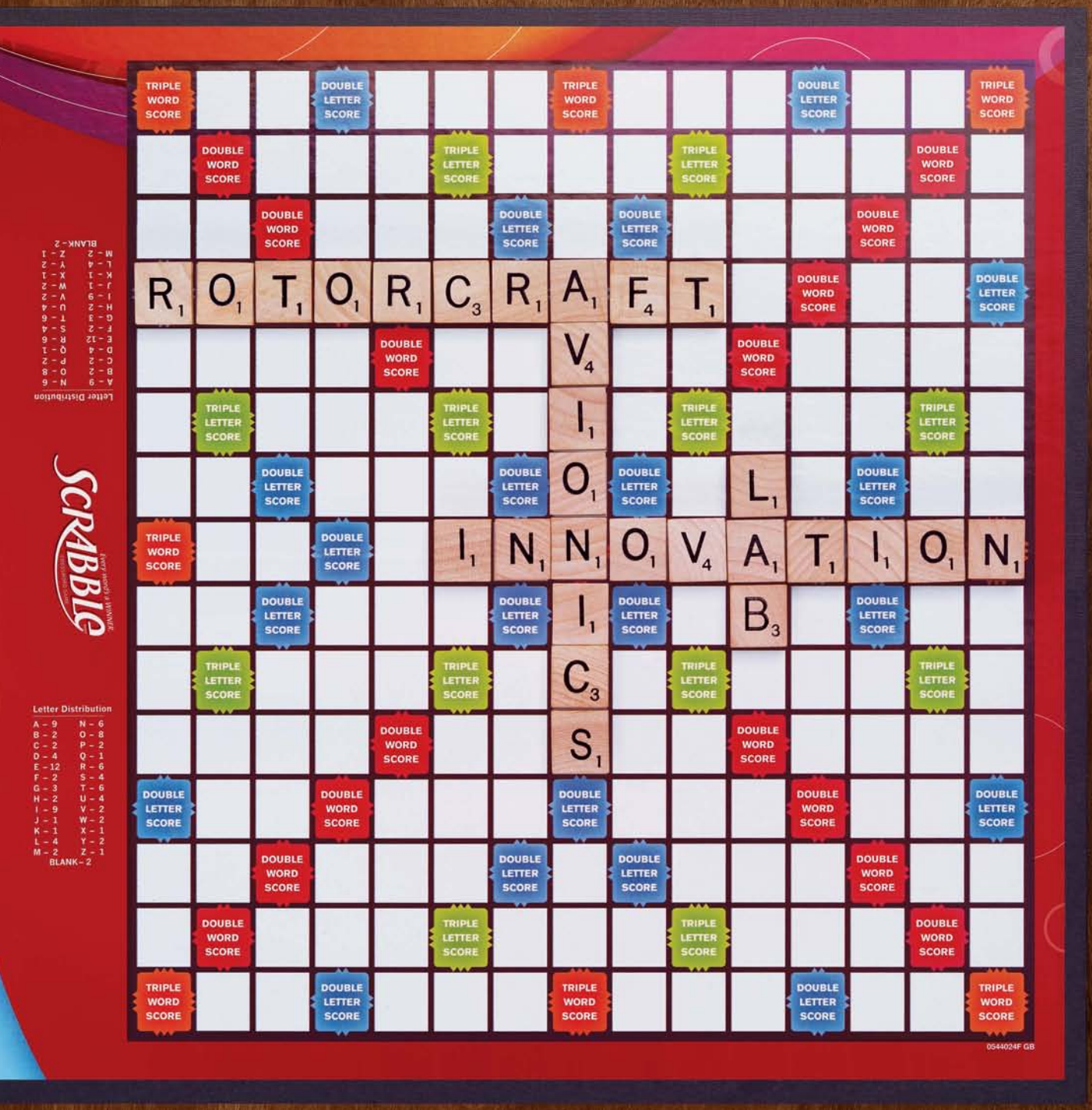

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the user to consider *operations* in every case.) An EMOE is a portion of the EMS definable in time, geo-space, relative energies and behaviors. In short, EMOEs are portions of the EMS Domain that correspond to Joint Operations Areas – just as in the Land, Sea and Air Domains.

THE THREE STATES OF SPECTRUM

To appreciate the full extent of EMS utility and responsibility, we must learn to think of the EMS Domain as having three distinct modes or "states." The EM energy of the EMSD can be thought of as a *medium* for containing or concealing the existence or movement of things, a *transport* capability for other important things, and a *weapon* for denying, disrupting or destroying things.

In practical terms, EM Spectrum energy provides noise and ambient emissions for masking covert communications and other sensitive propagation and this utility must be studied and well-understood in order to optimize capabilities development, exploitation of emissions, and EMS Management. Its most popular role is in transporting data and information from aperture to aperture of all EMS-dependent networks. Lastly, the energy itself is also used as a weapon in the case of EO/IR, laser, DE, plasma, HPM, EMP and gamma weapon applications, which do not seek to convey or conceal information, they convey energy, for both non-lethal/non-destructive or lethal/destructive purposes.

The important take away here is that it's NOT just for transport as many contemporary discussions or graphics would have us believe, although EMSW must remain committed to those missions as well.

EM SPECTRUM WARFARE

Upon superficial observation, one might conclude that EMSW is essentially EW, rebranded. This is because although our doctrine for EW is described well, it is named poorly and historically, implemented incoherently from a Joint warfighting perspective. So as there are salvageable pieces – which will appear as legacy similarities – we are obligated to identify and address the empirically failing portions in order to afford future warfare for the Spectrum the largest possibility for success.

