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JED

The AOC Electronic Warfare Publication
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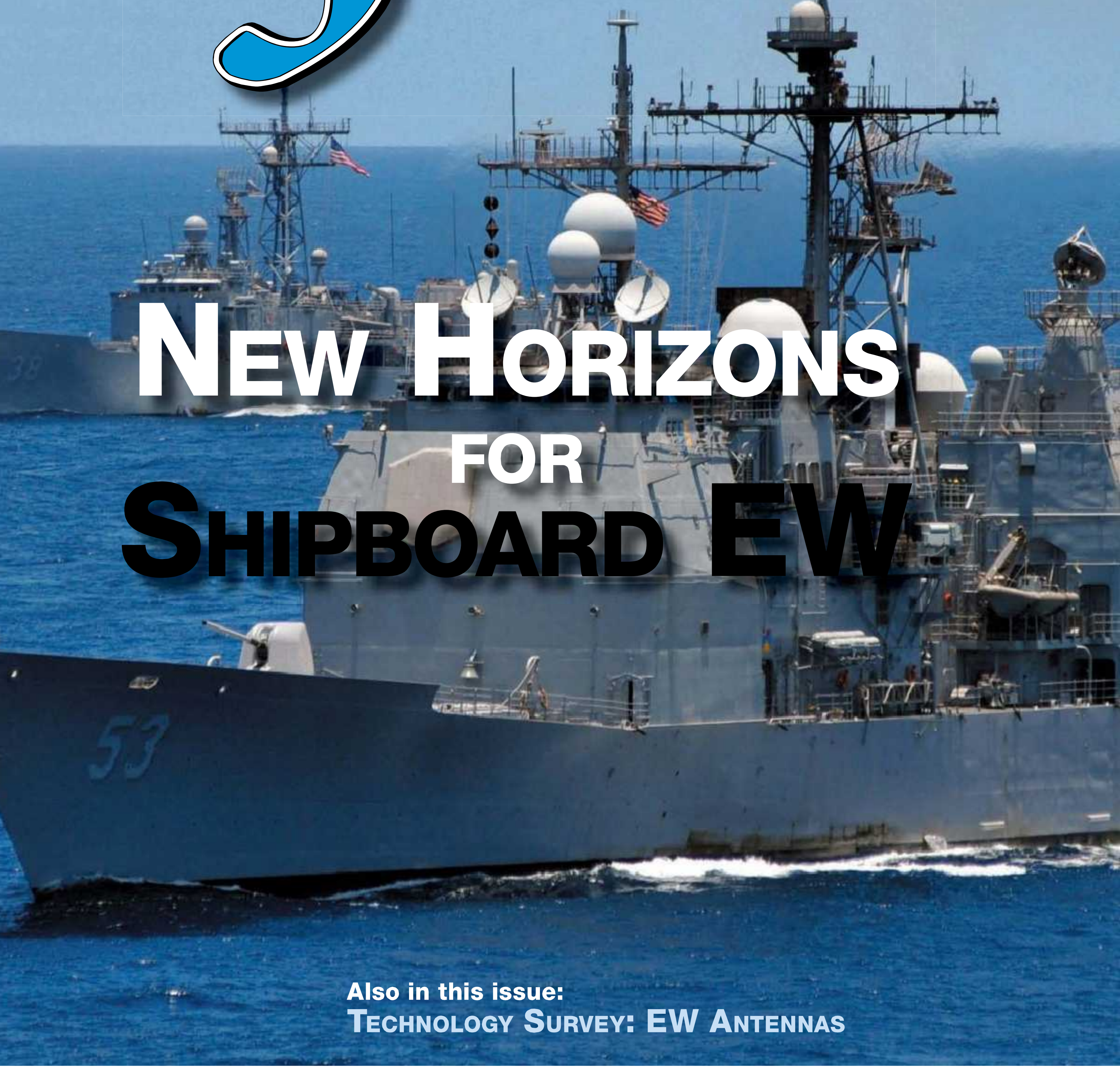
The Journal of Electronic Defense



NEW HORIZONS FOR SHIPBOARD EW

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TECHNOLOGY SURVEY: EW ANTENNAS

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DIGITAL JED

As *JED* enters its fourth decade of publication, we are continuing to evolve the magazine content and the way we deliver it to you. Before you read any further, don't worry, we're sticking with the print magazine. But we are always looking for new ways to improve the product and deliver it more efficiently.

In 1995, we started *JED* On-Line (www.jedonline.com). *JED* was one of the first defense publications to be published online and the staff was very proud of what we had created. As a junior editor on the staff at the time, I remember all too well the unforgiving process of manually typing HTML code (none of the HTML publishing programs were any good) for each article and linking to the referenced stories in the archives. (Fortunately, it was my boss's job to code the many years of back issues and upload them to the archive!) For a first-generation digital magazine, *JED* On-Line was a very good (and very unique) product. After many years, however, *JED* On-Line began to languish. Fortunately, the AOC brought it back in 2006, and it has been available (with back issues dating to January 2002) since that time.

This month, *JED* On-Line will undergo another transformation as we begin publishing it in a new digital format. Using technology developed by Nxtbook Media, the digital edition of *JED* will be much more interactive and enjoyable to read.

I have to confess that I am something of a skeptic when it comes to digital magazines because I have rarely come across one that is easy to navigate. However, I think you'll find that the digital edition of *JED* is a huge improvement over the PDFs and Web pages you used to read at *JED* On-Line. A few other publications have started using similar technology, as well, so you may already be familiar with it. If you are new to the technology, I recommend taking a few moments to play with the digital *JED* and learn some of the features. It is incredibly intuitive and does a great job of functioning like a print magazine.

The "legacy" *JED* On-Line site is still available if you want to search for *JED* articles between 2002 and 2008. Going forward, the Nxtbook version of JED will carry all articles published from January 2009 onward.

Another advantage to the digital edition of *JED* is our delivery system. Yes, you'll still receive your print edition of *JED* in the mail every month. But well before it arrives in the mail, you can receive e-mail notification indicating that your digital *JED* is available. The only thing you will need to access the digital *JED* each month is your AOC username and password. (The same one you have always used to access *JED* On-Line.) If you don't have one, go to www.myaoc.org and create it in just a few seconds. It's that easy.

We have some very interesting stories planned for *JED* in 2009, and I hope you enjoy reading your print and digital editions in the coming months.

– John Knowles

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JED The Journal of Electronic Defense

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JANUARY

AUSA Army Aviation Symposium and Expo
January 7-9
Arlington, VA
www.ausa.org

Surface Navy National Symposium
January 13-15
Crystal City, VA
www.navysna.org

Army Land EW Conference
January 20-22
Chantilly, VA
www.myaoc.org

AAR-47 MWS Conference
January 21-22
Clearwater, FL
www.atk.com

FEBRUARY

AFCEA West
February 10-12
San Diego, CA
www.afcea.org

Aero India 2009
February 11-15
Bangalore, India
www.aeroindia2009.com

Defexpo India 2009
February 16-19
New Delhi, Delhi
www.defexpo.com

IDEX 2009
February 22-26
Abu Dhabi, UAE
www.idex2009.com

AOC Capitol Hill Conference
February 24-25
Washington, DC
www.myaoc.org

AOC Capitol Hill Awareness Day
February 25-26
Washington, DC
www.myaoc.org

Air Warfare Symposium
February 26-27
Orlando, FL
www.afa.org

MARCH

Avalon 2009
March 10-15
Geelong, Victoria, Australia
www.airshow.net.au/avalon2009

Dixie Crow Symposium
March 22-26
Warner Robins, GA
www.dixiecrow.org

APRIL

Latin America Aero & Defence (LAAD) 09
April 14-17
Riocentro, Rio de Janeiro, Brazil
www.laadexpo.com

FiestaCrow 2009
April 19-23
San Antonio, TX
www.bmcaoc.org

InfowarCon 2009
April 23-24
Washington, DC
www.myaoc.org

MAY

Navy League Sea-Air-Space Exposition
May 4-6
National Harbor, MD
www.seaairspace.org

2nd Crane Annual EW Gaps and Capabilities Conference
May 5-7
Crane, IN
www.myaoc.org

AOC/Shephard EW 2009
May 13-15
London, UK
www.shephard.co.uk

For more information on AOC conferences, visit www.crows.org.


MT4100

FEBRUARY

Fundamentals of EW
February 2-6
Alexandria, VA
www.myaoc.org

NATO EW Course (1)
February 9-13
Florennes AFB, Belgium
www.tip.be

NATO EW Course (2)
February 23-27
Florennes AFB, Belgium
www.tlp.be

Digital Radio Frequency Memory (DRFM) Technology
February 24-26
Atlanta, GA
www.pe.gatech.edu

MARCH

Introduction to Radar and EW
March 2-6
Alexandria, VA
www.myaoc.org

EW - Communications
March 9-11
Shrivenham, Swindon, UK
www.cranfield.ac.uk

PSYOP Course
March 9-13
Alexandria, VA
www.myaoc.org

Modeling & Simulation of RF EW Systems
March 24-27
Atlanta, GA
www.pe.gatech.edu

Radar ESM
March 30-31
Shrivenham, Swindon, UK
www.cranfield.ac.uk

Radar EW
March 30-April 3
Shrivenham, Swindon, UK
www.cranfield.ac.uk

APRIL

Radar Countermeasures
April 1-3
Shrivenham, Swindon, UK
www.cranfield.ac.uk

CONOPS Course
April 6-8
Alexandria, VA
www.myaoc.org

Directed IR Countermeasures: Technology, Modeling and Testing
April 21-23
Atlanta, GA
www.pe.gatech.edu

Basic RF EW Concepts
April 21-24
Atlanta, GA
www.pe.gatech.edu

MAY

Fundamentals of EW
May 4-8
Alexandria, VA
www.myaoc.org

IR Countermeasures
May 12-15
Atlanta, GA
www.pe.gatech.edu

JUNE

Advanced EW Course
June 1-5
Alexandria, VA
www.myaoc.org

Basic RF EW Concepts
June 9-12
Atlanta, GA
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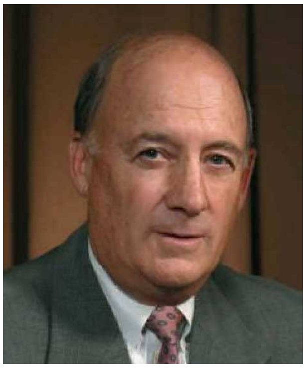

HELICOPTER ASE

The AOC will draw attention to aircraft survivability equipment (ASE) for helicopters in 2009 by making it a part of our 2009 Policy Agenda. Among other things, we will use this Agenda to inform Congress of an issue of importance during the Capitol Hill Round-up in February. Historically, the lion's share of electronic warfare (EW) investment has been focused on fixed-wing aircraft. Investment in helicopter self-protection (in terms of research and development, as well as procurement) consistently lags behind tactical aircraft. Helicopter combat loss rates (per sortie) have steadily increased in recent years while tactical aircraft losses have decreased. A significant portion of these helicopter losses is due to hostile fire in asymmetric warfare operations.

Today, in the Global War on Terror (GWOT), helicopters are far more likely to be downed by hostile fire than are tactical aircraft. It is worth noting that the majority of threats that helicopters face today – IR-guided missiles, small arms and rocket-propelled grenades – are the same threats that took down helicopters years ago in the combat theaters of Vietnam and the Middle East. Legacy weapons like the SA-7 are still effective against low/slow platforms, but advances in radar, IR and laser technology are increasing the dynamics of the threat environment that helicopter crews (and their passengers) face today.

Unlike fixed-wing aircraft, which in many cases utilize low-observable technology, stand-off targeting and GPS-guided munitions to achieve greater survivability, helicopters continue to operate at low altitudes while delivering personnel and cargo or engaging targets at much closer ranges. EW therefore must and will continue to be the primary survivability technology for rotary-winged platforms.

There have been some significant improvements in helicopter ASE over the past decade. A new generation of missile warning systems and new countermeasures flares are making an important contribution to helicopter survivability in hostile theaters of operation. However, there are significant technologies available that are still not commonly found on our rotary-winged platforms. More investment in and deployment of these technologies are called for to ensure protection for increasing vulnerabilities. Helicopters require enhanced IR countermeasures in the form of directed IR countermeasures (DIRCM), digital radar warning receivers, digital RF memory (DRFM) technology in RF jammers and warning systems capable of detecting small arms fire and rocket-propelled grenades.

Join us during the AOC's Capitol Hill Round-Up in February and help "take the words to the Hill" on helicopter ASE requirements and our other Policy Agenda issues. With a new Congress in town, presenting our agenda in early 2009 will ensure that congressional leaders understand that EW, and more specifically ASE, is a force multiplier for our combat forces.

– Kermit Quick

REGISTER TODAY!

