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The AOC Electronic Warfare Publication
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JED

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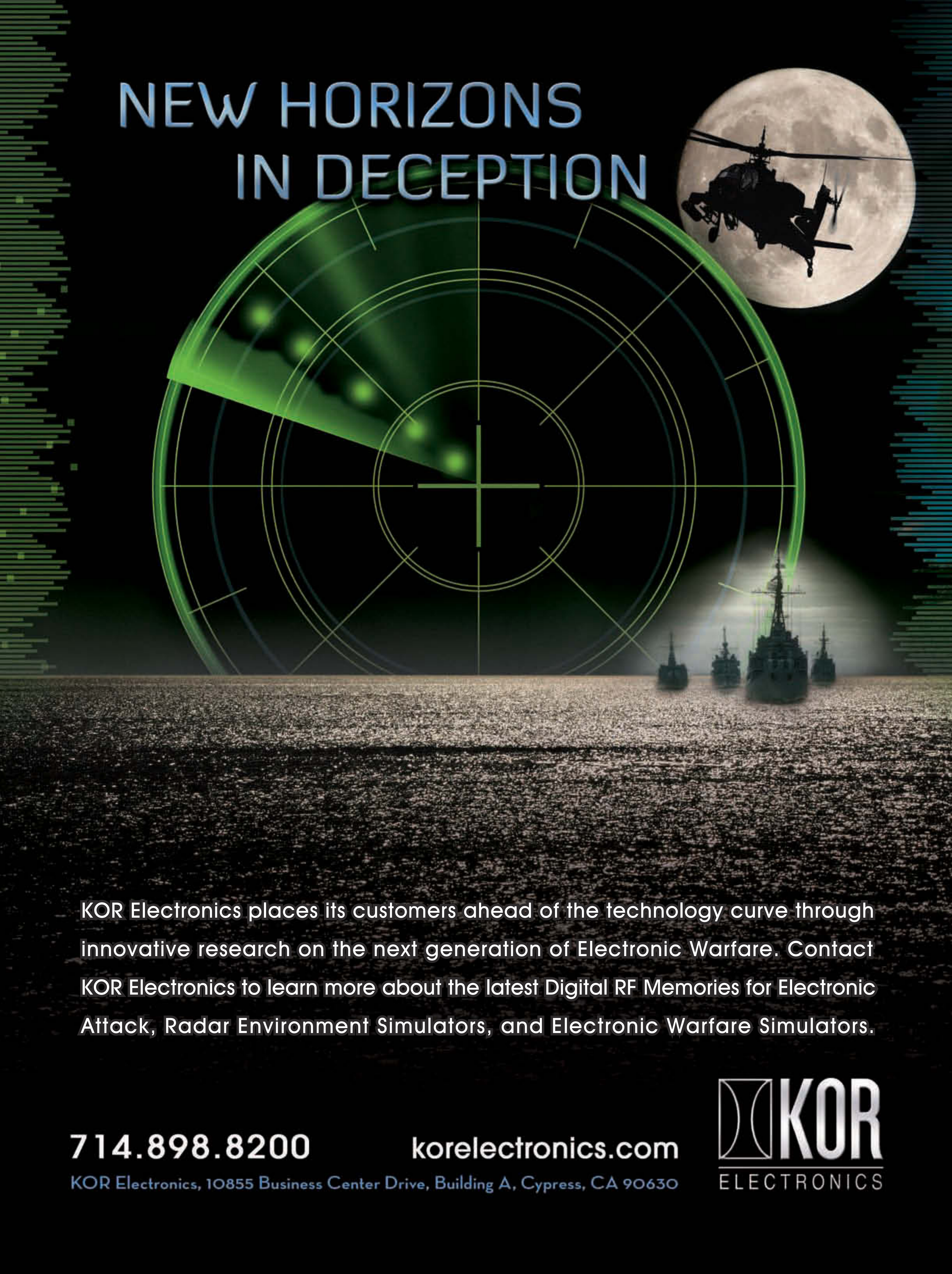
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the view from here

MOMENTUM

Last month, I had the opportunity to attend the AOC/Shephard EW 2009 Conference in London. It was, as always, a great event. It proved that you can hold an unclassified EW conference and still discuss issues that are very important to the global EW community.

One of the things I noticed from talking to conference attendees and exhibitors is the sense of momentum that has been building in the EW community over the past three years. Uniformed EW and SIGINT experts from across North America and Europe continue to rotate through Afghanistan and Iraq. In theater, the knowledge these experts possess is very much in demand, and their commanders know and appreciate what they can bring to the fight. Their specialized training and experience count. And their leadership, improvisation and innovation are what get the job done. As a result, EW is playing a starring role in Afghanistan and Iraq, and it is appreciated by just about everyone in those theaters.

When these EW personnel rotate back to their home stations, however, it can seem like they are stepping into another world. Organizational self-interest seems to influence major decisions. I'm not talking about EW organizations, here. I'm referring to service organizations that balkanize EW resources rather than concentrating them.

If we carried just 10 percent of the momentum EW has accumulated in theater and took it back home, I'm convinced EW could be adequately resourced. How does the EW community accomplish that transition? It's not difficult. We already bring our experiences home. We just need to relate them to our leaders and make sure they understand that broken, fragmented EW at home equals ineffective EW in theater. Our leaders can't understand the problems facing EW and support rational solutions if we don't speak up and tell them about it.

It's time to capitalize on our collective operational experience and convert it into the political capital we need to fix our widespread organizational problems. Otherwise, we can watch our EW gains atrophy over time until the next conflict.

– John Knowles

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JUNE

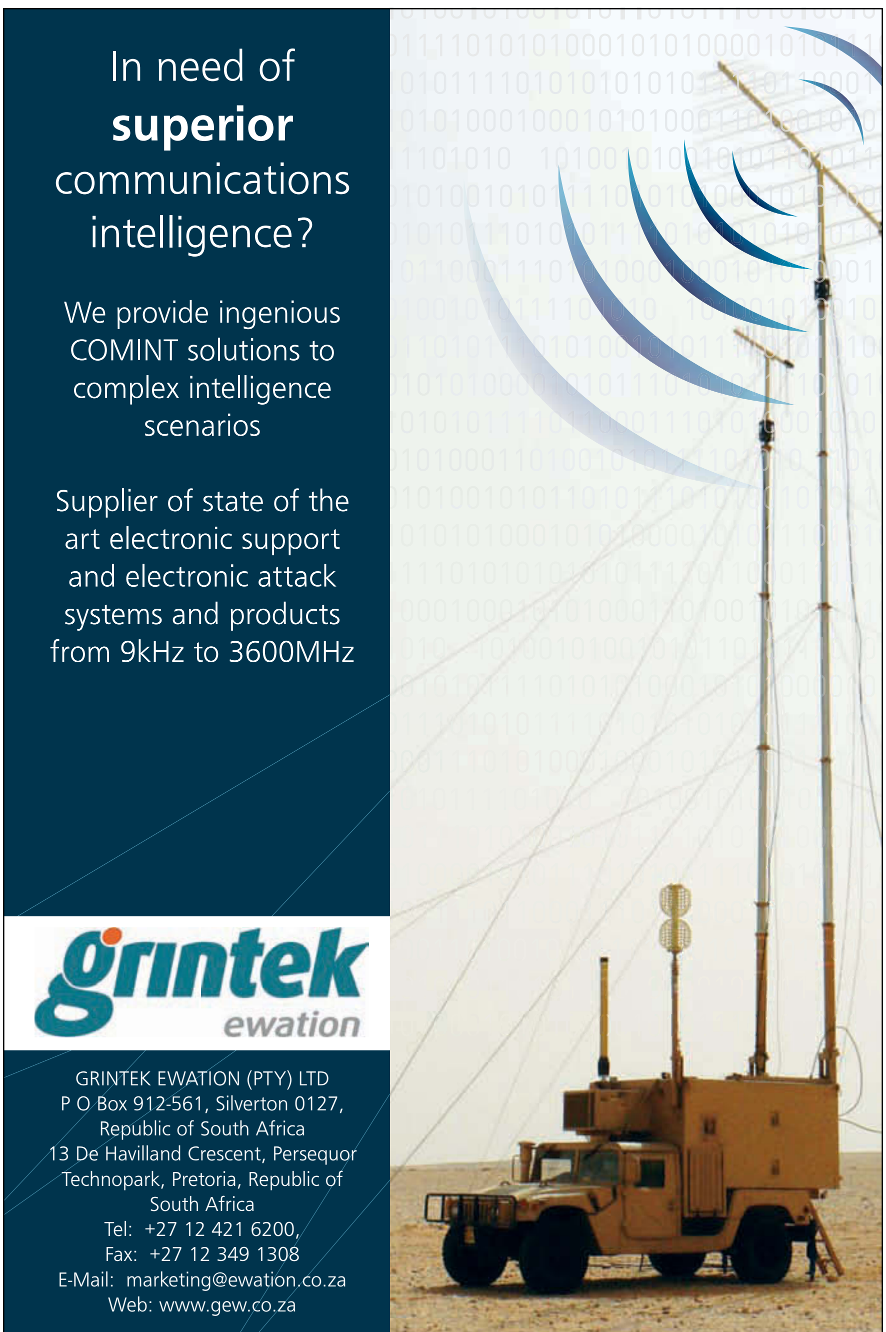
2009 International Microwave Symposium
June 7-12
Boston, MA
www.ims2009.com

36th Annual EW Symposium
June 9-11
NAS Whidbey Island, WA
Clearance: Secret/US only
www.whidbeycrows.org

Paris Air Show
June 15-21
Le Bourget, France
www.paris-air-show.com

Emerging EW Technologies Conference
June 16-18
GTRI, Atlanta, GA
www.crows.org

21st Annual Solid-State and Diode Laser Technology Review
June 28-July 2
Newton, MA
www.deps.org



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Bolton, MA
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July 15-17
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July 28-31
Las Vegas, NV
www.crows.org

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Unmanned Systems North America
August 10-13
Washington, DC
www.auvsi.org

TADTE 2009
August 13-16
Taipei, Taiwan
www.tadte.com.tw

MAKS 2009
August 18-23
Moscow, Russia
www.aviasalon.com

Space Protection Conference
August 25-27
Kirtland AFB, NM
www.crows.org

SEPTEMBER

DSEi
September 8-11
London, UK
www.dsei.co.uk

AFA National Convention
September 12-13
Washington, DC
www.afa.org

Passive Covert Radar Conference
September 15-17
Verona, NY
www.crows.org

11th Defense Operational Applications Symposium
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São Paulo, Brazil
www.sige.ita.br

OCTOBER

2009 AUSA Annual Meeting & Exposition
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JUNE

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June 9-12
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June 29-July 2
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A Primer in EW Modeling and Simulation
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Understanding Deception: A Primer in Deception History and Techniques
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AUGUST

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SEPTEMBER

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message from the president

EW IS MORE THAN EA

It is always great to read an article about electronic warfare in the mainstream media. However, I was disappointed last month to read an article by Loren Thompson of the Lexington Institute titled, "Pentagon Needs New Electronic-War Plan." Toward the beginning, I thought he was on the right track when he acknowledged the importance of EW and the need to control the electromagnetic spectrum in military operations. For the remainder of the article, however, he described the EW mission almost exclusively in terms of electronic attack (EA). He mentions electronic support (ES) in passing, and seemed to ignore the third part of the EW triad – electronic protect (EP).This was an important oversight in the article, because the next major focus area in EW is likely to be EP.

Consider the problems coalition forces have faced in Iraq over the past few years. The electromagnetic spectrum in that theater is so congested with civilian and blue force emissions that it has impacted (and in countless cases even prohibited) operations. UAVs have been grounded or gone out of control at times, communications have been limited periodically and EA systems have been turned off occasionally out of frustration – and all of this disruption has occurred without any adversary EA.

Why is this happening? The US and its allies have built their forces to be network enabled, and as our technology has accelerated so has our dependence on the electromagnetic spectrum. At the same time, we have failed to properly invest in the capability to adequately electronically protect the apertures that are critical to maintaining our technology edge over our adversaries. This means an adversary can utilize very inexpensive COTS technology to degrade or defeat our very expensive ISR assets and weapons platforms and therefore negate or severely reduce our technology edge. As COTS technology continues to outpace development of new military technologies, we become more and more vulnerable.

The EP situation in Iraq improved substantially with the deployment of hundreds of Navy, Marine and Air Force EW experts. However, that was simply a band-aid fix to a rapidly growing problem. Imagine trying to fight for a day in Iraq or Afghanistan without clear access to the spectrum. Or consider what happens to a carrier strike group in the Pacific if it can't use its radars, C2, communications and datalinks or rely on its GPS? The EP problem needs to be addressed immediately by senior military leaders.

Fortunately, some answers are becoming available. US Strategic Command's Joint EW Center has completed its Functional Solutions Analysis, which defines a comprehensive approach to address major EW shortfalls across the DOD. One of the key capability gaps it addresses is EP. STRATCOM and the Joint Staff will be briefed in the coming months. I think this study will begin to change the minds of defense leaders and explain in clear terms why EW is more than just EA.

– Kermit Quick

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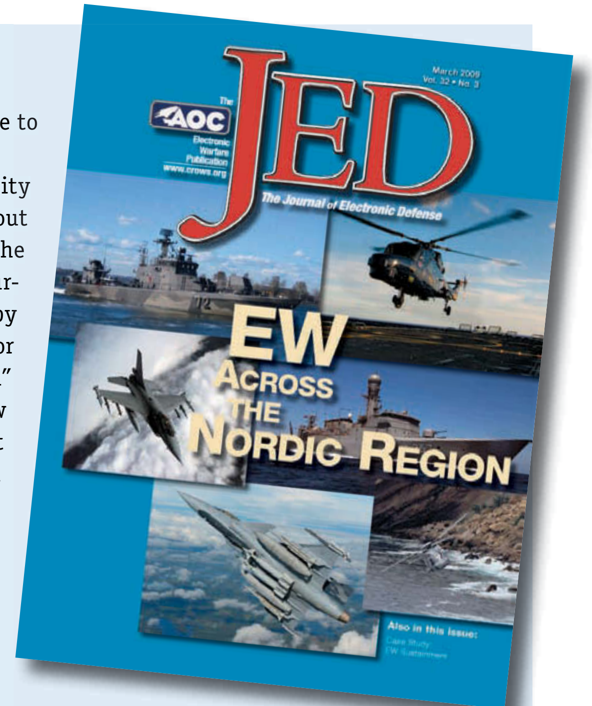
JED welcomes letters to the editor. Please send to editor@crows.org. Letters should include a phone number and contact e-mail. Letters may be edited for length, accuracy, clarity and to conform to JED style.

NOT A NEW IDEA

I know you don't regularly run Letters to the Editor, but this is in response to the "Washington Report," p. 26, in *JED*, Vol. 32, No.3, March 2009.



Full admission: I cut my teeth in this community as the Army Security Agency (ASA) was being dismantled and we MI and EW guys were brought out from behind the curtain (or the concertina wire, as the case may be) into the light, and better distributed throughout the Army. It should come as no surprise then that every time I read something like the statement attributed by the author, Glenn Goodman, to LTC John Bircher, USACEWP's Deputy Director for Futures – "FM 3-36 is the Army's first keystone EW document of its kind" – it raises my old CEWI (pronounced "see wee") Battalion hackles just a few angstroms. The statement by Goodman that "the new doctrine is the first effort to build an overarching concept of EW Operations that is nested in overall operational Army doctrine," also incorrect, raised them a few more.

The concept, doctrine and HTF (we used to say HTF for "how-to-fight" instead of TTP) of the 70s- and 80s-era Combat Electronic Warfare Intelligence (CEWI) Battalion – where collection and jamming companies were fully integrated with maneuvering combined arms units (see FM 34-12) – supersedes both Cold War and Vietnam War mentalities, and precedes what the USACEWP at CAC-L and your author apparently now consider a novel idea by about 25 years.

The vision – to "tightly integrate non-kinetic and kinetic capabilities across the Army" (as General Chiarelli refers to it) – is not new. It first began with the 1973 version of FM 30-9, Military Intelligence Organizations, which focused on the tactical orientation and maneuver of CEWI as a viable power projection at the battalion level. The so-called DePuy version of FM 100-5 went even further, including golden nuggets such as this: "Electronic warfare (EW) systems should be forward deployed and EW operations coordinated with fires and maneuver." It also included this: "Ground mobile EW elements must be mounted in armored vehicles that are compatible with and of equal mobility to the other elements of the combined arms team." If this sounds like the mantra coming out of the JEWC or the USACEWP at CAC-L, let me quickly note that it was written in 1976.

While FM 100-5 is now, in hindsight, hotly and correctly criticized for its heavy reliance on the superiority of our firepower (a reliance that "won" the Gulf War before it started and, unfortunately, also diminished the importance of CEWI distributed at Brigade and Below), and it failed to predict the asymmetric battlespace environment of today (in which superior firepower is diminished by ROE, urban terrain and the difficulties in distinguishing friend from foe), it is wrongfully ignored and forgotten as the first operations field manual to promote IEW as a form of tactical combat power on par with fires. It's true that FM 34-1 (1981), Intelligence and EW Operations, failed to include maneuver and offensive operations, and FM 34-80 (1986), the Brigade and Battalion version, devoted only a handful of pages to it, but the 1992 draft of FM 100-5 re-identified EW as a form of non-lethal fires under the definition of firepower.

My dismay is not one of simple nostalgia or prideful defensiveness. I certainly recognize that the Army's renewed integrated IEW initiatives are facing some different challenges and will require some innovative and unique doctrine and structure. And, as you stated in your "View from Here" on p. 6, I, too, am very interested to see how this second wave of integrated IEW takes shape. By the same token, there's nothing wrong – and lots of things right – with looking back to see more clearly ahead, and I certainly hope that the senior leadership at USACEWP at CAC-L has analysts, strategists and planners on staff who remember and are aware of the days of Army CEWI.

If not, I suggest they form a red team. I know of a few other gray beards that could help.

Greg Hyduke
US Army, Intelligence and Information Warfare Directorate (I2WD)(CACI)

Note from the Editor: JED *welcomes letters to the editor and does publish the limited number we receive. We are always happy to receive more.*

EW UPGRADES FOR USAF LEGACY FIGHTERS

USAF Col Bob Schwarze, the departing Chief of EW and Cyber Warfare Requirements on the Air Staff, told *JED* that the Air Force's recently released FY10 budget request, from an EW standpoint, was its best in more than a decade (see highlights on page 24). Buried in the budget documents are some small but potentially promising gains that the Air Force EW community achieved in setting the stage for funding of much needed upgrades to the self-protection equipment on the service's legacy fighter aircraft. The non-stealthy F-16s, A-10s and F-15s continue to fly with old analog EW systems.

Replacing the ALR-69 and ALR-56M radar warning receivers (RWRs) on F-16s and A-10s has been an unfunded requirement. Air Combat Command hopes to leverage the development work that has been done on Raytheon's new all-digital ALR-69A by Air Mobility Command (AMC) to meet this requirement. AMC has invested $180 million in the ALR-69A for its C-130s, but is curtailing this effort in FY10 due to budget constraints. However, there is money allotted in the Air Force budget to complete ALR-69A development for legacy fighters in FY10-FY11, Schwarze said, with an eye toward beginning procurement in FY12.

Upgrading the old Northrop Grumman ALQ-131 and Raytheon ALQ-184 external jamming pods used by F-16s and A-10s with digital RF memory (DRFM) technology is another imperative. Schwarze said the Air Force plans to purchase 400 upgraded ALQ-131 pods from Northrop Grumman with $190 million in its FY10-FY15 budgets. Col Joseph Skaja, Chief of EW Transformation at Air Combat Command, told the Shephard/AOC EW Conference in London last month that, in addition, the Warner Robins Air Logistics Center at Robins AFB, GA, this summer will undertake an obsolescence initiative to try to integrate select front-end components from the ALQ-184 into the older ALQ-131. The goal of both initiatives is a single common ALQ-131 pod with a DRFM capability, he said.