EM Spectrum Warfare (EMSW) exists to provide superiority in our control and use of the EM energy in the EMS Domain and its EMOEs. Like EW, EMSW includes exploit, attack and protect functions. In more specific terms, as Red forces attempt to maneuver within the EMS, Blue EMS Exploit (EMSE) adaptively senses Red actions and Blue EMS Attack (EMSA) may then be engaged to deny, deceive, degrade, or destroy

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Red effort, equipment, personnel, or facilities. As Blue forces experience operational stress due to congested or contested EMOEs (i.e., friendly interference and enemy attack), Blue EMS Protect (EMSP) "imposes" robust and survivable attributes onto stressed Blue capabilities and processes (e.g., spread spectrum applications, antenna selectivity, or satellite "flex power"), allowing their missions to survive and succeed. Other examples of EMSP are EMCON procedures, HAVE QUICK, SINCGARS, optical aperture hardening, "ECCM", Faraday cages and multi-spectral low-observables (i.e., stealth).

The EMSW mission area functions as the dominant participant in the EMS maneuver space as the necessary, unique "compliance enforcement" mechanism over all routine or common Blue and Red EM Spectrum "content," such as all C4ISR, sensors, data links, air defense systems, space vehicle interconnectivity, etc. Additionally, EMSW includes EM fires – both lethal and non-lethal – such as high energy lasers, electromagnetic pulse weapons and high-power microwave weapons.

MANEUVER IN THE EMS DOMAIN

The concept of Spectrum Maneuver is very simple, and adheres to the precedent set by physical maneuver, being a *manipulation of state in three dimensions, over time*. But the three dimensions here aren't physical as much as *physics*. That may help to explain our difficulty reconciling this new concept of maneuver. For the three dimensions in *this* physics-based maneuver space, I can control *spectrum* (frequency, modulation and waveform), *space* (location, directionality, and shape), and *power* (amplitude, relative gain, and ERP) – and leverage *time* (real-time and relative phase) – just like maneuver in the other four natural domains. We're just not used to thinking of it in this way yet.

EM SPECTRUM RELATIONSHIPS

The role of EM Spectrum Management (EMSM) is a critical element in managing EMST and reducing congestion in EMOEs. EMSM shares much in common with today's EMS frequency management and provides the essential protocols and structure for EM Spectrum Operations (EMSO).

To provide more perspective, envision the EMS as three concentric layers of activity. (See **Figure 1.**) The first layer, *EMS Traffic* (EMST), comprises the EMS *users*, such as radars, EO/IR sensors, comms, GPS, links, Space, etc., that must be protected against interference and adversary EMS attack. *EMS Management* (EMSM) comprises the second layer and provides the management, structure and standards for EMST behaviors. In essence, EMSM maintains the "roads" (or frequencies) that EMST uses. *EMS Warfare* (EMSW) forms the third, outer layer, monitoring adversary use of an EMOE via EMS Exploit, denying adversary access to an EMOE via EMS attack and ensuring Blue compliance with the Blue EMS/battle plan via EMS protect. As such, EMST *populates* the EMOE, while EMSW and EMSM *defend* it, creating EMS control for EMST's benefit.

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Under today's paradigm, the operational EW community (represented by the J3) and the frequency management community (represented by the J6) do not integrate effectively. Under the new concept, EMSW and EMSM, beginning with the *EMS Domain* as the unifying frame of reference instead of their respective *electronics* as a constant source of dispute, are more completely integrated. Fortunately, an opportunity now exists to formally incorporate operational EM spectrum management expertise into the fold of EMSW, because the effects of EMSM actually accomplish *EMS Protection* and the J-6 structure is soon to be dissolved by direction of the Secretary of Defense. It has always been true that EMSM has performed an essential portion of "EW's" protection mission *("…actions taken to protect personnel, facilities, and equipment from any effects of the EMS that degrade, neutralize, or destroy friendly combat capability…");* the SECDEF's decision delivers a tailored opportunity to realign our organizations based upon enduring operational responsibilities instead of legacy identities or ownership.

PULLING THE PIECES TOGETHER

We will fail in our efforts to achieve operational superiority in the EMS Domain unless we act *together*. That is, we will not do these things *effectively* until we plan to do them *coherently*, supported by:

a) intelligent/adaptive EMS-related capabilities acquisition and development (e.g., minimize Rapid Acquisition Authority);
b) compatible/interoperable EMSW capabilities within and across Services;
c) responsive machine-to-machine EM reprogramming across all EMS-relevant capabilities (not just "EW" systems);
d) platform-agnostic and meta-tagged databases shared over service oriented architectures (SOA) via standardized data exchange protocols; and
e) a truly Joint (i.e. cross-Domain, All-Service) EM Battle Control (EMBC) system of systems, ensuring Operational EMSO synchronization via adaptive awareness, planning, visualization, force allocation, mission execution and assessment.

The harmonized union of these fundamental efforts, assembled as described above and protected by one Joint, expert, operational overseer, will deliver the critical condition of advantage within our EMOEs for the times, locations, frequencies, and durations necessary to accomplish and enable campaign objectives. This operational end state is best described as *EM Spectrum Control* (EMSC).

Jesse "Judge" Bourque is a Manager of Spectrum Warfare Integration and Development for Northrop Grumman Technical Services. Throughout a 20-year career in the US Air Force, he served in many EW roles in Special Operations and in Joint assignments, including director of the EW Cell for Multi-National Corps-Iraq, Deputy Director of the 318th IO Group (USAF), and Director of Operations for the Joint EW Center at US Strategic Command. He is a member of the AOC Board of Directors.

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LESSONS FROM THE OPERATIONALIZING INTELLIGENCE FOR ELECTRONIC WARFARE IN THE 21ST CENTURY CONFERENCE

On July 27-28 the AOC held its first Intelligence and Electronic Warfare conference at the National Air and Space Intelligence Center on Wright-Patterson Air Force Base, Ohio. Titled "Operationalizing Intelligence for Electronic Warfare in the 21st Century," the conference's principle objective was to foster a better integration of Intelligence and Electronic Warfare.