Capitol Hill Conference and Capitol Hill Awareness Day 2009

Capitol Hill Conference

"Controlling the Spectrum: The Changing Face of Electronic Warfare"

February 24-25

The Capitol Hill Conference (CHC) will provide attendees with the latest in industry forecasting and analysis of EW programs and requirements in the FY 2010 defense budget. The conference is classified (SECRET, US Only). Following conference sessions on Wednesday, February 25, attendees are invited to Andrews AFB for an "EW Awareness Day," which will showcase leading EW systems and technology.

Capitol Hill Awareness Day

February 25-26

AOC members are encouraged to attend the annual Capitol Hill Awareness Day (CHAD) immediately following the conclusion of the Capitol Hill Conference. CHAD is designed to train AOC members to effectively communicate to Congress and provide members the opportunity to meet their congressional representatives. CHAD is FREE, but you must be an AOC member to attend. For our international members, you are welcome to register and attend all sessions as well as the "Recognizing Our Warfighters" reception; however, congressional meetings are reserved for U.S. citizens only.

To register online or for more information on both events, visit www.myaoc.org.

JCREW 3.3 RFP RELEASED

On December 15, US Naval Sea Systems Command (NAVSEA) released a request for proposals (RFP) for design, development, integration and testing of the DOD's planned Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3 System of Systems family of new jammers. Bids are due January 30, and multiple contracts could be awarded within 60 to 90 days.

The Navy is the DOD's executive agent for developing and procuring common ground-based CREW systems for the joint military services. (The Army alone doesn't plan to procure the JCREW 3.3 systems and instead will buy its own jammers in the future.) This responsibility is carried out by NAVSEA's CREW Program Office (PMS 408) at the Washington, DC, Navy Yard.

As the RFP states, "Previous procurements [e.g., CREW 2.1] have focused on the rapid acquisition of commercial off-the-shelf products to address a rapidly evolving threat. The enemy is versatile and the tactics and techniques are constantly evolving. In order to meet the current and future threats, JCREW will be technologically superior to earlier systems (greater spectrum coverage, more power, limited networking capability, etc.)."

JCREW will be a longer-term development program for a family of more advanced mounted, dismounted and fixed-site jammers with common components. Key features of JCREW 3.3 will be the use of open-architecture standards and an emphasis on incremental software rather than hardware upgrades to keep pace with changes in the threat. Contractors will be required to deliver up to 65 CREW 3.3 units – Performance Specification Verification Models for development testing and Engineering Development Models subsequently for development and operational testing.

The solicitation number is N0002409R6303 and the NAVSEA point of contact is George Boateng at (202) 781-2598, e-mail george.boateng@navy.mil. – *G. Goodman*

USMC CONDUCTING COMMS JAMMER SURVEY

The US Marine Corps is conducting a market survey to determine what products and technologies are available to upgrade its Communication Emitter Sensing and Attacking Systems (CESAS).

The CESAS is one of the Marine Corps' newest EW systems. Developed as a replacement for the ULQ-19 communications electronic attack system, the ULQ-30 CESAS is typically mounted on a high mobility multipurpose wheeled vehicle (HMMWV) and comprises government off-the-shelf equipment and Rockwell Collins USQ-146(V) jammers to deny enemy communications in the 20-MHz to 2.5-GHz range at distances up to 14 miles. So far, the Marines have contracted for a total of 12 CESAS vehicles, though the objective quantity is 29 systems.

With final deliveries expected soon, the Marine Corps Systems Command (Quantico, VA) is seeking to upgrade the CESAS and is soliciting potential solutions from industry. According to the request for information (RFI), "The technology should effectively detect, deny and degrade targeted communication systems, be easily integrated into a variety of Marine Corps ground vehicle assets and be capable of operations in both stationary and on-the-move configurations, able to switch between mobile operations and stationary operations in less than 10 minutes, capable of emergency displacement within 30 seconds, conduct automatic and manual omni-directional and directional attack providing maximum bandwidth coverage with automated switching between the omni-directional and directional antennas."

Program officials are seeking a system that can cover the 2-MHz to 6-GHz frequency range and jam ground frequency-hopping targets at ranges up to 30 miles. The desired systems should be ready for production in 2010.

Reponses to the RFI are due January 9. The program point of contact is Arnold

US NAVY SOLICITS AIRBORNE EW AGGRESSOR INFO

Naval Air Systems Command (Patuxent River, MD) is soliciting information from companies that can supply airborne radar and communications jamming services in support of Navy training exercises.

The Navy requirement calls for two aircraft (one stationed on the US east coast and one stationed on the west coast) that can provide three hours of on-station jamming (per mission) to train shipboard radar and communications operators in a hostile EW environment.

Phoenix Air (Cartersville, GA) currently provides these services under NAVAIR's Commercial Airborne Electronic Combat Services Program (CAECSP). It received a 10-year contract in 1999 and outfitted two Gulfstream G-1 aircraft to fly the EA training missions, which amount to approximately 500 training hours per year between the two aircraft.

The NAVAIR requirement outlined in the draft performance work statement calls for each aircraft to provide three to four high-power jamming subsystems that are capable of operating independently or simultaneously. The jamming subsystems must cover the B/D bands (400-980MHz), E/F bands (2-4 GHz), G band (5-6 GHz) and I/J bands (8-12 GHz) and provide a digital RF memory (DRFM) capability. Each aircraft must include a radar direction finder for locating victim radars. The aircraft also must be capable of carrying government-furnished equipment, including ALQ-167 jamming pods, and AST-6/9 radar simulator pods and USQ-113 communications jammers.

NAVAIR is requesting brief capabilities statements (20 pages maximum) from interested companies, including a timeline for aircraft readiness after contract award. The information is due January 7. Questions may be e-mailed to Colleen Combs at colleen.coombs@navy.mil. The performance work statement is available at www.navair.navy.mil. – *J. Knowles*

Eugene at (703) 432-4176, e-mail arnold.eugene.ctr@usmc.mil. – *J. Knowles*

AFRL AWARDS HTS RESEARCH CONTRACTS

The Air Force Research Lab's (AFRL) Sensors Directorate (Wright-Patterson AFB, OH) has announced plans to award three contracts to continue research under the Semiconductor-Tuned High Temperature Superconductor Filters for Ultrasensitive RF Receivers (SURF) Program. The objective of the SURF program, which is managed by the Defense Advanced Research Projects Agency (DARPA) in Washington, DC, in partnership with the Services, is to develop technologies for next-generation high-temperature superconducting (HTS) filters that feature low-noise and ultra-fast (microsecond) tuning speeds. Such filters are well-suited to future SIGINT systems that will detect extremely weak signals and unintended emissions from adversary radars and communications systems. These tunable "notch" filters also can be useful in identifying signals of interest or sources of interference in a congested RF environment.

The technologies being developed under the SURF contracts will be applied to a new generation of HTS filters made by Superconductor Technologies Inc. (STI) of Santa Barbara, CA. STI has partnered with DARPA for more than 20 years in the development of HTS filtering and receiver technologies for SIGINT, EW and communications systems.

One of the SURF contract awards will go to Teledyne Scientific & Imaging (Thousand Oaks, CA) for a new effort under Phase 2 of the SURF Program. This work calls for development of Antimonide Based Compound Semiconductor (ABCS) devices to build switches and amplifiers in support of STI's HTS planar thin film tuned filters. "These filters will be very small, integrated, reconfigurable cryogenic planar HTS filters that are cost-effective for military applications," according to the contract announcement. "The filters are intended to initially work over sub-bands in the approximate frequency range of 0.5 GHz to 2 GHz, but these limits are not hard and future applications may be outside of this range."

A separate contract will be awarded to Out of the Fog Research (Mountain View, CA) for development of a filter based on the use of decoupled cryogenic varactors and/or switches. According to the contract announcement, "The key element is the development of tunable filters that can be put in front of SIGINT or communication receivers, and even in the active elements of active electronically steerable arrays, with tuning speeds well below one millisecond. There is currently no technology that is capable of the ultra-fast, yet low-loss notch or bandpass filter capability that is necessary to solve this operational problem."

The University of California at Los Angeles (UCLA) will receive the third contract for Phase 2 SURF efforts. This work will focus on further development of cryo-optimized single pole single throw (SPST) switches and a cryogenically compatible CMOS deserializer. According to the contract announcement, UCLA will "extend capability in the high-frequency characterization of transistors/circuit blocks at temperatures from 77K to 300K, develop high-speed CMOS controllers for reconfigurable RF systems operated at reduced temperatures, investigate switch architectures to enable a broad frequency range that leverages the availability of an array of ultra high-Q filters, investigate optimizing the switch circuit architectures at 77K as well as developing circuits that have both low-temperature (LT) CMOS digital circuits (for controllers as well as other signal processing) and RF switches."

This work under the SURF program could have a major impact on future ESM and SIGINT system deigns. – *J. Knowles*

IN BRIEF

ITT Electronic Systems (Clifton, NJ) won a $32 million follow-on to a previously awarded contract from the US Navy to provide 12 AN/ALQ-214 jammer systems

AFRL SEEKS "MUD-WASP" ANTENNA

The US Air Force Research Lab's (AFRL) Sensors Directorate (AFRL/RY, Wright-Patterson AFB, OH) released a Broad Agency Announcement (BAA) last month soliciting technical and cost proposals for Multi-User Digital Beam-Forming for Wideband Array Signal Processing (MUD-WASP) Antenna Development. Bids are due January 23, and AFRL plans to award a single contract March 24. Anticipated funding for the program is $650,000 in FY09 and $450,000 in FY10. MUD-WASP is a project funded under AFRL's Sensor Technology Research, Development, Test & Evaluation Open-Ended BAA (STROEB) program.

The objective is to design, fabricate, test and deliver a wideband, multi-channel, phased-array antenna with an integrated RF manifold that will support eight simultaneous, frequency-independent users. This prototype system will be integrated into AFRL's in-house Transformational Element Level Array (TELA) test bed. AFRL intends to experiment with various wideband analog and digital and 41 ALQ-214 Weapon Replacement Assembly spare units for F/A-18E/F aircraft. In addition to Clifton, work will take place in East Syracuse, NY; San Diego, CA; and Rancho Cordova, CA, with a December 2011 expected completion date.

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ManTech International Corporation (Fairfax, VA) made final its acquisition of EWA Services, Inc. (Herndon, VA), a subsidiary of Electronic Warfare Associates, Inc. ManTech, a national security technology provider, intends to increase its defense business with EWA Services, which specializes in information technology, threat analysis and test and evaluation for customers such as the Joint Interoperability Command, the Big Crow Program Office at Kirtland AFB and the Defense Information Systems Agency.

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Textron Defense Systems (Wilmington, MA), a business unit within Textron Inc.'s Textron Systems, has signed an Other Transaction Agreement (OTA) deal with the Defense Advanced Research Projects Agency (DARPA) to put $21 million into designing, fabricating and testing a unit cell module for a 150-kW laser weapon system. The system is part of DARPA's High Energy Liquid Laser Area Defense System (HELLADS) program, and DARPA has stipulated that it meet HELLADS-specific weight, volume, beam quality and runtime requirements.

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Alloy Surfaces Company, Inc. (Chester, PA) announced December 9 that it was awarded a $51.9 million contract from the US Air Force to manufacture MJU-51 infrared countermeasure decoys. 784 CBSG/PK at Hill AFB, UT, is the contracting activity.

beam-forming techniques using the MUD-WASP antenna.

As the solicitation explains, "Electronic support (ES) systems need broad spatial and frequency coverage to achieve a high probability of intercept. At the same time they need the capability of detecting weak signals at long ranges in the presence of strong interferers. These are contradictory requirements. A logical solution is to provide multiple simultaneous narrow collection beams. Historically, high-gain phased-array antennas have been primarily used for narrowband radar applications in single-user systems. Recently, phased arrays capable of 10:1 and greater frequency coverage have been developed that are suitable for ES applications. New systems that support multiple simultaneous users with high accuracy direction-finding in a dense signal environment are required to meet the needs of the warfighter in the future."

The solicitation number is BAA-04-03-SNK, Call 62. The program point of contact is Lew Reed at (937)255-5372, e-mail lewis.reed@wpafb.af.mil. – *G. Goodman*

Argon ST (Fairfax, VA) won a $30 million follow-on to a previously awarded six-phase contract from the US Navy to produce sensor systems for Ship's Signal Exploitation Equipment (SSEE) Increment E, the US Navy's surface ship COMINT system. The contract allows for system procurement into 2009.

EMRISE Corporation (Rancho Cucamonga, CA), an electronics manufacturer for defense and aerospace markets, announced December 8 that it received $2 million worth of new orders for radio frequency devices for remote-controlled improvised explosive device (RCIED) jamming systems. The contract, which slates deliveries to begin in the first quarter of 2009, follows a $2 million signal jamming order in September. The company's recent subsidiary, Advanced Control Components, Inc. (ACC), will perform the work.

