AUGUST 2017

Military & Aerospace Electronics

ENABLING TECHNOLOGIES FOR NATIONAL DEFENSE

Armored combat vehicles

U.S. military leaders seek to upgrade fleet of ground combat vehicles. PAGE 4

Night-vision devices

Enhancements in size, weight, and power consumption bring night vision to nearly every warfighter. PAGE 20

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Electronic warfare evolution

U.S. military feels pressure to keep its technological lead in a never-ending battle for the electromagnetic spectrum. PAGE 10

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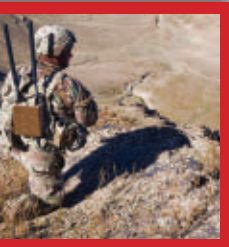

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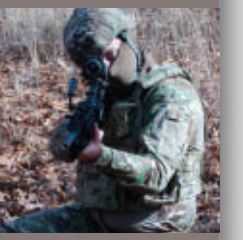
Electronic warfare evolves to meet new threats

U.S. military feels pressure to keep its technological lead in a never-ending battle for the electromagnetic spectrum.



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BY **JOHN KELLER**, EDITOR IN CHIEF

Growth seen in rad-hard and small sat markets for space electronics

Demand for radiation-hardened electronics for space applications continues to grow, with opportunities in traditional rad-hard spacecraft and radiation-tolerant small satellites.

Electronic component suppliers for space applications find themselves serving two distinctly different market segments today, company officials said last month at the IEEE Nuclear and Space Radiation Effects Conference in New Orleans.

The first rad-hard market segment is the traditional QML-V, in which components are designed from the ground-up for long-term resistance to the effects of the radiation environment of space. The second segment revolves around so-called "small sats" and "cube sats" that can use commercial-grade components. It involves relatively inexpensive satellites expected to last in space for no more than three to five years — sometimes even less.

The traditional rad-hard market deals in expensive components made in small numbers, that are expected to operate reliably for years or decades in orbit or in deep space. The small sat market deals largely in commercial off-the-shelf (COTS) parts upscreened for extra reliability that are expected to operate reliably for months to as long as five years.

"We see a segmentation of the market — even a new market," says Javier Valle, aerospace systems engineer for high-reliability products at Texas Instruments Inc. in Dallas. "It's not fair to compare these market segments because of scale. We are talking thousands of parts vs. hundreds of parts."

Both segments are growing — the traditional market is in a cyclic upswing, while the small sat market is increasing due to shrinking launch costs from commercial space companies and growing demand for small sats for applications ranging from Earth observation to space-based communications and networking.

"Small sats is an exciting area, but there are radiation effects that designers need to be concerned with," says Andrew Popp, space products marketing manager at International Rectifier HiRel Products Inc., an Infineon Technologies company in El Segundo, Calif.

Some small sat applications are expected to operate reliably for relatively short durations and are little concerned with long-term reliability. Still, those serving this market are starting to think about pushing the limits of reliability using upscreened COTS parts and subsystems designed for radiation environments.

One approach involves using at least one traditional radiation-hardened chip among many COTS components, designed for long-term space radiation, which can monitor the performance of other onboard components and subsystems.

"Small sats and constellations are growth areas," says Popp. "The traditional market is constant, cyclical but stable." He also points out potential growth in the traditional rad-hard market from India, Russia, China, and "anyone building satellites."

It's unlikely the traditional rad-hard space market will slow significantly in the long term, says Josh Broline, strategic marketing manager for mil/aero products at Intersil Corp., a Renesas company in Palm Bay, Fla. "In the high-rel traditional market, the growth is good; there's still a lot of interest in rad-hard." The small sat market "is all very interesting. Low cost is required, but there is volume to back it up."

Designers are getting smarter about using COTS and rad-hard designs for small sats, and are likely to continue pushing the limits of reliability with a mix of approaches.

"People are becoming more comfortable with how to produce and use the small sats," says Anthony Wilson, applications and radiation assurance engineer at Cobham Semiconductor Solutions in Colorado Springs, Colo. Down the road small sat designers may be able to take over some of the spacecraft tasks handled today by traditional rad-hard designs.

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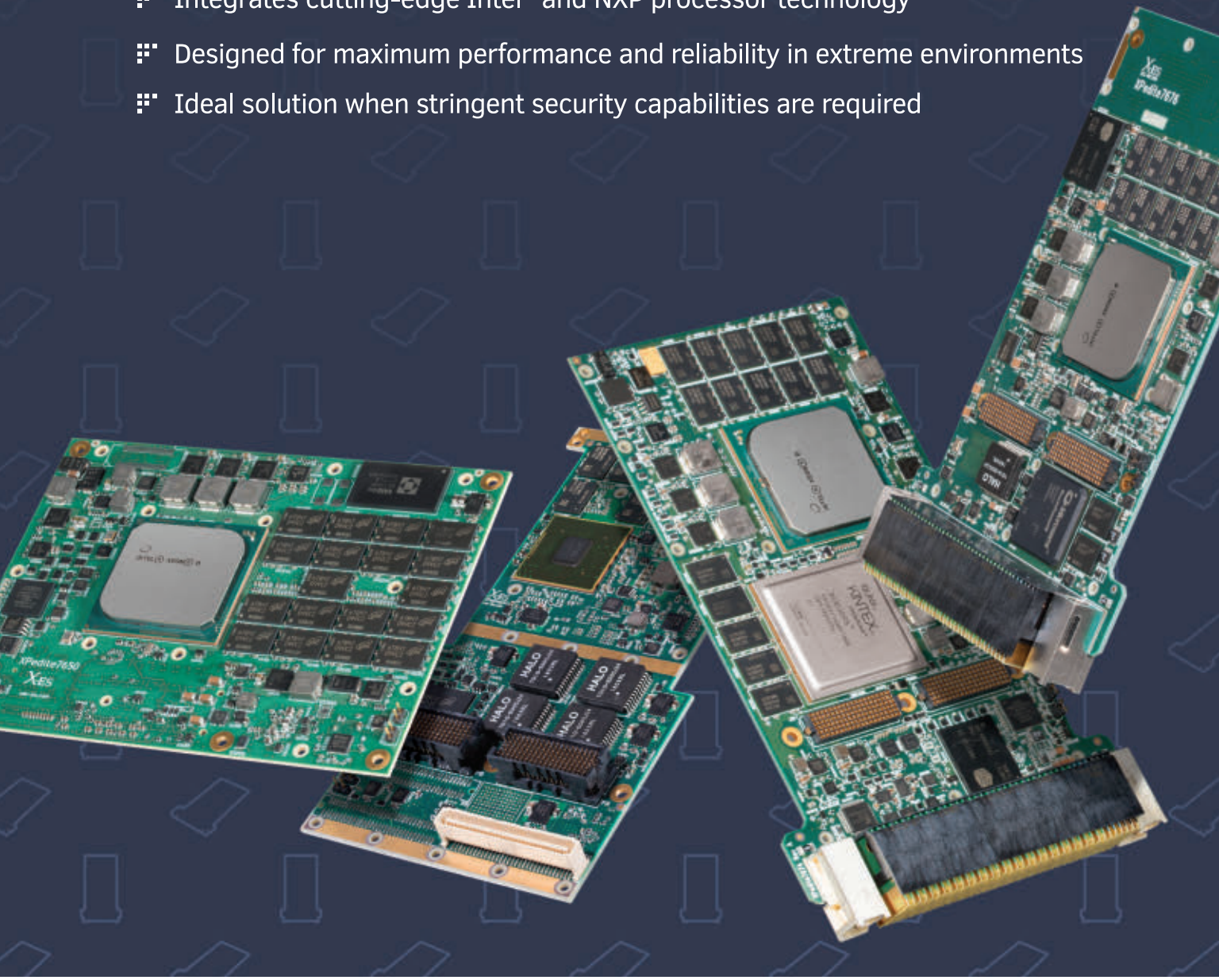

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news

Pentagon to hike spending for military armored combat vehicles

BY JOHN KELLER

WASHINGTON — U.S. military leaders are asking congress for additional money to pay for new armored combat vehicles, upgrades to existing military vehicles, and research into new combat vehicles, vetronics, and enabling technologies.

- Army Paladin Integrated Management (PIM);
- Army Family of Medium Tactical Vehicles (FMTV);
- Army Stryker; and
- Marine Corps Amphibious Combat Vehicle (ACV).

The U.S. Department of Defense (DOD) fiscal 2018 budget request to Congress proposes $4.5 billion for combat vehicle procurement and research, which is up 18.6 percent from 2017 levels of $3.8 billion for the same programs, which include the:

- Joint Light Tactical Vehicle (JLTV);
- Army Armored Multi-Purpose Vehicle (AMPV);
- Army Family of Heavy Tactical Vehicles (FHTV);
- Army M1 Abrams main battle tank;

Of all these armored combat vehicle programs, the big winner in the 2018 DOD budget, surprisingly, is the Army M1 Abrams tank from General Dynamics Land Systems in Sterling Heights, Mich. The DOD is asking Congress for $1.2 billion next year to upgrade this battlefield behemoth, which has been in service since 1980. This represents a 35.1 percent increase from 2017 M1 Abrams spending of $898.7 million.

For next year, Army leaders want to spend $1.1 billion in procurement

IN BRIEF

Air Force orders 36 MQ-9 Reaper UAV attack drones from General Atomics

Unmanned aerial vehicle (UAV) designers at General Atomics in Poway, Calif., will provide the U.S. Air Force with 36 new MQ-9 Reaper attack drones under terms of a $400 million contract. The armed Reaper UAVs are variations of the General Atomics MQ-1 Predator UAV. The latest version of the Reaper — the MQ-9 Block 5 — is designed for surveillance and attack missions using a suite of airborne sensors and the AGM-114 Hellfire air-to-ground missile. General Atomics refers to the Reaper Block 5 as the Predator B, which has been in production since 2013. Users are the U.S. Air Force and the British Royal Air Force. Other MQ-9 Reaper users are France, Italy, The Netherlands, and Spain. Compared to the MQ-9 Reaper Block 1 models, the Reaper Block 5 has increased electrical power, secure communications, auto land, increased gross takeoff weight, weapons growth, and streamlined payload integration capabilities.

Northrop to install Leonardo radar on MQ-8C unmanned helicopters

Military unmanned aerial vehicle (UAV) experts at Northrop

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and $198.6 million in research for M1 Abrams tank upgrades, which include reducing size, weight, and power consumption (SWaP) and adding protection against improvised explosive devices (IEDs).

Additional planned Abrams tank improvements include: sensor upgrades and the convergence of several tank round capabilities into a multi-purpose round.

The Army next year also plans to upgrade 56 legacy M1A1 tanks to the M1A3 SEP v3 variant, and proceeding with M1 upgrades that include adding the:

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IN BRIEF

Grumman Corp. will install a sophisticated surface-search radar system on the U.S. Navy's fleet of MQ-8C Fire Scout shipboard unmanned helicopters. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $32.9 million order to the Northrop Grumman Aerospace Systems segment in San Diego to install the AN/ZPY-8 Osprey MM radar from Leonardo MW Ltd. in Edinburgh, Scotland, aboard the Navy MQ-8C fleet. Northrop Grumman is the designer and systems integrator of the MQ-8C Fire Scout, an unmanned version of the Bell 407 helicopter from Bell Helicopter, a Textron Inc. company in Fort Worth, Texas. The manned version of the Bell 407 seats seven, can carry a useful load of 2,347 pounds, flies as fast as 140 knots, and has a range of 324 nautical miles.