As the saying goes "It's all about relationships." And nowhere is that more clear than those forged over the years between intelligence, acquisition and operations. Conference chairman Craig "Magnum" Harm, Col, USAF (Ret.) focused the assembled field at NASIC on ensuring that the relationship is refreshed and healthy. The lineup of speakers centered on these relationships and their respective perspectives. Presenters included technical and scientific intelligence analysts, system acquisition professionals and current operators. The topics discussed were centered on three key themes: Perspectives, Technology and Systems. Each theme was discussed within its own session, led by a senior leader with the respective experience and credentials. This flow gave the attendees the opportunity to take a look at the integration of EW and Intel from various perspectives, learn about the advancement in applicable EW technologies and finally gain an understanding of the impact of these perspectives and technology on EW system development and employment.

With enthusiastic and pointed comments about the increasing emphasis on warfare in the electromagnetic spectrum, Lt Gen Tom Owen, Commander, Aeronautical Systems Center, raised the curtain on the conference. Dr. Brian Kent's, the Chief Scientist Sensors Directorate, Air Force Research Laboratory keynote presentation on Electronic Warfare at AFRL provided the perfect discourse to give everyone a perspective on AFRL's EW activities. His comments on threats and their proliferation across the entire Electromagnetic Spectrum gave everyone a true understanding of the magnitude of the challenge ahead of us. We face countries around the world that don't throw away the older threat systems but are cheaply and effectively modernizing systems with incredible capabilities such as DRFMs readily available on the worldwide market. Meanwhile, with our own fiscal constraints we are unable to recapitalize aging systems, and new systems may be leading edge – but barely.

Day 2's keynote speaker, Maj Gen Thomas Andersen, Air Combat Command, A-8, turned the table on the conference and said the title of "Operationalizing Intelligence" had the modifiers backwards; what we needed to be doing was "Intelligizing Operations;" in fact it's really "Intelligizing S&T, acquisition and operations through execution." As joint operations have matured and technologies begin to converge, the relationships between the J2, 3, and 6 communities have gone through a lot of changes. These relationships are being tested by rapidly evolving threats and the availability of inexpensive but powerful commercial off-the-shelf technologies.

Meanwhile, growing demand for intelligence analysis is creating tension between time-dominant (immediate/on-seen) intelligence and content (deep-dive/long-term) intelligence. The intelligence community can only provide that time-dominant intelligence by maintaining content dominance on threats and capabilities. Technologically, threat content has been evolving at such an incredible rate and the demand for it increasing even more dramatically, that a focused prioritization is needed to prevent making the wrong tradeoffs.

Advanced Technology discussions challenged the audience to consider that as cyber capabilities mature and directed energy weapons proliferate, what will have to change? With a broad scope of topics including TechSIGINT and Electronic Warfare, Intelligence support for Acquisition, Proliferation of Digital Technology, Foreign Material Exploitation, and Current EW Operations, conference participants were actively engaged in addressing what it will take to advance the "intelligizing" of acquisition and operations.

To begin with, while no longer stove piped as before, intelligence must be integrated more horizontally than ever before. It is not enough to just get a threat assessment or intelligence brief at specific decision points in a process. Intelligence analysis must be integrated from start to finish throughout the entire lifespan of a weapons system of operation. With the rapid pace of technological changes and application, intelligence is now driving system development and operations, not just supporting them.

So how do we reintegrate and revitalize intelligence into the EW mission area in an economically austere environment without things like "intelligized" acquisition reform and "intelligized" operations? And how do we actively engage industry without a standardized fabric and infrastructure?

As a result of conference discussions, three common themes emerged for the community to come together and address in order for EW-related intelligence to maintain that content and thus time dominance ability.

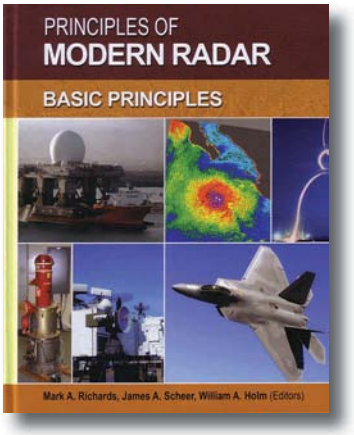
1. Intelligence requirements must be clearly prioritized though a process that brings together an integrated EW mission area: intelligence, acquisition and operations. In a world where everything is a priority and not resourced sufficiently, nothing is a priority. With the technological advances in digital capabilities we must focus clearly, so that we can continue to use the electromagnetic spectrum to achieve our desired effects. This is where operations and intelligence senior leadership must come together and take the lead.
2. The operations, acquisition and intelligence communities must develop standards across Electromagnetic Spectrum Operations. An immediate issue is EW databases and the multiple reprogramming languages now required. A long standing EW shortfall, harmonizing databases, is a growing challenge in all fields. For the EW community, it is now time to define a common standard and develop an infrastructure that can talk and take advantage of a common format.
3. The intelligence interfaces within the entire EW community need to be addressed across the kill chain of operations and the life cycle of systems. How do we use forward sensors more efficiently? How do we target across the growing EW and Cyberspace operational overlaps?

Conferences like this one at NASIC are essential for tapping into people's knowledge, perspectives and the sharing of their passion. They are even more critical to identify the hard issues and develop solutions in today's world of rapidly increasing technology application, constrained resources and complexity of interaction. We look forward to next year's event expanding and building on the foundation set this year at NASIC.

PRINCIPLES OF MODERN RADAR: BASIC PRINCIPLES

By Kernan Chaisson

SciTech Publishing has released *Principles of Modern Radar: Basic Principles*, a book that is becoming the "Radar 101" textbook of choice for the next generation of radar engineers, new-hires in the field, re-training professionals, or as a reference for program managers. This book, running 960 pages, can be a convenient and valuable self-study reference for electronic warfare engineers and planners, providing both computational vigor and functional narrative to help specialists get up to speed on today's radars. Avionics, signal processing, and communications engineers and planners will find this book to be valuable resource in their reference libraries.



Principles of Modern Radar focuses on modern principles, techniques and systems. Included in the 21 chapters are fundamental radar concepts, explanations of phenomenology, a description of the major subsystems of a modern radar, and treatment of the basic signal processing functions that make modern radar what it is today. The text strikes a balance between quantitative mathematical models and qualitative descriptions and insights. The authors were careful to balance range of topics versus depth of coverage relative to systems and external phenomenology.