Raytheon Missile Systems (Tucson, AZ) was awarded a $16.3 million contract from the US Air Force to provide logistics support for High-Speed Anti-Radiation Missile Targeting Systems. The contract covers a year, with two one-year options. Eglin AFB, FL, is the contracting activity.

The Non-Traditional SIGINT Segment Program Office/Applied Technology Department (NSPO/ATD), under the National Reconnaissance Office, has issued a broad agency announcement (BAA) requesting technology to reduce thermal resistance of heat flow at the chip/die level on future satellites. The BAA specifies that proposals should total less than $1 million, with a performance period of 12 months or less. The program point of contact is Kevin A. Boycourt at (703) 808-2643, e-mail kevin.boycourt@nro.mil.

Comtech PST (Melville, NY), a Comtech Telecommunications subsidiary, announced in late November that it won a $1.5 million contract from an undisclosed domestic prime contractor for broadband, solid-state, high-power radio signal jamming amplifiers. The contract follows a $1.5 million contract for jamming amplifiers announced in early November.

Daylight Solutions (Poway, CA), a laser technology manufacturer, has received a Phase 1 Small Business Innovation Research (SBIR) award from the Defense Advanced Research Projects Agency (DARPA). Daylight Solutions will use the award to increase the output power of its miniature, high-power, mid-infrared EC-QCL (quantum cascade laser) technology for infrared countermeasures (IRCM) to greater than 5W.


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washington report

NEW DOD ACQUISITION POLICY

John Young, the Undersecretary of Defense for Acquisition, Technology and Logistics, last month approved major changes to the DOD's 5000 series acquisition policy guidelines, the first since 2003. The new DOD Instruction 5000.02, "Operation of the Defense Acquisition System," calls for demonstrating the maturity of new technologies by having two or more competing industry teams build and test prototypes of a planned system or its key components in a realistic operational environment during the Technology Development phase that follows Milestone A decision approval. An independent Technology Readiness Assessment will be required to certify the maturity of the program technologies prior to obtaining Milestone B approval to enter the subsequent Engineering and Manufacturing Development (EMD) phase, previously called System Development and Demonstration (SDD). The purpose is to reduce technical risk before an acquisition program enters EMD, the final costly development phase that leads to initial production, minimizing the potential for cost and schedule overruns.

The new instruction also calls for more frequent program reviews to assess progress, making preliminary design and critical design reviews more significant decision points. In addition, the new policy includes steps to curb "requirements creep," in which the military services or system developers add new performance requirements after an EMD contract is awarded, slowing down programs and increasing costs. Configuration steering boards will be set up to forestall destabilizing requirements changes and to seek moderation of requirements that become costly drivers in the system design. Testing of developmental systems also will be increased to facilitate early identification and correction of technical and operational deficiencies.

Program managers for a number of existing military service development programs, aware that approval of the new DOD acquisition instruction was forthcoming last fall, have had to weigh whether to alter their acquisition strategy to comply with it by stretching out their Technology Development phase and awarding multiple industry prototyping contracts instead of a single EMD contract as planned. The Army's Aerial Common Sensor (ACS) program fell into this category. Last fall, the ACS project office at Fort Monmouth, NJ, planned to release a request for proposals (RFP) for a single EMD contract for ACS Increment 1 to be awarded in March 2009, following a Defense Acquisition Board Milestone B review. However, release of the RFP has slipped to early 2009, with the contract award planned in mid-2009. The Navy plans to award a single EMD contract in the second half of 2009 for its Surface EW Improvement Program (SEWIP) Block 2 (see feature article) because of the prototype testing it has already completed. – *G. Goodman*

HASC SEES ROOM FOR IMPROVEMENT AT JIEDDO

In its latest report released in November, the House Armed Services Committee's (HASC) Subcommittee on Oversight and Investigations expressed mixed feelings regarding the effectiveness of the Joint Improvised Explosive Device Defeat Organization (JIEDDO). Titled "JIEDDO: DOD's Fight Against IEDs Today and Tomorrow," the report evaluated the success so far of JIEDDO's three initiatives – developing technological countermeasures, locating and eliminating IED manufacturers and providing anti-IED training to US personnel.

With an annual budget of $4 billion, JIEDDO deserves a facelift, the subcommittee decided. Emphasized in the report is the intended role of JIEDDO at its institutional birth in 2006 – to be the DOD's go-to resource for all IED-related matters – yet the HASC says that JIEDDO currently does not lead all DOD counter-IED operations. JIEDDO also would benefit from better supervision, according to the report, since JIEDDO controls an extremely large budget and proves much of its success through counter-IED statistics that the HASC deems questionable.

The lingering nature of JIEDDO's undefined parameters also concerns the subcommittee. Though government officials hoped JIEDDO would sharpen in scope naturally over time, it instead is simultaneously hearing demands to concentrate exclusively on battling IEDs and expand its focus to countering other asymmetric threats. – *M. Kunkel*

DOMESTIC CELL PHONE JAMMING POLICY CHALLENGED

In a continuing bid to ease federal restrictions on the domestic use of communications jammers, CellAntenna Corp. (Coral Springs, FL) has opened up a new avenue that has garnered some level of cooperation from the Federal Communications Commission (FCC). In late November, the company assisted South Carolina prison officials in a demonstration that showed cell phones smuggled into prisons could be effectively jammed and prevent inmates from using them.

The company wants South Carolina officials to conduct more extensive testing under a cell phone jamming pilot program within the state prison system. The FCC allowed the test in South Carolina, but government officials in Texas postponed a similar test last month because of legal concerns. – *J. Knowles*

world report

MOROCCO SELECTS F-16 EW SUITE

The Royal Moroccan Air Force (RMAF) has selected Raytheon's Advanced Countermeasures Electronic System (ACES) to protect its 24 new Block 52 F-16 aircraft.

ACES comprises the ALR-69A digital radar warning receiver, the ALQ-187(V)2 RF jammer and the ALE-47 countermeasures dispenser. The terms of the sale were not disclosed. Deliveries are scheduled to begin in 2009.

Raytheon's ACES was selected in a tight competition against ITT's ALQ-211(V) 4 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS). ITT had won a string of previous F-16 EW contracts from Chile, Oman, Poland, Pakistan and Turkey. The two companies are expected to compete for several fighter programs, including Romania, Croatia, Bulgaria and India. – *J. Knowles*

IN BRIEF

- **South Africa** received its fifth dual-seat Gripen multi-role fighter November 29 in Cape Town. The aircraft is one of nine dual seaters scheduled for delivery to be used by South Africa's air force, along with 17 single-seat aircraft that will come later until 2012. The aircraft, which Saab instructors are currently training six pilot instructors on, is part of the air force's modernization and transformation program.
- **Australia**'s Air Warfare Destroyer (AWD) Alliance, which pulls the support of Defence Material Organisation, ASC and Raytheon Australia for the production off an all-purpose warship, signed three new contracts worth $20 million in early December, with the promise of $100 million in additional contracts soon. The contracts guarantee the help of six component companies in the $8 billion AWD project; these manufacturers will provide IR search and track capability, anti-ship missile and torpedo countermeasures and navigation radar on three ships. The first AWD is slated for delivery in late 2014. In a related announcement, Raytheon tapped Sagem Défense Sécurité to supply three VAMPIR NG IR search and track systems for the program. The contract included an option to buy a fourth system.
- **Australia**'s Royal Australian Air Force (RAAF) announced December 10 the official delivery of Boeing's F/A-18E/F Super Hornet with upgrades according to the Hornet Upgrade (HUG) Phase 2.2 configuration. The upgrade includes updates to the aircraft's radar system, avionics system, EW suite and a Hornet aircrew training system. The RAAF also confirmed that the last 14 Hornets to receive the EW upgrade were delivered under HUG Phase 2.3. Extra EW upgrades, including adding a new countermeasures dispensing system, data recorder and further software, will begin in May 2009.
- **The Australian Government** has entered into an agreement with Chemring Australia Pty Ltd (East Malvern, Victoria, Australia) valued at AUS$160 million (US$110 million) to buy flares and chaff over a 10-year period. Chemring will invest AUS$18 million in a new plant at Lara, Victoria, where the chaff and flare products will be manufactured. Australia's Parliamentary Secretary for Defence Procurement said, "The establishment of an in-country manufacturing capability positions Chemring Australia to demonstrate the capacity to manufacture these items for the JSF project and this will allow them to compete for work on the global fleet."

PAKISTAN BUYS ANTI-RADIATION MISSILES

The Pakistan Air Force (PAF) has bought 100 MAR-1 anti-radiation missiles (ARMs) from Brazilian missile manufacturer Mectron, according to press reports. The sale, reportedly valued at €85 million (US$120 million) was conducted by the Brazilian and Pakistani governments.

The deal marks the first export of the missile, which began development in the late 1990s and has recently been undergoing operational testing on Brazilian Air Force (FAB) AMX fighter aircraft. It is not clear which PAF aircraft will carry the MAR-1, but it is unlikely that the missile will be integrated onto F-16 aircraft. Leading contenders to carry the MAR-1s are Chinese-designed JF-17 fighters and Mirage V aircraft. – *J. Knowles*

AUSTRALIA BUYS DECOY LAUNCHER FOR DESTROYERS

Terma has agreed to supply $5 million in orders of its Soft Kill Weapon System (SKWS) to Australia's Air Warfare Destroyer (AWD) Alliance, the company announced in early December. Australia has said it will use the system to enhance the anti ship-missile defense systems on its three all-purpose AWD warships.

The SKWS, a sophisticated decoy launching system, will become part of Australia's Hobart Class combat system. The system features four deck-mounted MK-137 130-millimeter decoy launchers, plus a launch control computer and launcher interface unit, and is operable from specific control units or through the Australian Tactical Interface (ATI). It supports both passive and active decoys and is equipped for DL-6T upgrades if at some point the Royal Australian Navy requires them.

The contract, which is one of three that the AWD Alliance signed in December, follows Terma's delivery of the SKWS to the Royal Australian Navy's Adelaide Class-Guided Missile Frigates in 2003.

The first AWD ship is slated for completion in 2014. – *M. Kunkel*

New Horizons for Shipboard EW

US Navy Undertakes Major Renewal of its SLQ-32 ESM System

By Glenn Goodman

The US Navy is set to take a big step forward in its surface ship electronic warfare (EW) capabilities. While the service has long recognized that the best approach to ship self-defense is a balance of EW soft-kill and radar-based hard-kill systems, the latter have received the lion's share of Navy investment dollars for many years. Now the Navy will soon begin engineering development of the first hardware upgrades to major portions of the venerable SLQ-32 ("Slick-32") EW system on all of its surface combatants. These will effectively create a new-generation shipboard EW system with much greater capability.

The SLQ-32(V) electronic support measures (ESM) system, introduced into the fleet in the early 1980s, is the Navy's primary soft-kill EW air defense system. It provides early warning and classification of detected radar-based threats, particularly radar-guided anti-ship cruise missiles. About half of the fleet's SLQ-32s, predominantly those on larger ship classes, also have an active radar jamming capability. The Navy began formal development in 1997 of a next-generation replacement for the SLQ-32, called the Advanced Integrated EW System (AIEWS), but this program was canceled in 2002 due to cost and schedule overruns.