Pentagon to trim military spending for electronics and CET&I

U.S. military spending in substantial electronics accounts is set for slight reductions next year as trims are expected for procurement and research in military communications, electronics, telecommunications, and intelligence (CET&I) technologies. The U.S. Department of Defense (DOD) is asking Congress for $12.5 billion

IN BRIEF

for CET&I procurement and research in the fiscal 2018 proposed DOD budget, which is down by $535.1 million, or 4.1 percent, over 2017 levels. These accounts contained $15.1 billion as recently as fiscal 2012. The DOD request for CET&I procurement and research does not include military activities with substantial electronics content, such as aircraft avionics, vetronics, and missile guidance. When these additional DOD electronics-heavy accounts are added, Pentagon spending levels for military electronics and defense electro-optics next year could approach $90 billion, industry analysts say.

Raytheon to provide secure IFF avionics to safeguard military aircraft

The Raytheon Co. will provide the U.S. Air Force with secure identification friend-or-foe (IFF) equipment under terms of a $42.8 million contract. Officials of the Air Force Life Cycle Management Center at Joint-Base San Antonio, Texas, are asking the Raytheon Space and Airborne Systems segment in Aberdeen, Md., to provide KIV-77 Mode 4/5 cryptographic applique production. The KIV-77 Mode 4/5 crypto applique computers provide secure cryptographic capability for Air Force IFF gear to provide the warfighter with the latest

- Ammunition Data Link (ADL) to enabling firing the Army's new smart 120-millimeter ammunition;
- low-profile Commander's Remote Operating Weapon Station (CROWS); and
- Active Protection System.

Another big winner in the 2018 combat vehicle budget is the Joint Light Tactical Vehicle for the Army and Marine Corps. DOD is budgeting $1.1 billion next year to buy 2,777 JLTVs from prime contractor Oshkosh Defense in Oshkosh, Wis. This is a 47.3 percent

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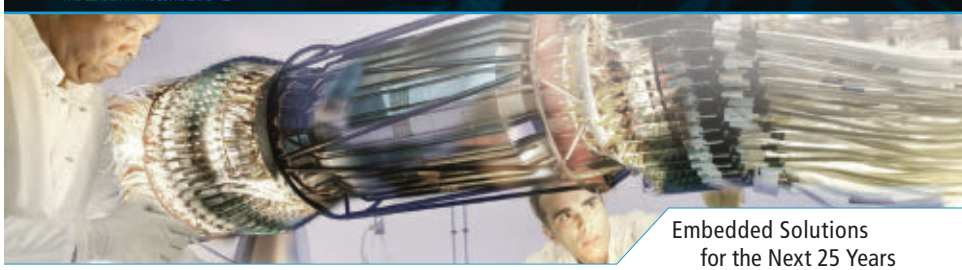

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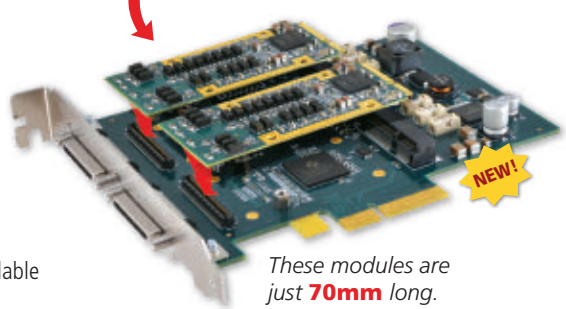

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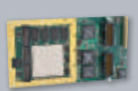
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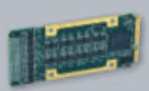
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technology in secure air, land, and surface combat-identification capability. IFF equipment aboard military aircraft sends a secret transponder code to help air traffic controllers, military radar operators, and missile crews tell the difference between U.S. and allied aircraft and those of potentially hostile forces. Without secure IFF capability, adversaries might be able to spoof sensors to evade surveillance and air-defense networks, or stage attack raids unmolested.

Lockheed Martin to provide smart munitions for allied GMLRS artillery

Lockheed Martin Corp. is building thousands of smart munitions for the Guided Multiple Launch Rocket System (GMLRS) field artillery for the militaries of Finland, France, Germany, and Singapore under terms of $471.7 million contract. Lockheed Martin will build 2,868 alternative-warhead GMLRS rockets, and 648 unitary-warhead GMLRS rockets. The GMLRS can fire guided and unguided projectiles at targets as far away as 26 miles. The system also can fire the Army Tactical Missile System (ATACMS) at targets as far away as 190 miles. The rocket-based artillery system also can fire its munitions quickly and the move away

increase from 2017 levels of $775.8 million.

Other JLTV research and procurement money in 2018 will pay for:

- full-up system level testing,
- multi-service operational test and evaluation,
- JLTV automatic fire extinguishing system test, and
- command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) testing.

Heavy artillery systems also are receiving substantial attention in the 2018 DOD budget.

The Army is asking for $778.2 million next year for the Paladin Integrated Management (PIM) program to upgrade obsolete parts and subsystems in the M109A6 Paladin 155-millimeter self-propelled howitzer and its companion M992A2 Field Artillery Ammunition Support Vehicles (FAASV). This is a 22.4 percent increase to the 2017 PIM funding level of $636 million.

The PIM program seeks to address weight and power concerns in the Paladin and FAASV combat vehicles, end ensures sustainment of the M109 family of artillery vehicles through 2050. It replaces the current Paladin and FAASV with a more robust platform that incorporates the M2 Bradley Fighting Vehicle common drive train and suspension. 2018 funding also will pay for 71 new PIM artillery systems. The PIM contractor is the BAE Systems Platforms and Services segment in York, Pa.

The Army's Armored Multi-Purpose Vehicle (AMPV) program to replace the M113 armored personnel carrier is budgeted at $674.4 million next year, which is more than triple 2017 AMPV funding levels of $184.2 million.

The AMPV will have five mission roles: general purpose, medical treatment, medical evacuation, mortar carrier, and mission command. The program integrates the current M113 mission equipment package onto a new Bradley Fighting Vehicle chassis to enable Army brigade combat teams to move quickly on the battlefield.

Fiscal 2018 AMPV funding would pay for 107 new AMPVs, as well as for AMPV test prototypes. The AMPV builder is the BAE Systems Platforms and Services segment in York, Pa.

The Marine Corps Future Amphibious Combat Vehicle (ACV) will see a major increase in research funding next year, as the 2018 DOD budget contains $340.5 million for this program — more than double 2017 funding levels of $158.7 million.

The ACV program will replace the Marine Corps ageing Amphibious Assault Vehicle, and will provide an armored personnel carrier that can swim through the ocean and drive onto assault beaches. Fiscal 2018 funding would pay for building 26 ACVs and four ACV test vehicles. The builder is BAE Systems Platforms and Services.

The Army's Family of Heavy Tactical Vehicles (FHTV) program, consisting of the Heavy Expanded Mobility Tactical Truck (HEMTT) and Palletized Load System (PLS) from Oshkosh Defense, is set to receive $118 million next year, more than double 2017 funding of $57.1 million.

The Army plans to buy 621 FHTV vehicles next year, as well

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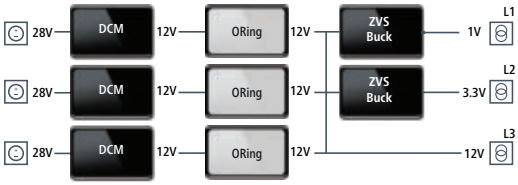

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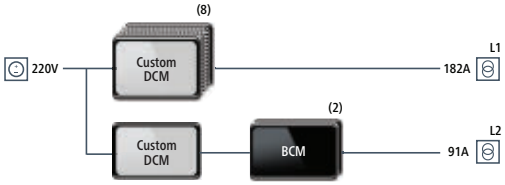

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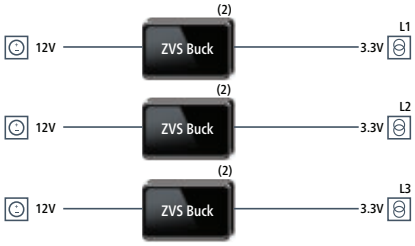

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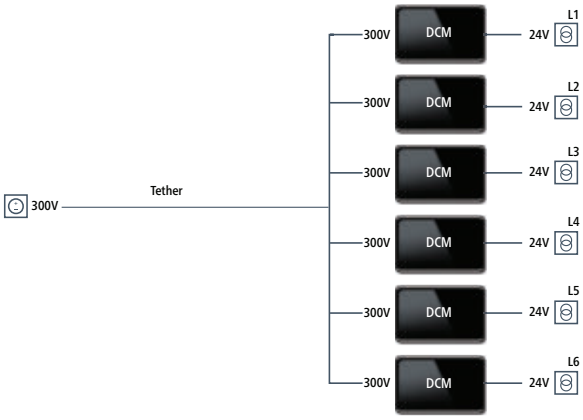

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as trailers to modernize the heavy tactical vehicles fleet for Army, National Guard, and Reserve units.

The Army's mature Family of Medium Tactical Vehicles (FMTV) program will see a substantial funding cut next year as the Army nears filling its FMTV fleet. It is a family of diesel-powered 2.5- and 5-ton trucks that handle battlefield cargo, wrecker, tractor, and air-drop missions.

The 2018 budget has $84.7 million to pay for 37 new trucks, which is down 76 percent from 2017 levels of $352.8 million for 1,252 new trucks this year. The FMTV builder is Oshkosh Defense.

Also set for a funding cut is the Army's Stryker family of armored vehicles, which has a 2018 budget of $178.2 million — down nearly 76 percent from 2017 levels of $735.5 million. Stryker is a 19-ton air-deployable wheeled armored vehicle for reconnaissance, anti-tank missile, medical evacuation, fire support, mortar carrier, and command missions.

The vehicle has been in service since 2002. Funding for 2018 would pay for lethality upgrades, general modernization, and fleetwide upgrades to the Stryker's C4ISR systems, adding a 30-millimeter weapon, and obsolescence mitigation. The Stryker builder is General Dynamics Land Systems. ←

IN BRIEF

to avoid counter-battery fire. The system's alternative-warhead rocket is a large airburst fragmentation warhead that explodes about 30 feet over a target area to disperse solid-metal penetrating projectiles to destroy enemy soldiers, armored vehicles, command posts, and other battlefield targets. Its unitary-warhead rocket is a GPS-guided munition with a 200-pound, high-explosive warhead that can be used on open battlefields and in urban areas. Its guidance system enables the rocket to avoid causing collateral damage, and enables GMLRS crews to fire fewer rockets. ←

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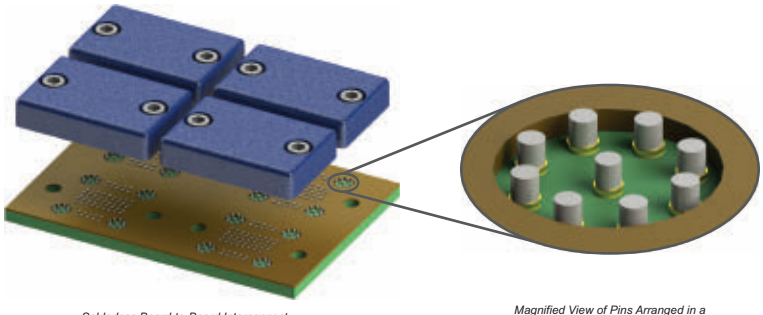

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Electronic warfare evolves to meet new threats

U.S. military feels pressure to keep its technological lead in a never-ending battle for the electromagnetic spectrum.