USAF F-15s use BAE Systems' ALR-56C RWR and Northrop Grumman's ALQ-135 jammer, which also are in need of upgrades. While replacing the ALR-56C with Raytheon's ALR-69A is an option, the most likely course of action the Air Force will choose, sources say, is to upgrade both the ALR-56C and the ALQ-135 on F-15Es and some older F-15Cs with digital components. BAE Systems has a study contract for an "LRU-3+" upgrade to the ALR-56C that would insert a digital receiver derived from the Joint Strike Fighter's EW suite. Northrop Grumman is studying integrating its "Digital Receiver-Exciter" (DRE) technology – the same components that are going into the ALQ-131 as well as the B-52H bomber's ALQ-155 – into the F-15's ALQ-135. Northrop Grumman's DRE is actually a new open architecture it calls "Banshee" that features common hardware and software modules. It allows the same core circuit cards and software to be used in multiple EW applications, such as the ALQ-155, ALQ-131 and ALQ-135, producing supportability cost savings. – *G. Goodman*

GROWLER COMPLETES OPEVAL

The US Navy's new EA-18G Growler airborne electronic attack (AEA) aircraft completed its independent Operational Evaluation (OPEVAL) May 5, CAPT Mark Darrah told reporters at the Navy League's Sea-Air-Space Exhibition. Darrah, the Navy's F/A-18 and EA-18G Program Manager (PMA-265) at NAS Patuxent River, MD, said a formal OPEVAL report will be completed this summer. It will be followed by a full-rate production (FRP) decision in August. The first EA-6B Prowler squadron to be trained and to complete its conversion to the Growler aircraft, VAQ-132, will achieve an initial operational capability in September and will be the first to deploy aboard an aircraft carrier in mid-2010, he said. The second squadron, VAQ-141, will become operational

USAF CYBER COMMAND FINDS HOME IN TEXAS

US Air Force officials announced May 16 their selection of Lackland AFB in San Antonio, TX, as the site of the headquarters for the service's new Cyber Command, which will be a numbered Air Force. Following an environmental impact study of Lackland that should conclude by the end of this summer, the 24th Air Force will transition from its present unofficial location, Barksdale AFB in Shreveport, LA, to Lackland by December. The other bases that were in the running were Barksdale AFB; Langley AFB, VA; Scott AFB, IL; Offutt AFB, NE; and Peterson AFB, CO. The new command will oversee 4,000 employees nationally in its efforts to deter cyber attacks on Air Force computer systems and networks. It will fall unin December. The Navy plans to buy 88 of the Boeing EA-18Gs to outfit 10 aircraft carrier squadrons with five Growlers each. A total of 56 EA-18Gs have been ordered through FY09; 22 more will be funded in FY10 following the FRP decision and the final 10 in FY11.

The Growler is a derivative of the Navy's two-seat F/A-18F Super Hornet aircraft with a support jamming mission. With its Advanced Electronically Scanned Array (AESA) radar and Advanced Medium-Range Air-to-Air Missiles (AMRAAMs), Darrah said, the EA-18G will not require fighter escorts like the Prowlers. Addressing the issue of whether the AESA radar itself

der Air Force Space Command at Peterson AFB, CO.

Already resident at Lackland are a number of related organizations: the Air Force ISR Agency, the service's Cryptologic Systems Group, its 67th Network Warfare Wing, its Information Operations Center and the Joint Information Operations Warfare Command. Also in the vicinity are the University of Texas at San Antonio, which performs cyber-related research, and the National Security Agency's Texas Cryptologic Center.

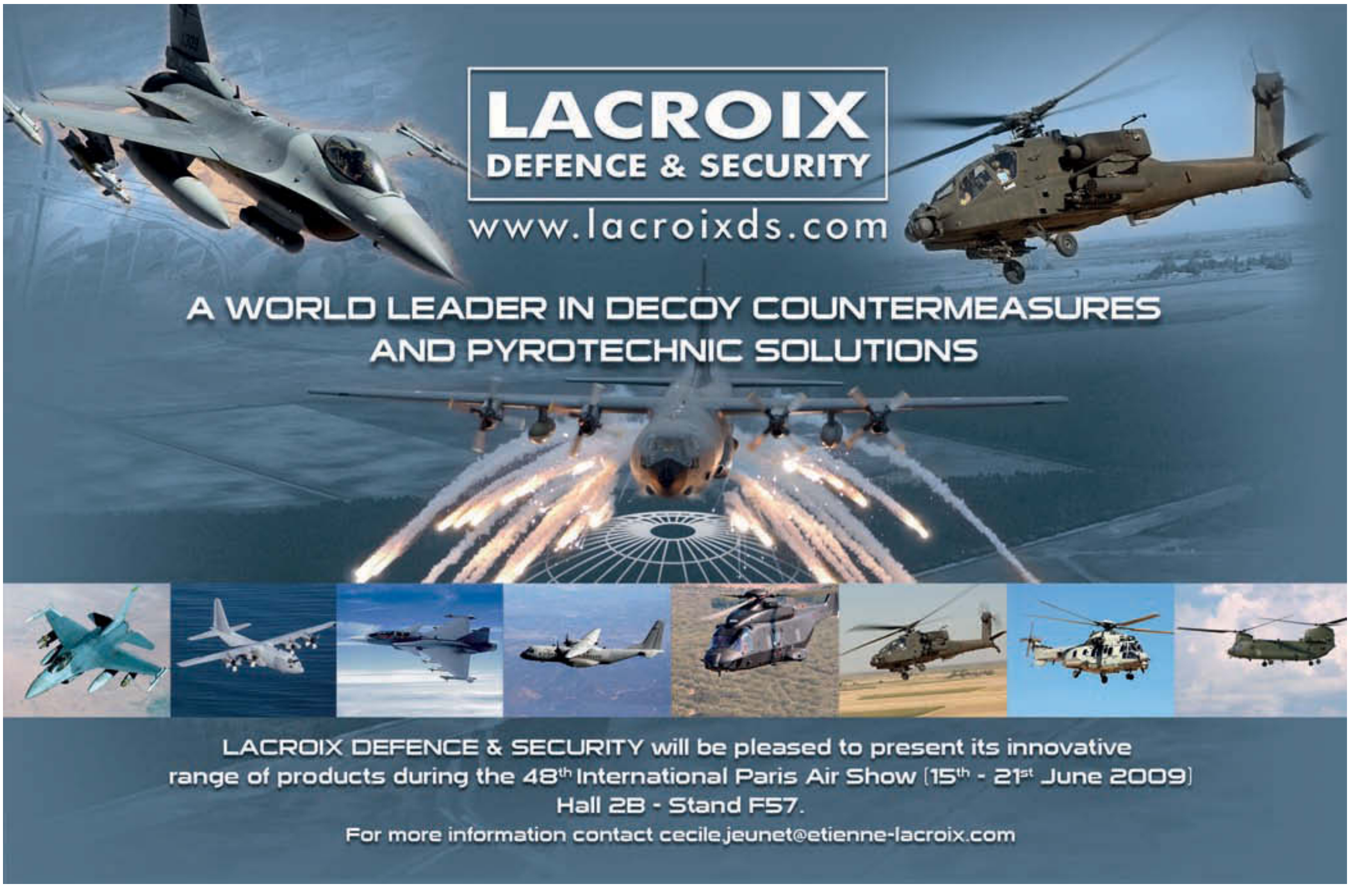
On April 22, Obama administration officials announced the planned creation of a new DOD Joint Cyber Command at Ft. Meade, MD, that will report to US Strategic Command at Offutt AFB, NE. – *M. Kunkel*

could perform jamming to augment the aircraft's external ALQ-99 wideband AEA pods, he noted, "We hear a lot about the EA-18G's AESA radar being potentially used to provide a jamming capability, but its ability to be used for AEA is limited to a very specific [and narrow] frequency range." – *G. Goodman*

NEGLECTING ELECTRONIC PROTECTION

USAF Lt Gen Robert Elder, commander of 8th Air Force at Barksdale AFB, LA, and of US Strategic Command's Joint Functional Component Command for Global Strike at Offutt AFB, NE, gave a keynote address at the Shephard/AOC Electronic Warfare 2009 conference in London May 15.

Countering those in the Air Force who have argued that electronic warfare (EW) is part of cyber operations, he noted, "The reality is that we conduct EW operations in every warfighting domain – air, land, maritime, space and cyberspace." Like the other four domains, cyberspace has a physical infrastructure piece, and it has a net-

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work with connectivity between nodes, he said. "When we do electronic attack operations in cyberspace, we are actually operating against the physical part of the cyberspace domain. It doesn't matter how many connections an adversary has, if we take away his infrastructure, it eliminates his connectivity and [actually makes cyber attacks unnecessary]."

The same applies to the United States and its Western allies, he said. "We are much more dependent on our physical infrastructure than most of our potential adversaries. If it is attacked, we could lose our connectivity and our ability to take advantage of our sensors, to integrate their data for situational awareness and to conduct integrated operations. Yet we don't pay enough attention to electronic protection." – *G. Goodman*

IN BRIEF

General Dynamics C4 Systems (Scottsdale, AZ) received a $3 million order from the US Army May 19 to integrate the new Prophet Enhanced tactical signals intelligence (SIGINT) system into BAE Systems 6x6 Medium Mine Protected Vehicles (MMPVs) to be delivered in October. General Dynamics received a six-year, indefinite delivery-indefinite quantity Prophet Enhanced contract from the Army in February with an initial $71 million order.

✪ ✪ ✪

The 43rd Expeditionary Electronic Combat Squadron and its EC-130H communications-jamming aircraft flew their 3,000th sortie May 19 after five years of continuous deployment to Southwest Asia. Each sortie lasted up to 12 hours. The US Air Force's 43rd EECS, which passed the 20,000 combat flight hour milestone in February, rotates aircrew members from the squadron's home base at Davis-Monthan AFB, AZ.

✪ ✪ ✪

BAE Systems (Nashua, NH) was awarded a $33.7 million contract from the US Navy, as well as Australia via Foreign Military Sales (FMS) channels, for Lot V production of the ALE-55(V) subsystem, consisting of an electronic frequency converter (EFC) and fiber-optic towed decoy (FOTD). The subsystem, intended for US Navy and Royal Australian Air Force F/A-18E/F aircraft, is part of BAE's larger Integrated Defensive Electronic Countermeasures (IDECM) system, which defends against surface-to-air and air-to-air missiles. Work will take place in Nashua and Mountain View, CA, and is scheduled for completion by August 2011. The US Navy contributed $27.5 million to the purchase, with Australia providing the remaining $6.2 million.

✪ ✪ ✪

Symetrics Industries (Melbourne, FL) was awarded a $3.5 million contract from the US Air Force for an ALE-47 Countermeasures Dispenser System (CMDS). The contract marks the 20th order in a five-year contract begun November 2006, bringing the delivery total to more than 9,200 assemblies at a cost of $28 million.

✪ ✪ ✪

Raytheon Co. (Goleta, CA) won a $7.3 million follow-on contract from the US Air Force for second-phase production of 10 all-digital ALR-69A(V) radar warning receivers for use by Warner Robins Air Logistics Center at Robins AFB, GA. The receivers will replace older ALR-69A(V)s currently on the US Air Force's C-130, F-16 and A-10 aircraft. Work will be executed by Raytheon's Tactical Airborne Systems division in Goleta, CA, with deliveries slated from May 2010 to September 2010. In related news, Raytheon received a $19.8 million follow-on contract from Warner Robins Air Logistics Center for 807 ALE-50 decoys to be used by the US Air Force and Navy, with deliveries through April 2011.

✪ ✪ ✪

Lockheed Martin (Bethesda, MD) announced May 5 that it has successfully flight-tested a new signals intelligence (SIGINT) payload and a next-generation wing design, both created for use on the company's small Desert Hawk III (DHIII) unmanned aircraft system (UAS). The announcement included news that the payload and wing design will become operational on the UAS in late 2009. With its new capabilities, the DHIII, used currently by the British army to support the GWOT, will detect and locate radio frequency emissions and offer increased performance in difficult weather conditions.

✪ ✪ ✪

Airborne Systems (Pennsauken, NJ) announced the release of an improved version of its IDS300 decoy, which currently is in use by the UK Royal Navy. The IDS300, designed for shipboard applications, is a floating anti-missile passive decoy.

✪ ✪ ✪

General Dynamics Advanced Information Systems (AIS) (Fairfax, VA) received a $39.9 million follow-on contract from the US Navy May 13 to develop and produce Surface Electronic Warfare Improvement Program (SEWIP) Block 1B2 systems, plus two engineering development models for SEWIP Block 1B3. All work on SEWIP, a surface-ship EW and anti-ship missile defense system slated to replace the US Navy's SLQ-32 EW suite, will take place in Fairfax.

CLARIFICATION

In the article "Next-Generation Jammer on Track" (April 2009 *JED*, page 22): "the Navy and CAPT Steve Kochman do not advocate a company or its technologies in the NGJ selection process. The competition leading to the studies awarded in January was full, open and conducted in accordance with the Federal Acquisition Regulation. Subsequent contracting efforts will be full and open as well. Any proposal submitted will be given every proper consideration and thoroughly evaluated in accordance with the competitive source selection procedures."

The Monitor photos courtesy of the US Air Force and US Navy.

SR Hawk™

washington report

DOD RELEASES FY10 BUDGET REQUEST

The Department of Defense released its Fiscal Year 2010 budget request on May 7 (see www.budget.mil or www.defenselink.mil/comptroller/budget.html). EW highlights include:

US AIR FORCE

- $42.2 million to upgrade the EC-130H Compass Call communications-jamming aircraft fleet, part of a $200 million increase for the fleet over the FY10-15 Future Years Defense Program (FYDP) that includes converting one additional TC-130H to be the 15th EC-130H;
- $94.8 million to complete development of the stand-in jammer variant of the Miniature Air-Launched Decoy (MALD-J);
- $190 million over the FYDP to purchase Digital Radio-Frequency Memory (DRFM) upgrades for 400 ALQ-131 external jamming pods used on F-16s and A-10s;
- $35.7 million to upgrade RC-135 Rivet Joint signals-intelligence (SIGINT) aircraft;
- $59.9 million to integrate an Airborne SIGINT Payload (ASIP) on the MQ-1 Predator/MQ-9 Reaper unmanned aerial vehicles (UAV) (with the MQ-1 variant entering low-rate initial production) and $29.1 million to complete the Global Hawk UAV's ASIP payload integration testing;
- $31.8 million to integrate and test the laser-based Large Aircraft Infrared Countermeasures (LAIRCM) System on EC-130Hs as well as two other C-130 derivatives;
- Funding over the FYDP to buy HDAM (High-Speed Anti-Radiation Missile Destruction of Enemy Air Defenses Attack Module) guidance upgrades for 500 existing air-to-surface HARMs; and,
- An increase of $50 million over the FYDP for EW data base reprogramming.

US NAVY

- $1.7 billion for 22 more new EA-18G Growler support jamming aircraft (56 purchased through FY09, a total of 88 planned);
- $97.6 million for EW Development, $65.5 million of it for Tactical Aircraft EW, including Integrated Defensive Electronic Countermeasures (IDECM) Block 4 – integrating the ALQ-214 jammer from the F/A-18E/F Super Hornet program on F/A-18C/Ds;
- $40 million to purchase 48 ALR-67(V)3 IDECM radar warning receivers to replace the old ALR-67(V)2 RWR on F/A-18C/Ds in FY11-12;
- $88.9 million for Ship Self-Defense (Soft Kill/EW), including $62.0 million for Surface EW Improvement Program (SEWIP) Block 2;
- $128 million for Next-Generation Jammer concept refinement and technology maturation;
- $63.7 million for Tactical Air Directional IR Countermeasures (TADIRCM);
- $67.8 million for Joint Counter Radio-Controlled Improvised Explosive Device EW (JCREW) jammers;
- Advance procurement funding toward the $1.8 billion cost of the first six new P-8A Poseidon maritime patrol aircraft to be ordered in FY11.

US ARMY

- $210 million to begin the revamped Aerial Common Sensor (SIGINT) aircraft development program;
- $16 million for Tactical EW Applied Research, $50.5 million for EW Advanced Technology and $19.2 million for EW Technology;
- $267 million for EW Development (a $40 million increase compared with last year's FY10 estimate), including $21.4 million for the Advanced Threat IRCM (ATIRCM)/Common Missile Warning System, $18.6 million for CREW jammers and $28.1 million for upgrades to the new Prophet Enhanced and older Prophet EW Support (ES) 1 vehicle-mounted SIGINT systems;
- $64.5 million to buy an additional 13 Prophet Enhanced sensors and 10 Prophet Enhanced Control systems;
- $164.4 million for Warlock-Duke CREW system upgrades and installation kits.

– *G. Goodman*

ARMY CUTS CYBER-EW LINK

The US Army is re-crafting a draft "Concept of Operations for Cyber-Electronics" into a "Concept of Operations for Cyberspace Operations," the newsletter *Inside the Army* reported last month. Army officials are reshaping the 87-page draft CONOPS this month after receiving a flood of feedback from stakeholders arguing against linking cyber warfare with electronic warfare. The original document was issued in March by the Concept Development Division of the Capability Development Integration Directorate, part of the Combined Arms Center at Fort Leavenworth, KS. As the article noted, "The document triggered debate over the linkage of cyberspace, which some view as strictly an information-driven environment, with the electromagnetic spectrum, which is populated by radios, jammers and improvised explosive devices." – *JED Staff*


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world report

AUSTRALIA SIGNS ON TO P-8A DEVELOPMENT

Australia signed on to the US Navy's P-8A Poseidon maritime patrol aircraft development program on May 5, CAPT Mike Moran told reporters the same day at the Navy League's Sea-Air-Land Exhibition in Washington, DC.

Moran is the Maritime Patrol and Reconnaissance Aircraft Program Manager (PMA-290) at NAS Patuxent River, MD. The Boeing P-8A, a modified Boeing 737, is slated to replace the US Navy's aging P-3C Orion, with an initial operational capability scheduled in FY13. Australia, in its first step toward buying the P-8A, will participate in Poseidon's Spiral 1 program to develop improvements to the aircraft. The Royal Australian Air Force plans to replace its P-3Cs by 2018 with a combination of eight manned aircraft, likely P-8As, and up to seven large Global Hawk unmanned aerial vehicles. The first flight of a Poseidon test aircraft occurred on April 25; the US Navy plans to buy 108 P-8As. India already ordered eight P-8Is from Boeing in January. – *G. Goodman*

IN BRIEF

- **Cobham** (Wimborne Minster, Dorset, England) received a $72 million follow-on contract from the US Navy to produce 51 ALQ-99 low-band transmitters (LBTs), plus spare parts, for the US Navy's and Marine Corps' EA-6B aircraft, as well as the US Navy's EA-18G Growler. LBTs protect against enemy radar and communications signals. Work will be performed by Cobham Sensor Systems in Lansdale, PA, which already has delivered 40 of the 120 LBTs originally ordered for $185 million.

- **Elisra** (Bene Beraq, Israel) has received a contact from Lockheed Martin Canada to supply EW equipment for the Canadian Navy's Halifax Frigate modernization program. The contract, valued at $55 million, supplies upgrades for 12 Halifax frigates, including implementation and integration support for new command and control, radar, data link and EW systems. Work will be performed at Lockheed's facility and Kanata, Ontario.