To create this uniquely "community-driven" radar textbook, the publisher enlisted a broad cross-section of radar content advisors from industry, government and academic settings. Three book editors, Dr. Mark A. Richards, James A. Scheer and Dr. William A. Holm, authored chapters themselves and enlisted an additional 12 subject expert chapter contributors.

Each chapter includes a series of self-study problems – over 250 total – with half of the answers provided in an appendix. They can help both in a classroom setting or for self-study readers in both the radar field and EW specialists. In addition, several instructor aids are available to course instructors who adopt the book. More instructor aids are in development. A request to pomr@scitechpub.com can provide all answers to the self-study problems. Also included are copies of all equations; each is available in Microsoft Equation Editor format. MATLAB® simulations will be consolidated among the contributors who have them now, and additional contributions will be solicited from the radar community.

There has been a steady stream of confirmed adaptations from several universities and corporate training programs, including the Air Force Institute of Technology, Penn State, Michigan Tech, Auburn Univ., Univ. of Central Florida, Wright State, Johns Hopkins Applied Physics Lab, Utah State, BYU and the Lockheed Martin and Northrop Grumman corporate training groups. SciTech maintains the growing list on the Principles of Modern Radar Web page together with instructor comments.

SciTech Publishing reports that the Web site is the first step in the development of a comprehensive set of resources for introducing radar systems and technology to a new generation of radar engineers. A separate website has been established to provide readers with supporting material, a complete and up-to-date list of reported errata, and an evolving set of new supplements and related books. This site is www.scitechpub.com/pomr.

Principles of Modern Radar Volume 2: Advanced Radar Techniques & Applications, edited by William Melvin and James Scheer, and a Study and Companion Guide by Byron Edde are slated to come off the press by Spring 2011. Also available from SciTech is a handy Pocket Radar Guide: Key Radar Facts, Equations, and Data by Richard Curry. A matching pocket guide for EW by Dave Adamy is due soon. Both will be useful companions to Principles of Modern Radar.

Principles of Modern Radar: Basic Principles is published by SciTech Publishing, Raleigh, NC, ISBN 978-1891121-52-4, and can be ordered from their website at www.scitechpublishing.com. The list price is $135 and the Website price is $115.

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EW Against Modern Radars – Part 11

Pulse Doppler Radar

By Dave Adamy

Electronic Protection Features of Pulse Doppler Radars

A Pulse Doppler (PD) radar has inherent Electronic Protection (EP) features, including:

- It expects its return in a narrow frequency range, so it can discriminate against non-coherent jamming.
- It can see spurious outputs from jammers.
- It can see frequency spreading from Chaff.
- It can see separating targets.
- It can correlate range rate and Doppler shift.

PD radars are coherent, because each pulse is a sample of the same RF signal, as shown in **Figure 1**. Thus, both the time of arrival and Doppler shift of received signals can be measured. The time of arrival allows determination of range to the target and the Doppler shift is caused by the radial velocity of the target relative to the radar. As will be discussed later, there are some significant ambiguity issues that must be overcome by PD radar processing.

The processor in a PD radar forms a matrix of range vs. velocity as shown in **Figure 2**. The range cells show the time of arrival of received pulses relative to the transmitted pulse, and each cell is one "range resolution" deep. The time resolution (or the depth of a range cell) is half of the pulse width. This gives the PD radar a range resolution of:

Range cell depth = (pulse width/2) x speed of light

These range cells are contiguous during the whole time between pulses.

The velocity cells are fed by a bank of channelized filters, or channelization by fast Fourier transform processing. The width of the velocity (i.e. Doppler frequency) channels is the bandwidth of each filter. The inverse of the filter bandwidth is the coherent processing interval (CPI), which is the time over which the radar processes the signal. Note that in a search radar, the CPI can be as long as the time the radar's antenna is illuminating the target. Thus, the frequency channels can be very narrow. For example, if the radar beam illuminates the target for 20 msec, the filters could be 50 Hz wide.

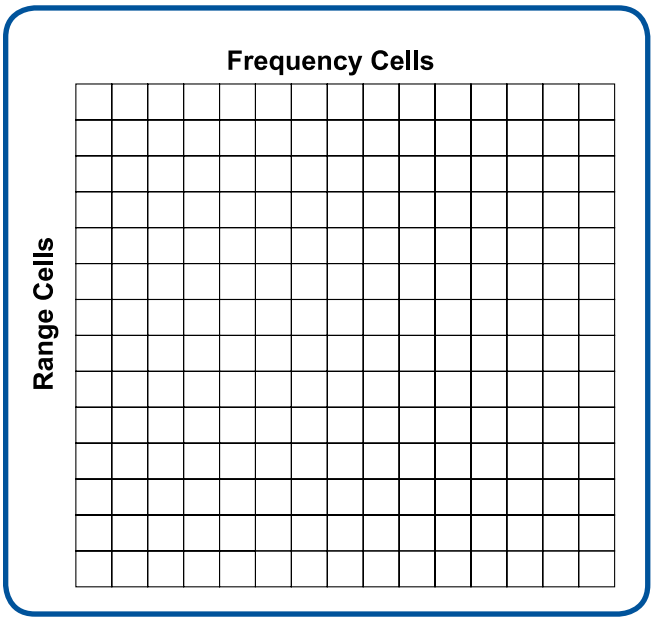

Figure 2: Pulse-Doppler radar processing allows generation of a range vs. return frequency matrix.