BY **J.R. Wilson**

"All war is based on deception." — Sun Tzu

The weapons and technologies of war are constantly evolving — changing more rapidly year to year in the 21st Century than they did century to century when Chinese general Sun Tzu wrote *The Art of War* some 2,500 years ago. Yet Sun Tzu's writings remain central guidelines even today; the need to control the high ground is applicable to one of the most advanced and increasingly critical realms of modern combat: electronic warfare (EW).

"Spectrum dominance is the new high ground; all weapons systems today are highly reliant on communications of one sort or another, whether global positioning system (GPS) or internal communications. If someone can distort GPS or disable onboard systems, you're toast," says Bob Schena, CEO of Rajant Corp. in Malvern, Pa. "On a scale of 1 to 10, it's a 12. We are so reliant on communications in our style of fighting that it is absolutely critical and will get even more critical. If you're at a communications

Soldiers in the field are able to carry electronic countermeasure systems that fit into individual backpacks. This man-packable capability, such as the Sierra Nevada system the warfighter in this photo is carrying, can be configured to provide on-the-move EW defensive, offensive, and support operations for any deployed force worldwide. [Photo: Sierra Nevada Corp.]

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disadvantage, I don't see how you can last very long."

EW itself is changing as well, with the lines between EW, cyber warfare, and signals intelligence (SIGINT) tending to blur in the heat of battle.

"We call it Spectrum Operations, which touches every type of operation — combat, humanitarian, etc.," notes U.S. Marine Corps Col. Gregory Breazile, director of the Marine Corps Information Warfare Integration Division at Quantico Marine Base, Va. "Spectrum is a physical means we use to support our operations, from sensing adversaries to supporting our own operational capabilities. We debated whether to call it Spectrum Warfare, but that was determined to be somewhat limiting, while Spectrum Ops better covered it all.

"We've also debated about whether spectrum should be another domain of warfighting," Breazile continues. "When we talk about 5th generation warfare, it really is spectrum that is the physical means where we will deliver effects on the battlefield that are different from what we've done in the past. I think that debate will continue and in the future we may see spectrum declared an operational domain. Nothing we've done in the past will resemble what we will do employing EW in the future, using multifunctional capabilities for sensing, attack, and force protection."

A similar reconfiguration is underway in the U.S. Army, says Maj. Richard Michel, Cyber & EW Operations Troop Commander within the Army's Asymmetric Warfare Group (AWG) at Fort Meade, Md. "As a result of our better understanding of multi-domain battle and our use of EW, cyber, and space ops as they continue to evolve, we will continue to experience a more advanced and capable Army than has ever been seen in history," Michel says. "AWG's job is to look at the decision-making process, how that will change doctrine and organizations. New technologies give commanders better options on how to employ that capability. That is an inevitability and an absolute positive for the Army, with greater capabilities and technologies empowering us to accomplish our goals.

"The force today is drastically different from what it was 10 years ago. Advances in EW enable a commander to make decisions he never had 50 years ago. In the past, a commander may have had no choice but to allow an adversary to use a specific asset or to destroy that asset. EW gives that commander other options, such as degrading or disabling an asset for a period of time."

> "Just as water retains no constant shape, so in warfare there are no constant conditions. He who can modify his tactics in relation to his opponent and thereby succeed in winning may be called a heaven-born captain." — Sun Tzu

While others maintain EW is not, and probably never will be, declared a full and independent domain of war — joining air, land, sea, space, and cyber — Kent Snyder, vice president of Sierra Nevada Corp. in Sparks, Nev., says he has a different perspective.

"Going from an asymmetric fight and limited capability adversary in an austere environment to a peer or near-peer fight changes the paradigm. The EW fight now is being looked at in a more traditional sense of full-spectrum military operations, making it an integral part of how we fight, where before it was more an appended capability. EW is becoming as critical as a domain of battle as air, sea, and land and is gaining parity with those actual domains of battle," Snyder says.

"How EW will change the battlefield is growing and we must move as aggressively as possible to improve our fielded capabilities," Snyder continues. "The capability that is integrated into military forces worldwide will be the most relevant. With respect to EW, it is the military force spun up to integrate into its various formations that will provide a decisive advantage on the battlefield. Obviously Russia and China are the other key players, but there are a lot of others out there."

Some of the key technologies that are either already part of deployed EW capabilities, soon will be, or are targets include:

- digital signal processing;
- high-performance, small-form factor embedded computing;
- advanced algorithms;
- RF and microwave transceivers and components;
- electronics miniaturization;
- digitally programmable radar and communications;
- jammers and anti-jammers;
- GPS and companion/replacement location/navigation systems; and
- counter-measures to the counter-measures.

"We provide oversight over the acquisition of capabilities we

require. When we write requirements, we give them to the Marine Corps acquisition arm," Breazile explains. "As part of that process, we also are tied into the S&T [science and technology] world and communicate with industry so we understand what is out there. We want to be well-informed about future capabilities."

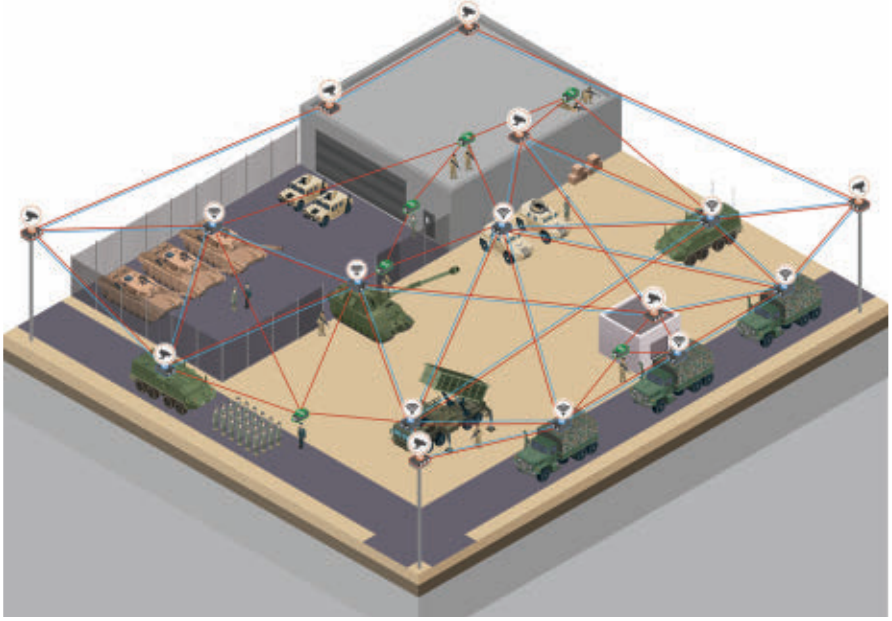
Gap-filling technologies

"We write joint concepts about the future operating environment and where we want to be in the next 10 years, keeping in mind where we think technology will lead us, then deconstruct that down to the capabilities required to operate in those future environments. Then we look to see where we have gaps and go to industry to find technologies to fill those gaps," Breazile says.

There are several similarities between the Marine Corps IWID and the Army's AWG, which was established in 2006 to enhance soldier survivability against the improvised explosive device (IED) threat in Southwest Asia. Today, the organization's primary focus is Cross-Domain Maneuver within Multi-Domain Battle, which replaced the Army's long-time Air-Land Battle approach. Yet the Army's Michel says technology is not AWG's true focus.

"AWG is involved in identifying threats regardless of source," Michel explains. "The operational environment we face today is certainly more complex than ever before in history. And as the environment changes, so do techniques and technologies. We bring that back to the Army for much larger strategic decisions on how the Army will counter those threats. AWG affects the tactical level, but informs the strategic level.

"Part of our solution development process is to make observations and



U.S. military bases are linking every individual, platform, office, and sensor into wireless communications networks. Overcoming the vulnerabilities of such systems has become a major task for the militaries growing cadre of electronic warfare researchers and warriors. (Drawing by Rajant Corp.)

SNC's software-definable electronic warfare and range instrumentation systems support man-portable, vehicular, fixed-site, and airborne applications with industry-leading size, weight and power (SWaP) solutions. [Photo: Sierra Nevada Corp.]

on-the-spot recommendations, but also bring those observations back to the Concepts and Integration Squadron within AWG, which thinks in broader terms about developing concepts to identify larger or better solutions, then how to take that to TRADOC [Training & Doctrine Command] or the Centers of Excellence with recommendations on how they might make changes to meet current or perceived threats."

They also assist with Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy — otherwise known as DOTMLPF-P.

"We're not just looking at equipment, but the personnel, the doctrine, the policies, the organization, and training facilities for EW to develop a rapid, capable solution. Identifying future threats is part of AWG's job — if this is the current threat, what recommendations do we have to counter that threat, then what will the enemy do to counter our counter?" Michel adds.

"We want to be proactive, not reactive. Given our current threat environment, the development of EW technologies is absolutely essential to the success of the Army in the future. But we're not solely dependent on changes in technology; we also rely on the adaptability of our soldiers. Technology is just a piece of that. If the EW capability exists in a way you've never experienced before, you will find new ways to use it," Michel says.

> "The clever combatant imposes his will on the enemy, but does not allow the enemy's will to be imposed on him." — Sun Tzu

"In defensive EW, you're trying to stop signals from affecting you; offensive EW is pushing your signals out to affect others," says Sierra Nevada's Snyder. "It's the same spectrum, just different applications of how you use the technology. With a true multifunction capability and simultaneity of effect, you can do both at the same time from the same device. EW is a critical win/no-win requirement. If you can maintain the integrity of your spectral capability and the enemy can't penetrate it, then you will dominate the battlefield."

For industry, technology is the key to developing advanced, cutting-edge EW capabilities, but they also must be cognizant of the military's multifaceted requirements — greatly improved size, weight, and power (SWaP), cross-service commonality, modularity, minimal training and maintenance, and the ability of EW systems to defend themselves against EW counter attacks.

Coming to the table in new or improved capabilities are several sensors on one platform; fast on-board processing of ever-growing amounts of raw data; onboard data fusion; command-and-control modules that can react to a new threat without waiting for ground station commands; longer unmanned aerial vehicle (UAV) ranges and loiter times; SWaP-C (SWaP plus cost) improvements at every level; and a close connection with commercial manufacturers to identify, adopt, and adapt new technologies for military applications.

As with nearly every other aspect of technology, the military has come to depend on all that is coming out of the commercial world, but put into extreme conditions, says Marc Couture, senior product manager for digital signal

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"In EW, you need to convert everything to ones and zeros with analog-to-digital converters. In terms of capturing the EM spectrum in an RF microwave sense, we have some products that capture data at 25 gigasamples per second, which is a huge amount and fairly unique," Couture says; 1 gigasample is one billion samples. "What's been very instrumental with the A/D converters is the speed of gigasamples per second is getting faster and faster and with greater resolution.