- **Italy** recently gave approval for upgrades to be made to its F-35 Joint Strike Fighter (JSF) aircraft and its Joint Airborne Multisensor Multimission System (JAMMS). Upgrades are valued at $792 million and $370 million, respectively. A COMINT, ELINT and EW platform, JAMMS is slated to replace Italy's G222VS SIGINT aircraft, which has been in service since 1981.

- The **UK Royal Air Force** is moving ahead with plans to develop a large-aircraft and helicopter protection system, called Common Defensive Aids System (CDAS), which will kick off in late 2009, according to *Aviation Week* (see HFI article on page 45). Selex Galileo (Basildon, UK/Florence, Italy) agreed to oversee the Demonstrator program throughout its projected four-year term. CDAS will integrate a missile warning system, hostile-fire indicator (HFI), directed infrared countermeasures (DIRCM) system and elements of a directed electro-optics countermeasures system. HFI candidates from BAE Systems, Thales and Selex Galileo already are expected to form part of the program.

- The **Australian government** released a defense-focused white paper on April 19 titled "Defending Australia in the Asia Pacific Century: Force 2030." The white paper mentions the government's replacement of six CH-47D helicopters with seven electronic warfare (EW)-enhanced CH-47F aircraft, as well as its 12 F/A-18F Super Hornets with optional conversion to EA-18G Growlers. It describes Australia's goal to strengthen its EW capabilities through improved RF detection systems and EW analysis and dissemination to ship and land forces, along with the formation of a Joint EW Centre, most likely located in Adelaide. This Joint EW Centre will combine the government's existing EW organizations and offer EW training and system development. New signals intelligence (SIGINT) capabilities also are proposed.

- **Thales UK** has signed a contract with the UK Ministry of Defence to provide support for EW equipment fitted to the Royal Navy's ship and submarine fleets. The agreement, a follow-on to the company's current logistics support agreement, combines sonar and EW support to the Royal Navy's fleet of Type 22 and 23 frigates and Type 42 destroyers, as well as all classes of submarines. Work will be fulfilled by a combined MoD and industry team based in Abbey Wood, Bristol.

- **EADS** has formed a new defense venture with Indian engineering company **Larsen & Toubro Ltd.** to develop and produce radars, military avionics and EW systems. The new company, which has an initial investment of 1 billion rupees ($20 million), is subject to approval by the Indian government.

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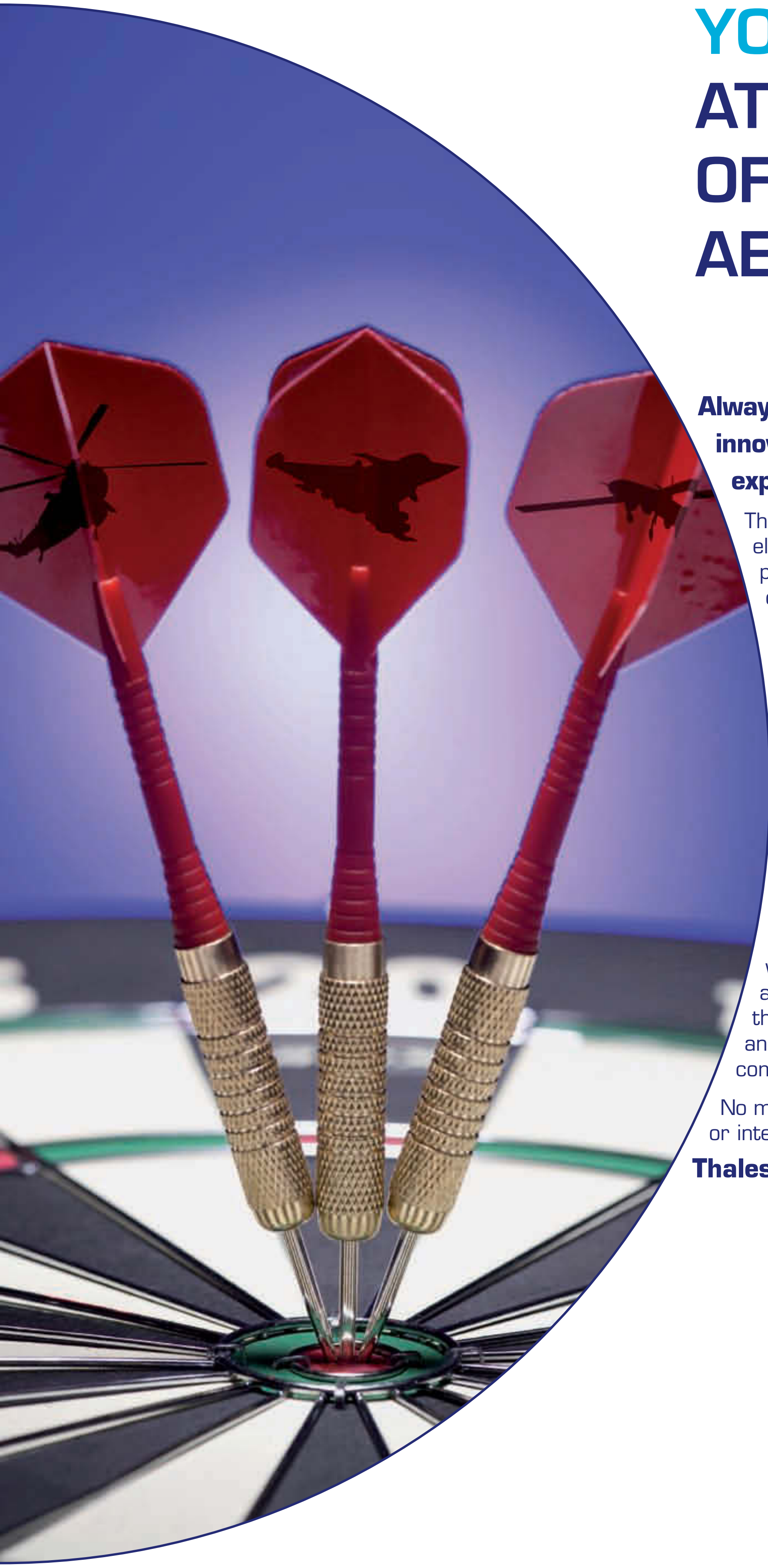

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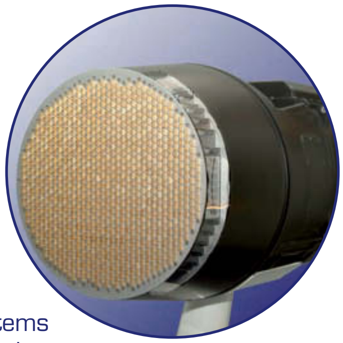

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Protecting the Worl

By Gábor Zord and Glenn Goodman

The fighter aircraft market has changed dramatically in the past decade. Many of the world's air forces now have (or soon will have) access to fighter/strike aircraft that offer a menu of survivability technologies, including electronic warfare (EW), stealth, stand-off targeting, stand-off munitions, advanced radars and forward-looking IR (FLIR) sensors, and avionics systems that can fuse off-board situational awareness information with data collected by onboard sensors. The net result: aircraft can achieve better combat survivability and attack more targets, resulting in unprecedented mission effectiveness. Evolving EW technology has contributed to this success, and it will continue to be an essential component of fighter survivability for decades to come.

In the United States, it's no secret that the Air Force has focused its funding in recent years on developing and fielding new stealthy fifth-generation fighter aircraft – the now-operational F-22 Raptor and the planned F-35 Joint Strike Fighter (JSF) – and has not invested in modernizing the EW self-protection suites of its large inventory of non-stealthy F-16, F-15 and A-10 aircraft. The service's F-16s and A-10s, for example, continue to fly with analog ALR-69 or ALR-56M radar warning receivers (RWRs) and ALQ-131 or ALQ-184 external jamming pods, all of which were developed in the 1970s and 1980s. Similarly, the Air Force F-15's integrated Tactical EW System (TEWS), with its analog ALR-56C RWR and ALQ-135 jammer, has not had a major performance upgrade introduced for almost a decade. The US Navy's F/A-18C/D fleet is in a similar position, relying primarily on the ALR-67(V)2, the ALQ-126B, the ALQ-165 and older versions of the ALQ-162. With a dearth of US government-funded EW upgrades for these legacy aircraft, Boeing and Lockheed have worked closely with EW systems manufacturers to meet the survivability requirements of export customers.

With the JSF's future now virtually assured, there are signs that the Air Force leadership is slowly turning its attention to the issue of replacing the analog EW systems on its legacy F-16 and A-10s, with initiatives in the service's new FY10 budget request. And with the Air Force's F-22 buy now capped at 187 aircraft instead of the original planned procurement of 381, this could lead the service to consider upgrading the TEWS suite on its F-15s in order to maintain its lead in air-to-air combat capabilities. As they address EW upgrades for their legacy aircraft over the next decade, the US Air Force and US Navy will look to leverage technology from the F-35's ASQ-239 Barracuda EW system. How this strategy plays out in specific EW programs is still to be decided. But it will be one of the leading factors in the fighter EW market over the next two decades.

F-16

The JSF is slated to enter full-rate production for the US Air Force, Navy and Marine Corps in 2014. Nine international partners are participating in the program and are the first likely JSF export buyers: the UK, Australia, Israel, the Netherlands, Denmark, Norway, Italy, Turkey and Canada. Meanwhile, many nations continue to purchase newly built non-stealthy US fighters, particularly F-16s, outfitted with EW suites that are more advanced than those on many US inventory aircraft.

The export market for F-16 EW systems is currently the largest, with the aircraft's wide global user base and multiple versions fielded since 1980s. The two leading competitors for new internally mounted F-16 EW suites, particularly as part of US Foreign Military Sales (FMS) of new-production F-16 Block 50M aircraft from Lockheed Martin, are ITT Electronic Systems (Clifton, NJ) and Raytheon Tactical Airborne Systems (Goleta, CA). (The Block 50M variant features a long dorsal fairing bulge that runs along the spine of the fuselage from behind the canopy to the tail and houses additional avionics, including EW equipment. Earlier-model F-16s either were not wired for an internally mounted EW suite or lacked the room for it.)

ITT's ALQ-211(V)4 Advanced Integrated Defensive EW Suite (AIDEWS) is an advanced fighter aircraft derivative of the company's Suite of Integrated RF Countermeasures (SIRFC) originally developed for US Army helicopters. It includes a digital RWR, a jammer and the ALE-47 chaff/flare dispenser (from Symetrics). Raytheon's Advanced Countermeasures Electronic System (ACES) features the company's ALQ-187(V)2 jammer and the ALR-93 RWR from Northrop Grumman or Raytheon's all-dig-

d's Fighter Aircraft

ital ALR-69A RWR, along with the ALE-47. Both are internally mounted systems, although AIDEWS now is available in an external pod configuration. Pakistan is expected to be the first customer for ITT's pod-mounted ALQ-211(V)9 AIDEWS for its older F-16 models, and currently is negotiating a Letter of Acceptance amendment with the US Department of Defense (DOD). According to an ITT official, the AIDEWS hardware is identical in the internal and podded versions of the system.

Seven international competitions have occurred this decade for an EW suite to outfit newly purchased F-16 Block 50Ms. Turkey conducted the most recent one, selecting ITT's AIDEWS in February. Last December, Morocco chose Raytheon's ACES. In earlier contests, Chile, Oman, Poland and Pakistan picked AIDEWS, and Greece selected an earlier version of Raytheon's ACES, called the Advanced Self-Protection Integrated Suite (ASPIS) II. Additional prospective buyers of new F-16 Block 50Ms include Egypt, Romania, Taiwan and Iraq.

Another competitor for these F-16 EW sales is BAE Systems' ALQ-178(V) Self-Protection EW System (SPEWS) and SPEWS II, which the company co-manufactures in Turkey with industrial partners MiKES and ASELSAN. Most of Turkey's 200-plus F-16s are equipped with SPEWS/SPEWS II suites, but the NATO nation nevertheless selected AIDEWS to outfit the 30 new F-16 Block 50Ms in its most recent order.

Israel's Elisra Electronic Systems also competes for F-16 EW upgrades. Its Advanced Self-Protection System (ASPS), including the SPS-3000 RWR and SPJ-40 jammer, is in service on Israeli F-16C/Ds and F-16Is. In addition, Elisra has supplied the internal EW suite for Singapore's F-16 Block 50Ms.

The market for EW upgrades for older F-16s continues to grow. For example, surplus F-16s that have had mid-life updates but need upgraded EW suites are being sold to new or existing F-16 user nations by prospective JSF buyers. Chile, for example, has acquired F-16s from the Netherlands, and Jordan has purchased them from Belgium and the Netherlands.

The Danish company Terma has supplied its ALQ-213(V) EW Management System for F-16s in use by Denmark, Belgium, the Netherlands, Norway and the US Air Force. The ALQ-213(V) controls and integrates the subsystems of the EW suite on the aircraft, reducing pilot workload.

After more than a decade of evaluation, the Royal Danish Air Force (RDAF) is about to realize its plan to deploy a missile warning capability on its F-16s. Terma, which proposed missile warners fitted to its PIDS pylon, received the integration contract from the RDAF in 2004. The first flight tests were flown in 2007 with the fighter-optimized AN/AAR-60(V)2 variant (MILDS-F) of EADS, and the system is under certification by the USAF Seek Eagle office. According to plans, it will reach operational status with the next F-16 Mid-Life Update (MLU) software iteration, the M5.

Another potential route for improved EW equipment for older F-16s involves upgrading venerable Northrop Grumman ALQ-131 or Raytheon ALQ-184 external jamming pods in wide use on F-16s around the world. The Netherlands has been in serious talks with Northrop Grumman about developing a Digital Radio-Frequency Memory (DRFM) Block 3 upgrade for the ALQ-131. Last month, the Air Force announced that it planned to fund a DRFM upgrade for 400 of the ALQ-131s used by F-16s and A-10s in its inventory. These two efforts could merge into a single program.

F/A-18

The US Navy's F/A-18 Hornet, built by Boeing, is in service in Australia, Canada, Spain, Finland, Switzerland, Kuwait and Malaysia. The Navy's Hornets fly with Northrop Grumman's ALR-67(V)2 RWR and BAE Systems' ALQ-126B pulse-radar jammer in combination with Northrop Grumman's ALQ-162 continuous wave-radar jammer. Some Navy/Marine Corps Hornets instead use ITT/Northrop Grumman's ALQ-165 Airborne Self-Protection Jammer (ASPJ), which only was procured in limited numbers in the 1990s. (ASPJ also is flown on South Korean F-16Ks and the ALQ-162 on Egyptian F-16s.)

The US Navy has been fielding the new Integrated Defensive Electronic Countermeasures (IDECM) internal EW suite on its F/A-18E/F Super Hornets. IDECM includes the ALR-67(V)3 RWR from Raytheon, ITT's ALQ-214 radar jammer, the ALE-47 expendable counter-

measures dispenser produced by Symetrics and Raytheon's ALE-50 towed repeater decoy. BAE Systems' more sophisticated ALE-55 fiber-optic towed decoy (FOTD) is slated to replace the ALE-50 in the IDECM suite once it is fielded in the fall of 2010, according to CAPT Paul Overstreet, the Navy's Program Manager for Advanced Tactical Aircraft Protection Systems (PMA-272) at NAS Patuxent River, MD.

For the past decade, international F/A-18A/B/C/D users, such as the Spanish Air Force, the Canadian Air Force, Switzerland's Luftwaffe, the Finnish Air Force and the Royal Australian Air Force (RAAF), have been frustrated by the lack of US Navy upgrades for the legacy F/A-18 Hornet. The RAAF opted to develop and integrate its domestically built ALR-2001 into its Hornets. While this effort did not ultimately succeed due to integration problems, it highlighted the need of F-18 users to perform EW upgrades. Under a separate program, the Spanish Air Force contracted Indra in late 2006 to perform an EW upgrade for its EF-18 fleet as part of a larger MLU program that began in 2004. The modification work covers a total of 56 single-seat aircraft and integrates the company's ALR-400 digital RWR, the ALQ-500 Jammer/Deceiver and the ALE-47 CMDS. As the SPS originally was conceived to replace the previous ALR-67/ALQ-126 combo, it is fully integrated into the existing cockpit displays and controls, but also adds extended frequency ranges, sensitivity, probability of intercept, processing and recording capabilities and countermeasures techniques. The series production first tranche is expected to be completed this year.

In recent years, F-18 users, such as the RAAF, the Canadian Air Force and Switzerland, have been transitioning from the ALR-67(V)2 RWR to the ALR-67(V)3, which is manufactured by Raytheon. The US Navy will join this group by initially acquiring 48 (V)3s for the F/A-18C/D Hornet fleet in FY10. Current Navy plans call for the purchase of an additional 100 ALR-67(V)3s for its F/A-18C/Ds. In addition, the Navy decided in April to move forward with plans to replace the ALQ-126B jammer on its F/A-18C/D Hornets with a derivative of the ALQ-214 from the Super Hornet's IDECM suite (referred to as the ALQ-214 Engineering Change Proposal). In December, the Navy plans to award a $52 million contract to ITT for development of the ALQ-214 ECP. Captain Overstreet told *JED* that the ALQ-214 ECP, also known as IDECM Block 4 (IB4), will become operational in 2014. He said the Navy does not plan to integrate the ALE-55 FOTD on its F/A-18C/Ds.


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F-15

The F-15's TEWS, integrated by Northrop Grumman Defensive Systems (Rolling Meadows, IL), includes the company's ALQ-135 jammer and BAE Systems' ALR-56C RWR and ALE-40/45 chaff/flares dispenser. TEWS has remained essentially the same since the early 1990s.

The other nations that fly F-15s are Israel, Japan, Saudi Arabia, South Korea and Singapore. Elisra has supplied the EW suite for the Israeli Air Force's F-15Is. Japan and Saudi Arabia have depended on the US Air Force for their F-15 EW upgrades, which have received minimal funding in recent years. South Korea selected the F-15 in 2002. It ordered a total of 61 F-15Ks (one of which crashed in 2006). Singapore is the newest F-15 customer, having ordered 25 F-15 SGs. As with its F-16 program, the Singapore Air Force selected Elisra in 2005 to provide the EW suite for its F-15 SGs, deliveries of which will begin this year.

Northrop Grumman provided ALQ-135M jammer upgrades for South Korea's F-15K that made its EW suite more advanced than that on USAF F-15s. Kevin Weppner, Director of Business Development for RF Combat and Information Systems at Northrop Grumman Defensive Systems, told *JED*, "The ALQ-135M upgrades for the F-15K resulted from both a US Air Force investment in hardware and software improvements to allow FOTD integration on its F-15s, which ultimately did not occur, and a substantial Northrop Grumman investment in new lower-cost solid-state transmitters called microwave power modules. They are about 85 percent smaller and 10 times more reliable than the legacy transmitters and use less power. And because we can load them in different locations on the aircraft closer to the antennas, they generate a lot more effective radiated power." South Korea's F-15Ks also feature an improved ALR-56C, which has expanded the performance envelope for the analog RWR.

Last fall, Boeing selected BAE Systems to develop a new Digital EW System (DEWS) for its international F-15 customers, particularly Saudi Arabia and Japan. In March, Boeing also unveiled an F-15SE Silent Eagle configuration for the international market. Its design features low-observable coatings and treatments (especially for the front aspect of the aircraft), an active electronically scanned array radar from Raytheon, redesigned conformal fuel tanks that also allow for internal weapons carriage and DEWS. This EW suite is expected to feature a digital RWR and a DRFM-based jammer. Its development is leveraging technologies used in the EW suite that BAE Systems developed for the JSF.

TORNADO

As the financial crisis may signal the cancellation, cut or postponement of new fighter acquisition programs, many legacy upgrade programs are on the table. Originally a warrior of the Cold War, the tri-nation (UK/Germany/Italy) Tornado will soldier on for the next 10 to 20 years, and it will need new EW to achieve combat survivability over this period.