In the wake of the AIEWS cancellation, the Navy has pursued a low-risk, evolutionary series of enhancements to


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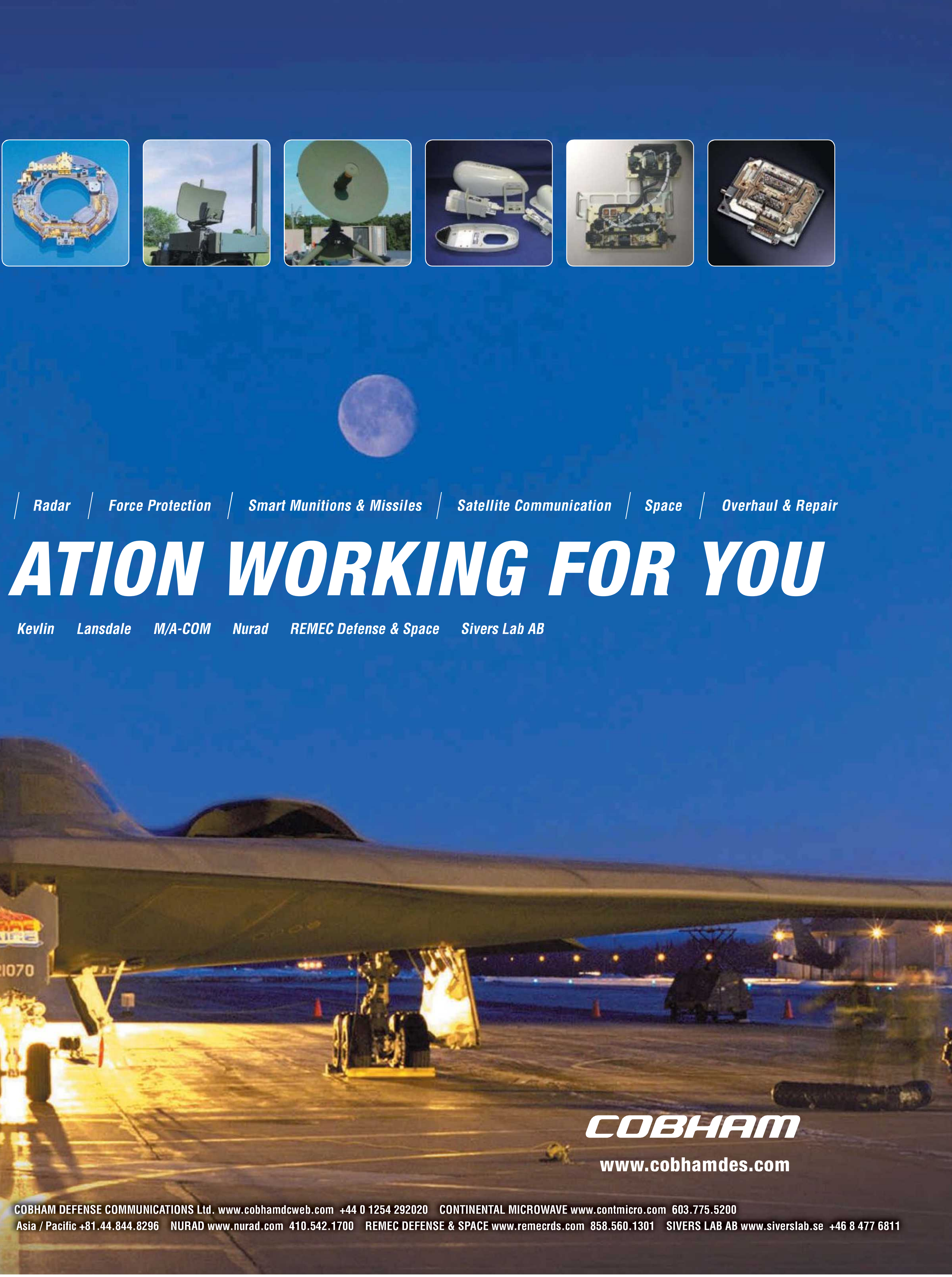
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its SLQ-32s under the Surface EW Improvement Program (SEWIP). As stated in a Navy FY09 budget document, "SEWIP will accomplish Block upgrades based on integrating technology advances and adding functional capabilities in an incremental fashion. Each Block and sub-Block will be developed and contracted in an individual yet coordinated and overlapping fashion." The initial series of SEWIP Block 1 upgrades are being layered on top of the SLQ-32's 1970s-vintage ESM technology and include the addition of a modern signal-processing computer and some adjunct stand-alone sensor systems.

The Navy is now ready to launch a competitive SEWIP Block 2 off-the-shelf acquisition that will replace the SLQ-32's receiver, antenna and combat system interface. The new digital receiver will use advanced signal processing techniques to passively detect and identify more radio-frequency (RF) emitters at longer ranges and provide more precise angle-of-arrival information on detected threat signals. The SEWIP Block 2 upgrades, according to the budget document, "are necessary in order to pace the threat, improving detection and accuracy as well as improving mitigation of electromagnetic interference."

The SEWIP Block 2 system must meet two other major requirements. It must feature a non-proprietary open architecture that will facilitate quick and inexpensive hardware and software upgrades in the future to keep pace with technology advances and emerging threats without incurring substantial upgrade costs. SEWIP Block 2 also must provide a modular enterprise EW solution designed to be common and scalable across future Navy ship classes, specifically the DDG-1000 Zumwalt-class guided missile destroyer, CVN-78 Gerald R. Ford next-generation aircraft carrier and CG(X) next-generation guided-missile cruiser, with back-fit application to existing Aegis cruisers and destroyers.

The Navy's Program Executive Office for Integrated Warfare Systems (PEO-IWS), co-located with Naval Sea Systems Command (NAVSEA) at the Washington DC Navy Yard, manages the SEWIP efforts. CAPT Larry Creevy, major program manager in the above-water sensors directorate of PEO-IWS, told *JED* December 10 that NAVSEA was making steady progress toward releasing a request for proposals (RFP) for SEWIP Block 2 in the very near future. The Navy plans to award a single industry contract for Block 2 System Development and Demonstration (SDD) about nine months after the RFP's release. The SDD phase has been renamed Engineering and Manufacturing Development and Demonstration (EMD) under new Defense Department 5000 series acquisition policy guidelines approved last month.

Because SEWIP Block 2 is the largest Navy surface ship EW acquisition program in many years, capturing the contract is a high priority for the key industry competitors – BAE Systems-General Dynamics, Lockheed Martin-ITT, Northrop Grumman and Raytheon.

SOFT KILL AND HARD KILL

Low-flying anti-ship cruise missiles (ASCMs) remain the principal threat to Navy surface ships. The key to defeating them is maximizing the reaction time that a ship has to detect, divert or engage incoming missiles. In particular, Navy surface combatants must be able to engage supersonic missiles as early as possible. In addition, sea-skimming missiles limit the reaction time of ship defenses because they break the horizon much closer to the ship than higher altitude missiles.

As stated in an unclassified Navy FY08 budget document, "The supersonic sea-skimming ASCM reduces the effective battle space to the horizon and the available reaction timeline to less than 30 seconds from first opportunity to detect until the ASCM impacts its target ship. Against such a threat, multi-sensor integration is required for effective detection, to reduce reaction time to acceptable levels and to provide vital coordination/integration of hard-kill and soft-kill assets."

For many years, the Navy has pursued integration of single-ship (and strike group) self-defense sensors and weapon systems to reduce reaction and engagement time. Examples of these efforts include the Cooperative Engagement Capability (CEC) installed on numerous Navy surface ships and the Ship Self-Defense System (SSDS) on the service's aircraft carriers and amphibious ships.

The US Navy's shift in focus in recent years from blue-water open-ocean missions to littoral environments closer to shore supporting Marine Corps and Army land forces means that its surface ships are more vulnerable to coordinated attacks from land-based ASCM batteries and coastal patrol boats. Moreover, the RF signal density is heavier in these coastal areas due to the proximity to shore and commercial shipping traffic. In addition, US Navy ships are more likely to operate alone or in very small groups without the layered defense protection provided by multi-ship aircraft carrier or expeditionary strike groups. Thus, individual surface ships are more dependent on their own self-defense capabilities in today's peacetime presence or interdiction operations.

The ESM system aboard a ship has a longer detection range than radar sensors, so typically it is the first ship sensor to detect a threat acquisition radar or ASCM radar seeker and can cue the ship's radars to the approaching threats. The ship's crew can employ radar jamming, launch chaff and active RF decoys first to counter incoming missiles, and then fire shipboard anti-air warfare missiles and guns when the missiles come within range if the soft-kill jamming and decoys fail to divert them away from the ship.

Performing the EW support (ES) or surveillance mission at sea on a surface ship, particularly to detect ASCM seekers at long ranges in littoral areas, is no easy feat. "The maritime environment is a complex signal environment," noted one industry representative, citing the multi-path effect caused by transmitted radar signals reflecting off the sea surface that decreases the signal-to-noise ratio, attenuating the strength of the received signals. Co-site electromagnetic interference among the large number of radar, communications and EW antennas atop a Navy surface combatant also is a challenge for an ES system.

Raytheon EW Systems in Goleta, CA, began SLQ-32 production in 1977. The system passively detects threat radar emissions, including those from radar-guided ASCMs or their associated shipboard or shore-battery target-acquisition radars; identifies the type of radar; and provides a bearing to the emitter. The SLQ-32 electronic attack variant performs deception jamming against missile seekers to alter their trajectories and noise jamming to defeat acquisition radars.

The other EW soft-kill systems on Navy ships are passive and active off-board decoys. The Mk-36 decoy launching system (DLS), consisting of 130-mm mortar-like tubes, dispenses passive Rapid Blooming Offboard Chaff (RBOC) and Super RBOC (SRBOC) chaff cartridges, as well as flare rounds. The Mk-36 has been modified to also launch two Nulka decoys, resulting in the Mk-53 DLS. Nulka is an active decoy, developed by the Navy in cooperation with Australia, which employs a broadband RF repeater mounted atop a hovering rocket. After launch, the 6.5-foot-long, 8-inch-diameter decoy radiates a large ship-like radar signature while flying a trajectory that lures incoming radar-guided ASCMs away from the target ship.

INCREMENTAL IMPROVEMENTS

The SEWIP Block 1 systems integrator is General Dynamics Advanced Information Systems (AIS) in Fairfax, VA. The first increment of Block 1A upgrades to the SLQ-32 entered full-rate production in 2006. Block 1A provides improved control and display (ICAD) technologies, built on the Navy standard UYQ-70 display console manufactured by Lockheed Martin (Eagan, MN), and a new signal processing computer. These allow the SLQ-32 to more quickly identify threats and better correlate and display signal intercepts to the operator.

The new commercial off-the-shelf (COTS) signal-processing computer, built by Northrop Grumman Decision Support & Technology (formerly PRB Systems, Goleta, CA), is called the Electronic Support Enhancement (ESE) system. Its

hardware and software development was led by the Naval Surface Warfare Center-Crane (IN). Northrop Grumman is building more than 200 ESEs that will be delivered by 2010. The company says the ESE provides a significant increase in capability against ASCMs.

The next step in the SEWIP incremental upgrades is Block 1B, which gained approval last February to enter a System Development and Demonstration phase. Block 1B initially is integrating General Dynamics' stand-alone SSX-1 Small Ship Electronic Support Measures (SSESM) system with the SLQ-32, which adds a specific emitter identification capability. (This enables the SLQ-32 to passively identify and "fingerprint" the transmitter of a radar signal from its unique emitter signature. This helps determine if an emitter is hostile or friendly and also allows the SLQ-32 to distinguish among multiple incoming ASCMs flying close together.) The SSESM portion of Block 1B is in full production.

Another specialized capability being developed under Block 1B is a high-gain (antenna)/high-sensitivity (receiver) (HGHS) that will serve as an adjunct sensor to the SLQ-32. HGHS will enhance threat correlation and early-warning of ASCMs and provide "improved situational awareness through non-cooperative detection and identification of airborne platforms, beyond radar-horizon and overland passive surveillance [and] extended Nulka cuing ranges," according to the Navy's 2007 Program Guide. On December 1, General Dynamics AIS awarded Lockheed Martin Radar Systems (Syracuse, NY) a subcontract to develop the HGHS subsystem, including the top-side antenna systems and the below-deck signal processor and its software algorithms. HGHS is slated to undergo operational testing at sea in 2011.

The Naval Research Laboratory (NRL) in Washington, DC, did the early development work for the SSESM and HGHS.

Block 1B also includes developing further ICAD enhancements to reduce operator workload. A SEWIP Block 1C effort is integrating ESE and the Block 1A ICAD improvements on aircraft carriers and other ships that have SLQ-32(V) variants equipped with active countermeasures.

The Navy plans a SEWIP Block 3 program in the future to significantly improve the active radar jamming capabilities of the SLQ-32, while a subsequent Block 4 program envisions adding an IR jamming capability.

SINGLE ENTERPRISE SOLUTION

"SEWIP Block 2 is the enterprise solution for EW for our surface platforms," CAPT Creevy noted. As he told *JED* in a previous interview, "We know we have to go to a common modular EW architecture across those ships because if we don't, we just can't afford it," he said. "We have too many variations on too many ships. Investment-wise, we want to leverage multiple platform resources so that we're not building something new with each new platform."

Even though the Navy, for budgetary reasons, now plans to buy no more than three new DDG-1000 destroyers, this ship remains the planned first platform for SEWIP Block 2. "We are working to ensure that Block 2 will have an open-system interface that will be interoperable with the open-architecture combat system of the DDG-1000 [to integrate EW capabilities with it and allow data to flow back and forth] or where we go with the combat system on CVN-78 or the Aegis ships," Creevy said. "And we want Block 2 to have an open architecture that is easy to upgrade and also is open from a business standpoint as well, allowing us to compete hardware or software module suppliers in the future."

TECHNOLOGY MATURATION

Research efforts by the Office of Naval Research (ONR) and NRL have laid some of the groundwork for SEWIP Block 2 by maturing key technologies.

ONR started a technology project in the late 1990s called the Advanced Multi-function RF Concept (AMRFC). Now evolving into the "Integrated Topside" program, its aim has been to reduce the number of antennas atop Navy ships through the use of multi-function, multi-beam arrays, with EW, radar and communications functions sharing common receive and transmit antennas. As stated in an ONR solicitation, "Navy surface combatants are increasingly employing large numbers of federated RF apertures to perform EW, communications and radar functions; each function (and hence system) historically has its own aperture, electronics, operator and logistics/maintenance tail. This classic stand-alone RF systems approach results in electromagnetic interference/compatibility problems that degrade system performance and increase life-cycle cost for the combatant. Ship RF signature and radar cross section are also difficult to reduce when restricted to stand-alone RF aperture/antenna approaches."