"With an EW system, then, you can keep an eye on more of the spectrum at the same time," Couture continues. "Ten years ago, technology would not have been able to pick out all the signals deep in the noise. But this also means the data becomes a bigger fire hose, so you will need multiple high-power processing to sort it all out."

The role of artificial intelligence

While advances in technology have occurred at a record pace in the past decade, experts say they will witness even greater speed and evolutionary technologies in the next decade and beyond that few can even partially predict. One that is on everyone's list, however, is artificial intelligence (AI), which is likely to play a major role in the future of EW.

"In the past in EW, you had a classified list of target signatures, but now there are more and more new threats and to counter some of them — especially if you are in theater in combat and seeing something for the first time — you have cognitive systems, a neural net AI, sometimes called deep learning or machine learning, to do this on the fly," Couture says. "It's in the toddler phase now, but these cognitive techniques will begin deploying in the next decade. This will require a lot more processing power than a decade ago. It used to be megaflops, now gigaflops, and becoming teraflops."

Today's processing challenge likely will require more than one kind of processing device, such as field-programmable gate arrays (FPGAs), general-purpose graphics processing units (GPGPUs), and advanced general-purpose processors (GPPs). "It will take a combination of two or more processors contributing what they do best to the EW technique," Couture says. "Everything also is getting faster, with multi-core processors and going from 10 to 40 to 100 gigabit Ethernet."

New techniques, such as swarming UAVs, are increasing the need for cognitive applications as a standard component of many, if not most, defense systems.

"When we think of technology advancing, we've tended to think of faster processors and GPUs with more cores, but while the underlying silicon enables a lot of advances, we are starting to code differently to enable far more sophisticated interconnected, correlated sensors," Couture says. "So it will be interesting to see what things look like in the next 10 to 20 years," he adds.

Adapting commercial off-the-shelf (COTS) technologies for secure military applications is, by itself, insufficient in today's evolving EW environment. More layers are required that neither interfere with, nor slow communications, across the wireless networks now linking all services and allied forces in the battlespace. An example of this is the small-form-factor Secure Wireless Command Post for forward operating bases from Pacific Star Communications Inc. (PacStar) in Portland, Ore.

PacStar's small-form-factor Secure Wireless Command Post enables high-performance Wi-Fi for warfighters in the field. The customizable and configurable technology is designed to meet NSA Commercial Solutions for Classified (CSfC) program requirements.

Secure command post

The Secure Wireless Command Post system, based on the PacStar 400-Series modular platform, meets U.S. National Security Agency (NSA) Commercial Solutions for Classified (CSfC) Campus WLAN Capability Package v2.0 requirements and is

customizable and configurable to meet other NSA CSfC capability package specifications.

End users have access to built-in commercial Wi-Fi on mobile devices to provide one layer of the required two-layer NSA encryption requirements, enabling warfighters to use commercial smartphones, tablet computers, and laptops to access classified information over Wi-Fi and LTE in deployed, expeditionary, and tactical environments.

"As computing gets more powerful and smaller, it has allowed the DOD to deploy more and more enterprise-class technology out to the network. But that can involve a huge system warfighters are not necessarily trained to use. So we integrate all those into a single system that is easier to use, burying a lot of enterprise items the warfighter doesn't need to interface with, but also making it easier for them to find and access those if they do need them," PacStar Chief Technology Officer Charlie Kawasaki explains.

"Through our management software, we automate and make simple the tasks that do need to be performed in the field and even cut across information technologies from different vendors, orchestrating the configuration under a single integrated user interface," Kawasaki says. "A rapidly deployable network infrastructure that is an enabler for any IP-based system at the edge of the battlespace, some of the components include an extensive implementation of wireless intrusion detection and prevention."

Part of the NSA requirement to field wireless is the ability to detect attacks over the Wi-Fi spectrum in a wide variety of forms, such as rogue access points and attempted connections into the infrastructure. Then the system must quarantine those potential threats, even flooding them with distributed denial-of-service (DDoS) attacks over the RF spectrum.

"As configured, our solution is not designed purposely as an offensive weapon; it is designed to maximally secure the system. But that isn't to say it can't be used for offense," Kawasaki adds. "If there is a proactive attempt to do something malicious to deny our forces access to a wireless network, then our system can take them down."

Evolving technologies

Future EW solutions also will take advantage of continuing evolutions in other technologies, especially the concept of deploying swarms of small UAVs linked across moving wireless mesh networks providing more than 100 megabits per second of usable bandwidth, UAV-to-UAV, enabling the sharing of fused sensor data, says Rajant Corp.'s Schena.

"We have a vision of applying our networking technology, which we already are doing to drone swarms, to create a wide-aperture lens over a battlespace that would allow the U.S. military to defeat an enemy's efforts in stealth technology," Schena says. "Our adversaries are moving quickly and investing as much in stealth as we have over the years. So while the U.S. hasn't had to face much stealth to date, it is coming. We are developing a technique to connect hundreds of drones and integrate hundreds of radar sets; we believe the analytics of that data will allow you to see

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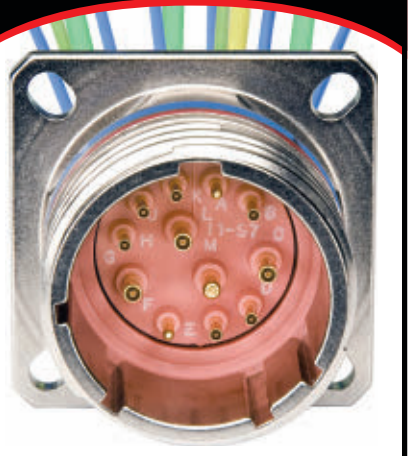

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The next step is to create a coherent radar lens across a wide part of the battlespace, says Rajant Hardware Design Engineer Dave Grund. "As we connect these drones, we can form a very large aperture radar, communicating all this information through our network, to enable us to see things no one else can today," he says. "We could connect a large number of [radar-equipped UAVs] together in real time and gain a much greater level of information from different angles for analysis."

Schena says such a system could have a great impact on defensive EW, eliminating most of the advantages the enemy hopes to gain through stealth.

"We have a partnership with Moorehead State University in Kentucky, which has one of only five space and engineering programs in the country and is part of the deep-space network. Its students hand-build cubesats as part of their education and our next-generation plan includes moving our OS to small-scale satellites," Schena says.

"Where that is a defensive EW capability, if an adversary takes a shot at our GPS satellites, we can respond with a rapidly launched swarm of meshed satellites as a replacement — very little latency, highly effective, node-switching on the ground, in the air, and in the future, in space.

Don Gilbreath, Rajant's vice president of systems, points out that SWaP has become even more critical with the increasing demands on fielded technologies like EW. It is another area where the commercial market has taken the research lead, but military contractors must adopt and adapt those developments to support the Pentagon's growing demands.

"The more we looked at increasing numbers of units swarming in the air, we started looking at co-processing," Schena says. "But in any denied GPS environment, without miniaturization, we could never get to the level of horsepower needed to deal with that. The big bottleneck is the power source. Batteries, in terms of power density, really haven't gotten better in 25 years," he says, adding that much of today's commercial development is occurring outside the U.S.

"At the semiconductor level, some of the top-level components come from countries that may not be militarily friendly to the U.S," Schena says. "If you look at products coming out of Asia in recent years, we're seeing more wearable electronics. We clearly are doing more in localized distributed processing because communications is a lot more expensive and spectrum is limited."

> "Secret operations are essential in war; upon them, the army relies to make its every move." — Sun Tzu

Ironically, while part of EW is the defense of classified information in the battlespace, other nations are using human and electronic spies to steal U.S. technology on a larger scale than perhaps at any other time in history. At the same time, most electronics are now being manufactured overseas. America's technology lead — with EW and other military systems — is in jeopardy.

"We're constantly surprised at what we find, both in the U.S. and internationally," Schena says. "We know our adversaries — even the biggest — are extremely sophisticated at stealing American technology, which greatly reduces the time gap between what we develop and when they match it. We still see a great deal of technology leadership in the U.S., but also growing capability globally and more and more theft of U.S. technology.

"With the resources available to us, both capital and human capital, we should be able to maintain our technology lead," Schena continues. "But our adversaries sometimes seem more focused on closing the gap than we are in maintaining it. In the past few decades, the U.S. has had such a profound lead in so many areas, especially the military, that we have come to believe that is the way it will always be."

Sierra Nevada Corp. has been one of the largest providers of small-form-factor EW technology across the DOD, with some 10,000 systems in the field, including the ALT-5 electronic RF countermeasure system, THOR II and III, and Baldr manpackable counter Radio-Controlled Improvised Explosive Device (RCIED) systems. Now they have made a significant departure from those legacy technologies with the Advanced EW System-Modular (AEWS-M).

"It is completely modular, mission-configurable, and all software-defined, ideally suited to provide offensive electronic attack, electronic defense, and electronic

Sierra Nevada's electronic warfare and range instrumentation systems protect the user against improvised explosive devices; provide counter unmanned aerial system; counter command, control, and communications; and create electromagnetic spectral awareness. [Photo: Sierra Nevada Corp.]

support capability, all within the same system. For example, counter-RCIED EW and counter-UAS," notes Sierra Nevada's Snyder.

"It is manpackable, but can be scaled up by adding auxiliary elements to connect to radar, additional amplifiers, and directional antennas, Snyder says. "This makes it a much more expandable capability, based on mission requirements. Because of its modularity, it also is ideally suited for vehicles or aircraft. The AEWS-M is already fielded and deployed worldwide, but I can't identify the customer."

Manpackable EW

The new AEWS-M's provenance also demonstrates a change in how industry is taking a more autonomous approach to evolving EW and related technologies through independent research and development (IRAD).

"This wasn't driven so much by government requirements as understanding the environment at large, so a lot of our work is done on IRAD, aligning with where the military is trying to go. They used to have a lot of set pieces providing a single function, which raised SWaP issues. Now you have to provide a capability that is adaptable to current and future environments to deal with all threats in the spectral domain," Snyder explains. "The spectrum is finite and contained for now, but you must have the ability to expand your frequency range going forward.

"You need a foundation in your architecture that allows continued expansion to maintain the relevancy of your technologies," Snyder says. "If you cannot quickly adapt to an adversary, you will not maintain relevance against the threat. That's why systems are becoming software-defined, to dynamically support program changes. You have to be spectrally aware and robust, so you're looking at as much relevant spectrum as possible to understand what is going on around you and adapt to it quickly."

That means moving from fixed architectures to more ad-hoc mesh capabilities. A primary part of the EW design is disruption of communications. For those architectures to stay alive, they must be self-healing and not so fragile that disrupting one part brings the whole network down.

"You need an amazing amount of resources and agility. Countermeasures are the trade space going forward, the key spaces. You don't necessarily focus on jammer versus jammer, but on my spectral integrity versus your spectral integrity, pairing EW capabilities against an adversary's spectrum. The enemy's jammer won't necessarily be defeated; you harden against it or find ways to mitigate its effects, but you don't build EW tech to squarely go against EW tech," Snyder says.