Italy's Elettronica has been involved in the Tornado program from the outset, together with the UK's Selex Galileo supplying the Tornado's original Radar Warning Equipment (RWE), which still is present on Italian Air Force (ItAF) IDS and ECR variants. Elettronica also developed and built the ELT/553 Mk 1 Active Self-Protection System, and then upgraded it to the Mk 2 during the Desert Storm campaign in 1991. According to a company official, the research for the replacement of both the RWE and Mk 2 on the ItAF Tornados was launched in 2000 as part of a Tornado mid-life update program. Elettronica won the competition with a proposal for an integrated next-generation active/passive EW system, designated AR-3/MK3i. This update will help to extend the operational life of the platform up to a year. Germany's Luftwaffe selected its own solution to update the Tornado Defensive Aids Subsystem (TDASS), which involved the integration of an advanced radar warning and electronic support measures (ESM) system based on Saab Avitronics' BOW family.

With these RF-oriented mid-life upgrades underway, the specter of IR Man-Portable Air-Defense Systems (MANPADS) threats in the Afghan theater of operations recently has driven three separate cases of urgent operational requirements for the European Tornado community. In late 2007, the German Air Force equipped six reconnaissance Tornados with Terma's Special Dispenser System (SDS), the so-called MCP-8F version of the company's Modular Countermeasures Pod (MCP). The Danish firm's solution expands the aircraft's flare capacity in view of the IR MANPADS threat, within the form and space constraints of its original BOZ pod, by fitting two each of its Advanced Countermeasures Dispensing System (ACMDS) dispensers into four modules. The modules can be rotated in 15-degree increments to ensure maximum coverage against missiles from different directions.

The Royal Air Force (RAF) also contracted BAE Systems and Terma in 2008 to provide Advanced Infrared Protection Systems (AIPS) to its Afghanistan-bound Tornados. However, it went a step further, as the MCP variant for its GR4 aircraft accommodates US-supplied missile warning sensors along with five dispensers. Delivery took place in the early spring of this year, and flight tests were begun by BAE Systems. In both the British and German programs, Terma's AN/ALQ-213(V) EW management system controls the new countermeasures pods.

This February, it was revealed that the ItAF contracted Saab Avitronics to upgrade an unspecified number of BOZ-102 pods for its deployed reconnaissance-configured Tornado IDS aircraft. Described as a breakthrough by the company, the new pods are renamed BOZ-102EC (Enhanced Capability) and, according to a company official, include an Electronic Warfare Controller (EWC), five BOPL-39 dispensers and MAW-300 ultraviolet-band missile warners at the rear. Development and production will take place at Saab Avitronics in Järfälla,

Sweden, and in Centurion, South Africa. Deliveries will be carried out during the third and fourth quarter of this year.

TYPHOON

Praetorian, the Defensive Aids Sub-System (DASS) of the Eurofighter Typhoon, is produced by EuroDASS, a consortium of Selex Galileo, Elettronica, Indra and EADS. It provides ESM and radar jamming, a fiber-optic towed decoy, laser warning, missile warning and chaff and flare dispensers. However, not all Typhoon users share the same configuration. For example, the RAF, which is the most ambitious customer, has laser warners in the package. The Luftwaffe (and Austria), which operates the aircraft primarily as an air defense fighter, does not.

Deliveries to Tranche 2 production are ongoing, and the future of Tranche 3 seems to be assured, although quantities won't be determined until later this year. According to Selex Galileo, technology insertion will occur as part of the suite's planned capability growth. This means development in its spherical-coverage ESM to adopt new digital receiver architectures, broaden reception bandwidth and increase DRFM and RF jamming transmission capabilities through phased-arrays and towed radar decoys. Concepts are being developed to determine how to make better use of real-time data generated within the sensor suite in a net-centric fashion.

GRIPEN

The JAS-39 Gripen now is operational in four countries (Sweden, Czech Republic, Hungary and South Africa), while a fifth customer (Thailand) also has selected the aircraft. These C/D Gripens are equipped with a Saab Avitronics EW system, designated EWS39/2, which encompasses an advanced RWR/ESM system, a fully integrated internal jammer and countermeasure dispensing systems.

Saab has started to rebuild 31 older A/B Gripens to the C/D standard, and this work also includes the installation of the integrated EWS 39 suite. Last month, the Czech Air Force began its first foreign tactical operational deployment since World War II, when four aircraft of the Czech Air Force began air policing tasks over the Baltic area in proximity to a revitalized Russian-Belorussian integrated air defense system (IADS) equipped with SA-10s.

As Saab pursues further export sales of the Gripen, a demonstrator program also is underway that evaluates new onboard technologies on a rebuilt Gripen two-seater. In terms of EW, the demonstrator program is evaluating Saab Avitronics' MAW-300 missile warners, laser warners and a new interferometric antenna array for the EWS 39 integrated EW system, which also will include "second-generation" DRFM technology.

RAFALE

The Spectra EW system of France's Rafale, manufactured by Thales and MBDA, provides a multispectral threat warning. Besides modern RF detection and jamming modules, which according to company officials employ interferometric angle-of-attack techniques with an accuracy of 1 degree and have phased-array active antennas that provide compatible narrow beamwidth, the Spectra system

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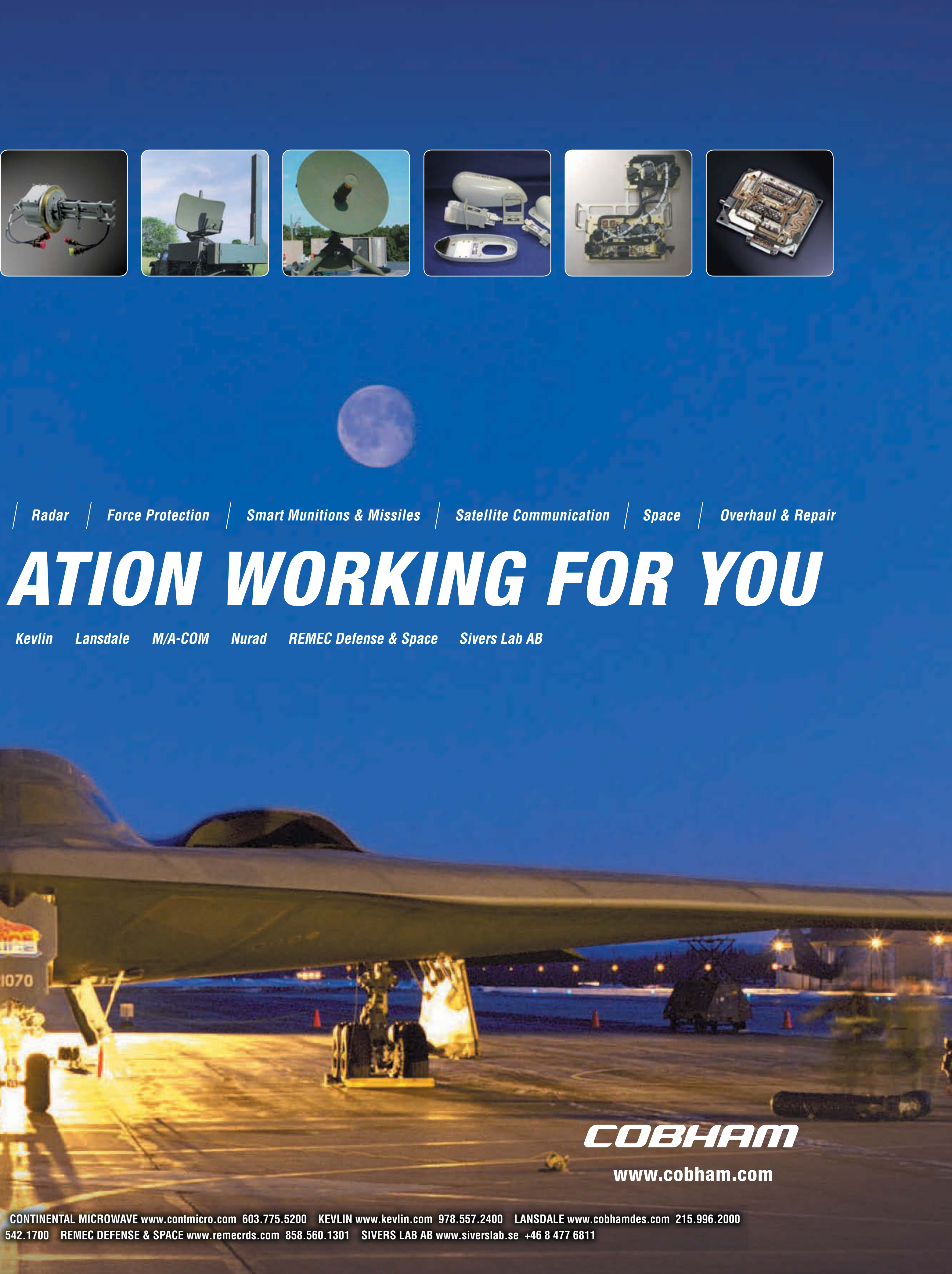
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from Thales and MBDA also features a missile warning system and a laser warner. Its performance enables it to be used for targeting ground-based radars.

The Spectra's DAL (laser warner) has three sensors that provide 360 degrees azimuth and 90 degrees elevation coverage against laser range finders, designators and beam-riders. The DDM (missile launch warner) is a dual-color sensor mounted on the top of a fin, providing 360-degree azimuth coverage. The DDM-NG (new generation) already is in production for new F3 standard aircraft and retrofits from 2008 to avoid parts obsolescence in the original DDM. The DDM-NG also will provide new capabilities, such as full-sphere detection and high angular resolution, which are compliant with a future Directed IR Countermeasures (DIRCM) installation. Marketed as an "omni-role fighter" by manufacturer Dassault Aviation, the Rafale is likely to fill an escort/support jammer role in the future as well. For this role, Thales has developed a new electronic attack concept centered on a pod-mounted standoff jammer cued by digital receivers, an active phased-array transmitter and "multi-bit" DRFM techniques.

MIRAGE 2000

For its customer in India, Thales has proposed the Integrated Countermeasure System (ICMS) Mk 4 for the Indian Air Force's fleet of Mirage 2000 aircraft. It includes wideband digital receivers for RF warning and DRFM-based jamming subsystems. According to Thales, one key feature of the ICMS Mk 4 system is its dedicated programmable onboard computer, which cross-cues sensor data on known and unknown threats, generates a composite operational picture for the crew and records all the emitter parameters detected. With this centralized approach, the operator retains full control over the choice of sensors, jammers and decoys deployed and progressively can build up operational databases for subsequent missions. The system can be configured as a basic self-protection system or as a complete multifunction suite of defensive aids including passive situation awareness, ESM and electronic intelligence (ELINT) technical analysis.

Elettronica, in cooperation with Thales, provided the EW solution for one of the most prestigious Mirage 2000 customers, the United Arab Emirates (UAE), in a program that started 10 years ago. The Integrated Multimission Electronic Warfare System (IMEWS) comprises a full suite performing RWR, ESM, ELINT and RF jamming roles operating in the high and low bands. All the tracks intercepted by the sensors, including the ECM receivers, are combined to create – each with its own characteristics – an integrated picture of the operational environment. The ESM system features a digital receiver that performs quick emitter geo-location and ELINT for acquisition of tactical or strategic data.

MIG AIRCRAFT

Although NATO operators of the MiG-29 have elected not to upgrade their aircraft beyond basic interoperability modifications, other users of the type (and potential customers of future variants) are interested in reliable EW solutions provided

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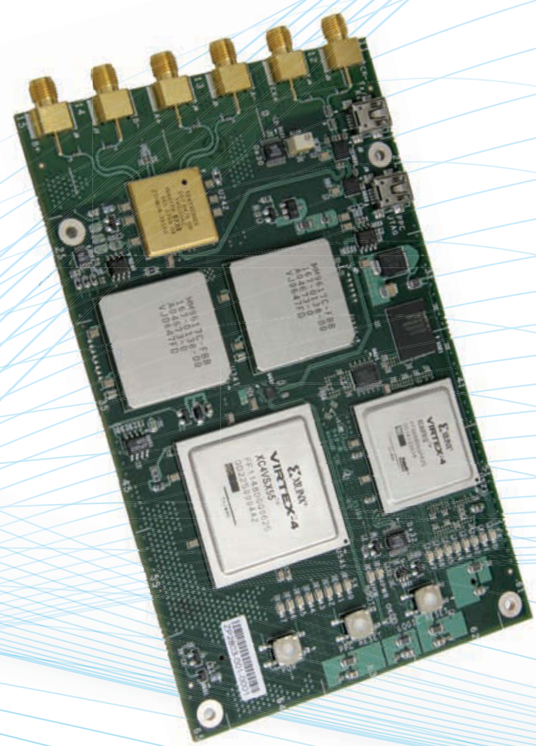

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by Western industry. This said, it is not a surprise that Russian Aircraft Corporation MiG teamed with Elettronica to bid for India's 126 (potentially as high as 200) Multirole Combat Aircraft (MRCA) program. According to their proposal, the MiG-35 would be equipped with the ELT/568(V)2 self-protection jammer. Based on a mockup presented at Farnborough 2008, the four phased arrays of the system are going to be fitted into the leading-edge root extensions (LERX) and to the roots of the vertical fins.

SUKHOI AIRCRAFT

The proliferation of different Su-27 variants has drawn the attention of many countries in regions around the world. Beyond their range, maneuverability and advanced weapons, a modern, reliable and flexible EW system could turn these platforms into "equal-opportunity players" on a future battlefield. The Indian Su-30MKI has the Mk 2 version of the Tarang RWR system developed by India's Defence Avionics Research Establishment and produced by Bharat Electronics. The IAF also uses IAI-Elta EL/L-8222 jammer pods from Israel on its Su-27s.

Another glimpse into the future is provided by Malaysia's Su-30MKMs, which are equipped with the MAW-300 missile warner from Saab Avitronics.

As time passes by and the clear technological division of the Cold War fades away, integrating new EW systems has less and less to do with the origin of the platform. As security rules can prevent some Western EW equipment from being sent to a Russian airframe manufacturer, the presence of an integrator preferably in the customer country would ease these concerns.

According to an official from Israel's Elisra, the company does not differentiate between platforms of US or Russian origin. It has provided EW solutions for many F-16s around the world, from simple RWRs to complex high-end integrated systems, he said. At the top of the list probably is the Israeli Air and Space Forces' F-16I Sufa fighter, which has the Advanced Self Protection Suite (ASPS), including the SPS-3000 RWR, SPJ-40 jammer and PAWS-2 mid-wave IR missile warner. A more common solution was the installation of the company's SPS-1000(V)5 RWR on the Portuguese Air Force's F-16s during their mid-life update several years ago. Earlier this year, Elisra announced it had won a prototyping contract from Korean Aerospace Industries (KAI), as the latter continues the light attack FA-50 development of its T-50 supersonic trainer. Eventually, this could lead to serial production of 60 aircraft. Elisra also will upgrade the EW system of Brazilian Air Force AMX aircraft.

PROTECTING THE TIP OF THE SPEAR

From fifth-generation dogfighters to Cold-War era strike platforms, fighter aircraft will continue to represent some of the most demanding requirements in the EW market in terms of cost, size, weight and performance. These programs drive innovation within the EW industry, and they also represent some of the leading strategic business opportunities in the global EW market. As threat technology evolves and new threat systems proliferate, fighter aircraft will depend heavily on new EW solutions to defeat them.

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HFI: The Emerging Requirement

By John Knowles

Helicopters, ground vehicles and soldiers have always been targets for enemy ground forces equipped with sniper rifles, automatic weapons and rocket-propelled grenades. Being ballistic threats, however, they were always considered outside the purview of EW self-protection concepts. Armor and maneuver were the typically the only answers to these threats. Years of fighting in Iraq and Afghanistan, however, have changed these perceptions, especially among US and European forces. Today, many companies are developing new concepts for hostile fire indicators (HFI) to meet this emerging need.

From a functional perspective, an HFI system must first detect and declare enemy small arms fire or an RPG. Then it must precisely locate the source of that fire. Ideally, it will also identify or at least classify the type of weapon being fired. This is not a simple job. Helicopters, for instance, need an HFI system that can operate in the presence of noise (including outgoing gunfire) and vibration generated by the host aircraft. (The noise level on a helicopter is so high that helicopter crews often don't know they are under fire until they are hit.) Ground vehicles present a slightly different set of environmental challenges (dust and dirt, for instance), and they may also need an HFI capability that can accurately cue an active protection system. For soldiers, the issue isn't so much noise and vibration as it is size and sensitivity of the HFI. Soldiers can usually hear and locate nearby gunfire. But detecting and locating snipers at long distances is a challenge. Just as with any military electronics system, the goal is to develop an HFI capability that is affordable, effective against a range of ballistic threats and presents a minimal size, weight and power footprint on the host platform. The problem today is that no one technology is perfectly suited to perform robust HFI on all platforms.

HFI systems that use acoustic sensors to detect and locate the sound of gunfire were among the first operationally deployed capabilities in the 1990s. But early models of acoustic HFI systems were too large for use on ground vehicles and helicopters, so they were primarily used in static ground applications. The technology has evolved to the point where acoustic sensors can be hosted on most ground vehicles and helicopters, but sensitivity is an issue. Another HFI solution is to use IR/UV sensors. With more and more IR/UV-based missile warning systems being installed on helicopters, they present an excellent candidate to host the HFI function. The challenge is to open up the aperture, so to speak, and enable missile warners to detect the smaller IR/UV signatures of small arms without introducing false alarms in the missile warning function. Some users, such as the US Army, are looking at a suite of acoustic, IR and UV sensors that collectively perform the HFI role while also enhancing other threat warning capabilities.

Operations in Iraq and Afghanistan are driving an urgent need to develop and integrate HFI capabilities on helicopters. In the US, the Army's Intelligence and Information Warfare Directorate (I2WD) in Fort Monmouth, NJ, and the Naval Research Lab in Washington, DC, have been focusing on helicopter HFI development since about 2005. This was first accomplished through studies. More recent work has addressed prototype hardware development and algorithms. The Army is seeking to integrate an HFI function into its AAR-57 Common Missile Warning System (CMWS) while the Navy wants to incorporate HFI into its inventory of AAR-47 missile warners, as well as its AAQ-24 Department of Navy LAIRCM systems and the missile warner it is developing under the Joint Allied Threat Awareness System (JATAS) program.

In FY10, the I2WD plans to spend $3.7 million to investigate how it can augment the UV-based AAR-57 with IR and acoustic sensors to improve missile warning performance, as well as to add HFI capabilities. According to the Army's recently released FY10 budget, it has allocated about $150 million in EMD funding over the next five years to develop and integrate a multispectral HFI capability into the AAR-57. CMWS manufacturer BAE Systems (Nashua, NH) is supporting much of this work, which covers acoustic, UV and IR sensors that can provide fused HFI information to air crews.

The US Navy is carrying out a number of efforts aimed at developing HFI for its various helicopter missile warning programs. One involves integrating a miniature hyperspectral sensor, developed by Solid-State Scientific Corp. (Hollis, NH), into the AAR-47 sensor unit. The goal is to demonstrate the capability during a military utility assessment next year. AAR-47 manufacturer Alliant Techsystems (Clearwater, FL) is also participating in this effort by providing integration, test support and data collection.

Although the Navy will eventually replace the AAR-47 with the IR missile warning system being developed under the JATAS program, it will depend on the AAR-47 well past 2020, which means it wants to integrate a robust HFI capability into the system. This is being accomplished in two phases. Alliant Techsystems is currently supporting an upgrade to the AAR-47B(V)2 operational flight program that will give it a partial HFI capability. This is scheduled for an initial operational capability (IOC) by the end of this year. The Navy is planning to integrate a full HFI capability in a future version dubbed the AAR-47C(V)1, also known as the AAR-47 Multi-Function Threat Detection (MFTD) system. IOC is planned for 2012.