The number of pulses that are integrated by the radar determines its processing gain (above the noise level). The processing gain is:

Processing Gain (in dB) is 10 log (CPI x PRF) or 10 log (PRF / filter BW)

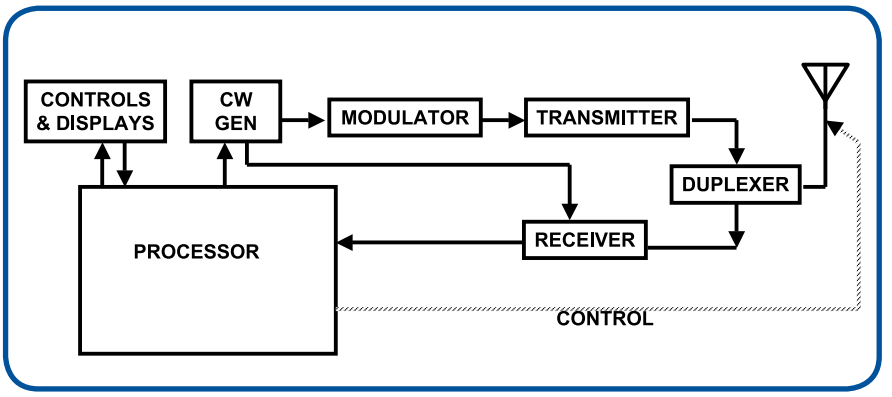

Figure 1: A Pulse-Doppler radar is coherent and uses complex processing to deal with ambiguities.

Separating targets

Consider the use of range-gate-pull-off (RGPO) deceptive jamming (discussed in the January 2010 "EW 101"). **Figure 3** shows the true return pulse and the false pulse generated by the jammer. In a conventional radar, the processor has an early and a late gate (rather than the contiguous range cells of the PD radar).

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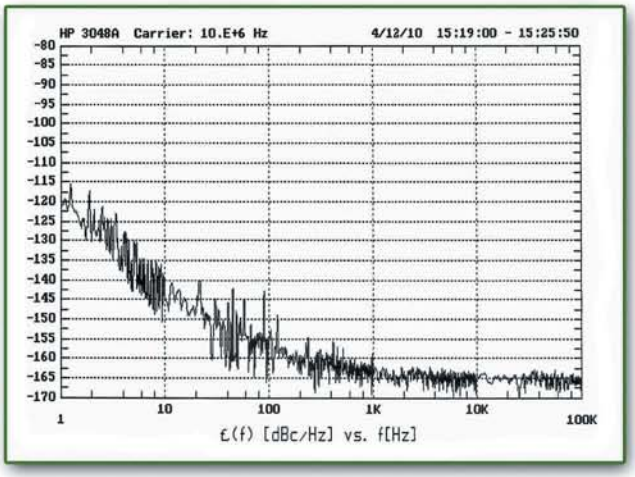

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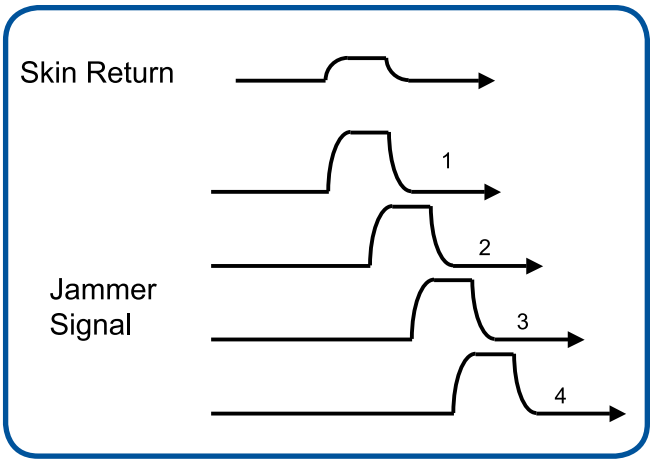

Figure 3: Range-gate-pull-off involves sequential delay of the return pulse, which loads up the radar's late gate.

The jamming pulse captures the range tracking of the radar because it has positive J/S. By delaying each subsequent jamming pulse, the jammer loads up the energy in the late gate, making the radar think the target is moving away. However, a PD radar can see both return pulses (i.e., separating targets). Each of the pulses is placed in the time vs. velocity matrix as shown in **Figure 4**.

The true target return signal will move through a series of range cells with increasing range value. This increasing range indicates a radial velocity. The target return pulses will fall into the velocity cell corresponding to the Doppler shift caused by the true target range rate. However, the jammer pulses are increasing in apparent range because the jammer is delaying the returns. The Doppler frequency cell that holds each jamming pulse will be determined by the actual radial velocity of the jammer. Thus the jammer pulses will fall into velocity cells that do not correspond to the range rate that can be calculated from the changing range indicated

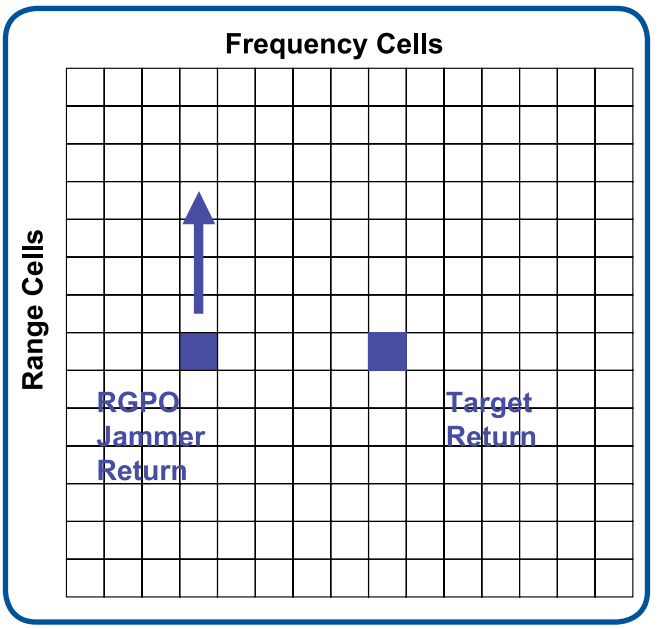

Figure 4: Pulses generated by a RGPO jammer do not have Doppler shift consistent with their rate of change of range.