"You may have great weapons, but without vehicles to maneuver about the battlespace, you can't win. That also applies to EW," Snyder adds. "Not dominating the battlespace will reduce your communications capability, which, holistically, degrades your overall capability. Our tech is warfighter-focused and we are evolving it to meet what the warfighters need, when, where, and how they need it — a small-form-factor, multifunction, mission-configurable, system-of-systems EW design that can be used by an EW specialist, a cook, a scout, or anyone, which is critical at the edge of the battlefield." ←

The evolution of night-vision devices

Enhancements in size, weight, power consumption, and cost are bringing night-vision capability to nearly every warfighter on the front lines, with police, automotive, and commercial uses not far behind.

BY **John Keller**

The Leonardo DRS Joint Effects Targeting System (JETS), shown above, is a next-generation hand-held precision laser targeting system. It has day and thermal night-vision sights, celestial compass sensors, an eye-safe laser range-finder, and a digital magnetic compass.

Since the first Persian Gulf War in 1991, and even before, one of the U.S. military's most important goals has been to own the night with a broad range of night-vision devices that rely on technologies like infrared (IR) imaging and light intensification.

The early night-vision devices that enabled U.S. and allied forces to prevail in that first Gulf War more than a quarter-century ago were relatively heavy and bulky, and required substantial power sources to run them. Today it's different, and advances in the size, weight, power consumption, and cost (SWaP-C) of military night-vision devices are putting these sensors into the hands of a growing number of warfighters, and are helping to proliferate night-vision sensor technology into public safety applications, and hold promise for commercial, automotive, and medical applications in the near future.

"The key is the detector," says Adam DeAngelis, director of marketing for surveillance equipment at FLIR Systems in Wilsonville, Ore. "In the future these devices will be lighter in weight, and will save more power." At FLIR, researchers are making progress in reducing the pitch size of the sensor, which refers to the size of the individual detectors in the sensor array, DeAngelis explains.

FLIR Systems specializes in long-wave infrared sensors for thermal imaging, which detects light in wavelengths of 8 to 15 microns—outside the human eye's ability to perceive light. This kind of sensor typically detects the heat signature of objects against a cooler background.

"Size, weight, and power are at the forefront of everything we do here," says Darrell Hackler, senior director of global business development for the Harris Corp. Night Vision segment in Roanoke, Va. Harris Night Vision (formerly ITT and Exiles Night Vision) specializes in light-intensification technology for military night-vision goggles, night-vision monoculars, and night-vision weapon sights.

"If you go back in time and look at what night-vision devices started out to be and what they are today, it is a natural progression for things to be smaller, lighter, and offer a higher-performing product," Hackler says.

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Pitch and pixels

Perhaps the most important aspect of bringing down the size of today's night-vision devices is the size of the pixel in the sensor's detector array. "The volume of an imaging system is defined by how small and fine your pixel is," explains Tony Bacarella, vice president of dismounted systems at the Leonardo DRS Inc. Electro-Optical and Infrared Systems segment in Dallas.

"In the long-range uncooled IR detector area, most of our competition is going from a 17- to a 12-micron pixel," Bacarella says. "DRS has gone down to a 10-micron pixel. That is a 40-percent reduction in the image plane. The main thing is it drives the system's size and weight smaller; it all drives size and weight."

As the sizes of night-vision sensors have come down, these new technologies lend themselves to a growing number of applications. "The smaller the pixel, the more platforms you open yourself up to," Bacarella says. "With enhanced SWaP-C you will see these sensors on more UAVs [unmanned aerial vehicles] and other platforms that will be hugely significant."

Additional systems-integration benefits emerge as sensor sizes goes down, points out FLIR's DeAngelis. "As the array size comes down, there is less cooling power and battery power you need to use, and that has a trickle-down benefit through the entire product.

"As the detector sizes come down, you save more power, but you gain in range because you can put a larger lens on and see farther," DeAngelis continues. "Everything depends on the size of the array and on the quality of the imaging power."

Shrinking the size of the pixels in night-vision sensor arrays can offer a design trade-off that involves resolution vs. sensor size. Certainly a larger number of small pixels could offer high resolution, but systems designers often choose to reduce the size of the array as a way to reduce overall system size.

The Leonardo DRS Sniper Precision Acquisition Rifle Thermal Night Sight (SPARTN) provides day and night visibility for military snipers by clipping on to their existing day scopes.

Evolution of pixel size

Back during the first Gulf War and before, uncooled long-wave infrared sensor pixel size was 50 microns, and after that it evolved to 25 and then to 17 microns, says DRS's Bacarella. "It was a big jump from 50 to 25 microns. Then you're talking about a system at 17 microns that is half as long and 50 percent lighter than what you used to have.

"From 17 microns to 10 microns, the shift in the size of the optic becomes so big, and you have other benefits from improvements in FPGAs [field-programmable gate arrays], displays, and other processing assets," Bacarella continues. "At this stage the power requirements are such that you can start eliminating batteries from the system."

The density of long-wave infrared sensor arrays has doubled in just a short amount of time. "We had 320-by-240-pixel arrays a few years ago, and now 640 by 512 is the standard," says FLIR's DeAngelis.

Reduced pixel size in the detector, however, has its drawbacks, DeAngelis cautions. "You can make a pretty small array, but the actual noise level you will get out of it,

and your gain, might not be something you would put into the hands of the military or law enforcement," DeAngelis says.

The amount of noise in a night-vision image is a product of how well the sensor is manufactured, and how designers use sensor-processing technologies. Enhancements in these areas can help, but likely never will never eliminate noise altogether. "There always will be noise in an image, DeAngelis says. "There always will be other photons in there that you don't want. It's very important how you process it to show the best image."

With such a quick pace of evolution in the size, weight, power consumption, and cost of night-vision sensors, what might be in store for the near future? Industry experts say the rate of improvements is likely to slow.

"There is a lot of discussion about reducing the size of the pixels, but that is not likely to change in the next five years," says DRS's Bacarella. "When you think about the pixel, long-wave is 8 to 12 microns. We're at a 10-micron pixel pitch now I don't think it will go down to 5 microns; you would lose your bang for the buck at that point."

System-level designs

Instead, the industry crusade to reduce system size likely will focus on optics and other areas. "A bigger gain at the system level might be reducing the optics between 10 and 30 percent," Bacarella says.

"Germanium typically is used to see in the long-wave band. It is very expensive, and the more you can reduce that, the better off you are."

At Harris Night Vision, engineers are trying to reduce the size of the company's image-intensification tube, but are looking to other system-level factors as well. "The magic behind seeing at night is the image-intensification tube," says Harris's Hackler. "That's where we change photons into the electrons, and it is a standard size. There's a certain amount of space that it takes to do that."

For the company's night-vision goggles, helmet-mounted night-vision devices, and weapon sights, Harris designers are looking at mounting configurations and other areas where they could shave size and weight. "Once you have the magic piece reduced in size, then the rest is just packaging," Hackler says.

Key issues that Harris designers deal with, Hackler says, involve how heavy and balanced the device is to the user. "Is it too heavy; does it have too much forward projection, or too much weight on the helmet that changes the user's center of gravity?" Harris also is in talks with military helmet manufacturers to integrate night-vision devices directly into the helmets of warfighters of the future, Hackler says.

New capabilities

Wired and wireless networking is providing new options for night-vision device users. The DRS ENVG III night-vision device, for example, offers off-boresight capability

The Leonardo DRS Family of Weapon Sights Individual, or FWS-I, will use night-vision sensors to enable warfighters to kill targets without bringing their weapons up to eye level.

that enables the warfighter to link his weapon sight to his night-vision goggles. This can speed target acquisition, enable the warfighter to shoot from the hip, as well as around corners or over obstacles.

The system transmits the image from the warfighter's weapon sight through a wireless connection to a battery pack attached to the back of the soldier's helmet, which then transmits the weapon sight's image to the night-vision device's eyepiece through fiber optic cables. This capability could be available to deployed warfighters in the next few years.

Networking night-vision devices comes naturally to Harris Night Vision, which is a sister company to Harris RF Communications in Rochester, N.Y.—one of the world's most advanced military radio communications systems designers. "Harris traditionally is a communications company, so we can network the goggle to the radio," says Harris's Hackler.

Connecting digital communications systems like a software-defined radio to night-vision goggles offers the potential of transforming the soldier's goggles into a heads-up device that can display real-time text messaging, intelligence imagery, and enable the warfighter on the front lines to act as a sensor node on tactical military networks.

"Certain text messages and other information for situational awareness can be transmitted to the soldier through his goggle," Hackler says. "He can capture and send back video to the tactical information center from the goggle. It was a natural fit for us to integrate the night-vision goggle to the communications network."

In the future, infantry warfighters also might be able to overlay intelligence imagery over what they see through their night-vision goggles in a type of augmented reality

The Harris F5032 lightweight night-vision binocular features close-focus technology, an integrated IR illuminator, and hot-swappable image intensifier tubes.

that could speed tactical engagements and help reduce incidents of friendly fire casualties.

Blending tactical networking with night-vision devices also offers new capabilities for intelligence gathering and dissemination. "I think technology will split off into two sides: traditional optical imaging like a soldier's weapon sight, and an analytical portion where IR is the sensor," says FLIR's DeAngelis.

This design approach could offer the ability to use imagery and video captured and recorded from a warfighter's night-vision device for extensive intelligence analysis at a combat command post or at higher echelons.

A warfighter wearing night-vision goggles while operating on the front lines, for example, is concerned primarily with threats and opportunities right in front of him, and might miss something in the background that could be significant to an intelligence analyst. The infrared signature of recently disturbed dirt, for example, might escape the warfighter's notice, but actually might indicate the presence of an improvised explosive device (IED).

Night vision for everyone

As costs come down and performance increases, it stands to reason that night-vision devices will come into the hands of an increasing number of people—including many who might never consider a need for night-vision capability.

FLIR Systems, for example, offers the FLIR ONE thermal imaging camera attachment for Apple and Android smart phones, which is available commercially for as little as $200. This affordable capability can enable those leaving work late to scan a dark parking lot for lurking muggers, look into a dark backyard at night to determine if that thump was from a burglar or a raccoon, or aid in navigating a house when the power goes out.

Such affordable night-vision capability also has the potential to notify homeowners of pipe leaks, electrical wiring malfunctions, or heat leaks in an attic's insulation. It's clear that night-vision technology in the future could be as common as GPS is today.

"We want to bring thermal imaging to everyone at a price low enough so that everyone has access to it," says FLIR Systems's DeAngelis. "I think that will happen, but it will be a tool that you don't even know you're using."

New Pentagon EW strategy calls for increased technology investment

The Pentagon's electronic warfare (EW) strategy calls for increased investment in advanced technology designed to defend U.S. assets and use the electromagnetic spectrum to attack enemies. The prospect for a first-of-its kind Department of Defense EW strategy gained new urgency following Russia's use of advanced EW technologies in Ukraine, and the pace of global technological progress in EW systems. Electronic weapons can be used for an increasingly wide range of combat activities, from detecting and defending IED attacks to jamming enemy communications or even taking over control of enemy drones. The report will specify cross-geographical boundary radiated energy technologies designed to strengthen U.S. platforms and allied operations, and calls for new defense spending to challenge potential adversaries' electromagnetic systems.