Another HFI focus area is the Navy's JATAS program. Last year, the Naval Research Lab awarded four contracts to Alliant Techsystems, BAE Systems, Lockheed Martin (Orlando, FL) and Northrop Grumman (Rolling Meadows, IL) to evaluate IR-based HFI solutions at the Aberdeen Proving Ground in Maryland. The evaluations helped the Navy to determine the technology readiness levels of these systems and decide how and when to incorporate HFI into the JATAS program. All four companies are bidding for a pair of JATAS development contracts that the Navy expects to award later this year.

The need for HFI is not restricted to the US. The UK flies a variety of helicopters outfitted primarily with the AAR-47, AAR-54 and AAR-57, and it is likely to acquire HFI capabilities through upgrades to those systems. However, it is also pursuing its own missile warning development program. Last year, Thales announced the Elix-IR missile warner, which was in the final stages of development. The system, which was developed with funding from the UK MoD, provides missile warning, as well as HFI. The company, along with BAE Systems and Selex, is expected to participate in HFI studies as part of the UK's Common Defensive Aids System (CDAS) demonstrator program, which is expected to begin later this year. Thales is also seeing a lot of interest from ground vehicle users. As reported in *JED* last month, the Elix-IR is undergoing evaluations by France and Australia, as well as the UK. Other missile warning manufacturers, such as Saab Avitronics, EADS and Elisra, are also pursuing HFI capabilities for their systems.

With HFI capabilities such as these poised to achieve operational status in the coming years, the system developers will begin to focus on the countermeasures to defeat small arms. One likely solution is to use DIRCM systems as eye-safe visual dazzlers or disruptors against the shooters. This work is still mostly in the concept stage. But as it evolves, it will likely influence DIRCM requirements beyond jamming IR missiles.


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TECHNOLOGY SURVEY

SAMPLING OF AIRBORNE DISPENSERS AND IR EXPENDABLES

By Ollie Holt

JED's last survey of dispensers and expendables was published in March 2007. At that time, *JED* covered airborne, naval and ground-vehicle dispensers of both infrared (IR) and radio frequency (RF) expendables. This survey only covers airborne dispensers and IR expendables. A future survey will look at naval chaff and flare launchers and decoy rounds, and another will cover airborne RF expendables, such as towed decoys and chaff.

DISPENSERS

As the March 2007 dispenser survey noted, very little has changed mechanically in the design of dispensers. As this survey shows, the ALE-47 and its variants are the most commonly used dispenser. The ALE-47 is used both in fixed- and rotary-wing platforms. It is designed to support magazines that are configured for either round or square IR expendables or RF chaff rounds.

As processors improve, the major design change in the dispenser has been in the dispenser controller. This is where the intelligence resides to select the correct dispense program for the rounds available and to cause the dispensing of rounds to this program. Some systems contain their own controller, while others depend on control from an external source.

The major area of focus for dispensers is in the concepts of operations for dispensing. The dispenser controller can be set up for dispensing expendables in different sequences. Work to define optimal dispense sequences for defending against current and emerging missile types continues to be the major focus in dispenser design.

IR EXPENDABLES

As noted above, the last IR expendable survey was in March 2007. The previous survey discussed current technology and technology improvements being examined to make IR expendables more effective as the counter-countermeasures within missile systems become more effective at detecting and reducing the IR expendables' impact on missile tracking systems. In this introduction, we will discuss some of the important characteristics of the IR expendable and why they are important to the selection of the correct IR expendable for the application.

First, let's define the source of the IR radiation that the missile is detecting and tracking. This source is solar reflection – hot metal parts caused both by operation and by aerodynamic heating and the major contributor, the engine plume. Some of these sources can be reduced by special paints and by redirecting the engine plume to make it less detectable by external sources.

Typical IR expendable characteristics are defined by rise time, burn time, energy output, spectral output and temperature. Each of these characteristics contributes to the IR expendable's success in defeating the missile seeker.

Rise time is important because the expendable needs to be up to temperature relatively quickly after leaving the aircraft, but before it is out of the field of view of the missile. If the IR expendable is not powered in any way, it will fall away from the aircraft relatively quickly, so the expendable needs to be up close to its maximum intensity while still centered within the field of view of the missile. The rise time of the expendable defines the time from ignition to when it achieves a large enough intensity to have a jam-to-signal ratio of at least one (jam power is the intensity of the IR expendable and signal is the IR signature of the aircraft). If the rise time is not fast enough, the expendable will move out of the center of the missile's field of view before the expendable can obtain the missile's attention. The further the flare moves away from the missile seeker's central field of view, the larger the expendable's intensity must be to seduce the missile from the aircraft. The rise time of the expendable must be matched to the speed of the aircraft. Faster aircraft will require either a faster rise time or must be powered in some way to move with the aircraft and stay in the center of the missile's field of view as it achieves its maximum intensity. Slow aircraft do not need as fast of a rise time. Also, if the expendable is dispensed late and the missile is very close when the dispense occurs, a fast rise time is required.

The burn time of the expendable must be long enough for the expendable to seduce the missile and then move the missile away from the aircraft. The optimum goal is to obtain complete separation from the aircraft so that the aircraft is out of the missile's field of view and the missile's ability to reacquire the aircraft is lost. The minimum goal is to get the missile far enough away from the aircraft so that the missile will not fuse, or detonate, near the aircraft. Ideally, the burn time is proportional to the speed at which the expendable separates from the aircraft and how fast the aircraft can get out of the field of view of the missile. The longer the burn time, the more protection the expendable provides.

The energy output is mostly determined by the type and amount of fuel. The fuel usually is finely powdered magnesium or aluminum and an oxidant. These fuels need to be mixed uniformly so that they burn at a constant temperature. A combination of magnesium, teflon (Polytetrafluoroethylene) and viton (also known as MTV) is the most common flare material.

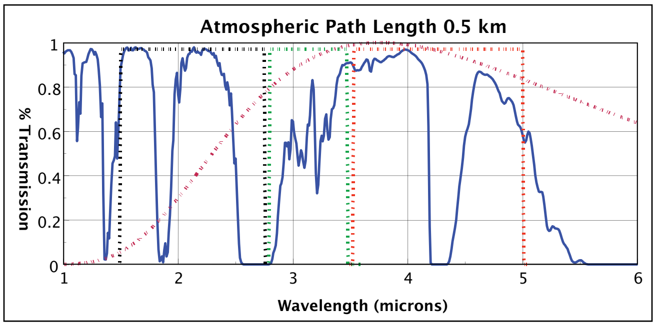

Figure 1: Three possible spectral bands of 1.5-2.7, 2.8-3.5 and 3.5-5 microns.

The flare's spectral output should be closely matched to the signature of the aircraft. The spectral output defines the operational wavelength (band) of the expendable. The aircraft IR signature typically has components in the 1.2- to 1.5-micron range and the 3- to 5-micron range. **Figure 1** shows the different spectral bands used.

The expendable's energy output is spread over this total spectral range, with a portion of the energy in each spectral band. The portions are defined by the chemical mixture of the fuel. The fuel is mixed to provide the maximum energy output in the spectral band desired to provide the most effective performance of the expendable. Because some missile seekers are designed to detect the hot metal parts of the aircraft (1.2 to 1.5 microns), while others are designed to detect the aircraft's hot exhaust or plume gasses (3 to 5 microns), the power in both spectrums needs to be optimized to match that of the platform for best expendable performance.

The temperature defines the spectral output power at different wavelengths. The higher the burn temperature, the more power is available at the different wavelengths. The higher the temperature, the higher the spectral density at different wavelengths. The temperature, spectral density and operating wavelength must all be optimized by varying the chemical composition of the expendable.

DISPENSERS AND IR EXPENDABLES SAMPLING

Two different surveys were sent out – dispensers and IR expendables. The surveys were sent to companies known to be involved in the development of these devices. The companies were asked to provide information for up to five dispenser products and seven IR expendables per survey for inclusion in this article. Only information supplied by the survey respondents was used in this compilation.

Our next survey, covering SIGINT Antennas, will appear in August. E-mail editor@crows.org to request a questionnaire.


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TECHNOLOGY SURVEY: DISPENSERS

MODEL	EXPEND TYPE	# OF EXPENDS	PROGRAMMABLE	INTERFACE
BAE Systems (OEM); Austin, TX; +1-512-929-4371; www.baesystems.com				
ALE-47 (V) Threat Adaptive Countermeasures Dispenser System (TACDS)	Flares: MJU-7, MJU-10, M-206, MJU-47, MJU-48, etc. Chaff: RR-170 and RR-180, etc.	30-960	Threat Adaptive Customer Expandable via Mission Data File and associated Mission Data Generation PC tools.	Cockpit display u STD-1553 glass EW bus.
AN/ALE-47 Countermeasures Dispenser System (CMDS)	Flares: MJU-7, MJU-10, M-206, MJU-47, MJU-48, etc. Chaff: RR-170 and RR-181.	30-960	US DOD software and software reprogramming.	Cockpit display u STD-1553 glass EW bus.
ALE-47H Threat Adaptive Countermeasures Dispenser System (TACDS) for helicopter applications	Flares: M206, M211 and M212. Chaff: RR-170 and RR-180.	30-480	Threat Adaptive Customer Expandable via Mission Data File and associated Mission Data Generation PC tools.	Cockpit display u STD-1553 glass EW bus.
AN/ALE-58 (BOL)	MJU-52	160-640	Programmable and controllable via ALE-47 or via mission computer.	Discrete dispens MIL-STD-1553.
BAE Systems Rokar; Jerusalem, Israel; +972-2-5329888; www.rokar.com				
Advanced Countermeasures Dispensing System (ACDS)	RR-170, RR-180, MJU-7 and M-206.	30, 18, 15 and 6	16 manual programs, 16 escape programs, 500 automatic programs and a Jettison program.	1553, RS-232 ar
MBDA France; Paris, France; +33-01-42-24-24-24; www.mbda-systems.com				
ELIPS	IR and RF	190	yes	RS 422
SPECTRA Dispenser	IR, RF and EO	180	yes	1553
SPIRALE + ECLAIR-M	IR, RF and EO	210	yes	Digibus, RS 422
SAPHIR-M	IR and RF	190	yes	RS 422
SAPHIR-400	IR and RF	*	yes	1553
MES; Rome, Italy; +39-06-41627-200; www.mesroma.it				
ECDS-1	Chaff, flare, RF MEB, IR MEB and others.	30 type 1 x 1 x 8 in, 15 type 2 x 1 x 8 in and 60 type RF/IR MEB.	256 dispensing programmable. 5 manual programmable select among 256. 1 escape programmable among 256. 1 by-pass programmable.	RS-422, RS-485 I/O lines.
ECDS-2	Chaff, flare, RF MEB, IR MEB and others.	30 type 1 x 1 x 8 in, 15 type 2 x 1 x 8 in and 60 type RF/IR MEB.	256 dispensing programmable. 31 manual programmable select among 256. 1 escape programmable among 256. 1 by-pass programmable.	MIL-STD-1553 B 485 and discrete
ECDS-2(V28)	Chaff, flare, RF MEB, IR MEB and others.	30 type 1 x 1 x 8 in, 15 type 2 x 1 x 8 in and 60 type RF/IR MEB.	256 dispensing programmable. 31 man programmable select among 256. 1 escape programmable among 256. 1 by pass programmable.	MIL-STD-1553 B 485, RS-232 and lines.
Rodale Electronics Inc.; Hauppauge, NY; +1-321-632-1130; www.rodaleelectronics.com				
179750-0001	chaff and flare	30 per magazine	*	various
D-66 and D-67 (3268AS402-002)	chaff and flare	30 decoys per magazine.	yes	digital and analo
ALE-39	chaff and flare	30 decoys per magazine.	no	digital and analo
Saab Avitronics; Stockholm, Sweden; +46-8-580-840-00; www.saabgroup.com				
BOZ-EC	Pyro IR and chaff	195 1 x 1 x 8-in cartridges.	yes	PPD-bus, RS422 discretes, MIL-S Arinc 429.
BOA	CIV-IR IR decoy	12	yes	28 VDC discrete

	PWR (in W)	SIZE (in in/cm)	WEIGHT (in lb/kg)	FEATURES
unit and MIL- cockpit and	45 W standby for four dispenser fighter or helicopter systems. 65 W standby for a 10-dispenser cargo aircraft. Average power when expending is 170-200 W.	Various configs. Programmer is 6.14 x 3.6 x 5.75 in. Dispenser dimensions vary based on aircraft config. ALE-39, -40, -45 and helicopter M-130 form factor versions available.	60 lbs for a typical four-dispenser/magazine system. 12-15 lbs per additional dispenser/magazine.	Full O, I and D level support equipment and software support tools available.
unit and MIL- cockpit and	45 W standby for four dispenser fighter or helicopter systems. 65 W standby for a 10-dispenser cargo aircraft. Average power when expending is 170-200 W.	Various configs. Programmer is 6.14 x 3.6 x 5.75 in. Dispenser dimensions vary based on aircraft config. ALE-40 and -39 form factors available.	60 lbs for a typical four-dispenser/magazine system. 12-15 lbs per additional dispenser/magazine.	Full US DOD logistics and EW software support via WR-ALC Program Office.
unit and MIL- cockpit and	45 W standby for a typical helicopter system. Average power when expending is 170-200 W.	4.85 x 8.95 x 12.93 in. directionally-mounted dispenser to helicopter to fire flares or chaff.	40 lbs for a typical helicopter installation.	Full O, I and D level support equipment and software support tools available.
e RS-422 and	30 W standby and 500 W dispensing.	67.9 x 8.9 x 7.4 in. installed in a typical fairing.	40 lbs per dispenser. 80 lbs typical 2-dispenser aircraft config.	Full O, I and D level support equipment and software support tools available. Optional WR-ALC depot support available.
nd PPD	Every dispensed payload requires 5 amps. System operates on 28 V.	*	*	Simultaneous dispensing of four payloads from same magazine. Mixed types of payloads in same magazine. Either installed with designated panel, or activated from aircraft MFD. Event recording and debriefing. Software eraser. Reloading software on aircraft. Training mode.
	*	*	approx 12 kg	Used on helicopters and mission aircraft.
	*	*	*	Used on RAFALE.
	*	*	*	Used on Mirage 2000.
	*	*	approx 12 kg	Used on Tigre and NH90.
	*	*	*	Used on A400M.
5 and discrete	15 W (standby). 203 W (firing at 20 ms).	CCU: 3 x 5.74 x 5.39 in. SDU: 6.87 x 8.3 x 11.41 in. SSU: 3.14 W x 3.74 L in. MAGAZ: 5.54 x 7.5 x 8.5 in.	CCU = 3.96 lbs. SDU = 7.05 lbs. SSU = 0.55 lbs. MAGAZ = 3.7 5 lbs (unloaded).	Reaction time: <100 ms. PBIT and CBIT.
. RS-422, RS- e I/O lines.	16 W (standby). 206 W (firing at 20 ms).	EIU: 4.47 x 4.92 x 7.87 in. SDU: 6.87 x 8.3 x 3.74 in. SSU: 3.14 W x 3.74 L in. MAGAZ: 5.54 x 7.5 x 8.5 in.	EIU = 5.51 lbs. SDU = 7.05 lbs. SSU = 0.55 lbs. MAGAZ = 3.75 lbs (unloaded).	Library data loaded by MIL-1553. 16 payload map config.
. RS-422, RS- d discrete I/O	25 W (standby). 250 W (firing at 20 ms).	EIU: 5.27 x 5.27 x 10.23 in. SDU: 6.77 x 8.48 x 10.23 in. SSU: 3.14 W x 3.74 L in. MAGAZ: 5.54 x 7.5 x 8.5 in.	EIU = 5.51 lbs. SDU = 8.81 lbs. SSU = 0.55 lbs. MAGAZ = 3.75 lbs (unloaded).	Misfire detection and recovery.
	*	10.125 x 7.25 in	6.5 lbs without decoys	Interfaces with ALE-47 countermeasures systems. Utilizes inventory monitoring.
g	5 V	10.125 x 6.304 in	6.5 lbs without decoys	Interfaces with and is a part of the ALE-47 CMDS. Utilizes inventory monitoring.
g	5-9 V	*	8 lbs without decoys	Dispenser for the ALE-39 Countermeasures System.
, 28 VDC TD-1553B and	*	approx 4,000 cm-long pod	approx 250 kg	Podded self-protection system with integrated missile approach warning.
and RS485.	<50 W standby. <400 W dispensing.	*	7.5 kg loaded	Non-pyro dispenser for civil aircraft protection. Part of the CAMPS protection system.

TECHNOLOGY SURVEY: DISPENSERS

MODEL	EXPEND TYPE	# OF EXPENDS	PROGRAMMABLE	INTERFACE
Saab Avitronics; Stockholm, Sweden; +46-8-580-840-00; www.saabgroup.com *continued*				
BOL	Non-pyro IR and chaff	160	yes	28 VDC discrete, 1553B.
BOP-L	1 x 1-in or 2 x 1-in chaff or IR cartridges.	Modular design with capacity from 23 to 39 1 x 1-in cartridges.	yes	RS485 or CAN
Symetrics Industries, LLC; Melbourne, FL; +1-321-254-1500; www.symetrics.com				
AN/ALE-47(V) Countermeasures Dispenser System (CMDS)	Round and square: chaff, flare/ IR decoy, RF decoy and special purpose. (Round: 1.5-in D x 6-in form factor. Square: 1 x 1 x 8-in form factor.)	Round magazine: 30 per magazine. 1 x 1-in. Square magazine: 30 expendables per magazine. 1 x 2-in. Square magazine: 15 per magazine. 32 magazines max or 960 expendables max.	Six reprogrammable, manual programs. Hundreds of situation-dep programs.	1553, RS-422, R discrete.
TERMA A/S; Lystrup, Denmark; +45-8743-6000; www.terma.com				
Advanced Countermeasures Dispenser System (ACMDS)	Chaff: chaff, dual chaff (RR-180), CCB, MEB, etc. Flares: MTV, spectral, SMD, aerodynamic, etc.	MJU-11/A: 30 cartridges of type 118 (1 x 1 x 8 in), MJU-12/1: 15 cartridges of type 218 (2 x 1 x 8 in) and MJU-17/A: 6 cartridges of type 228 (2 x 2.5 x 8 in).	Flightline reprogrammable via MDF, which can hold up to 16 or 32 different dispense programs per mission.	RS-232-based D RS-485 SDL inte interfaces, but n sequencer switc
Thales Land and Joint Systems; Suffolk, England; +44-(0)-1284-750599; www.thalesgroup.com				
Vicon 78 Series 455 (helicopter config)	NATO rectantangular format: chaff: 1 x 1 x 8 in. Flares: 1 x 1 x 8 in and 2 x 1 x 8 in. MEB: chaff and flares.	Per dispenser unit: 32 payloads in 1 x 1 x 8-in format. 16 payloads in 2 x 1 x 8-in format. 64 payloads in MEB format.	yes	EIA-422A
Vicon 78 Series 455 (fixed-wing config)	NATO rectantangular format: chaff: 1 x 1 x 8 in. Flares: 1 x 1 x 8 in and 2 x 1 x 8 in. MEB: chaff and flares.	Per dispenser unit: 30 payloads in 1 x 1 x 8-in format. 15 payloads in 2 x 1 x 8-in format. 60 payloads in MEB format.	yes	EIA-422A and M