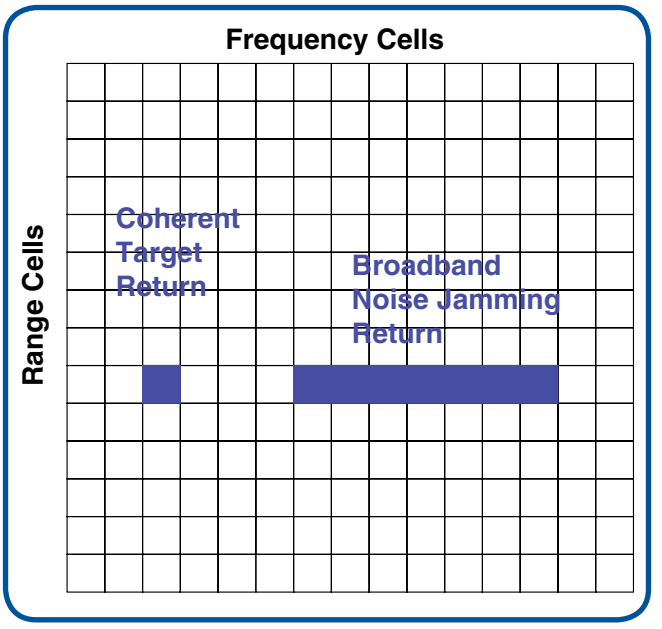

Figure 5: Coherent PD radars observe the target return in a single frequency cell, while their rate of change of range.

in the range cells. This allows the PD radar to select the pulses for which the change-rate of range corresponds to the observed Doppler frequency. Hence, it will continue to track the target – defeating RGPO jamming.

The above discussion is, of course, simplified. Understand that in a dynamic engagement, the target range will most likely be changing – but the time history of the range cells occupied will indicate a radial velocity which agrees with the velocity value indicated by the Doppler filter which contains the return signals. For the jamming signal, the calculated and indicated range rates will be different.

Note that this also allows the PD radar to discriminate against range gate pull in (RGPI) jamming.

In order to overcome this advantage of the PD radar, the jammer must also apply velocity-gate-pull-off (VGPO) as explained in the February 2010 "EW 101." The frequency offset must be coordinated with the rate of range gate pull off to fool the PD radar.

Coherent Jamming

As shown in **Figure 5**, the coherent return from a target will fall within a single Doppler cell. A wideband jamming signal (for example barrage or non-coherent spot noise) will occupy multiple frequency cells, so the radar can discriminate in favor of the coherent target return. This means that a jammer, if it is to deceive a PD radar, must generate a coherent jamming signal.

Note that the scintillation caused by a chaff cloud also spreads the radar signal. The PD radar can detect this frequency spreading and thus discriminate against the chaff return.

What's Next

Next month, we will continue our discussion of the EP features of Pulse Doppler radars. For your comments and suggestions, Dave Adamy can be reached at dave@lynxpub.com.

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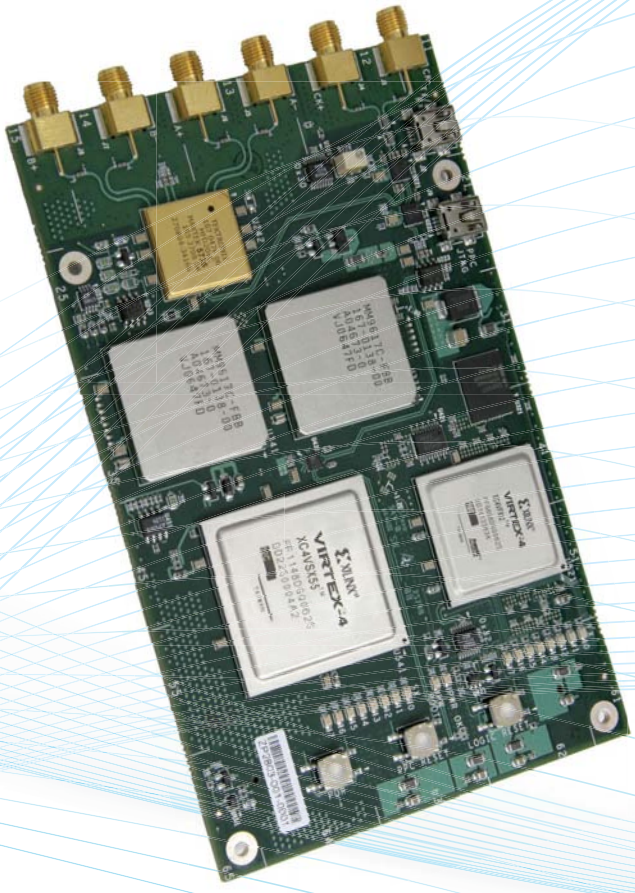

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Peachtree Roost

By C. Nooriel Nolan

Chuck Dunehew, president of Atlanta's Peachtree Roost, the host chapter for the AOC's 47th Annual International Symposium and Convention, is looking forward to hearing about the future direction of electronic warfare (EW) from the senior military and civilian leadership in attendance. As a former US Navy Electronic Countermeasures Officer during Operations Desert Shield, Desert Storm, Northern Watch and Southern Watch (with more than 2,000 combat hours of fly time), Dunehew understands the importance of EW.

Like all AOC chapters, the Peachtree Roost is devoted to preserving and strengthening EW through community forums that promote the exchange of new ideas and technologies. The Peachtree Roost also works closely with Georgia Tech University to encourage future generations to pursue careers in the EW field. Dunehew is proud of his chapter's commitment to inspiring young professionals. The Peachtree chapter recently learned that one of their scholarship recipients has accepted a post-graduation position in EW. "I felt like our chapter contributed to building the next generation of EW professionals," says a proud Dunehew.

Dunehew currently heads the Large Aircraft Integration Branch in the Electronic Systems Lab (ELSYS) at Georgia Tech Research Institute (GTRI). ELSYS researchers are nationally recognized for their countermeasures techniques developed in support of US government agencies. As a Senior Research Associate, Dunehew "integrates federated aircraft defensive systems to provide increased situational awareness and survivability and decreased aircrew workloads in a combat environment." To him, the most important element of EW is ensuring the safety of US soldiers, sailors, Marines and Airmen: "I am most proud when I see something that GTRI has developed, and I say, 'Wow, I wish we had that when I was flying.' When I have that reaction, I know [they] are safer, better trained and more effective because of our work."