Raytheon orders Anaren beamforming assemblies for Navy AMDR air and missile defense radar

Anaren Inc. in Syracuse, N.Y., has received a potential $97 million order from Raytheon Integrated Defense Systems to provide RF beamforming assemblies needed to produce the

JTE simulates anti-aircraft missiles and other radar threats to military aircraft

BY **John Keller**

HILL AIR FORCE BASE, Utah — U.S. Air Force flight training experts are asking the Northrop Grumman Corp. Amherst Systems segment in Buffalo, N.Y., to build realistic simulation and training equipment to help Air Force combat aircraft crews learn to evade anti-aircraft missiles, anti-aircraft artillery, and other radar threats.

Officials of the Air Force Life Cycle Management Center at Hill Air Force Base, Utah, announced a $10.4 million order for two wideband Joint Threat Emitter (JTE) units. The JTE transmits RF signals that simulate single- and double-digit, surface-to-air missiles and anti-aircraft artillery radar systems to provide training for combat aircrews by creating a modern, reactive battlespace war environment.

The JTE helps train military personnel to identify and counter enemy missile and artillery threats. It has a multi-threat, hi-fidelity simulator with realistic effective radiated power levels to help train combat aircrews to defeat or avoid integrated air defense systems (IADS) in a war-like training environment.

"When they go to a real-world situation, they won't see anything that we haven't thrown at them before," says Staff Sgt. Rick Woltkamp, 266th Range Squadron ground radar systems craftsman with the Idaho Air National Guard. "We simulate a ground attack, and the pilot will react and respond accordingly to the simulation."

A computer in the JTE collects data and evaluates the aircrew's response to simulated threat signals to evaluate their performance during their training sortie.

On this contract, Northrop Grumman will do the work in Buffalo, N.Y., and should be finished by June 2019.

FOR MORE INFORMATION visit the **Northrop Grumman Amherst Systems** online at *www.northropgrumman.com*, and the Air **Force Life Cycle Management Center** at *www.wpafb.af.mil/aflcmc*.

Harris wins contract to provide Special Operations forces with new manpack radio

BY **John Keller**

MacDILL AIR FORCE BASE, Fla. — Radio communications experts at Harris Corp. are building a next-generation secure manpack radio for U.S. Special Operations Command to enable commando teams to communicate on frequencies from 30 to 2,600 MHz with embedded communications security.

The new manpack radio for Special Operations forces will have an open-systems architecture to enable periodic hardware, firmware, operating software, and radio waveform upgrades.

Officials of Special Operations Command (SOCOM) at MacDill Air Force Base, Fla., announced a potential $255 million, six-year contract in June to the Harris RF Communications segment in Rochester, N.Y., to provide the Special Operations Forces Tactical Communications Next Generation Manpack (STC NGMP) Radio system.

The new radios will replace SOCOM's current radio communications equipment like the AN/PRC-117F and PRC 117G multiband multi-mission radios, as well as the AN/PRC-150 multiband radio.

> "The new manpack radio for Special Operations forces will have an open-systems architecture to enable periodic hardware, firmware, operating software, and radio waveform upgrades."

The new radios also will enable Special Operations forces to receive and distribute intelligence, surveillance, and reconnaissance data in the form of full motion video, and support simultaneous dual-channel line-of-sight, and beyond-line-of-sight operation using legacy and advanced digital radio waveforms.

SOCOM experts are asking Harris to provide a radio with National Security Agency (NSA) and Joint Interoperability Test Command (JITC) certifications, and make the new

communications system available for purchase no later than June 2018.

The new radio will be capable of simultaneous two-channel operation with each channel able to support narrowband and wideband waveforms simultaneously while receiving intelligence, surveillance, and reconnaissance (ISR) data in full-motion video as an embedded capability or via an attached mission module.

The STC NGMP will be able to crossband data from one of its two channels to the other and from the ISR receiver to either of the two radio channels, as well as include an embedded selective availability anti-spoofing module (SAASM) global positioning system (GPS) receiver.

SOCOM is asking for capabilities like the Demand Assigned Multiple Access (DAMA) integrated waveform (IW) for UHF satellite communications (SATCOM), Mobile User Objective System (MOUS), general-purpose narrowband and wideband high-frequency (HF) waveforms, advanced special communications modes (ASCM), and electronic counter-countermeasures (ECCM) waveforms.

Harris also will provide program and configuration management, systems engineering to include software, logistics support, operational and depot-level maintenance, data, and training.

On this contract Harris will do most of the work in Rochester, N.Y., and should be finished by June 2023.

FOR MORE INFORMATION visit **Harris RF Communications** online at *www.harris.com*.

U.S. Navy's new air and missile defense radar. Anaren officials say they obtained $31.5 million to support low-rate initial production of AN/SPY-6(V) AMDR shipboard radar systems designed for use on the DDG 51 Flight III Arleigh Burke-class destroyers. Work will occur at Anaren's facilities in New York, Colorado and New Hampshire. Anaren received $8.5 million from Raytheon in April 2014 to produce beam former technology as part of the engineering and manufacturing development phase of the AMDR program.

Boeing develops system to network jet fighters

Using a new airborne networking system, engineers at the Boeing Co. have demonstrated the ability to send secure communications and data between fourth- and fifth-generation fighter aircraft. During a flight test at Nellis Air Force Base, Nev., company experts showed they could connect an F-15C Eagle with an F-22 Raptor jet fighter via a data link enabled by a system known as the Talon Hate pod, says Paul Geery, vice president of mission solutions at Boeing's Phantom Works division in St. Louis. "Right now in the current system, there's limited ability to communicate between those two aircraft with data," he says. With the Talon Hate pods, the aircraft can share real-time updated information via communication links for a robust operating picture.

Unmanned space plane lands after secret two-year mission

The Boeing-built Air Force X-37B Orbital Test Vehicle (OTV) landed in Florida on 7 May after completing a nearly two-year-long secret mission. Return of the unmanned space plane didn't go unnoticed by anyone close to the Kennedy Space Center. The OTV created a sonic boom as it reentered Earth's atmosphere that woke up some nearby residents. After launching in May 2015, the unmanned, reusable craft was in orbit for 718 days during OTV-4, its fourth and longest mission to date. The mission brought the OTV's total number of days in orbit to 2,085 since its first mission launch in April 2010. Details of the OTV's mission are classified. Some speculate that the vehicle's capabilities might include military capabilities in addition to the mission's stated goals of "risk reduction, experimentation and concept of operations development for reusable space vehicle technologies."

FAA Testing new drone-sensing technology to avoid airport collisions

Last August, the pilot of an American Airlines Boeing 777 arriving from Hong Kong spotted a white, diamond-shaped drone as the aircraft made its final descent into Dallas/Fort Worth International Airport. The drone was 100 feet below and

Kratos to build 45 high-performance target drones to mimic performance of cruise missiles

BY **John Keller**

PATUXENT RIVER NAS, Md. — High-performance target drones experts at Kratos Defense & Security Solutions Inc. are moving to low-rate initial production of a new subsonic aerial target designed to help Navy aircraft and surface warship crews learn to defeat enemy cruise missiles.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $37.1 million order to the Kratos Unmanned Systems Division in Sacramento, Calif., for low-rate initial production (LRIP) of 45 BQM-177A subsonic aerial targets. The BQM-177A is the Navy's next-generation subsonic aerial target, which is designed to mimic the behaviors and radar cross sections of dynamic, high-subsonic, sea-skimming, anti-ship cruise missiles to help naval personnel practice air-to-air engagements.

Last November, Kratos Unmanned Systems achieved the final development program milestone for the BQM-177A target drone leading up to LRIP. The BQM-177A program is designed to meet the U.S. Navy's requirements for a new high-fidelity target to replicate subsonic anti-cruise missile threats in direct support of fleet training and weapon system testing and evaluation.

Capable of speeds more than 0.95 Mach and a sea-skimming altitude as low as 10 feet above the surface

The BQM-177A high-performance target drone helps aircraft and weapons crews train to fight against cruise missiles.

of the water, the BQM-177A carries internal and external payloads including proximity scoring, identification friend or foe (IFF), passive and active RF augmentation, electronic countermeasures, infrared plume pods, chaff and flare dispensers, and towed targets.

The BQM-177A is based on the Kratos BQM-167X aircraft, a derivative of the U.S. Air Force BQM-167A Skeeter target. The BQM-177A introduces a new fuselage with area ruling, high-mounted wings, and an internally integrated MicroTurbo TR-60-5+ turbo jet engine for reduced transonic drag. It will augment and later replace existing BQM-74E aerial targets, and will deliver longer range, lower cruise altitudes, and greater maneuverability than previous-generation target drones.

FOR MORE INFORMATION visit **Kratos** online at *www.kratosusd.com*.

DARPA seeks to enable machine autonomy for safety-critical aircraft applications

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are kicking off a project to improve machine autonomy technology sufficiently to enable its use in safety-critical applications such as unmanned autonomous aircraft operating together with passenger planes in controlled airspace.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., briefed industry earlier this month on the upcoming Assured Autonomy project (DARPA-SN-17-62).

Autonomous systems increasingly are critical to the military, and researchers have made tremendous advances in the last decade — particularly for unmanned vehicles that operate in the air, on the ground, and in the ocean.

Enabling these advances in machine autonomy have been innovations in sensor and actuator technologies; computing technologies; control theory; design methods and tools; and modeling and simulation technologies. Despite these advances, however, adoption of such systems in safety-critical Department of Defense applications remains challenging and controversial. Designing in reliability to ensure trust is key to widespread use of machine autonomy.

DARPA is developing technology to enable unmanned aircraft to operate with manned passenger planes in controlled airspace.

The upcoming DARPA Assured Autonomy project seeks to assure that systems will operate safely and perform as expected, which will promote trust in machine autonomy and speed its adoption. The goal of the Assured Autonomy program is to develop rigorous design and analysis technologies to guarantee safety of autonomous machines that can learn on their own, based on experience.

This project will center on military autonomous vehicles. It will produce a set of publicly available software tools for use in commercial and defense sectors. DARPA seeks innovative techniques that render the learning algorithms inherently safe by incorporating safety constraints in the learning process, while meeting learning objectives.

E-mail questions or concerns to DARPA at AssuredAutonomy@darpa.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-SN-17-62/listing.html*.

100 feet to the right of the plane, according to a Federal Aviation Administration report. The plane landed safely, but airport police were notified about the drone's unauthorized intrusion into the airspace, one of 44 reported at North Texas airports through the first nine months of 2016. None of the cases resulted in planes being struck and just one, a small Beechcraft plane, had to alter its flight course to avoid a collision at an elevation of 10,500 feet near DFW Airport. Airport officials and U.S. aviation regulators are increasingly worried about potentially catastrophic encounters as drones become more widely used by businesses and hobbyists.

Air Force MQ-9 Reaper UAV test-fires GBU-38 JDAM bomb

The MQ-9 Reaper unmanned aerial vehicle (UAV) has been outfitted to be able to drop the GBU-38 Joint Direct Attack Munition (JDAM). Tests of the JDAM from the MQ-9 Reaper UAV were undertaken by the 432nd Air Expeditionary Wing and the 26th Weapons Wing out of Nellis Air Force Base, Nev. The JDAM system attaches to unguided free-fall bombs and converts them to GPS-guided targeting packages at relatively low cost. The MQ-9 Reaper is one of the premier attack drones used by the U.S. military and CIA and is built by General Atomics.