NRL established an AMRFC test bed at its Chesapeake Bay Detachment at Chesapeake Beach, MD, and conducted demonstrations of AMRFC technologies with industry participation by Lockheed Martin, Northrop Grumman and Raytheon. Navy officials, with an eye on the needs of the DDG-1000 program, subsequently asked ONR to focus first on the EW component of AMRFC by developing an ES prototype called the Multi-Function EW (MFEW) advanced development model (ADM). In 2005, ONR selected Northrop Grumman Electronic Systems in Baltimore, MD, to design, build and test it.

The MFEW goals included improved performance in the areas of specific emitter identification, precision direction-finding, high probability of intercept, signal classification and effectiveness in dense threat environments, according to a Northrop Grumman brochure.

In late July 2008, Northrop Grumman announced that the MFEW ADM had completed seven months of land-based testing against key DDG-1000 performance requirements at NRL's Chesapeake Bay Detachment site. The company release stated, "NRL and ONR have been pleased with the results so far... The design uses a modular, open-systems approach developed in concert with the surface Navy community. The tests performed at CBD demonstrated the ability to track simulated threats while the antenna array pitched and rolled at Sea State 5. This creates a worst-case scenario for the already difficult problem of performing precision direction-finding on a surface ship. The Northrop Grumman MFEW design utilizes digital receiver technology and advanced processing to detect and classify a wide variety of signal types to meet operational requirements in a tactically relevant environment."

AT-SEA DEMONSTRATIONS

Last summer, industry contenders for the SEWIP Block 2 contract got a chance to demonstrate prototypes of their prospective offerings at sea off the coast of Hawaii during the US Navy's Rim of the Pacific (RIMPAC) operational exercise. NRL coordinated the demonstrations, which were not formally part of the SEWIP program.

Northrop Grumman's MFEW ADM was tested during RIMPAC and "successfully demonstrated such key performance factors as precision direction-finding, high sensitivity, the ability to rapidly detect and classify advanced threats and mitigation of shipboard RF interference while onboard [a Navy ship]," the company said.

BAE Systems said its open-architecture system "consistently detected, identified and located enemy threat signals. The system performed flawlessly in sea tests, demonstrating … the maturity of a system that meets or exceeds the Navy's requirements. The system features an improved receiver and antenna group that uses digital signal processing to detect more targets at longer ranges."

Lockheed Martin-Syracuse said its Integrated Common EW System (ICEWS) had performed successfully during the at-sea demonstrations and "was specifically designed to provide a sensors capability upgrade, as well as built-in system commonality, to the SLQ-32 (V) system. The modular ICEWS – which will use common electronics across the enterprise system – will provide the Navy with the latest surface EW capabilities, as well as enhanced agility to upgrade technology as it becomes available to address changing and emerging threats. ICEWS will also provide proven cost savings and ease of maintenance through the use of commercial off-the-shelf components."

READY TO ENTER EMD

Northrop Grumman said in September that the MFEW ADM had "successfully established the required baseline [for SEWIP Block 2]. The key performance and technology readiness factors required were demonstrated during relevant over-water tests of the MFEW ADM at the Navy's Chesapeake Bay facility, and during the recent RIMPAC Fleet operational exercises." A company official noted, "Our success at the RIMPAC sea trials further validated achievements we made during tests at CBD that resulted in demonstrating a significant technology readiness level for the MFEW program."

In this regard, the Navy, under the new DOD acquisition guidelines, must provide a Technology Readiness Assessment (TRA) to gain "Milestone B" approval for the SEWIP Block 2 program to enter the EMD phase. (This Milestone B decision is expected in three to six months prior to the contract award.) The TRA, to be conducted by ONR, must report that a Technology Readiness Level of 6 or higher has been achieved based on the performance of a system prototype in a relevant operational environment. ONR is set to make this declaration, Creevy indicated, as a result of the progress made in the MFEW ADM testing, as well as in industry independent research and development efforts.

On October 20, BAE Systems (Hudson, NH) and General Dynamics AIS announced that they had teamed for the SEWIP Block 2 competition. On December 1, Lockheed Martin-Syracuse and ITT Reconnaissance and Surveillance Systems (formerly EDO, Morgan Hill, CA) announced that they had combined forces for SEWIP Block 2. SLQ-32 manufacturer Raytheon is the other likely SEWIP Block 2 competitor.

Rusty Kollmorgen, BAE Systems' Director of Maritime Situational Awareness, told *JED* that his team's planned Sea Lightning SEWIP Block 2 offering would be based on the digital receiver hardware and software from his company's Barracuda common EW family, which is in production for US fifth-generation fighter aircraft. "We're adding signal-processing algorithms to our Barracuda baseline to handle the multi-path, co-site interference and other unique challenges of the maritime RF environment," he said, drawing on BAE Systems' experience in developing shipboard signals-intelligence systems.

Joe Ottaviano, Advanced EW Senior Programs Manager at Lockheed Martin-Syracuse, told *JED* that the scalable, modular enterprise approach of his team's open-architecture ICEWS SEWIP Block 2 offering was similar to the one his company had successfully developed for the Navy's BLQ-10(V) enterprise ESM system. The BLQ-10 has been in production for new Virginia-class and existing Navy nuclear attack submarines. It uses common electronics across the different subclasses and is designed to be easily upgraded through the insertion of new COTS components. He said his company had already integrated several different receivers and tuners into its ICEWS architecture and, during the RIMPAC demonstrations, had evaluated the performance of two different sets of them, which required only a short integration time at sea.

"We're really excited about pursuing the SEWIP Block 2 capability for our surface combatants," CAPT Creevy said. "We think the competition is great for industry and it's great for the Navy, in terms of advancing maritime EW technologies. We think we are going to see some really innovative ideas and approaches in the industry proposals."

TECHNOLOGY SURVEY

SAMPLING OF EW ANTENNAS

By Ollie Holt

JED's last antenna survey was published in the March 2007 issue, when *JED* collected data on both EW and SIGINT antennas. This month's survey is focusing exclusively on EW antennas – antennas that are used with an EW system that can both receive and transmit. (*JED* will cover SIGINT/DF antennas in its August 2009 issue.) All of the antennas surveyed in this article can handle transmit powers from 10 to 1,000 Watts.

The typical EW antenna is a horn, a spiral, a multi-element array or a monocone. Research to improve current antenna performance is looking at methods of making an antenna less reflective while still providing some gain in the direction of interest. This is sort of an oxymoron in that more gain typically means more reflection. Another research area is focused on developing conformal antennas that can handle high power. Typically, high-power antennas are big and require a lot of surface area. Some current research is looking at different antenna element types that can be conformal and still handle relatively high power.

The antennas covered in this survey are typically used on radar warning receivers (RWRs) and radar or communication jammers. Most cover a relatively wide frequency range and have a spatial coverage of +/-45 degrees. In this spatial region, the antennas have typical gains of 2-3 dB. As the spatial and frequency coverage get smaller, the gains increase to around 7-10 dB because the antennas become more focused (less spatial coverage) and tuned (narrower frequency range) for higher performance.

The goal of an RWR or jammer is to search a large amount of frequency and spatial region as quickly as possible so the jammer can provide disruptive power on the threat as quickly as possible. Consequently, antennas for RWR and jammer applications tend toward a broad frequency range and wide spatial range because of the limited space available and the desire to observe as much of the threat frequency and spatial area as possible. If the antenna's frequency range were more constrained, the receiver or jammer either would have a small operational range or require more antennas to obtain the desired coverage.

EW ANTENNA SAMPLING

The EW antenna survey was sent to 20 antenna manufacturers. The surveyed companies were asked to provide information for up to five of their EW antenna products for inclusion in this survey. Fourteen of these manufacturers responded with information about their EW antenna products. These responses addressed their products that could be used in the military environment. Only information supplied by the survey respondents was used in this compilation.

NEXT SURVEY

Our next survey, in the February *JED*, will cover RWR and ESM systems.

TECHNOLOGY SURVEY: EW ANTENNAS

MODEL	TYPE	OP FREQ	PATTERN	POLARIZATION	GAIN
Cobham Defense Electronic Systems (CDES); Baltimore, MD; +1-410-542-1700; www.cobhamdes.com					
54HC7	jammer	2.5-8.1 GHz	*	LHCP	-3-5 dBiL
14D31300	jammer	6-18 GHz	*	RHCP	2-8 dBiL
122HC4	jammer	6-18 GHz	*	LHCP	-2.5-2 dBiL
122HC5	jammer	6.5-18 GHz	*	LHCP	-2.2 dBiL at 6.5 GHz. 5.3 dBiL at 18 GHz.
14D27400	jammer	8-16 GHz	*	dual CP	4-9 dBiL
Cobham Defense Electronic Systems-Sensor and Antenna Systems-Lansdale; Lansdale, PA; +1-215-996-2182; www.cobhamdes.com					
AHO-2036	quadridge horn	1.5-23 GHz	directional	dual linear	10-15 dBil
CJ Ambi	deformed spiral	0.5-18 GHz	hemispherical	dual CP	2 dBil
ASK-2163	phase tracked spiral	18-40 GHz	hemispherical	CP	0 dBil
ASO-2154	phase tracked spiral	2-18 GHz	hemispherical	CP	2 dBil
ASO-1995	ambidextrous	2-18 GHz	hemispherical	dual CP	2 dBil
Electro-Metrics; Amsterdam, NY; +1-518-762-2600; www.electro-metrics.com					
EM-6968	ridged guide antenna	2.5-7.5 GHz	none	linear	9.5-16 dBi
EM-6956	log periodic antenna	0.5-3 GHz	none	linear	5 dB typ
EM-6969	double-ridged guide antenna	6-18 GHz	none	linear	13-20 dBi
ETS-Lindgren; Cedar Park, TX; +1-512-531-6400; www.ets-lindgren.com					
3164-08	dual horn	700-10,000 MHz	directional	dual linear	10 dB
3164-05	dual horn	2-18 GHz	directional	dual linear	12 dB
3116	horn	18-40 GHz	directional	linear	12 dB
3115	horn	750-18,000 MHz	directional	linear	12 dB
3181	biconical	500-18,000 MHz	omindirectional	linear	2 dB
European Antennas; Cheveley, Newmarket, Suffolk, UK; +44-(0)1638-732152; www.european-antennas.co.uk					
PSA-50200-LP/1211	planar high-pwr spiral	0.5-3 GHz	directional	RHCP	5-8 dBiC
UWBA15300/1221	planar high-pwr spiral	0.25-3 GHz	directional	RHCP	3-8 dBiC
XPO2V-2.0-18.0/1397	biconical	2-18 GHz	omnidirectional	vertical	3 dBi
XPO2V-0.8-6.0GF/1441	biconical	0.8-6 GHz	omnidirectional	vertical	2 dBi
OA2-0.3-10.0V/1505	biconical	0.3-10 GHz	omnidirectional	vertical	2 dBi

BEAMWIDTH	POWER	SIZE	WEIGHT	PLATFORM	FEATURES
75 deg at 2.5 GHz. 35 deg at 8.1 GHz.	500 W CW, 5 KW peak.	7 H x 5.62 D	1.8 lbs	air	*
115 deg x 90 deg at 6 GHz. 110 deg x 45 deg at 12 GHz. 90 deg x 45 deg at 18 GHz.	100 W CW	4.26 x 0.97 x 2.3	3 oz max	air	lensed horn
120 deg x 45 deg at 6 GHz. 95 deg x 40 deg at 18 GHz.	350 W CW	6.98 H x 4.84 D	0.75 lbs	air	*
70 deg x 90 deg at 6.5 GHz. 40 deg x 30 deg at 18 GHz.	300 W CW	5.14 x 1.23 x 1.11	0.4 lbs	air	*
AZ: 180 deg. EL: 30 deg.	20 W CW	7.38 H x 3.33 W x 8.4 D	1.25 lbs	air	*
20 deg-50 deg	100	4.5 D x 5 deep	1.5 lbs	air/grd	compact broadband
80 deg	5	7 D x 2.5 deep	3.5 lbs	air/grd	ultra broadband
80 deg	2.5	0.4 D x 1.5 deep	0.05 lbs	air/grd	phase tracked in sets
80 deg	5	2 D x 1.5 deep	0.3 lbs	air/grd	phase tracked in sets
80 deg	5	2.2 D x 1.5 deep	0.3 lbs	air/grd	dual polarization
30 deg x 30 deg nom at midband	1.6	5.5 x 4.1 x 7.25	2.5 lbs	grd/shp	SMA (feminine)
70 deg E- and H-Plane	800 mW	10.24 x 8 x 1.25	1 lb	grd/shp	SMA (feminine)
30 deg x 18 deg nom	2	8.5 x 3.5 x 4.5	0.73 lbs	grd/shp	SMA (feminine)
60	100	14 x 14 x 14	11 lbs	grd-fix	broadband
60	25	7 x 7 x 7	1.6 lbs	grd-fix	broadband
60	50	2.4 x 4 x 5	0.3 lbs	grd-fix	broadband
60	500	9 x 11 x 6	4 lbs	grd-fix	broadband
360	50	14 x 6 x 7	8 lbs	grd-fix	broadband
75 x 75	100 W CW transmit pwr	19.3 x 14.4 x 1.3	5.5 lbs	grd/shp	50-90 percent efficient across the band.
76 x 75	100 W CW transmit pwr	27 x 26 x 1.4	11 lbs	grd/shp	50-90 percent efficient across the band.
360 x 70	50 W CW transmit pwr	4 H x 1.5 D	3.3 oz	grd/shp	Peak gain on the horizon across the band.
360 x 75	100 W CW transmit pwr	5.6 H x 3.1 D	12 oz	grd/shp	Peak gain on the horizon across the band.
360 x 65	101 W CW transmit pwr	12 H x 6.3 D	3.6 lbs	grd/shp	50-90 percent efficient across the band.