Ensuring cyber security, is key in this information age, Dunehew says. With the widespread use of EMS (electromagnetic spectrum) commercial technologies around the globe, countering military attacks from adversaries is much more difficult for the Department of Defense (DOD.) In the past, the DOD had years to develop countermeasures as a system was being developed and deployed. Today, technology can be replaced in as little as three years time. Therefore, systems must become adaptable to keep pace with this constant turnover, predicting how widely available commercial technology could become a threat to future operations. "I am most fascinated in the new importance of COTS (Commercial Off-the-Shelf) systems brought about by the IED threat in Iraq and Afghanistan," Dunehew says.

Given the tech savvy world we live in, it might seem a daunting task for the military to stay ahead of the game. But Dunehew is optimistic. He believes EW is headed toward a broader view of operations in the electromagnetic spectrum. "We now see that we have to be able to operate across the spectrum at will," he explains. The community is broadening its scope to look at the entire EMS and not just the RF (Radio Frequency) portion." Dunehew is confident in the future of EW technology, citing the fact that newer generations are growing up in a world of commercial technology. He believes younger leadership understands the value, and impact, of technology as it applies to all fields and will not need to be convinced of its importance in electronic warfare.

Learn more about the Peachtree Roost by visiting www.peachtreeroost.org.

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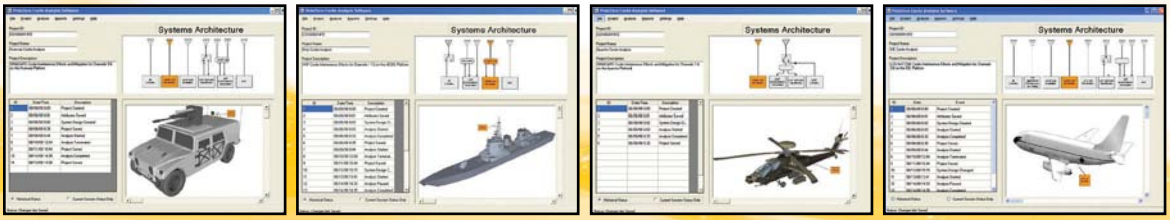

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Dixie Crow Chapter

By C. Nooriel Nolan

Since 1964, The Association of Old Crows (AOC) and its chapters have been dedicated to continued professional dialogue among leaders in the field of electronic warfare (EW) – scientists, engineers, government officials, military personnel, educators and the like. "Electronic Warfare is part of the critical infrastructure of defending the United States," says Lisa Frugé, president of the AOC's Dixie Crow chapter.

Headquartered in Warner Robins, GA, home to Robins Air Force Base, where EW development and sustainment of war fighting capabilities takes place, the Dixie Crows are ideally positioned to see the continued importance of electronic warfare. Their proximity to, and close involvement with, the Warner Robins Air Logistics Center and the Museum of Aviation allows the Dixie Crows the ability to witness continued implementation of new EW technologies.

The Dixie Crows have understood this position, and excelled at leading the EW discussion. Its community outreach provides local, state, national and worldwide communities with social events, technical information awareness meetings, and more than $600,000 in educational scholarship contributions (including the Dixie Crow Scholarship Fund established in 1979 to assist those pursuing degrees in engineering/hard sciences). Its annual EW symposium provides a forum for sharing new EW information. This year's symposium, the 36th, boasted 1,600 registered guests from around the world, the largest Dixie Crow Symposium in event history, Frugé notes, with over half coming from military units and private industry. (Thanks to this yearly event, more than $155,000 has been pledged to the Warner Robins Museum of Aviation to date.) This continued commitment to EW forums and support of education has contributed to the Dixie Crows winning the National AOC's Chapter of the Year Award 11 consecutive years, from 1995 to 2006.

Frugé and other chapter members understand the importance of remaining on top of EW technology. As Forward Deployed USAF Systems and Requirements Manager for BAE Systems in Warner Robins, Frugé routinely interfaces with the Robins AFB personnel on company programs and products. Given that the current warring climate is essentially a technology race, electronic warfare is a large component of U.S. Department of Defense (DOD) strategy, Frugé says. And EW systems must constantly evolve more accurate technologies to remain relevant in the defense realm. "The digital world of today cannot be defeated with yesterday's technology," Frugé says.

THE FUTURE OF EW

Frugé believes the answer lies within the five objectives of the Air Force EWAG (Electronic Warfare Advisory Group): (1) advocate and coordinate efficient/effective capabilities, processes, and infrastructure at all levels; (2) ensure decisions are based on operational gaps, vulnerabilities and/or technical opportunities to counter current/projected threats/targets; (3) foster a collaborative environment with government, industry and academic entities, as required, to advance, sustain and upgrade EW capabilities; (4) synchronize newly emerging technologies into developmental and legacy systems; (5) reduce redundancy to lower overall life-cycle costs; (6) continue to grow in complexity to meet newer threats.

When asked about the future, Frugé notes there is concern about the DOD budget. "Allowing them [virtual/EW technologies] to be unavailable would have a debilitating impact on… the ability of our US government to function." She is adamant about communicating the necessity of EW, and promoting its constant betterment. Frugé admits this is one of her personal challenges along with finding ways to reduce bureaucracy within companies and governments to accomplish tasks quickly. "If I can help in some way to ensure that the warfighter's needs are met to fight whatever current threat exists, I am proud."

Learn more about the next Dixie Crow Symposium online at www.dixiecrow.org.