TECHNOLOGY SURVEY: IR EXPENDABLES

MODEL	EXPEND TYPE	EJECT METHOD	DISPENSER COMP	SIZE (in in/cm)
Alloy Surfaces Company (ASC), part of the Chemring Group; Chester Township, PA; +1-610-772-1134; www.alloysurfaces.com				
M-211	SM	pyro	ALE-4X series, M-130 and similar dispensers.	1 x 1 x 8 in
MJU-49	SM	pyro	ALE-39 and ALE-47	36 mm x 5.8 in
MJU-50/B	SM	pyro	ALE-4X series, M-130 and similar dispensers.	1 x 1 x 8 in
MJU-51A/B	SM	pyro	ALE-4X series, M-130 and similar dispensers.	2 x 1 x 8 in
MJU-52/B	SM	mechanical	SAAB BOL	2 x 3 x 1/4 in
MJU-52/B	SM	mechanical	SAAB BOL	3 x 3 x 1/4 in
MJU-64/B	SM	pyro	ALE-4X series, M-130 and similar dispensers.	1 x 1 x 8 in
Chemring Countermeasures Ltd.; Wiltshire, UK; +44-(0)-1722-411611; www.chemringcm.com				
118 Mk3 Type 1	1 x 1-in MTV flare	PW11 Mk1 impulse cartridge.	All 1 x 1-in compatible dispensers.	1 x 1 x 8 in
218 Mk3 Type 1	1 x 2-in MTV flare	PW21 Mk1 impulse cartridge.	All 2 x 1-in compatible dispensers.	2 x 1 x 8 in
118 Mk3 Type 3	1 x 1-in spectral flare	PW11 Mk2 impulse cartridge.	All 1 x 1-in compatible dispensers.	1 x 1 x 8 in
218 Mk3 Type 3	2 x 1-in spectral flare	PW21 Mk2 impulse cartridge.	All 2 x 1-in compatible dispensers.	2 x 1 x 8 in

	PWR (in W)	SIZE (in in/cm)	WEIGHT (in lb/kg)	FEATURES
RS485 or MIL-	<50 W standby. <400 W dispensing.	*	11.9 kg empty	Non-pyro, high-capacity dispenser.
	*	*	<2 kg empty	Low-weight, high-capacity pyro dispenser.
S-485 and	<25 W in standby. 5+ amps for 50 ms while dispensing an expendable.	Dispenser (D-66 or D-67) for round expendables: 10.2 x 9.8 x 6.7 in. Dispenser (D-49) for square expendables: 6.6 x 8.5 x 9.7 in.	Dispenser (D-66 or D-67) for round expendables: 4.4 lbs. Dispenser (D-49) for square expendables: 4.5 lbs. Typical two-dispenser config (square, D-49) with 60 M206 flares: 59 lbs.	Dispenser connects to EW and air data buses to customize dispense pattern according to individual threats and environments.
SDB interface, erface and 1553 ot directly to the h.	Power consumption: 3 W max at 28 VDC (standby). Per DSS: 12 W pulsed, 30 sec max (during continuity check) and 140 W pulsed, 15 ms max (during squib firing).	DSS: 7.91 x 14.61 x 14.61 cm. Safety switch/EMI filter: 5.91 x 11.16 x 8.14 cm. Dispenser assembly: 16.94 x 21.55 x 24.54 cm. Breech plate: 14.38 x 19.05 x 2.46 cm.	DSS: 1.3 kg. Safety switch/ EMI filter: 0.5 kg. Dispenser assembly: 9.45 kg (full) and 2.4 kg (empty). Breech plate: 1 kg.	Dispenser hardware can be delivered as standard dispenser assemblies ("buckets") or integrated into applied aero-structures, e.g., fuselage-mounted, PIDS, MCP, SCDs or SWPs.
	CPM: 5 W. Safety disarm unit: 0 W. Dispenser: 14 W.	CPM: 15.2 x 14.5 x 1.75 cm. Safety disarm unit: 6.5 x 7.62 x 7.94 cm. Dispenser: 26.3 x 11.9 x 27.3 cm.	CPM: 0.22 kg. Safety disarm unit: 0.3 kg. Dispenser: 3.12 kg.	Designed for helicopter applications and used in tightly integrated ASE architectures. Controller can be mounted within another host LRI. Automatic, semiautomatic and manual operating modes.
IL-STD-1553B	CFDCU: 28 W. Safety disarm unit: 0 W. Dispenser: 14 W.	CFDCU: 14.6 x 7.62 x 23.5 cm. Safety disarm unit: 6.5 x 7.62 x 97.4 cm. Dispenser: 21.5 x 17.0 x 24.4 cm.	CFDCU: 2.25 kg. Safety disarm unit: 0.3 kg. Dispenser: 3.2 kg.	Designed for fixed-wing and retrofit applications. Lightweight, low-power and has control of up to 24 dispenser units. Mixed payload capability. Automatic misfire detection and recovery.

FORMAT	WEIGHT (in lb/kg)	NATO STOCK #	FEATURES
square	310 g	1370-01-534-9804	Extremely safe to handle.
round	340 g	1370-01-449-0577	Extremely safe to handle.
square	275 g	1370-01-468-6077	Extremely safe to handle.
square	620 g	1370-01-544-2965	Extremely safe to handle.
square	54 g	1370-01-490-2432	16-unit pack
square	54 g	1370-01-519-7838	80-unit pack
square	*	1370-01-523-0965	Extremely safe to handle.
rectangular	180 g	1370-99-051-9514	Flare remains safe until pyro-ejected from outer case.
rectangular	380 g	1370-99-225-5931	Flare remains safe until pyro-ejected from outer case.
rectangular	180 g	1370-99-306-4128	Has a spectrally-matched payload to combat advanced third-generation heat-seeking missiles employing spectral discrimination techniques.
rectangular	380 g	1370-99-997-8224	Has a spectrally-matched payload to combat advanced third-generation heat-seeking missiles employing spectral discrimination techniques.

TECHNOLOGY SURVEY: IR EXPENDABLES

MODEL	EXPEND TYPE	EJECT METHOD	DISPENSER COMP	SIZE (in in/cm)
Chemring Countermeasures Ltd.; Wiltshire, UK; +44-(0)-1722-411611; www.chemringcm.com *continued*				
26 mm	MTV flare	PW26 impulse cartridge	All 26-mm compatible dispensers.	26 mm x 86 mm
50 mm	MTV flare	CCM50 Mk2 Type 2 impulse cartridge	All 50-mm compatible dispensers.	50 mm x 202 mm
K7 Type 2 Advanced Decoy	2 x 1-in MTV thrusted flare	PW21 Mk1 impulse cartridge	All 2 x 1-in compatible dispensers.	2 x 1 x 8 in
Esterline Defense Group; Coachella, CA; +1-760-398-0143; www.armtecdefense.com				
ARM-001 IR Decoy Flare	flare or free fall	pyro (CCU-136 or CCU-63)	ALE-39, ALE-47 or equivalent systems.	36 mm D and 148 mm L.
ARM-002 IR Decoy Flare	flare or free fall	pyro (CCU-136 or CCU-63)	ALE-39, ALE-47 or equivalent systems.	36 mm D and 148 mm L.
ARM-010 Spectral Flare	flare or free fall	pyro (BBU-35/B)	ALE-40, ALE-47 or equivalent systems.	1 x 1 x 8 in
M206 IR Decoy Flare	flare or free fall	pyro (BBU-35/B or M796)	M130, ALE-40, ALE-47 or equivalent systems.	1 x 1 x 8 in
MJU-7A/B IR Flare	flare or free fall	pyro (BBU-36/B)	ALE-40, ALE-47 or equivalent systems.	1 x 2 x 8 in
MJU-10/B IR Flare	flare or free fall	pyro (BBU-36/B)	ALE-40, ALE-47 or equivalent systems.	2 x 2.5 x 8 in
MJU-59/B Spectral Flare	flare or free fall	pyro (BBU-35/B)	ALE-40, ALE-47 or equivalent systems.	1 x 2 x 8 in
Etienne-Lacroix; Muret, France; +33-(0)-561-677-955; www.etienne-lacroix.com				
LIR 110	free flight	pyro	AN/ALE 40-47, etc.	8 x 1 x 1 in
LIR 111	free flight	pyro	AN/ALE 40-47, etc.	9 x 1 x 1 in
LIR 112	aerodynamic	pyro	AN/ALE 40-47, etc.	10 x 1 x 1 in
LIR 120	free flight	pyro	AN/ALE 40-47, etc.	8 x 1 x 2 in
LIR 121	free flight	pyro	AN/ALE 40-47, etc.	8 x 1 x 2 in
LIR 410	free flight	pyro	MBDA Spirale/Spectra	40 mm D
LIR 411	free flight	pyro	MBDA Spirale/Spectra	41 mm D
Kilgore Flares, LLC, Part of the Chemring Group; Toone, TN; +1-731-658-5231; www.kilgoreflares.com				
M206	Conventional MTV hot spot. Point source.	expulsion cartridge or pyro	M130, AN/ALE-40, AN/ALE-45 and AN/ALE-47.	1 x 1 x 8 in
M212	Multispectral point source.	expulsion cartridge or pyro	M130, AN/ALE-40, AN/ALE-45 and AN/ALE-47.	1 x 1 x 8 in
MJU-7A/B	Conventional MTV hot spot. Point source.	expulsion cartridge or pyro	AN/ALE-40, AN/ALE-45 and AN/ALE-47.	1 x 2 x 8 in
MJU-53/B	Conventional MTV hot spot. Point source.	expulsion cartridge or pyro	AN/ALE-40, AN/ALE-45 and AN/ALE-47.	1 x 2 x 8 in
MJU-55/B	companion decoy flare	expulsion cartridge or pyro	D27/ALE-29 A, MX-7721/ ALE-29A, MX-7829/ALE-29A, AN/ALE-39, AN/ALE 29A and AN/ALE-47.	36 mm x 6 in
MJU-39/B	Kinematic performance-tailored decoy flare.	expulsion cartridge or pyro	custom	custom
MJU-40/B	Kinematic performance-tailored decoy flare.	expulsion cartridge or pyro	custom	custom
Rheinmetall Waffe Munition; Unterluess, Germany; +49-5827-80-6827; www.rheinmetall-defence.com				
DM69 A2	area flare	pyro	ALE-40, ALE-47, MCP10, etc.	1 x 2 x 8 in
BIRDIE 118	free fall	pyro	ALE-40, ALE-47, MCP10, M130, etc.	1 x 1 x 8 in
BIRDIE 218	free fall	pyro	ALE-40, ALE-47, MCP10, M130, etc.	2 x 1 x 8 in
BIRDIE 218	free fall	pyro	ALE-40, ALE-47, MCP10, M130, etc.	2 x 1 x 8 in

FORMAT	WEIGHT (in lb/kg)	NATO STOCK #	FEATURES
round	76 g	1370-99-985-9089	Is a direct fit and form replacement for the FSU L056V-type flare. STANAG-approved 1-amp, 1-W, no-fire impulse cartridge.
round	760 g	*	Direct replacement to existing Russian PPI-50 flares, and will readily fit into dispensers already installed into FSU aircraft.
rectangular	540 g	1370-99-259-8266	Is a direct fit and form equivalent of the US MJU-7 series flare but provides a flare trajectory tailored to overcome the rate-bias CCMs.
round	254 g nominal	1370-01-533-0033	Conventional MTV IR decoy flare for fast jets.
round	254 g nominal	1370-01-533-0030	Conventional MTV IR decoy flare for helicopters and transports.
square	200g nominal	*	Spectral flare suitable for helicopters, transports and modest signature jets.
square	185 g nominal	1370-01-048-2138	Conventional MTV IR decoy flare for jets, helicopters and transport aircraft.
rectangular	394 g nominal	1370-01-296-8395	Conventional MTV IR decoy flare for jets and transports.
rectangular	1,061 g nominal	1377-01-263-1602	Conventional MTV IR decoy flare for F-15 and transports.
rectangular	415 g nominal	1370-01-508-9534	Spectral flare suitable for jets, transports and helicopters.
square	180 g	1370-14-558-4235	For helicopters and transport aircraft.
square	175 g	1370-14-559-3880	For helicopters and transport aircraft.
square	220 g	1370-14-559-3568	For helicopters and transport aircraft.
rectangular	380 g	1370-14-558-8564	for fighter aircraft
rectangular	370 g	1370-14-558-8653	for fighter aircraft
round	350 g	1370-14-558-7564	For Rafale and Mirage 2000.
round	330 g	1370-14-558-7578	For Rafale and Mirage 2000.
square	0.5 lbs	1370-01-048-2138	Conventional parasitic ignition. Used in AIRCMM.
square	0.5 lbs	1370-01-460-1687, 1370-01-534-3060	Sequenced ignition. Weighted nose. Used in AIRCMM.
rectangular	1 lb	1370-01-296-8395	Sequenced ignition.
rectangular	1 lb	1370-01-503-1455	Sequenced ignition. High intensity. Sealed/marinized.
round	0.5 lbs	1370-01-504-3979	Companion free fall. Sealed/marinized.
rectangular	3 lbs	1370-01-498-2045	Sequenced ignition.
rectangular	3 lbs	1370-01-498-2050	Sequenced ignition.
square	approx 360 g	1370-12-336-6251	Masking capability.
square	approx 150 g	1370-12-368-0173	High bispectral decoy.
square	approx 305 g	1370-12-366-5771	High bispectral decoy.
square	approx 305 g	1370-12-366-5771	High bispectral decoy.

Survey Key – Dispensers

MODEL

Product name or model number

EXP TYPE

Types of expendables dispensed

- IR = infrared
- RF = radio frequency
- EO = electro-optic
- D = diameter
- CCB = Configuration Control Board
- MEB = Modular Expendable Block
- MTV = Magnesium Teflon Viton

 # OF EXPENDS

Quantity of expendables

PROGRAMMABLE

- PC = personal computer
- MDF = mission data file

INTERFACE

Interface for control

- EW = electronic warfare
- DSDB = Dispenser Station Database
- SDL = Serial Data Link

PWR (in W)

Power dissipated in Watts per channel

- DSS = digital sequencer switch
- CPM = Countermeasures Dispenser System Processor Module
- CFDCU = Chaff/Flare Dispenser Control Unit

SIZE (in in or cm)

- EMI = electromagnetic interference

FEATURES

Additional features

- MFD = multifunction display
- CMDS = Countermeasures Dispenser System
- CAMPS = Civil Aircraft Missile Protection System
- PIDS = Pylon Integrated Dispenser System
- MCP = Modular Countermeasures Pod
- SCD = Scab-on Dispensers
- SWP = Stub-wing Pods
- ASE = aircraft survivability equipment
- LRI = line-replaceable item

OTHER ABBREVIATIONS USED

- max = maximum
- min = minimum
- config = configuration
- approx = approximately
- > = greater than
- < = less than

** 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
Alkan	www.alkan.fr
IMI	www.imi-israel.com

Survey Key – IR Expendables

MODEL

Product name or model number

EXPEND TYPE

Expendable type

- SM = Special Materials
- MTV = Magnesium Teflon Viton

EJECT METHOD

Ejection method

DISPENSER COMP

Dispenser compatibility

SIZE (in in. or cm)

- D = diameter

FEATURES

Additional features

- FSU = Former Soviet Union
- STANAG = Standardization Agreement per NATO Standardization Group
- CCM = counter-countermeasure
- AIRCMM = Advanced Infrared Countermeasures Munition

OTHER ABBREVIATIONS USED

- 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
Alliant Techsystems	www.atk.com
IMI	www.imi-israel.com
Raytheon	www.raytheon.com
Wallop Defence Systems Ltd.	www.wallopdefence.com

August 2009 Product Survey: SIGINT Antennas

This survey will cover signals intelligence (SIGINT) antennas. Please e-mail editor@crows.org to request a survey.

V/UHF JAMMER

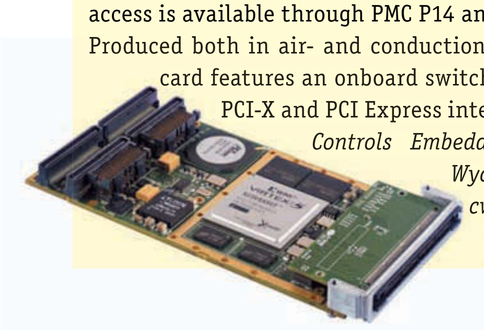
Jordan Electronic Logistics Support's V/UHF Smart Jammer, called WaveStorm, is an electronic warfare (EW) product that implements digital radio frequency memory (DRFM) technology into its jamming ability. The 8.8-lb jammer has a 50-2,850 MHz frequency range and generates instantaneous spot or band barrage jamming signals at a 10 KHz-8 MHz bandwidth, with capability up to 32 MHz. It also performs sweep jamming. Its jamming response time is less than 1 ms and, with an RF output power ranging from -40 to 20 dBm, it can sustain an external high-power RF amplifier. Its other features are a Windows XP graphical user interface and a 12 V DC power supply. Measuring 15.8 x 15.8 x 3.2 in., it operates in -10 to 55 deg Celsius temperatures. *Jordan Electronic Logistics Support; Amman, Jordan; www.jels-tech.com*

SEVEN-CHANNEL EW DIGITIZER

The QuiXilica Tarvos-V5, an FPGA-based, seven-channel digitizer from TEK Microsystems Inc., is designed for radar, signals intelligence (SIGINT), ELINT and EW applications. A digitizer board made up of six analog input channels and three Xilinx Virtex-5 field-programmable gate arrays (FPGAs), the Tarvos V-5 features a high processing density per channel, a 72-dBFS signal-to-noise ratio and a 95+-dB spurious free dynamic range, making it well-suited for direction-finding, jamming and anti-jam operations. Other features include DDR3 SDRAM, digital-to-analog (D/A) and analog-to-digital (A/D) conversion capability and functionality with 30 percent smaller systems than other XMC-based digitizers, plus conduction cooling. *TEK Microsystems; Chelmsford, MA; www.tekmicro.com*

FPGA-BASED I/O XMC CARD

Curtiss-Wright Controls Embedded Computing released the XMC-FPGA05D, an FPGA-based XMC card with a configurable I/O interface. Used for radar and SIGINT operations, the card delivers up to 138 signals from its front panel, which features A/D and D/A converters, a camera link and RS485 and LVDS module capability, and 64 signals from its backplane through the host card. Non-front-panel I/O access is available through PMC P14 and XMC 16 connectors. Produced both in air- and conduction-cooled versions, the card features an onboard switch to transfer between PCI-X and PCI Express interfaces. *Curtiss-Wright Controls Embedded Computing; High Wycombe, England; www.cwcontrols.com*



RF CONVERTER/EXCITER

The SMS-ACX RF converter/exciter, introduced by Spinnaker Microwave, can generate signals with bandwidths up to 1 GHz and offers a 10 MHz-14 GHz frequency output, with capability up to 40 GHz. Designed for use in EW, electronic intelligence (ELINT) and radar applications, the SMS-ACX accepts a wide variety of intermediate frequency (IF) signals with undistorted modulating characteristics, cutting down on the incorporation of arbitrary waveform generators (AWGs) in embedded systems. The converter/exciter offers a 10-dBm conversion gain, a -55 dBc spurious signal rejection and a 30 percent maximum modulation depth. Encased in aluminum housing that measures 4.65 x 4.7 x 1.68 in., it weighs almost 2.3 lbs and consumes less than 20 W. *Spinnaker Microwave Inc.; Santa Clara, CA; www.spinnakermicrowave.com*

DF SENSOR

The RDF-110 Direction-Finding (DF) Sensor from L-3 Communications-ASIT is designed to make DF tasking using communications intelligence (COMINT) scan and intercept systems easier. Based on L-3's RAPID FIRE technology that integrates low size, weight and power (SWAP) tuners and FPGA signal processors with DF solutions, the RDF-110 is fully self-contained but also works in conjunction with a group of DF sensors on platforms ranging from battery-powered manpacks to unmanned ground sensors. Operating on a 400-3,000 MHz frequency range, the sensor supports CW, SSB, AM and FM signals and consumes less than 20 W. It weighs less than 12.5 lbs and measures 13.7 D x 7.3 H in. Suited for humidity, shock and vibration and high altitudes, it works in -25 to 60 deg Celsius temperatures. *L-3 Communications-Applied Signal and Image Technology (ASIT); Linthicum Heights, MD; www.L-3com.com/asit*

2-18 GHz MINIATURE POWER DIVIDER

The APD-2-218-M-BB is a miniature power divider from Planar Monolithics Industries. Measuring only 0.799 x 1.026 x 0.3 in., the 2-18 GHz power divider is intended for wideband SIGINT applications. It offers a maximum 2.2 dB insertion loss, a minimum 16-dB isolation and a 2:1 VSWR at 1.5 W and 1.2:1 VSWR at 2 W. It can perform at temperatures as cold as -55 deg Celsius and as hot as 85 deg Celsius, and is MIL-STD-202F-compliant in terms of shock and vibration and altitude. *Planar Monolithics Industries; Frederick, MD; www.planarmonolithics.com*

Communications EW – Part 25

Jamming Frequency Hopping Signals

By Dave Adamy

Frequency hoppers are arguably the most important of the low-probability-of-intercept (LPI) signals both because they are widely used and because they can provide very wide frequency spreading.