TECHNOLOGY SURVEY: EW ANTENNAS

MODEL	TYPE	OP FREQ	PATTERN	POLARIZATION	GAIN
ITT Corporation, Antenna Products & Technologies; Bohemia, NY; +1-631-218-5500; www.defense.itt.com					
AM-423-Series	spiral	2-18 GHz	hemispherical	dual CP	1 dBic nom
AS-48461	horn	2-18 GHz	directional	dual linear	5-18 dBi
Q107-4	spiral	0.5-18 GHz	hemispherical	dual CP	-10-1 dBil
AS-48951	biconical omnidirectional	0.5-18 GHz	omnidirectional	slant linear	-20-0 dBi avg (matched polarization)
Q175-Series	spiral	0.5-2 GHz	hemispherical	dual CP	-8-0 dBic
JEM Engineering; Laurel, MD; +1-301-317-1070; www.jemengineering.com					
Wideband Spiral Antenna (901-0060-001)	spiral	500 MHz-6 GHz	directional	RHCP	3-5 dBiC
UHF Monocone Antenna (901-0049-001)	monocone	550 MHz-2.55 GHz	omnidirectional	vertical linear	3-5 dBiL
Broadband Transmit Antenna (901-0010-001)	notch array	1.6-6 GHz	fan beam	vertical linear	3-8.5 dB
Broadband High Gain Antenna (901-0012-001)	notch array	1.5-6 GHz	fan beam	vertical linear	7-11 dB
Broadband Omni Coverage Antenna (901-0022-001)	monocone	2-18 GHz	monocone	vertical linear	2-4 dBiL
L-3 Communications Randtron Antenna Systems; Menlo Park, CA; +1-866-900-7270; www.L-3com.com/randtron					
Broadband Sinuous	DF, interferometer	0.4-18 GHz	cardioid (principal plane), circular (conical plane)	Horizontal and vertical. Slant, +45 and -45 deg. Dual CP.	-8 dBli-3 dBli
Broadband Spirals	DF, interferometer	0.5-42 GHz	cardioid (principal plane), circular (conical plane)	dual CP	-8 dBli-3 dBli
Quad Monopole	DF array	0.7-2 GHz	cardioid (conical plane), directional (principal plane)	vertical	-1 dBli-5 dBli
Pharad, LLC; Glen Burnie, MD; +1-410-590-3333; www.pharad.com					
MP-25-6000	*	25-6,000 MHz	omnidirectional	vertical	3 dBi
MP-25-6000-EG	*	25-6,000 MHz	omnidirectional	vertical	5 dBi
MP-800-6000-GN	*	800-6,000 MHz	omnidirectional	vertical	0 dBi
MP-800-6000-EGN	*	800-6,000 MHz	omnidirectional	vertical	3 dBi
Poynting Antennas (Pty) Ltd.; Wynberg, Johannesburg, Gauteng Province, South Africa; +27-(0)11-262-5155; www.poynting.co.za					
OMNI-A0075 (Tactical Tri-Band GSM Antenna)	multi-element	925-960 MHz (GSM 900); 1,805-1,880 MHz (GSM 1800); 1,930-1,990 MHz (GSM 1900).	omnidirectional	vertical	Max: 5 dBi ± 0.5 dB (GSM 900); 6 dBi ± 0.5 dB (GSM 1800); 6 dBi ± 0.5 dB (GSM 1900). Min: 4 dBi (GSM 900); 5 dBi (GSM 1800); 5 dBi (GSM 1900).
MONO-A0030 (High Power VHF Whip)	single	30-100 MHz	omnidirectional	vertical	>-7 dBi
LPDA-A0067 (High Power LPDA Antenna)	multi-element	800-3,000 MHz	directional	vertical	12 dBi avg, 11 dBi min.
LPDA-A0036-01	multi-element	20-3,000 MHz	unidirectional	adjustable	gain on horizon

BEAMWIDTH	POWER	SIZE	WEIGHT	PLATFORM	FEATURES
75 deg nom	1	2.38 D x 1.53 deep	0.5 lbs	air/grd/shp	Available with hemispherical radome for high-speed applications.
60-10 deg	10	5.5 D x 13 deep	4.25 lbs	air/grd/shp	High-pwr (100 W CW) versions available.
75 deg nom	1	5 x 5 x 4.2	1.5 lbs	air/grd/shp	*
AZ: 360 deg. EL: 20 deg min.	*	5.5 L x 5.8 D	4 lbs	air/grd/shp	Usable to 26 GHz (for ground and shipboard applications only).
75 deg nom	1	7 D x 3 deep	2 lbs	air/grd/shp	100 percent unit-to-unit phase tracking available.
AZ and EL: 90 deg.	10	2.28 x 5.79 x 5.59	15.5 oz	air/grd	Optimized for max gain in a small package.
AZ: omnidirectional. EL: 45 deg nom.	50	3.9 x 4.575 x 4.575	9.5 oz	air/grd	*
AZ: 120 deg. EL: 30 deg.	75	3.73 x 2.50 x 6.31	11.2 oz	air/grd	Unique fan-beam pattern with broad H-plane beam for sector coverage.
H-plane: 120 deg. E-plane: 20 deg.	40	4.45 x 2.50 x 8.92	1 lb	air/grd	Unique fan-beam pattern with broad H-plane beam for sector coverage.
AZ: omnidirectional. EL: 40 deg nom.	40	1.25 H x 6 D	3.5 oz	air/grd	Ultra-wideband omnidirectional antenna.
3 dB 100 deg-65 deg AZ and EL	7 W CW	various from 2-10 D	variable 4 oz-5 lbs	air/grd/shp/sub	Can be built to specification, alternative radomes.
3 dB 100 deg-65 deg AZ and EL	7 W CW	various from 0.5-8 D	variable 5 oz-2 lbs	air/grd/shp/sub	Can be built to specification, alternative radomes.
3 dB 100 deg-60 deg AZ. 30 deg-60 deg EL.	20 W CW	typ 5 x 5 x 7	typ 4 lbs	air/grd/shp	Can be built to specification: opt BIT and omni ports.
*	25	39.5 H x 1.8 D	1.1 lbs	manpack	Wideband and lightweight for dismounted CREW systems.
*	25	39.5 H x 2.5 D	2 lbs	manpack	Wideband, with flexible elements, for dismounted CREW systems.
*	25	20 H x 1.3 D	1 lbs	manpack	Flexible gooseneck for dismounted CREW systems.
*	25	20 H x 1.3 D	1.1 lbs	manpack	Flexible gooseneck for dismounted CREW systems.
E-plane: 3 dB beamwith. 40 deg ± 10 deg (GSM 900); 30 deg ± 10 deg (GSM 1800/1900). H-plane: 3 dB beamwidth = 360 deg.	50	22 x 1.3	360 g	grd-mob	*
60 deg	300	82.7 L x 5.3 D	4.5 kg	grd-mob	*
H-plane: 60 deg. E-plane: 10 deg.	100	5.9 x 21.6 x 27.6	4.5 kg, including mounting bracket	grd	*
E-plane: 3 dB beamwith = 60 deg.	1,000 W up to 1 GHz rolling off to 250 W at 3 GHz.	32.6 x 110.4 x 113.5	32 kg	grd-fix	*

TECHNOLOGY SURVEY: EW ANTENNAS

MODEL	TYPE	OP FREQ	PATTERN	POLARIZATION	GAIN
Q-par Angus Ltd.; Leominster, Herefordshire, UK; +44-1568-612138; www.q-par.com					
D884 6-18 GHz Jammer	high gain horn and prime focus reflector	6-18 GHz	Wideband and narrow beam, switchable.	linear	9.5-18 dBi and 24-31 dBi, switchable.
D1132	prime focus reflector system with linear horn feeds	2-18 GHz, 6-18 GHz, 2-6 GHz	linear	*	2-18 GHz: 19-35.1 dBi. 6-18 GHz: 35.8-43.8 dBi. 2-6 GHz: 26.4-33.5 dBi.
Dual Circularly Polarised Sinuous Antenna QSPDCP2-18S	dual circularly polarized sinuous	2-18 GHz	*	dual CP	-4-4 dBiC
Rohde & Schwarz; Munich, Germany; +49-89-4129-0; www.rohde-schwarz.com					
R&S HL040	LPDA	400 MHz-3 GHz	directional	linear	5-7 dBi
R&S HL223	LPDA	200 MHz-1.3 GHz	directional	linear	>6 dBi
R&S HE055	active antenna	1.5-600 MHz	omnidirectional	linear, vertical	5 dB (30-600 MHz).
R&S HE500	active antenna	20 MHz-3 GHz	omnidirectional	linear, vertical	-26-15 dBi
R&S HF907OM	biconical/horn	800 MHz-26.5 GHz	omnidirectional	linear, vertical	1-5 dBi
Saab Avitronics (Antenna Systems group); Pretoria, South Africa; +27-12-674-3500; www.saabgroup.com					
Spinning DF Antennas	Reflector (high gain) or horns (low profile).	0.5-40 GHz in sub-bands	Directional. Omni antenna opt.	slant 45 deg	5-22 dBi, dep on config and frequency range.
Interferometer array panels	spiral	1-6 and 6-18 GHz	directional	dual CP	2 dBic nom
High-power parabolic reflector antennas	parabolic reflector	1-18 GHz or smaller sub-bands. 18-40 GHz also available.	directional	V/H/±45 deg adjustable	Dep on reflector size (23.6-71 inches).
Interferometer blade antennas	blade (phase track)	20-500 and 500-2,000 MHz	monopole on ground plane	vertical	monopole on ground plane
TECOM Industries, Inc.; Thousand Oaks, CA; +1-805-267-0100; www.tecom-ind.com					
Spinning DF, Type 204207-8	Shaped reflector with broadband fee. Single axis pedestal.	0.5-22 GHz	Near constant elevation beamwidth.	45 deg slant linear	3 dBi min at 0.5 GHz
Airborne Broadband Omni-Directional Antenna (Type 201564-3)	bicone	0.5-18 GHz	*	slant linear	-6 dBi at 0.5 GHz
Broadband Dual Polarized Log periodic Antenna	*	1-18 and 0.5-18 GHz	*	dual linear	7.5 typ