ELECTRO OPTICS watch

Lockheed Martin to provide displays for Navy vessels and aircraft

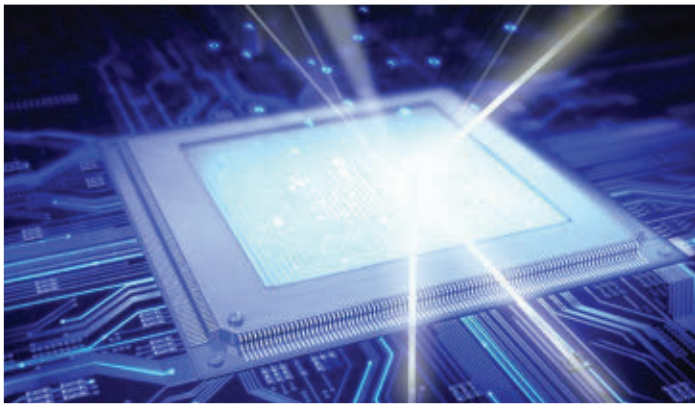
U.S. Navy shipboard electronics experts are asking Lockheed Martin to build open-architecture enterprise displays for Navy surface warships, submarines, and aircraft under a $15.2 million order. Naval Sea Systems Command officials in Washington are asking the Lockheed Martin Mission Systems and Training in Manassas, Va., to provide water-cooled Common Display System (CDS) conversions and production units. The CDS family of enterprise display systems for Navy surface warships is designed to be compatible with commercially available hardware and software; to conform to open-architecture computers and standards; and to incorporate human systems integration design principles.

Adaptive optics for rugged imaging camera offered by Nüvü

Nüvü Cameras in Montreal is introducing adaptive optics for the company's HNü 128 EMCCD camera, designed for scientific imaging applications in harsh environments. The cooling behind Nüvü adaptive optics option is optimized for rugged use in a non-vacuum packaging, and provides cooling for a fast frame rate in low light. The camera offers detection in near complete darkness. The adaptive optics option is available with a 128-by-28-pixel, scientific-grade EMCCD detector for imaging sensitivity between 500 and 1000 frames per second. ←

DARPA asks industry to develop photonic-electronic processor for advanced SIGINT

BY **John Keller**



DARPA is developing a combination hybrid analog, digital, photonic, and electronic processor to help analyze RF and optical signals for situational awareness.

ARLINGTON, Va. — Military researchers are asking for industry's help in developing a combination hybrid analog, digital, photonic, and electronic processor to help analyze radio-frequency (RF) and optical signals for situational awareness.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a solicitation (HR001117S0044) for the All-Signal Tactical Real-time Analyser (ASTRAL) program.

The future ASTRAL hybrid analog/digital photonic/electronic processor is to demonstrate real-time nonlinear cyclostationary and convolutional processing, as well as low-probability-of-intercept signal processing gain over input electromagnetic signals filling a bandwidth of 1 to 10 GHz.

The project also seeks to identify architectures and algorithms for military applications that are well-suited to real-time wideband hybrid analog, digital photonic/electronic use. DARPA briefed industry on the program on 18 July 2017.

The program seeks to develop and demonstrate a system for RF and optical electromagnetic signal surveillance, situational awareness, and understanding that improves current signal awareness speed and spectrum coverage by 1,000 times. This technology also should be suitable for mobile tactical operations.

The project seeks to plug technology gaps in the U.S. military's ability to counter ever-increasing electronic attack and cyber technology threats from potential enemies.

The ASTRAL program seeks to ensure U.S. military access to the congested and contested electromagnetic environment of the battlefield by using hybrid analog/digital photonic/electronic processor technologies of wideband real-time signal processing to detect hidden electromagnetic signals in real time and to perform high-value military signals intelligence (SIGINT), surveillance, and reconnaissance.

The electromagnetic signal environment contains valuable information about the enemy's order of battle, their maneuvers and actions, and early indications of potential threats, DARPA researchers point out.

The electromagnetic signal environment, however, is crowded and cluttered, and DARPA experts say they expect it to grow exponentially more so as new technologies enter service, like 5G wireless communications, unmanned vehicles, and millimeter wave radar.

The project seeks to enable U.S. and allied warfighters to understand in near-real-time all the waveform details, source type and class, signal format, and geolocation of detected RF signals, as well as the information these signals carry and whether or not the information is encrypted.

The ASTRAL program will enable superior electromagnetic signal awareness at the tactical edge with new technology suitable for tactical mobile units. ASTRAL technology will enable U.S. tactical forces fighting in all kinds of conditions to understand what adversaries are doing around them, anticipate adversaries' future actions, and recognize potential threats.

ASTRAL seeks to combine new analog photonic technology with state-of-the-art digital electronics in a hybrid photonic/electronic processing system. The analog photonic elements could take advantage of the wide bandwidth, wide optical dynamic range, ease of parrelization, and ability to implement multiplications by square-law detection that photonic technology offers. the digital elements, meanwhile, could implement general algorithms, low costs, and programming flexibility of electronics.

Some spectrum awareness applications of interest to DARPA include: optical communication real-time internet protocol (IP) packet identification and exploitation for physical layer network defense; city-wide wireless device geolocation; X-Ku-Ka band low probability of intercept radar warning; and theater-wide spread-spectrum radio geolocation.

DARPA officials expect to award several contracts in each of the two technical areas.Companies interested should submit proposals no later than 5 Sept. 2017 at https://baa.darpa.mil. E-mail questions to DARPA at HR001117S0044@darpa.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/HR001117S0044/listing.html*.

NASA JPL asks industry for lidar sensor to help land on Europa

BY **John Keller**

PASADENA, Calif. — Researchers are surveying industry for light detection and ranging (lidar) electro-optical sensor technology that could enable a future unmanned spacecraft to land safely on the rugged terrain of Europa, a large moon orbiting Jupiter that may be able to support life.

Officials of the NASA Jet Propulsion Laboratory (JPL) in Pasadena, Calif., issued a solicitation (RFP_MD-2673-949208) for the Technology Development for Europa Lander Lidar project. NASA JPL researchers are looking for a lidar system that is robust enough for the extreme Jovian and Europan environments, and that is compatible with the future lander's deorbit, descent and landing. NASA JPL is conducting trade studies for components and architectures, analyses of environmental impacts on the sensor, and evaluation and progressive refinement of various sensor design options leading to an eventual point design.

NASA is developing a lidar system to help future spacecraft navigate the rugged terrain of Europa.

Those interested should e-mail JPL Subcontracts Manager Mai Drummond at mai.r.drummond@jpl.nasa.gov to receive the solicitation documents.

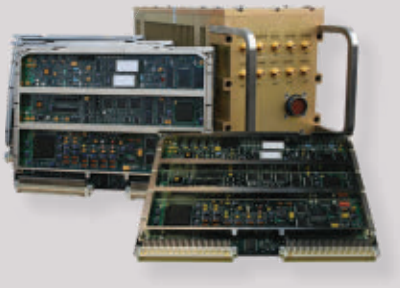
Responses to this Europa lander lidar solicitation are due to NASA JPL BY 31 Aug. 2017. For more information contact NASA's Mary Helen Ruiz by email at maryhelen.ruiz@jpl.nasa.gov, or by phone at 818-354-7532. Also contact NASA JPL's Mai Drummond by email at mai.r.drummond@jpl.nasa.gov, or by phone at 818-354-0295.

MORE INFORMATION IS online at *http://bit.ly/2veSMxp*.

PRODUCT applications

ELECTRONIC WARFARE

Navy continues buying radar-spoofing equipment from Mercury Systems



U.S. Navy airborne electronic warfare (EW) experts are continuing their support of radar-spoofing EW technology from Mercury Systems Inc. that can fool enemy radar systems with false and deceptively moving targets.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., announced an $8.6 million contract to the Mercury Defense Systems (MDS) subsidiary of Mercury Systems in Cypress, Calif., for 18 additional Type II Advanced Digital Radio Frequency Memories (DRFM) units. The U.S. Air Force Small Business Innovative Research (SBIR) project called Advanced Techniques for Digital Radio Frequency Memories brings several unique features for covert EW applications. It provides coherent time delay of RF signals in applications like radar and EW. It also produces coherent-deception jamming to an enemy radar system by replaying a captured radar pulse with a small delay, which makes the target appear to move.

DRFM can modulate captured pulse data in amplitude, frequency, and phase to provide other affects. A Doppler shift correlates range and range rate trackers in the radar. DRFM also can replay captured radar pulses many times to fool the radar into perceiving many targets.

Small packages, fast response, and large volumes of low-latency compute power define modern DRFM evolution, Mercury officials say. The company's latest DRFM technology produces modules as thin as 0.44 inches, and capitalizes on direct digital synthesizer (DDS) local oscillator (LO) technology. DDS technology delivers sub-microsecond tuning speeds over a wide bandwidth.

Mercury engineers are continuing technology advancements to the company's DRFM technology to keep pace with evolving threats and ensure that U.S. aircrews are trained realistically for combat. Mercury will do the work in Cypress, Calif., and should be finished by December 2018. ←

FOR MORE INFORMATION visit **Mercury Defense Systems** online at *www.mrcy.com/defense_systems*.

AIR TRAFFIC CONTROL

Selex ES to provide ILS precision landing systems for military airports

U.S. Navy air traffic management experts needed instrument landing system (ILS) equipment to support precision approach landing capability at Navy and Marine Corps airports. They found their solution from Selex ES Inc., a Leonardo company in Overland Park, Kan.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., announced a $20.9 million, six-year contract to Selex ES for as many as 31 ILS equipment sets for Department of the Navy installations.

The instrument landing system is a ground-based instrument approach system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions (IMC), such as low ceilings or reduced visibility due to fog, rain, or blowing snow. The system consists of a localizer, glide slope, remove control status unit, distance measuring equipment (DME), and ILS antenna.

Among the Selex ES ILS products is the flagship model 2100, which is FAA-certified for category I, II, and III airport operations. The 2100 is available in many different configurations and antenna arrays, and

provides a Windows-based graphic user interface.

The intent is to create a program of record to provide Navy and Marine Corps airfields with one configuration of an instrument landing system, as well as for future maintenance and upgrades.

The Selex ES ILS 2100 ILS equipment is available in dual- and single-equipment and frequency configurations; 8-, 14-, 16-, and 20-element LPD antenna arrays; null reference, capture effect, sideband reference and end-fire glide slope configurations; is available with a portable maintenance data terminal, and meets ICAO Annex 10 standards.

The Model 2100's localizer, glideslope, and market beacon equipment operate in temperatures from -50 to 70 degrees Celsius, can operate in 100 percent humidity, and can be installed at altitudes as high as 15,000 feet above sea level.

On this contract Selex ES will do the work in Overland Park, Kan., and should be finished by May 2023.

FOR MORE INFORMATION visit **Selex ES** online at *www.us.selex-es.com*.

EMBEDDED COMPUTING

Hughes chooses rugged embedded computing from Kontron for SATCOM airborne modem

Satellite communications (SATCOM) specialist Hughes Network Systems LLC needed rugged embedded computing and packaging for the Hughes HM-200 airborne modem. They found their solution from Kontron America Inc. in Poway, Calif.

The Hughes Defense Systems division in Germantown, Md., is providing the HM-200 SATCOM model for manned fixed-wing aircraft, as well as unmanned fixed-wing aircraft and helicopters for airborne intelligence, surveillance, and reconnaissance.