FREQUENCY HOPPERS

Figure 1 shows the frequency vs. time plot for a frequency hopping signal. The signal pauses at one frequency for a short period of time and then moves to another randomly selected frequency. The dwell time at one frequency is called the hop duration. The hopping rate is, of course, the number of hops per second. The hopping range is the frequency range over which the transmission frequencies can be selected. The whole signal bandwidth is moved to the assigned frequency for each hop. A typical example is the Jaguar VHF frequency-hopping radio. It has a signal bandwidth of 25 kHz and its hop range can be as wide as 30 to 88 MHz (i.e., a 58 MHz hopping range).

The block diagram of a frequency-hopping transmitter is shown in **Figure 2**. A digitally modulated signal is converted to hop frequencies using a synthesizer, which is tuned to pseudo-randomly selected frequencies. The front end of the frequency hopper receiver has a synthesizer, which is tuned to the same frequency as the transmitter synthesizer. This requires a synchronization scheme common to the transmitter and receiver. When a receiver first is turned on, it is necessary to go through a lengthy synchronization procedure. Each time a new signal is received, the receiver must go through a limited resynchronization procedure. To allow for this synchronization period, a short tone may be inserted into the ear piece of a frequency hopping transceiver when the transmit key is depressed to delay the start of a voice transmission. When digital data is transmitted, this delay can be automatic.

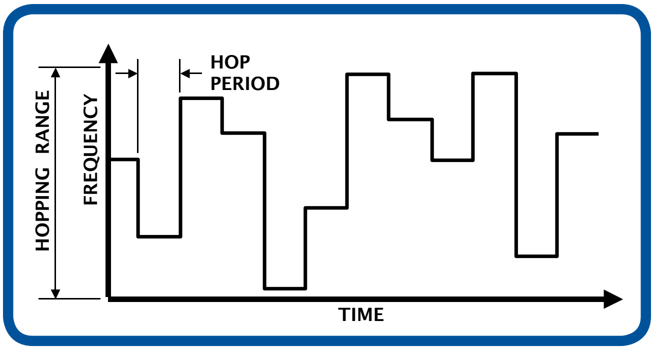


Figure 1: A frequency hopping signal changes its transmit frequency many times during a message.

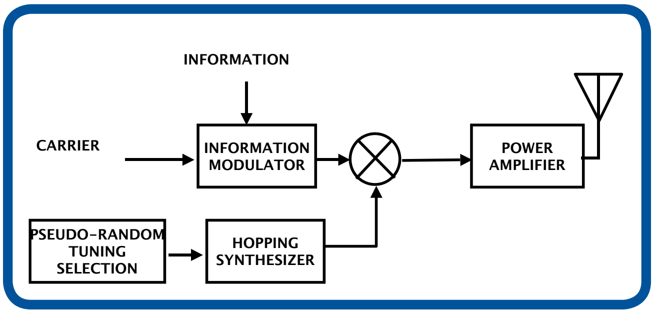


Figure 2: The frequency-hopping transmitter includes a pseudo-randomly tuned synthesizer to rapidly hop the transmitted signal over a wide frequency range.

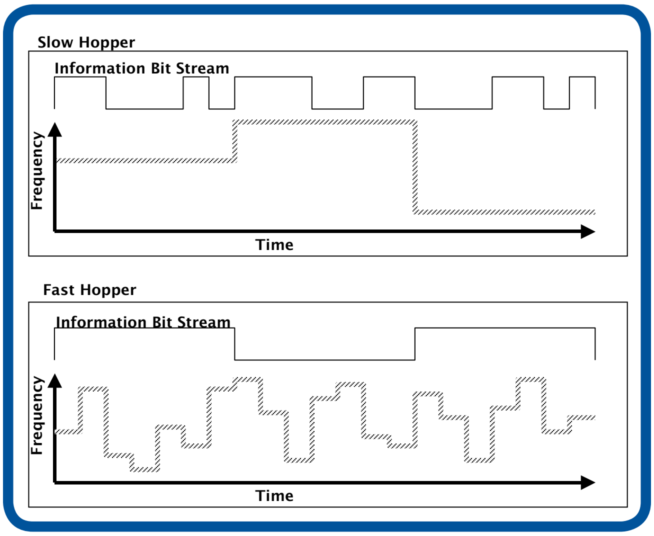


Figure 3: A slow hopper transmits multiple bits per hop; a fast hopper has multiple hops per bit.

SLOW AND FAST HOPPERS

Frequency-hopping systems either can be slow hoppers or fast hoppers. A slow hopper (such as the Jaguar mentioned above) carries multiple bits during each hop. A fast hopper changes to multiple hop frequencies during each bit of data. These two waveforms are shown in **Figure 3**.

Slow Hopper

The slow hopper uses a phase-lock-loop synthesizer as shown in **Figure 4**. This synthesizer can be designed to cover a very wide frequency range and to support many hop frequencies. For example, the Jaguar has a 25 kHz bandwidth and can hop over 58 MHz. This provides 2,320 maximum hop frequencies. Note that this system also has smaller hopping ranges (256 and 512 hops selectable within the 58 MHz to avoid high occupancy frequency ranges).

Because all of the signal power remains at a single transmission frequency for long enough to transmit multiple bits, the slow hopper is relatively easy for a receiver to detect. However, the constantly changing and unpredictable frequency makes it difficult to perform important electronic warfare (EW) functions such as emitter location and jamming.

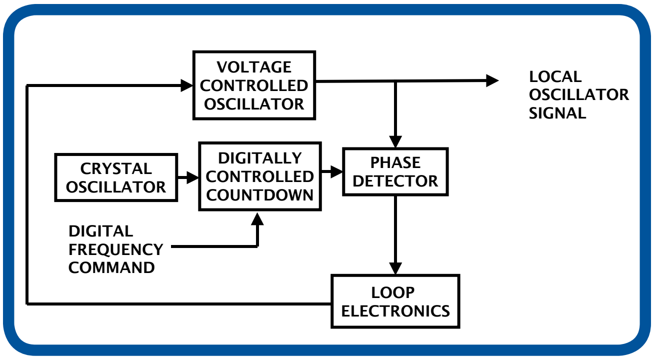


Figure 4: A slow hopper typically uses a phase-lock-loop synthesizer with the loop bandwidth optimized for settling time vs. signal quality.

The bandwidth of the feedback loop in a phase-lock-loop synthesizer is designed to optimize its performance. The wider the bandwidth, the faster the synthesizer can come up on a new frequency; the narrower the bandwidth, the higher the signal quality. A typical synthesizer used in a frequency hopping system will be close enough to its final hop frequency in a time equal to approximately 15 percent of the hop period. Thus, at 100 hops per second, the system would spend 1.5 ms waiting for the synthesizer to settle at the beginning of each hop. As shown in **Figure 5**, the system can transmit its information only after this settling time. This 15 percent drop-out of data (or voice) would make the system unusable.

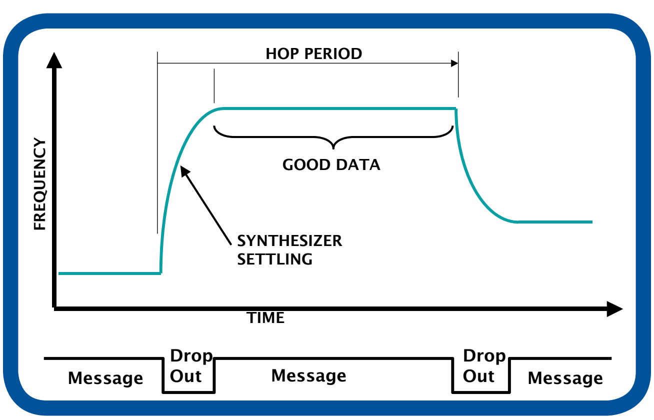


Figure 5: The slow hopper must delay its transmission until the synthesizer has settled on each new hop frequency.

To hear and understand a voice signal, we need to have a continuous signal. Thus, it is necessary to digitize the input signal to the transmitter and place the digital signal into a first-in-first-out (FIFO) device. This signal might be, for example, 16 kbps. Then the signal would be clocked out of the FIFO at something like 20 kbps during the time between the synthesizer settling periods. At the receiver, the process is reversed. The 20 kbps data is input to a FIFO and clocked out as a continuous signal at 16 kbps.

When the transmitter and receiver hop times and frequencies are synchronized and the settling time drop-outs are removed, the frequency-hopping process is basically transparent to the user. Although the above discussion considered voice signals, the same considerations obviously apply to digital data transmissions.

Fast Hopper

Fast-hopping signals present significantly more challenge to hostile receivers because they change frequencies so quickly. There is an inverse relationship between the dwell time of a signal in a receiver bandwidth and the receiver bandwidth required. An often used rule of thumb is that the dwell time must be the inverse of the bandwidth (i.e., 1 ms dwell time requires 1 MHz bandwidth). Since the bandwidth of the information carried by the system is much narrower than this, the receiver sensitivity is strongly compromised (see the January 2007 EW 101 column).

A synchronized receiver will remove the hopping so the rest of the receiver can operate at the bandwidth of the information signals carried. Because a hostile receiver cannot remove the hopping, it must operate in a wider bandwidth. This makes it difficult to detect the presence of the signal, providing increased "transmission security."

The problem with fast hoppers is that they require more complex synthesizers. **Figure 6** shows a block diagram of a direct synthesizer. It has multiple oscillators and quickly switches one or more into a combining/filtering network to generate a single output frequency. Because this process is much faster than tuning a phase-lock-loop, the direct synthesizer can switch frequencies multiple times during each data bit. Because the complexity of the direct synthesizer is proportional to the number of signals it can output, a fast hopping system can be expected to have fewer hop frequencies than a slow hop (i.e., phase-lock-loop) system.

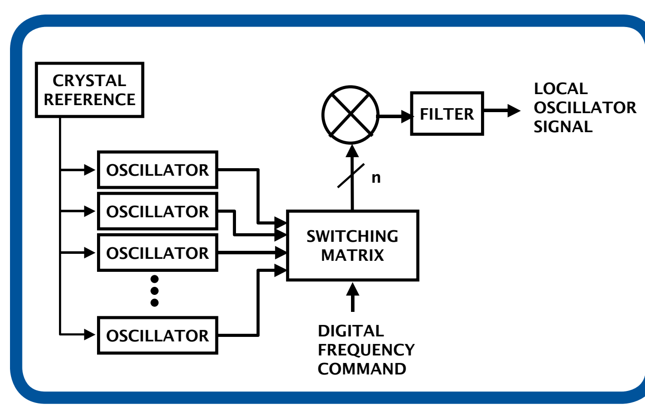


Figure 6: The fast hopper can be expected to use a direct synthesizer. Its increased complexity may limit the number of hopping frequencies.

ANTI-JAM ADVANTAGE

The anti-jam advantage of a frequency-hopping system, either slow or fast hop, is the ratio between the hopping range and the receiver bandwidth. The total power of a received jamming signal spread over the hopping range must be increased by this factor to provide J/S equal to that achieved in a fixed frequency system. For the VHF Jaguar example, 58 MHz / 25 kHz = 2,320 or 33.7 dB.

WHAT'S NEXT

Next month we will continue our discussion of frequency hop jamming. For your comments and suggestions, Dave Adamy can be reached at dave@lynxpub.com.

CALL FOR TECHNICAL PAPERS AND POSTERS

The AOC is soliciting papers for the **46th International Symposium and Convention** to be held October 18-21, 2009, in Washington DC.

The symposium theme this year is **"Modernizing EW: Balancing Cost and Capability."** For more information, visit **www.crows.org**.

After Orlando 2007, which focused on the "new," and Reno 2008, which focused on the "how," the 2009 venue in Washington, DC will focus on the trade-space of EW affordability (both politically and economically) vs. EW capability (what is really required).

Paper Submission Deadline is **June 15, 2009**.
Poster Submission Deadline is **October 1, 2009**.

For more information and guidelines, visit **www.crows.org**.

AOC
WASHINGTON D.C.
2009

2009 Election Guide

CANDIDATES FOR PRESIDENT

VOTE FOR ONE

Walter E. Wolf

Walter has served the global electronic warfare (EW) community for more than 36 years and is a widely recognized visionary leader in EW, both in uniform and out.

While in the US Air Force, Walter served as a B-52G/H EW officer (EWO), a Central Flight Instructor Course (CFIC), a B-1B Defensive Systems Officer (as initial cadre) and served as Chief of Tactics, where he developed 319th BMW KC-135R Tankers' defensive tactics that performed flawlessly in Desert Storm I. Walter developed the winning B-1B EW game plan, garnering "Best in Electronic Warfare, 15th Air Force Shoot-Out, Superior Valley" between B-52 and B-1B Wings. Walter also led the B-1B team that won the HQ SAC Bombing and Navigation Competition's Best B-1B Wing Electronic Countermeasures.

Walter was selected to the initial operations staff at HQ Air Combat Command (ACC) and was Deputy Chief of Bomber Electronic Combat Systems. During his HQ ACC staff tenure, Walter was cited as an "architect of airpower" by the HQ ACC Director of Operations in 1995. Serving both in Operations and Requirements, Walter developed EW requirements for the US Air Force Bomber fleet and frequently supported HQ US Air Force on temporary assignments.

Following his retirement in 1996, after a 24-year career in the US Air Force, Walter has been employed in the EW industry for the past 12 years. He has been an AOC member for 27 years and is a life member. Walter is a Technology Hall of Fame inductee and recipient of the AOC's Colonel Anton D. Brees Life Achievement Award.

Walter is a past AOC national treasurer and North East Region Director, president of the Granite State Roost, past president of the Red River Ravens Roost and past vice president of the Old Crows of Tidewater Chapter. During his tenure as an AOC national president, Walter reinvigorated the association both nationally and internationally.

Walter's key accomplishments as AOC president included the new and improved *Journal of Electronic Defense* (*JED*), updated national Constitution and Bylaws, business discipline of the association's budget planning and financial reporting, renewed European presence by partnering with the Shephard Group for annual European EW conferences, initiating the AOC certification program and ensuring that the association's investment accounts weathered financial uncertainties.

Walter's platform is to continue the AOC's growth as an association of EW/information operations (IO) professionals by enhancing the technical depth of the conferences and conventions, ensuring AOC-sponsored training remains valuable to industry and individuals, accelerating the AOC certification program, expanding the engagement of national and international business and government leadership on EW/IO, revitalizing chapters' value to members and ensuring the AOC remains clearly focused on support to warfighters and those who support them.

With more than 30 years of operational and managerial experience of EW/IO in the US Air Force and industry and more than five years of service on the AOC Board of Directors, including 18 months as national president, Walter is extremely qualified to serve as AOC president.

Frank I. Goral

Throughout a 40-plus-year US Marine Corps career, Frank has devoted his actions to the goals of the AOC, first as an Electronic Countermeasures Officer (ECMO) flying EA-6As over Vietnam, as an acquisition professional at NAVAIR, as a staff officer and commander supporting policy makers at HQ Marine Corps and eventually with the joint world.

In his current tour with industry, Frank helps to initiate contracts in the intelligence world for systems and support.

If elected president of the AOC, Frank will build his campaign platform on three pillars: warfighter support, expanding the AOC's base and increasing involvement with the regions and local chapters.

Frank's primary emphasis as president will be a return to the AOC's heritage. The AOC will renew its warrior spirit and concentrate on accomplishing activities that support the achievement of warfighting objectives. It is urgently required that the United States' electronic advantage over adversaries be leveraged to maximum operational effect, while at the same time protecting soldiers, sailors, airmen and Marines so they may return safely to their families. The AOC will reinforce its reputation as the premier organization where operators, technical wizards and intelligence specialists can converge on collaborative ventures benefiting warfighters.

With a focus on the warfighter, Frank's second objective will be to expand the AOC's membership base. EW is more extensive than airborne electronic attack (AEA) and tactical aviation support. All the traditional roles for EW must be preserved and continually refined to remain current with evolving technology. The AOC also must look beyond to new applications. Defeating remote-controlled improvised explosive devices (RCIEDs) clearly is a current hot area. Attacking terrorist and insurgent communications on personal communications devices, wireless computing or information networks will become a high-priority undertaking. Countering ones and zeros in fiber optics or wire cable is EW, albeit without r-squared propagation loss. All activities attacking or exploiting tactical communications among adversaries with electromagnetic energy is EW. The AOC will offer the Department of Defense (DOD) and the US services integrated solutions. It will become the honest broker for operational innovations. Cooperation, collaboration and creativity will be its bywords. Frank will focus on recruiting new members and soliciting active participation from the information warfare (IW)/cyber warfare, space control, information assurance, unmanned aerial vehicle (UAV) and other communities.

Frank's final emphasis will be on the AOC and its organizational relationships. He wants to reinvigorate the AOC's interaction with the regions and local chapters. It is important to coordinate regional symposia to strive for a synergistic perspective on EW issues. It is important to provide educational opportunities broadening the AOC's understanding beyond limited individual views. It is important to take the AOC's shared view and combined knowledge as a foundation to advocate within the DOD leadership and on the Hill for solutions that provide the most benefit for the warfighter. These goals only can be achieved by unfettered interactions among operators, technical people and intelligence specialists from across the country and the world.

Kenneth Parks

Kenneth "Kilo" Parks is a native of Gretna, LA. He attended the University of Mississippi, where he earned a bachelor's degree in public administration in 1976.

After graduating, he was commissioned as an Ensign in the US Navy and reported for flight school training, earning his Wings of Gold in 1977. He is a retired Naval Officer with more than 26 years of military operational experience. He has served in the EW/IO arena at the highest levels of leadership.

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

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

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

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

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

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

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

CANDIDATES FOR AT-LARGE DIRECTOR

VOTE FOR THREE

Malcolm Dylan Petteway

Malcolm is a 20-year veteran of the US Air Force. He flew B-52s as an EWO and has 3,000 flight hours and 300 combat hours. Throughout a distinguished career, Malcolm has used his knowledge in the art of war, military weapons and combat defenses in planning more than 400 combat sorties. Malcolm currently is a military analyst for the US Air Force in the Pentagon in Washington, DC.

Besides his Meritorious Service Medal with three oak leaf clusters and numerous other awards, Malcolm is the recipient of the US Air Force Air Medal and the US Air Force Air Achievement Medal for his actions during Operation Enduring Freedom.

In addition to a bachelor's degree in computer science, Malcolm holds a master's degree in international relations for which he has studied the development and lifecycle of power struggles between third- and first-world countries.