BEAMWIDTH	POWER	SIZE	WEIGHT	PLATFORM	FEATURES
55 deg-20 deg widebeam and 8 deg-4 deg narrowbeam.	800 W CW	15.7 x 15.7 x 11.8	13 kg	grd/shp	remote switching
2-18 GHz, 16 deg-2 deg; 6-18 GHz, 2.4 deg-1 deg; 2-6 GHz, 7 deg-3 deg.	400 W CW	2-18 GHz: 32 D x 38 L. 6-18 GHz: 56 D. 2-6 GHz: 56 D.	2-18 GHz: 42 kg. 6-18 GHz: 19.1 kg. 2-6 GHz: 20.6 kg.	grd	>86 dB isolation between Tx and Rx antenna.
100 deg-60 deg, 6dB Squint ≤ ±2.5 deg, 2-6 GHz; ≤ ±2 deg, 6-16 GHz; ≤ ±4 deg, 16-18 GHz. Axial ratio: <2 dB across the band.	*	2.4 D x 3.9 H (including connectors)	approx 200 g	air/grd/shp	Dual linear also available.
E-plane: 60 deg. H-plane: 105 deg.	150 W-50 W CW	5.1 x 11.8 x 26.8	approx 2.8 kg	grd-fix	*
E-plane: 60 deg. H-plane: 105 deg.	1,500 W-600 W CW	28 x 29.9 x 4.7	approx 2 kg	grd-fix	*
AZ: omnidirectional	only Rx	55.1 L x 5.9 D	approx 3.5 kg	grd-mob	*
AZ: omnidirectional	only Rx	6.7 x 14.6 x 2.6	approx 1.2 kg	grd-mob	*
AZ: omnidirectional. EL: 150 deg-20 deg.	50 W-10 W CW	10.4 L x 8.3 D	aprrox. 1.5 kg	grd-mob	*
AZ: 70 deg -1 deg (dep on config and frequency range). EL: >15 deg at highest frequency.	only Rx	51 H, including omni and positioner (reflector) or 24.8 (low-profile) x 32-35.4 D.	60-70 kg nom, dep on config	air/grd/shp	*
85 deg nom	only Rx	4.7 x 9.5 x 22.8 for panel with 4 spirals per band.	4 kg (complete assembly with radome).	air/shp	*
dep on reflector size	Up to 300 W CW at 18 GHz.	*	dep on reflector size	grd/shp	Incorporates a high-efficiency feed antenna for optimal illumination of parabolic antennas. Feed pattern 10 dB beamwidth at 18 GHz 120 deg (H-plane) by 100 deg (E-plane).
Omni in AZ, monopole on ground plane in EL.	only Rx	Dep on config. 11.8 x 3.9 x 11.7 and 4.5 x 1.8 x 5.3.	1.4 kg and 220 g	air	*
AZ: 60 deg nom at 0.5 GHz. EL: 25 deg nom at 0.5-22 GHz.	≤5	37.5 H x 38 D	100 lbs	grd/shp	Frequency extension to 40 GHz. Omni antenna.
360 deg x 30 deg typ	5	9.1 H x 10.25 D	approx 8 lbs	air	Altitude: 40,000 feet. Airspeed: 500 mph. Receives horizontal, vertical and dual CP signals.
E-Plane: 65 deg. H-Plane: 100 deg.	≤5 typ	1-18 GHz: 9.5 H x 8 D. 0.5-18 GHz: 1.7 H x 15.1 D.	1-18 GHz: ≤4.5 lbs. 0.5-18 GHz: ≤10 lbs.	air/grd/shp	wide bandwidth

Survey Key – EW Antennas

MODEL
Product name or model number

TYPE
Antenna type
- DF = direction-finding
- LPDA = log periodic dipole array

OP FREQ
Operating frequency
- GSM = Global System for Mobile communications

PATTERN
- AZ = azimuth
- EL = elevation

POLARIZATION
- LHCP = left-hand circular polarization
- RHCP = right-hand circular polarization

POWER
Power (in Watts)
- CW = continuous wave
- Rx = receive out

SIZE (in in.)
Size by height x weight x length, or diameter, in inches
- L = length
- H = height
- W = width
- OD = optical density

PLATFORM
Platform
- air = airborne
- grd = ground, mobile and ground, fixed
- grd-fix = ground, fixed
- grd-mob = ground, mobile
- shp = shipboard
- sub = submarine

FEATURES
Additional features
- BIT = built-in test
- CREW = Counter Radio Controlled Improvised Explosive Device Electronic Warfare
- Tx = transmit out

OTHER ABBREVIATIONS USED
- pwr = power
- nom = nominal
- avg = average
- min = minimum
- max = maximum
- opt = optional
- deg = degree
- dep = dependent
- config = configuration
- < = greater than
- > = less than
- typ = typical
- approx = approximately

** Indicates answer is classified, not releasable or no answer was given.*

OTHER COMPANIES
This reference list includes websites for additional companies in the field that were unable to provide survey information due to security constraints or publication deadlines, or that declined to participate.

Company Name	Website
Delphius	www.delphius.co.za
Elisra	www.elisra.com
Fractal Antenna Systems Inc.	www.fractenna.com
Microwave Engineering Corp.	www.microwaveeng.com
Seavey Engineering	www.seaveyantenna.com
UB Corp.	www.ubcorp.com

2009 Technology Surveys
These following surveys are upcoming in *JED* during 2009. Please e-mail editor@crows.org by the date below to request a survey.

JUNE: IR Expendables, Decoys and Dispensers: Request by **February 1**
JULY: COMINT/DF Receivers: Request by **March 1**
AUGUST: SIGINT Antennas: Request by **April 1**
NOVEMBER: ELINT Systems: Request by **July 1**

EW 103: COMMUNICATIONS ELECTRONIC WARFARE

By Kernan Chaisson

After years of prompting and begging by the membership, Old Crow Dave Adamy has come out with a new book, *EW 103: Communications Electronic Warfare*, released this month. Like his previous books, *EW 101* and *EW 102,* this book is based on the tutorials published monthly in *JED* but organized into chapters, with added introductory text and discussion. *EW 103* comes with a specialized slide rule for calculating antenna and propagation values. "While there are many similar slide rules floating around," Adamy told *JED.* "This one has some newly-designed scales not found in any of the others, especially calculation of near-ground propagation."

The book focuses on the practical aspects of EW against enemy communications signals. The target audience is new EW professionals, specialists in some part of EW, specialists in technical areas peripheral to EW and managers who are responsible for the efforts of EW engineers and technicians – not to mention the rest of us who found *EW 101* and *EW 102* indispensable references.

While the first two books were written to go together, this one can stand alone. In the introduction, Adamy explains, "This book is intended to be an easy read. Explanations of hardware and techniques are given in physical, rather than mathematical, terms. The math is largely simple dB formulas which are easy to remember and to use. Like the two earlier EW100-series books, the technical material is intended to be accurate as opposed to precise. In most cases, the formulas and examples are set up to calculate values to 1 dB accuracy. However, constants are provided to higher accuracy for the convenience of those who will be using the formulas in higher precision applications." Further explaining the book, Adamy says, "Communications signals can be either analog or digital, with digital signals becoming more common as time goes by. There are significant differences in the way EW systems deal with these two classes of signals. For digital communication signals, there are many ways in which an enemy can make the EW tasks more difficult by use of sophisticated techniques for the preservation of signal integrity."

Chapters include An Introduction, with DB math, Signals, Antennas, Receivers (with sensitivity and dynamic range), Radio Propagation, Search, Emitter Location, Intercept and Jamming. The tables and illustrations are of the same clear, easy-to-understand quality we have become used to in the *JED* "EW 101" series. In addition to the problems and solutions appendix, there is a suggested reference material and a guide to using the CD that comes with the book.

The CD contains built-in formulas for the propagation of losses, received signal strength, effective range, jamming-to-signal ratio and similar important values. The formulas are in spreadsheet format because this is the one most commonly used. "MatLab would be more elegant," Adamy said, "but the program is very expensive. Readers are welcome to convert the spreadsheet formulas (which are provided) to MatLab or any other program if they would like."

EW 103: Communications Electronic Warfare, ISBN: 978-1-59693-387-3, 370 pages, Artech House. The book is available to AOC members through publishing partner SciTech Publishing at a guaranteed lowest price. (To purchase the book using your AOC discount, log onto www.scitechpub.com or www.scitechpublishing.com and type in the AOC discount code EW103AOC.)

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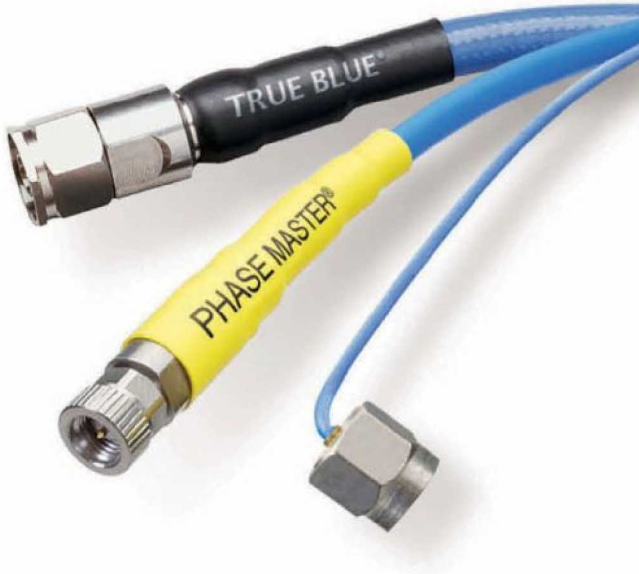

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www.teledynestorm.com/jed0109

BROADBAND DRIVER AMPLIFIER

The KS5388, a new broadband driver amplifier from CAP Wireless, is designed for instrumentation and EW simulation, specifically for electronic countermeasures (ECM), multi-band communications, signal simulators and instrument and test equipment applications, and also functions as a receiver amplifier in high-dynamic-range, broadband receiver systems. It features 5 W of power amplification, 6-18 GHz bandwidth, 37-dBm output power and 35-dB gain, and comes with a copper heat spreader for thermal management. Other characteristics include high-temperature co-fired ceramic (HTCC) packaging and solid-state, gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) reliability. *CAP Wireless Inc.; Newbury Park, CA; www.capwireless.com*

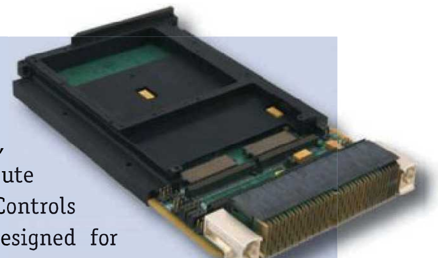
SIGINT RECEIVERS AND DOWNCONVERTERS

Elcom Technologies has launched the FlxGen™ series of six HF-VHF/UHF-MW receivers and downconverters, which range from 10 KHz to 40 GHz. Designed for SIGINT applications, the products feature flexible sensors utilizing the company's RF architecture, which allows users to embed mission-sensitive signal analysis and detection strategies and to adapt to many form factors, and commercial off-the-shelf (COTS) DSP hardware. Other features include the capability to control IF bandwidths, IF frequencies and communication protocols and formats. *Elcom Technologies; Rockleigh, NJ; www.elcom-tech.com*

LOW-BAND DIRECTION-FINDING MODULE

The LBDFM-052-BD-DP from Planar Monolithics Industries (PMI) is a low-band, direction-finding module that operates at the 500-MHz to 2-GHz frequency range and is well-suited for EW applications. The unidirectional module routes signals through one of four channels from the RF input port to the RF output port, and both ports can be switched to internal 50-Ohm terminations during off times and isolation or VSWR tests. The module, which measures 6.9 x 2.48 x 0.85 inches, features a 70-dB minimum RF input signal-to-noise ratio, an 8.5-dB maximum noise figure, a 2:1 VSWR and a maximum switching speed of 10 nsec. It can operate up to 10,000 feet above sea level in temperatures ranging from 20 to 60 degrees Celsius, plus it can withstand -20 to 70 degrees Celsius in storage. *Planar Monolithics Industries Inc.; Frederick, MD; www.planarmonolithics.com*

RUGGED SMALL FORM-FACTOR FPGA



The VPX3-450, a rugged, small form-factor 3U compute engine from Curtiss-Wright Controls Embedded Computing, is designed for radar, sonar and SIGINT applications on UAVs and land vehicles with size, weight and power (SWAP) constraints. It is the company's first Xilinx Virtex®-5 FPGA-based 3U VPX device, and also features a Freescale 8640 Power Architecture processor and support for high-bandwidth serial switched fabrics like PCI Express and Serial RapidIO (SRIO). A bank of DDR SDRAM and two banks of QDR-II+ SRAM memory are attached directly to the FPGA, and these, along with two four-lane, high-speed serial ports to the backplane and one to the XMC site, offer 7.5 GB/s total bandwidth. VxWorks®- and Linux™-compatible, the device also supports the company's Continuum FXtools software package, which provides FPGA-specific function libraries, memory control and serial and LVDS interfaces, plus a scriptable FPGA simulation environment. *Curtiss-Wright Controls Embedded Computing; Charlotte, NC; www.cwcembedded.com*

MINIATURE WIDEBAND SIGINT RECORDER

DRS has introduced the Scout SCT-A7040-1 data recorder as a part of its line of wideband SIGINT recorders. Scout is designed for space-constrained, low-power RF spectrum survey applications. The 3 x 1.5 x 6-inch recorder weighs 30 oz, operates on 12 VDC at 10 W and records 40 MHz of signal bandwidth from a 70-MHz IF for 30 minutes. The unit provides users with a variety of data offload options, a 256-GB removable storage pack, a USB 2.0 interface and support peripherals. *DRS Signal Recording Solutions; Columbia, MD; www.drs-srt.com*

WIDEBAND RF TRANSISTORS

TriQuint Semiconductor has introduced a line of high-power, wideband RF transistors, called the PowerBand™ family, operating from 500 MHz to 3 GHz with up to 50 W of output power. Designed for use in broadband applications such as radars, signal jammers and wireless communications, the transistors have an operating voltage range of 12-28 V and a high-performance efficiency of 50 percent PAE. In a standard application, two to four of the transistors perform the job of six to 12 conventional RF transistors. Other features include compatibility with typical semiconductor applications and the option for the transistors to be developed using gallium arsenide (GaAs), gallium nitride (GaN) or RF laterally diffused metal oxide semiconductor (LDMOS) technologies. *TriQuint Semiconductor; Hillsboro, OR; www.triquint.com*

Communications EW – Part 20

Communication Jamming *(continued)*

By Dave Adamy

PROPAGATION MODELS

In the "EW 101" columns in the July, August and September 2008 issues, we discussed the three propagation models that most commonly characterize tactical communication link performance. Last month, we talked about desired signal, intercept and jamming links, which all are tactical communication links. It is important to realize that each can have any propagation model. This is the reason that we left the loss terms in the jamming to signal (J/S) ratio equations as merely losses, rather than simplifying the equations to remove some of the common terms.