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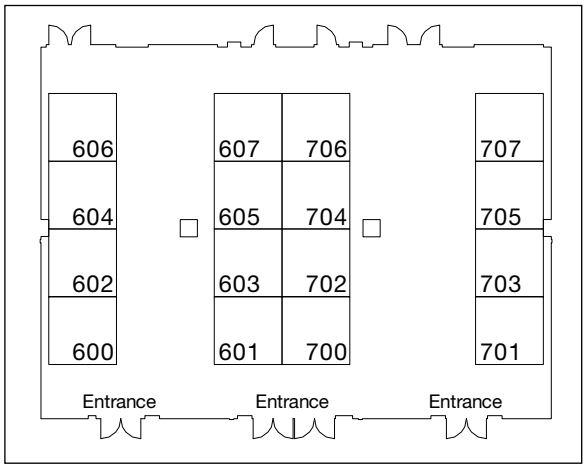

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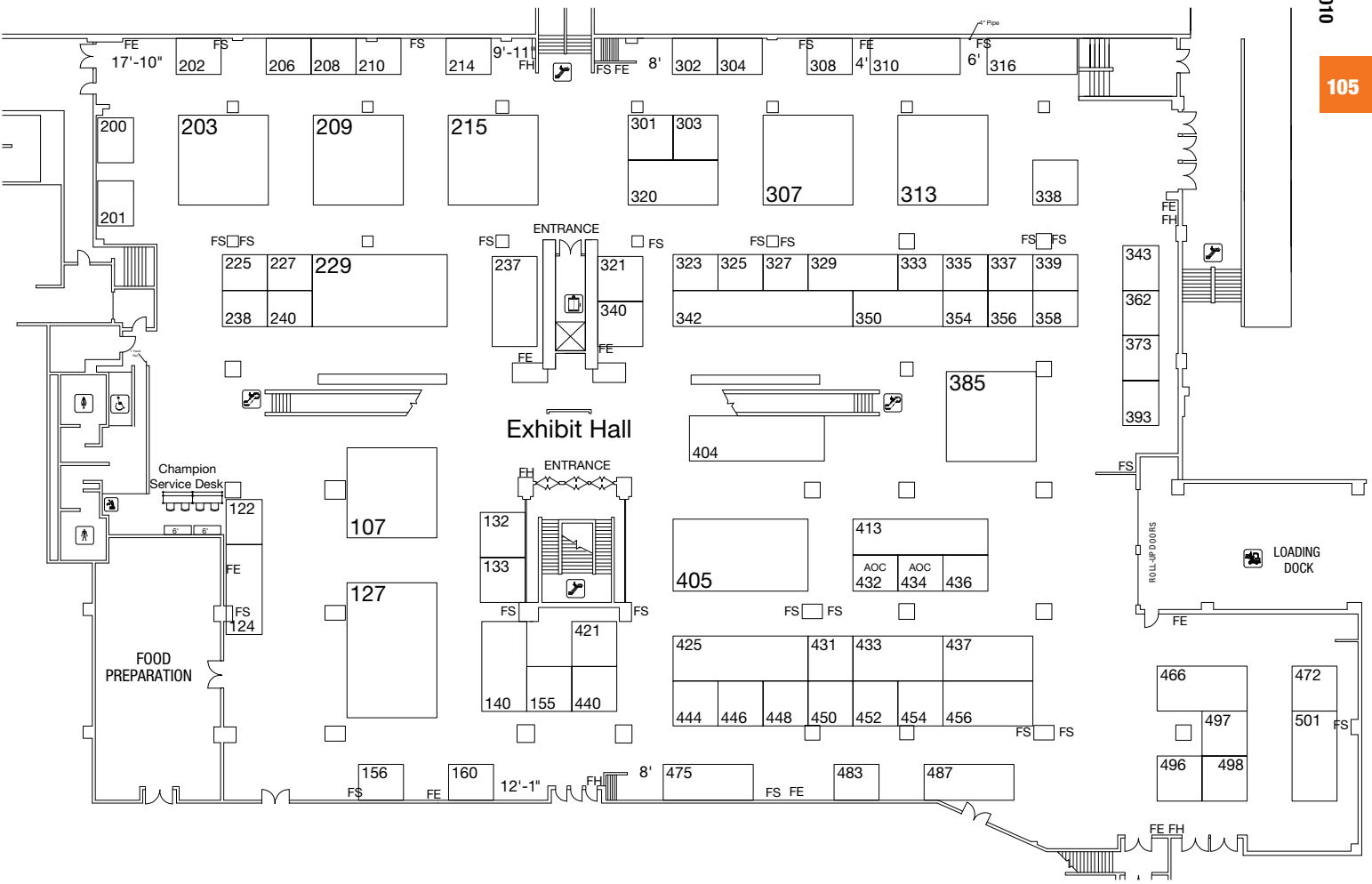

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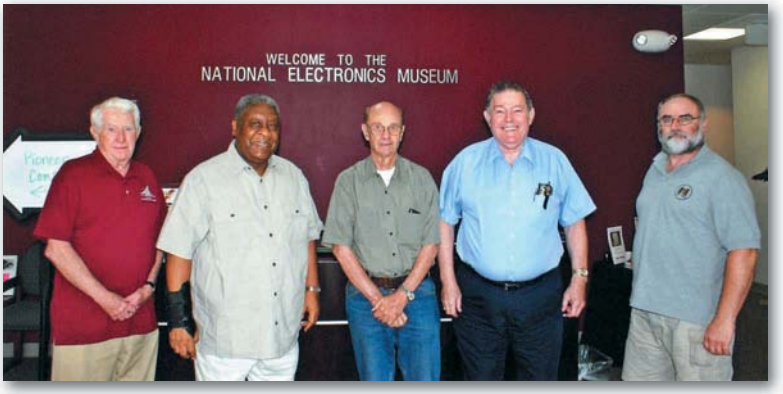

Chesapeake Bay

MEDIUM CATEGORY

CHAPTER OF THE YEAR

Billy Mitchell Chapter

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AOC Chapter Award Winners

SMALL CATEGORY

CHAPTER OF THE YEAR
Prowler Roost

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Date: 2010.09.24 15:41:04 -04'00'

Date: 9/24/2010

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