In his spare time, Malcolm writes science fiction novels and has published three books and several short stories in the past seven years. He also volunteers once a week to feed and clothe the homeless through a community church. Malcolm resides with his wife, Karen, and daughters, Rashila and Shakara, in Woodbridge, VA.

Wayne L. Shaw III

Wayne is an active duty US Air Force officer (until September 1, 2009) who has been qualified as an EWO in the B-52, a B-1B Defensive Systems Officer, an EF-111 EWO and an EA-6B ECMO. He was a Department Head of a Navy fleet squadron and then an instructor at the US Navy's EA-6B Weapons School. He also worked EW issues with the US Army as the ALO for the division leading the fight in Baghdad in 2006. He has grassroots experience in AOC chapters as president of the Fairchild AFB Chapter in the late 1980s, which won "Chapter of the Year" for the small-chapter category.

Wayne also was president of the Grand Forks AFB Chapter in the early 1990s. Before leaving the EA-6B, he also served as the vice president of the Prowler Roost at NAS Whidbey Island and moved it toward more regular operations/activities. On the Air Staff, he was the programmer for most US Air Force EW programs and gained valuable insight into programmatic, funding and budget issues.

As the chief of the US Central Command's (CENTCOM) EW shop in the Middle East for a one-year remote, Wayne supervised members from all US military services, as well as Coalition partners, and worked operational EW and radio frequency (RF) spectrum issues from all domains for the wars in Iraq and Afghanistan. Now, at the Joint EW Center (JEWC) working on the "EW Functional Solutions Analysis," Wayne has worked the gaps in EW capability and gained valuable insight into "the realm of the possible" from government and industry just before retirement.

Linda Palmer

Linda retired from the US Air Force as Assistant Deputy for Test at the Missile Defense Agency in Washington, DC. She served as engineer and manager for space defense, air-to-air weapons evaluation and other acquisition, test and international programs. She taught Astronautical Engineering at the US Air Force Academy. Linda initiated a distributed data system to share Measurement and Signature Intelligence (MASINT) information. She commanded the US Air Force EW Evaluation Simulator (AFEWES), oversaw the transition of the Real-time Electromagnetic Digitally Controlled Analyzer and Processor (REDCAP) from New York to California and served as the Research & Development Liaison Officer in Paris, France. She managed the Foreign Comparative Testing program and set up the Defense Acquisition Challenge program for the US Office of the Secretary of Defense (OSD). Linda currently works for COLSA Corporation in Huntsville, AL, and built laboratories for payload integration and sensor data fusion for the US Army.

Linda joined the AOC in 1994, and has been a member of four chapters in the United States and Europe. She served in the Ft. Worth Chapter as program chair and in the Capitol Club as secretary, vice president and president, and was named Capitol Club Professional of the Year. She has spoken at international EW and test conferences. She has led the National Awards program for the last three years, working with the AOC staff to streamline the process and decrease costs. She hopes to continue representing and recognizing the contributions of the membership at the national level.

Cliff Moody

Cliff, a retired US Air Force Chief Master Sergeant, has more than 36 years of IO experience in industry and government. He served in several DOD and international association leadership positions, providing operational and technical guidance for technology development, operational demonstrations and systems acquisitions.

He has more than 20 years of experience leading developmental and operational test and evaluation (D/OT&E) teams on EW and IW systems. He served on several government and industrial association senior advisory panels as an EW and IW representative for Aircraft Survivability; EW Roadmap Development; Joint Suppression of Enemy Air Defenses (SEAD) Mission Needs; and Intelligence, Reconnaissance and Surveillance (ISR) Analysis Studies.

Cliff has an extensive background in all facets of EW and signals intelligence (SIGINT). He currently is the executive director of ManTech Real-Time Systems Laboratory, ManTech SRS, Space and Intelligence, a division of ManTech International Corporation.

Kent Shin

Kent is the regional manager for ITT Electronic Systems, Integrated EW Systems, Dayton Field Office. His primary responsibility is business development for US Air Force and international EW programs.

Prior to his transition to ITT in 2007, he served as an active duty US Air Force officer, retiring as a Lieutenant Colonel. He was a EWO logging more than 2,500 total hours in the MC-130E Combat Talon I, MC-130H Combat Talon II, F-16D and the RC-12 "Horned Owl."

In 2004, he was the RC-12 unit commander in Operation Iraqi Freedom, leading the unit to fly more than 300 combat missions, and was credited with finding 18 IEDs and several IED weapon caches. He was awarded a Bronze Star and four Air Medals for this mission. Upon his return to the Pentagon, he also served as an action officer for the Secretary of the US Air Force, Dr. James G. Roche. He earned a master's of science degree in electrical engineering from the University of New Mexico in 1996, and a bachelor's of science degree in electrical engineering from the US Air Force Academy in 1986. He has been a member of the AOC since 1987, and an active member in the Eglin, Querque, Silver State, Capitol Club and Kittyhawk AOC Chapters.

He is married to the Reverend Kelley Wehmeyer Shin, a Presbyterian minister, and they live in Centerville, OH. They have three children, Darren, Matthew and Rosemary. Kent is an avid golfer. He also enjoys classical music and is a violinist in the Miami Valley Symphony Orchestra.

Paul "PJ" Westcott

Paul has more than 40 years in the EW community. He has been on the national AOC Board of Directors for more than 20 years and stepped down in 2007 due to term limits. Paul is anxious to re-engage in national AOC EW and IO advocacy and furthering the goals of the association. Paul currently is the director of engineering at the Dayton Operation for Mercer Engineering Research Center (MERC). He was a senior member of the technical staff for SAIC from 2003 to 2007.

Prior to his retirement from the US Air Force Research Laboratory (AFRL) with 36 years of service, his last position was the Division Chief of the Sensor Applications and Demonstrations Division in the Sensors Directorate (AFRL/SNZ). Paul is a life member of the AOC and recipient of the National AOC Lifetime Achievement Award (1999), Silver Medal (1997), Distinguished Service Award (2003) and AOC Technology Hall of Fame.

Paul is a frequent speaker and master of ceremonies for many local, regional and national defense electronics events. He holds a bachelor's degree in electrical engineering from the University of Detroit and master's degrees in engineering management and business administration from the University of Dayton.

Lawrence Kingsley

Larry was commissioned out of Utah State University in 1977. His first assignment was to Whiteman AFB, MO, where he was a ICBM Crew Commander. In 1988, his first squadron was the Component Repair Squadron. In his second squadron, he took command of all A-10 and F-16 flight-line maintenance with the Aircraft Generation Squadron at Eielson AFB, AK. Selected for his third squadron in 1994 at Incirlik, Turkey, he ran theater logistics operations. In 1995, he was selected to be Chief of Aircraft Maintenance on the HQ staff for US Air Forces in Europe.

Personally selected by the Oklahoma City Air Logistics Commander in 1998, Larry took command of his fourth squadron, an elite maintenance squadron deployed worldwide. He moved back to Alaska as the Deputy Logistics Group Commander and in 2001, he took command of the Logistics Group and then the Maintenance Group at Incirlik, Turkey. After 9/11, he directed all maintenance activities for more than 10 units with combat in Afghanistan and Iraq. He continued in this combat role through 2003, when he was relieved and took command of the Reserve Officers' Training Corps (ROTC) detachment at Brigham Young University in Provo, UT. It was in 2006 that Larry was selected as vice director of the Combat Sustainment Wing at Warner Robins, GA, where he retired with more than 30 years of active service. He now is a program manager for BAE Systems. He is married to the former Cynthia Beacham and they have seven sons and three daughters.

Matthew Smith-Meck

Matt is a 20-year veteran of the US Marine Corps, having attained the rank of lieutenant colonel before retiring in March 2006. Primarily an EA-6B Prowler Electronic Counter Measures Officer (ECMO) by specialty, Matt is a veteran of Desert Shield and Desert Storm, the Bosnia Campaign, Operation Enduring Freedom and Operation Iraqi Freedom. A Weapons and Tactics Instructor (WTI), he served as both the EA-6B Division Head and EW Specialist while assigned to Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) aboard Marine Corps Air Station Yuma, AZ, from 1992 to 1996. Upon completing this tour of duty, Matt served as Maintenance and Operations Officer of VMAQ-4 and 3, respectively, from 1996 to 1998. He went on to serve as the Marine Air Group Fourteen (MAG-14) EA-6B Requirements Officer.

In 1998, he served as the Deputy Program Manager for USMC Programs in PMA-272 at NAVAIR, advocating for and advancing Rotorcraft Aircraft Self-Protection Equipment (ASE), something that would become a life passion for him. In early 2002, Matt returned to MAWTS-1 to serve as both the Operations and Executive Officer. In late 2003, he served as the Joint Strike Fighter Joint Program Officer USMC Requirements Officer. After retiring from the Marines, Matt took a position at Northrop Grumman, serving as Director for Business Development at the company's Rolling Meadows, IL, facility. Currently, Matt is a consultant for NAVAIR/PMA-272 on Rotorcraft ASE and Stability and Reconstruction efforts for Enterra Solutions. Matt is an incumbent At-Large Director for the AOC.

CANDIDATE FOR CENTRAL REGION DIRECTOR
VOTE FOR ONE

Judy Westerheide

For the past nine years, Judith has been employed as a Facility Security Officer (FSO) for Defense Research Associates Inc. in Beavercreek, OH, and has acquired numerous training certificates in the security field. Judy has more than 30 years of leadership/management experience in marketing/engineering operations at Enterprise Engineering Inc., Litton Guidance and Control Systems and Systems Research Laboratories. An active AOC member since 1977, Judy has a passion to improve AOC processes and procedures and consistently raise scholarship funds and grant them to young "Best and Brightest" engineering students in the Central Region. She was a member of the Kittyhawk Board of Directors as director of the Scholarship Program. During the past 32 years as a member of the association, Judy has organized, led and participated in chapter events and membership drives. She is chairperson of the 2009 Kittyhawk Christmas Dinner/Dance.

Judy is an instrument-rated pilot and member of the 99s Association of Women Pilots and owner of 1976 Cessna aircraft.

Judy has been educated at Wright State University in Fairborn, OH, and Sinclair Community College in Dayton, OH, with numerous certifications in business, management and leadership development courses.

CANDIDATES FOR MID-ATLANTIC DIRECTOR
VOTE FOR ONE

Bennett Hart

Mr. Hart joined QinetiQ North America in 2007 as vice president of Technology Solutions Group and works across the three business groups to enhance end-to-end technology solutions to the DOD and intelligence community. He has more than 40 years of defense and intelligence experience with 17-plus years in the Senior Executive Service that include the Joint IED Defeat Organization (JIEDDO) and Counter IED Operations Integration Center, the National Reconnaissance Office, the Defense Intelligence Agency, DCI TF, OASD/C3I, US Army PEO C3S and the US Army Intelligence Agency. He was an experienced SIGINT/EW officer and commanded the 314th USASA Battalion, served at the National Security Agency (NSA) and graduated from NSA's Military Officer Cryptologic Career Course. He is a past secretary of the Capitol Club, AOC.

Bennett states, "I am a strong advocate of the EW/cyber/IO capability and believe it is as necessary today as never before. I believe adversaries and potential adversaries see this as an inexpensive/asymmetric way to confront, disrupt or attack the United States' infrastructure, military, government, industry, business and academic institutions. I believe that the Association of Old Crows does and should continue to support the development of technical capabilities, the education of our officials and citizenry, the training of our operators and analysts and the use of forums at the national and 'roost' levels to promote professionalism and inform our large constituency. I would like to have the ability to help further these aims and goals by actively serving our association and the people in it."

William "Bill" Tanner

Bill is with BAE Systems as the Director for Army Requirements and Army Systems at the Pentagon in Arlington, VA. In this position, he works closely with the company's lines of business to provide expertise regarding customer emerging requirements, technology development and competitive responses to critical US Army requirements. His subject matter expertise includes Army Aviation, EW, IO and Space Operations. Previous to this assignment, he served as a senior analyst at the Army G-3/5/7 HQDA, EW Division, at the Pentagon in Arlington, VA.

Prior to joining BAE Systems, Bill served 25 years in the US Army as an Army Aviator. He served in a variety of command and staff positions that included tours with the 1st Armored Division, 101st Airborne Division, 2nd Infantry Division in Korea, 9th Infantry Division, 82nd Airborne Division, 7th Special Forces Group, 17th Aviation Brigade in Korea and Apache Training Brigade in Ft. Hood. Later assignments included Chief of Planning, US Army Space Command, in Colorado and Deputy IG, I Corps, in Ft. Lewis, WA. He received a bachelor's of science degree from Norwich University and a master's degree from Troy University. Military schools from which he graduated include Basic Infantry Course; Airborne, Ranger, Infantry Advanced Course; Army Rotary Wing Course; Special Forces Qualification Course; Space Fundamentals Course; and the Army Command and General Staff College.

As the AOC conference development coordinator, Bill was instrumental in bringing the US Army EW and IO communities into the AOC.

CANDIDATES FOR PACIFIC REGION DIRECTOR

VOTE FOR ONE

Joseph "JJ" Johnson

Joe completed the US Air Force EWO School in 1989 and has been an avid Old Crow ever since. He has more than 20 years of US Air Force operational and staff experience on a variety of platforms spanning the end of the Cold War to transformational non-kinetic weapons in the Global War on Terror (GWOT). His experience includes duties as a Tomahawk Ground Launched Cruise Missile (GLCM) Launch Officer, F-111F Weapon Systems Officer and two tours flying the US Navy's EA-6B Prowler as an ECMO. He served as the ACC SEAD Requirements Officer and was the ACC lead in the watershed AEA Analysis of Alternatives advocating Air Force and Joint Airpower needs. As the Air Force's EA-6B Unit Commander, he mentored his people to stardom in Operations Iraqi and Enduring Freedom embedded in US Navy Expeditionary EA-6B Squadrons.

Since leaving the US Air Force, he is the founder and president of AEA Inc., providing EW expertise and engineering services to commercial and government entities. He is a graduate of the US Air Force Academy, holds a master's degree and is a lifelong western US resident. He was elected to the AOC Board of Directors in 2006 as the Northern Pacific Regional Director and currently serves on the AOC's Membership and Awards Committees. He also is the AOC National Constitution Committee Chairman and a lifetime member of the AOC.

Vince Battaglia

An AOC industry life member and a participant in the EW community throughout his career, Vince has made numerous technical and leadership contributions to the EW/IO field. Starting as a design engineer and moving through various executive management positions, Vince has played a key role in the fielding of a number of very successful operational systems.

Vince has been an active member of a number of chapters, including the Metropolitan, Capital, Windy City, Golden Gate, Golden West and Greater Los Angeles Chapters, holding leadership positions in a number of them. Vince has participated in a number of key AOC functions, including studies, conferences and education, as well as the Awards and Membership Committees. Vince has led the AOC certification effort. Always an advocate of the organization and its membership, he has helped to establish new chapters and revitalize dormant ones.

The AOC has recognized Vince's contributions by presenting him with the Management Medal and the Life Achievement Award. He is a member of the Technology Hall of Fame and is chairman of the Technology and Education Committee. He currently is president of the Greater Los Angeles Chapter and director of the Southern Pacific Region.

As director of the integrated Pacific Region, Vince will provide his forthright leadership style to supporting the AOC's continued growth. His experience with the needs and issues facing small and large chapters will help the organization to serve the membership. His industry and military community recognition will assist the AOC in getting its message out.

2009 ON-LINE VOTING INSTRUCTIONS

Beginning July 1, you can visit the AOC homepage, www.crows.org, where you will see election information and a link to electionsonline.us, the independent vendor that will conduct the on-line election. Once into the electionsonline.us website, type in your AOC member number and password. The website will direct you to your ballot, where you can make your selections. If you have not registered on the AOC website, you need to use your membership number and "crows" as the password. Your membership number can be found on the mailing label of your copy of *JED*, your membership card or you may call AOC headquarters for assistance. Your dues must be current as of May 15 to vote. If your membership has lapsed, you may call the AOC to have your access to the election activated once your dues are paid.

As with past AOC elections, your ballot is secret. No one at the AOC (members, directors or headquarters staff) will be able to access completed ballots during or after the elections. Electionsonline.us will hold all completed ballots, tabulate them and send the results to the AOC when the election is complete. Once you have cast your on-line vote, electionsonline.us will send you an email confirming that it has received your completed ballot. Providing your e-mail address is not essential for voting, but it is necessary in order to receive e-mail confirmation that your vote was processed.

PAPER BALLOTS

For those AOC members who do not want to vote on-line, the AOC will provide paper ballots and election guides upon request. Members who prefer to vote via paper ballot may request to do so by submitting a Ballot Request Form no later than June 15, 2009. The AOC will then send out paper ballots to those members July 1. As the election authenticator, electionsonline.us will open your ballot and enter your votes into the computer. To avoid any chance of a member being able to vote more than one time, you may not vote on-line once you have requested and have been sent a paper ballot.

AOC MEMBERSHIP APPLICATION

FIRST	*MI*	*LAST*	*RANK/TITLE*
MAILING ADDRESS:			
CITY	*STATE*	*ZIP CODE*	*COUNTRY*
TELEPHONE		*FAX (OPTIONAL)*	
EMAIL			

PAYMENT INFORMATION (Make checks payable to: Association of Old Crows)

❑ *1yr $45*	❑ *3yr $115*	❑ *LIFE $500*	❑ *STUDENT $15*	❑ *RETIRED $15*
AOC EDUCATIONAL FOUNDATION DONATION $______________________				
Payment (US dollars only) Check One: ❑ *Check enclosed* ❑ *Visa* ❑ *MasterCard* ❑ *American Express*				
Credit Card Number ____			*Expiration Date _____________*	
Please Sign____ Date________________________				
Recruited By				

❑ Check here if you would like to be a part of the Information Operations Institute (IOI): The IO Institute is a department of the Association of Old Crows chartered by the AOC Board of Directors to give members of the IO community an opportunity to exchange ideas and keep informed about current and discrete developments in the field of Information Operations.

EMPLOYER TYPE ❑

1. Army
2. Navy
3. Coast Guard
4. Marines
5. Air Force
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7. Government Non-DoD
8. Industry
9. Education
10. Other

PRINCIPAL JOB FUNCTION ❑

1. Management Corp.
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4. Operations
5. Marketing
6. Data Processing
7. Procurement
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9. Engineering Support
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11. Testing
12. Other

PRODUCT/SERVICE/APPLICATION ❑

1. EW/C2W
2. Avionics
3. Intelligence
4. C3
5. Computers
6. Electronics
7. Electro-Optics
8. Communications
9. Test/Diag.
10. Logistics
11. Consultant
12. Components
13. Space Applications
14. Radar
15. Directed Energy
16. IO
17. Other

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Sign up now to become an industry or institute/university member and receive a discount on exhibit space at the AOC National Convention in Washington, DC. Exhibit space is selling quickly. For more information on industry membership visit our website at www.crows.org or contact Glorianne O'Neilin at oneilin@crows.org or (703) 549-1600.

AOC INDUSTRY OR INSTITUTE/UNIVERSITY MEMBER BENEFITS

- Opportunity to designate key employees for AOC membership
- Reduced rates for exhibit space at the AOC National Convention
- Free organization narrative annually in the *Journal of Electronic Defense (JED)*
- Names of industry members will appear in each issue of *JED*
- Sponsored members receive discount for courses, and technical symposia
- Strengthened industry/association/government coalition
- Nonpartisan government relations
- Highly ethical forum for free exchange of information
- Expanded participation in professional activities
- Valuable professional contacts.

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(Company size determines fee except for sustaining members)

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MEDIUM (50-399 Employees)	$1,000	15
SMALL (10-49 Employees)	$500	10
CONSULTANT (1-9 Employees)	$300	5

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