Because any link might have any loss model, it is necessary – when approaching a communication jamming problem – to first determine the appropriate loss model for each of the links involved. This involves consideration of the geometry and often the calculation of the Fresnel zone (FZ) distance for each link. For air-to-air situations where the desired signal transmitter, receiver and jammer all are far from the ground, both the desired signal and jamming links have line-of-sight propagation. This also is normally true when the jammed communication takes place at microwave frequencies and narrow directional antennas are used. However, when the problem involves ground-to-ground or air-to-ground jamming at VHF and UHF, the only way to determine the required propagation model is to calculate the FZ distance for each link.

GROUND-BASED COMMUNICATION JAMMING

Let's jump right into the most complex situation: the target communication link and the jammer all are ground-based, as shown in **Figure 1**. In this problem, the target link is operating at 250 MHz over 5 km with a 1-W transmitter. Both the transmit and receive antennas are 2-dBi whip antennas, which are mounted 2 meters above the ground. The jammer has a 500-W transmitter and a 12-dBi log periodic antenna mounted on a 30-meter mast. It is 50 km from the target receiver. All three stations are within line-of-sight of each other. We want to determine the J/S ratio that is achieved.

To solve the problem, the first step is the calculation of the FZ distance for the desired signal and jamming links. The formula for FZ distance (from the August 2007 "EW 101" column) is:

$$\mathbf{FZ(km) = [\ h_T(m) \times h_R(m) \times F(MHz)]/24{,}000}$$

For the desired signal link, the FZ is:

[2 x 2 x 250] / 24,000 = 0.0417 km = 41.7 meters

For the jamming link, the FZ is:

[30 x 2 x 250] / 24,000 = 0.625 km = 625 meters

In each case, the link distance is far greater than the FZ distance, so two-ray propagation applies, as shown in **Figure 2**.

Because the receiving antenna is a whip, it has the same gain toward the jammer and the desired signal transmitter, thus the formula for J/S (from last month) is:

$$\mathbf{J/S\ (dB) = ERP_J(dBm) - ERP_S(dBm) - Loss_J(dB) + Loss_S(dB)}$$

The ERP of the jammer is:

ERP (dBm) = PT(dBm) + GT(dB) = 10 log (500,000 mw) + 12 dB
= 57 + 12 = 69 dBm

The ERP of the desired signal transmitter is:

ERP (dBm) = 10 log (1000 mw) + 2 dB = 32 dBm

The two-ray loss for either link (from the August 2007 "EW 101") is:

Loss (dB) = 120 + 40 log d(km) - 20 log h_T(m) - 20 log h_R(m)

For the jamming link, the loss is:

[120 + 68 - 29.5 - 6] = 152.5 dB

For the desired signal link, the loss is:

[120 + 28 - 6 - 6] = 136 dB

So the J/S is:

J/S (dB) = 69 dBm - 32 dBm - 152.5 dB + 136 dB = 20.5 dB

FORMULA SIMPLIFICATION

If you are working a series of problems in which you know the propagation for both the desired signal and jamming links will be two-ray, you could use a simplified formula for J/S:

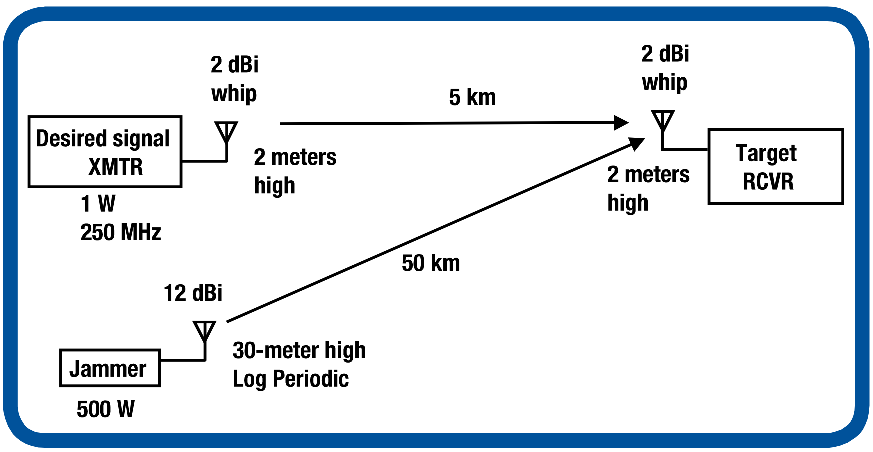


Figure 1: The J/S achieved from a ground-based jammer depends on jamming geometry.

$J/S\ (dB) = ERP_J(dBm) - ERP_S(dBm) - Loss_J(dB) + Loss_S(dB)$
$= ERP_J\ (dBm) - ERP_S(dBm) - (120 + 40 \log d_J - 20 \log h_J - 20 \log h_R) + 120 + 40 \log d_S - 20 \log h_T - 20 \log h_R$

where d_J is the distance from the jammer to the target receiver in km
d_S is the distance from the desired signal transmitter to the target receiver in km
h_J is the height of the jammer antenna in meters
h_T is the height of the desired signal transmitter antenna in meters
h_R is the height of the target receiver antenna in meters

Because the receiving antenna is the same for both links, this formula simplifies to:

$J/S = ERP_J - ERP_S - 40 \log d_J + 20 \log h_J + 40 \log d_S - 20 \log h_T$

AIRBORNE COMMUNICATIONS JAMMING

Now consider the case shown in **Figure 3.** We are jamming the same communications net, but now our jammer is mounted on a helicopter that is hovering at 500 meters. The jammer is still 50 km from the target receiver. The jamming transmitter outputs 200 W and the jamming antenna is now a 2-dB folded dipole antenna on the belly of the helicopter. What is the J/S?

First, we need to determine the FZ distance for the jamming link.

$FZ\ (km) = [h_T \times h_R \times F] / 24{,}000 = [1000 \times 2 \times 250]/24{,}000 = 20.8\ km$

Since the jammer is more than 20.8 km from the receiver, the jamming link propagation is two-ray.

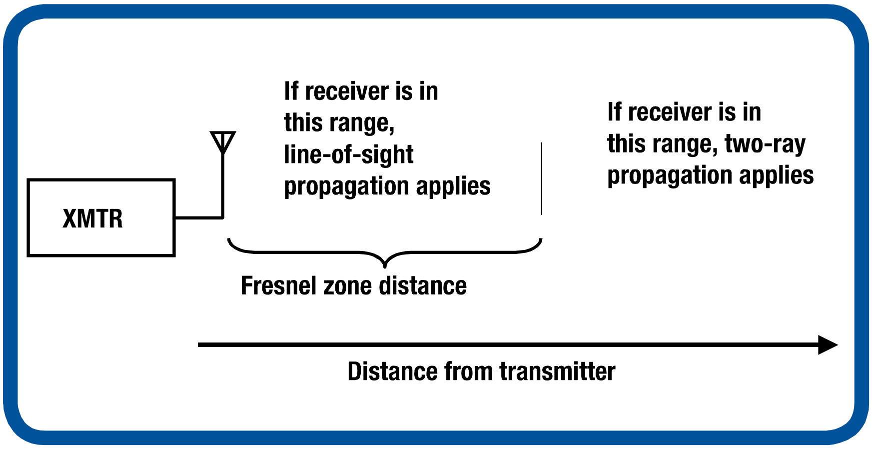


Figure 2: The applicable propagation model depends on the relationship between the link distance and the Fresnel zone distance.

The jamming link loss is thus:

$Loss_J = 120 + 40 \log d - 20 \log h_T - 20 \log h_R = 120 + 68 - 6 - 54 = 128\ dB$

The jamming ERP is now:

$ERP_J = 10 \log (200{,}000\ mw) + 2\ dBi = 53\ dBi + 2\ dB = 55\ dBm$

The J/S is then:

$J/S\ (dB) = ERP_J - ERP_S - Loss_J + Loss_S = 55\ dBm - 32\ dBm - 128\ dB + 136\ dB = 31\ dB$

Because the jammer is elevated, it creates almost 10 dB more J/S even though the jammer ERP is reduced by 14 dB.

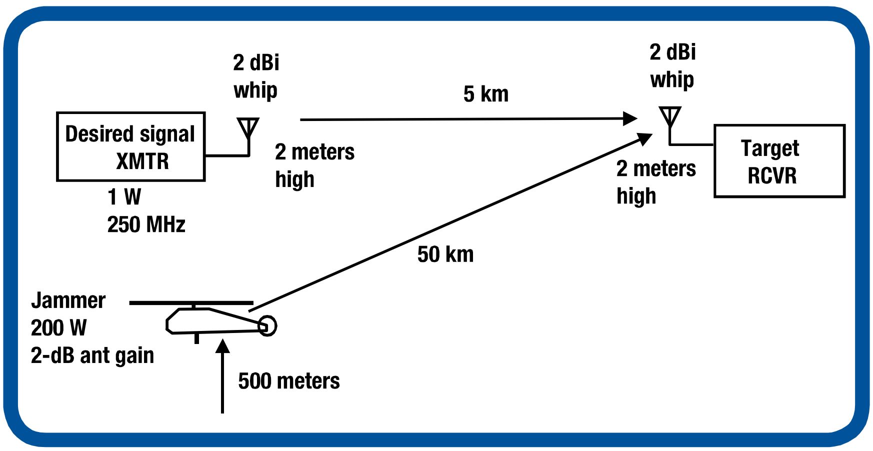


Figure 3: The J/S achieved from an airborne jammer is generally increased significantly by the jammer elevation.

WHAT'S NEXT

Next month, we will look at some other communication jamming geometry issues. For your comments and suggestions, Dave Adamy can be reached at dave@lynxpub.com.

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association news

CALL FOR NOMINATIONS: AOC 2009 ANNUAL ELECTION

Each year the AOC membership helps determine the future direction of the AOC by electing representatives to its Board of Directors. Nominations for the 2009 election are now being accepted.

This year's election slate will include the position of President, who will serve as Vice President in 2010 and as President in 2011. The AOC President appoints the Association's Secretary and Treasurer, presides over the Board of Directors and Executive Committee and appoints committee chairs. The President is also the AOC's primary spokesperson, visiting AOC chapters across the world and meeting with defense leaders. This is a significant but rewarding commitment.

The 2009 election slate will also include three At Large Director positions. At Large directors serve a three-year term. In addition, Regional Directors will be elected for three-year terms from the Central, Mid-Atlantic and Pacific Regions. This year, the Northern Pacific and Southern Pacific Regions will be combined into one region – the Pacific Region.

Nomination forms are available on the AOC website at www.crows.org or by contacting Carol Vann at the AOC. Nominations must be submitted to Ms. Vann by close of business on April 10, 2009.

For any questions or assistance, please contact:

Carole Vann, AOC Election Coordinator
Office: (703) 549-1600
Fax: (703) 549-3279
E-mail: vann@crows.org

JOINT ADVANCED CONCEPTS DIRECTOR VISITS CHESAPEAKE BAY ROOST

Chesapeake Bay Roost members welcomed James Durham, Director of Joint Advanced Concepts at the Office of the Secretary of Defense (OSD)/Pentagon, as the speaker at their November luncheon. Durham spoke on the subject "Strategy to Maintain US Electromagnetic Dominance," reviewing and elaborating on topics such as electronic warfare challenges, the awareness of losing the advantage, the Electronic Warfare Joint Analysis Team, the strategy to task method, integrating in the major EW stakeholders, translating strategy into capabilities and the EW Industry Day. He ended by summarizing his presentation and indentifying his conclusions and the way ahead.

The Chesapeake Bay Roost luncheons, held in the Pioneer Hall of the Historical Electronics Museum in Linthicum, MD, occur on the third Thursday of every month from September to May. For more information about the Chesapeake Bay Roost and its activities, contact John Hawkins at (410) 551-0620.

Pictured above, left to right, are James Durham, Director of Joint Advanced Concepts at OSD/Pentagon, and John Hawkins, President of the Chesapeake Bay Roost.

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