Kontron is providing Hughes with embedded computing technology based on the Kontron COBALT 901 rugged small-form-factor embedded computer. The COBALT 901 has standardized I/O, is ruggedized to mil-standards for shock, vibration, and electromagnetic interference, and is a sealed conduction-cooled system that resists water immersion and other contaminants.

Kontron's scalable COBALT product family is based on the COM Express embedded computing mod-

ule basic and compact form factor module (Type 6) with a specialized carrier board assembly. It is available with a selection of power, interface options, thermal solutions, and mounting kits.

Pre-designed building blocks in the COBALT 901 help Kontron designers make as few modifications as possible to the core system to create a custom design based on commercial off-the-shelf (COTS) technology.

In addition to the HM-200, Hughes is working with Kontron on the HM-400 SATCOM modem for the General Atomic Predator B combat unmanned aerial vehicle (UAV), which the U.S. military calls the MQ-9 Reaper UAV. One of the most promising applications of the Hughes HM-200 airborne modem is manned and unmanned helicopters, which represent a severe shock-and-vibration environment.

FOR MORE INFORMATION visit **Kontron America** online at *www.kontron.com*.

RADIATION-HARDENED ELECTRONICS

NASA chooses radiation-tolerant multiplexers from Cobham for space applications

Space electronics researchers at NASA needed radiation-tolerant analog multiplexers for a variety of space applications. They found their solution from Cobham Semiconductor Solutions in Plainview, N.Y.

Officials of the NASA Shared Services Center (NSSC) at the NASA Stennis Space Center near Bay St. Louis, Miss., announced plans to issue a sole-source contract to Cobham for flight Aeroflex multiplexers, part numbers 8511-201-1S and 8512-201-1S. The value has yet to be negotiated.

The Cobham ACT8511 64-channel analog multiplexer module is radiation-tolerant and protected from electrostatic discharge (ESD). It offers 64 channels provided by four 16-channel multiplexers; resists 150 kilorads of total-dose radiation; offers single-event upset resistance of 90 MeV-cm2/mg; and is single-event latchup immune by process design.

The Cobham ACT8512 is designed to meet exposure to radiation environments; comes in a 96-lead HTCC CQFP package; operates over the full military temperature range of -55 to 125 degrees Celsius; and is screened to MIL-PRF-38534.

FOR MORE INFORMATION visit **Cobham Semiconductor Solutions** online at *http://ams.aeroflex.com*.

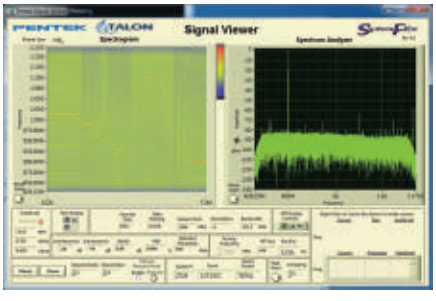
new PRODUCTS

To submit new products for consideration, contact John Keller at jkeller@pennwell.com.

SIGNAL PROCESSING

Pentek offers enhancements to Talon SystemFlow software for radar and communications recording

Pentek Inc. in Upper Saddle River, N.J., is offering enhancements to the company's Talon SystemFlow software to benefit radar, signals intelligence (SIGINT), and communications recording applications where reliability, speed, and data integrity are mission-critical. SystemFlow is the software interface integrated into Talon recorders that includes the graphical user interface (GUI) that controls the recorder with point-and-click configuration management, a



client/server communication interface, NTFS file system support, and an application programming interface (API) for custom user applications. Signal-analysis tools include a virtual oscilloscope, spectrum analyzer, and spectrogram to monitor signals before, during, and after data collection. Enhancements include auto file naming; one-click profiles; segmented recording; and data extraction utility. Targeted recording modes include looped recording and pulsed radar recording, and GPS functions for target triangulation and time stamping. Other enhancements include auto-initiated recording; GPS position tracking; signal viewer; encryption; and instant secure erase.

FOR MORE INFORMATION visit **Pentek** online at *www.pentek.com*.

EMBEDDED COMPUTING

Module with time synchronization for sonar and bistatic radar introduced by VadaTech

VadaTech Inc. in Henderson, Nev., is introducing the AMC005 time and frequency embedded computing module with on-board global positioning system (GPS) for applications that require precision time synchronization, including communications networks, sonar, bi-static radar, and SIGINT. The AMC005 provides a GPS/PTP (1588)/IRIG/NTP bus-level timing solution to MicroTCA and ATCA systems. Precision UTC time stamps and GPS location/time/status are all made available via PCI Express registers to the host CPU/application. GPS location, time, and status data are available via backplane Ethernet broadcast/unicast with selectable bonding and failover. Optional

backup provides non-volatile storage of the Almanac, Ephemeris, and Last position data to enable rapid "warm start" re-acquisition. The AMC005 can demodulate IRIG amplitude modulated (AM) signals and receive/transmit IRIG DC level shift (DCLS) signals. The disciplined clock, 1PPS, divided-down clocks, IRIG DCLS, and time trigger may be output in any combination of the backplane clock channels.

FOR MORE INFORMATION visit **VadaTech** at *www.vadatech.com*.

TEST AND MEASUREMENT

Marvin to help extend life cycles of legacy semiconductor test sets

Marvin Test Solutions Inc. in Irvine, Calif., is introducing the Marvin Test Expansion Kit (MTEK) semiconductor test and measurement subsystem aimed at extending the life cycles of legacy semiconductor test sets. The MTEK subsystem adds test capabilities to legacy semiconduc-

tor test systems that lack the ability to meet the test requirements of current devices. Based on Marvin's portfolio of PXI and PXI Express chassis and instrumentation as well as selections from other suppliers, MTEK enables customers to configure a subsystem with exactly the resources needed to deliver the capabilities lacking in their current legacy ATE. MTEK is an open-architecture plug-and-play solution that adds RF, high-performance digital,

and high-performance analog capabilities. MTEK is compatible with legacy semiconductor testers, including Teradyne, LTX/Credence, Eagle, ASL100, Sentry, and Verigy.

FOR MORE INFORMATION visit **Marvin Test Solutions** online at *www.marvintest.com*.

RADAR PROCESSING

FMC RF conversion module for radar receivers introduced by Abaco

Abaco Systems in Huntsville, Ala., is introducing the FMC134 FMC+ FPGA mezzanine card (FMC) direct RF conversion module for wide-bandwidth,

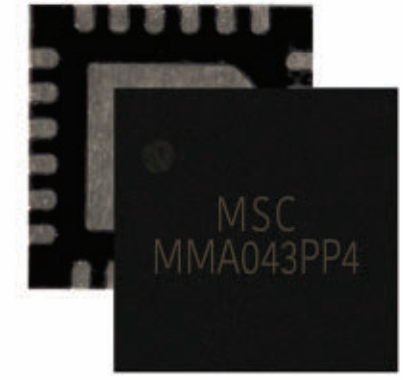
multi-channel receivers in modern radar systems. The FMC134 is suited for applications including traditional and bi-static radar; multi-channel radar; digital beamforming; wideband receivers; wireless communication SDR; and signals intelligence receivers. The card brings A/D converter performance and density, and can operate as a 4-channel receiver at 3.2 gigasamples per second or a 2-channel receiver at 6.4 gigasamples per second. Using 16 of the available 32 high-speed JESD204B lanes, the FMC134 is capable of a total maximum transfer rate of 200 gigabits per second, and is compliant with the VITA 57.4 standard for compatibility and interoperability across different FPGA carriers. The JESD204B core is available as part of the FMC134 board support package, and this works out of the box when used in combination with an Abaco FPGA carrier card. The FMC134 includes two reference outputs and an external trigger input for multi-board synchronization.

FOR MORE INFORMATION visit **Abaco Systems** online at *www.abaco.com*.

MICROELECTRONICS

MMIC devices for electronic warfare offered by Microsemi

Microsemi Corp. in Aliso Viejo, Calif., is introducing a family of wideband plastic packaged and chip monolithic microwave integrated circuit (MMIC) devices for size-constrained aerospace, defense, and industrial applications like electronic warfare (EW), microwave radio, and unmanned aerial vehicles (UAVs). Microsemi's new MMIC wideband LNA, distributed wideband MMIC



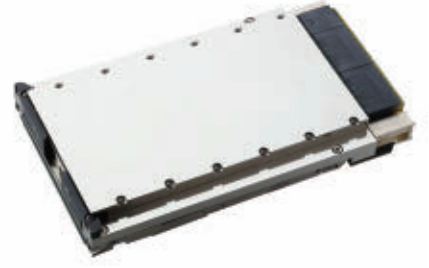
power amplifier and wideband MMIC switches include four plastic packaged low-noise amplifiers (LNAs), MMA040PP5, MMA041PP5, MMA043PP4, and MMA044PP3; a wideband power amplifier (PA) chip, MMA053AA; and two plastic packaged switches, MMS006PP3 and MMS008PP3. The new offerings are for EW, test and measurement, high-linearity microwave radio, UAVs, and other military communications applications.

FOR MORE INFORMATION visit **Microsemi** online at *www.microsemi.com*.

GPGPU PROCESSORS

Rugged GPGPU graphics processor for military uses introduced by EIZO

EIZO Rugged Solutions Inc. is introducing a rugged, high-performance NVIDIA CUDA-based 3U VPX embedded computing graphics processor combined with an XMC form factor



single-board computer for demanding aerospace and defense applications. This new technology that combines graphics processor and central processing unit (CPU) creates a powerful single-slot 3U VPX general-purpose graphics processing unit (GPGPU). There are two configurations: the Condor GR3-C3 3U VPX and Condor GR3-X7 3U VPX supporting Intel i3 or i7 processors, respectively. Other computer board configurations will be supported in the near future. The Condor GR3 3U VPX rugged conduction-cooled graphics module was developed for an airborne reconnaissance application where size, weight, and power (SWaP) were key considerations. The card offers an upgrade path of the graphics module and the computer board, and has a range of I/O options including 1-gigabit-per-second Ethernet, RS-232, USB, and SATA.

FOR MORE INFORMATION visit **EIZO** online at *www.eizorugged.com*.

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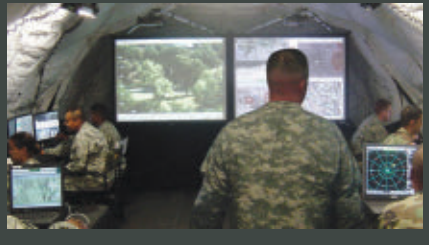

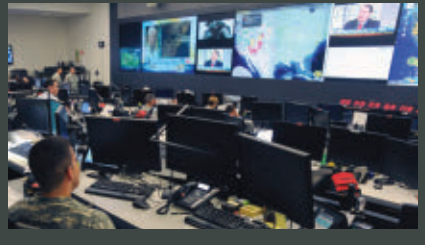

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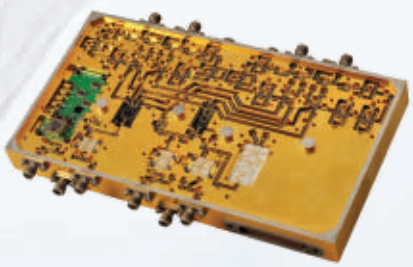

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