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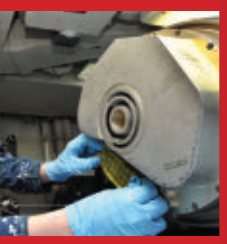

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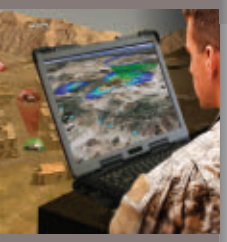

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BY **JOHN KELLER**, EDITOR IN CHIEF

The major technology trends to look for in 2016

There's plenty to look forward to in 2016. For starters, we're crafting a *Military & Aerospace Electronics* industry awards program to reward the most important innovations in the military and aerospace electronics industry. We plan to kick off the program this spring, and present our awards sometime this fall. Stay tuned.

The year 2016 promises to be an interesting time, with the global war on terror continuing unabated, shifts to national leadership with the presidential election next fall, and international tensions heightening in the Western Pacific involving the military expansion of China.

China is establishing an air and naval base in the Spratley Islands in the South China Sea between the Philippines and Vietnam, in which U.S. military and government forces believe to be international waters. The U.S. Navy continues military patrols in the area, while China warns dire consequences for continuing to do so. On the other side of China, India is looking to the U.S. to buy sophisticated reconnaissance and attack unmanned aerial vehicles (UAVs) to counter what Indian officials claim are border incursions by China.

Look for increased emphasis in 2016 on military technologies like anti-submarine warfare and cooperative sonar, cyber warfare, military UAVs for battlefield and shipboard cargo delivery, adaptive radar and electronic warfare (EW), passive radar and sonar, augmented reality, laser weapons, unmanned underwater vehicle (UUV) motherships able to deploy covert reconnaissance and attack UUVs, developments in persistent surveillance, and advanced data mining to uncover potential terrorist threats in social media.

Anti-submarine warfare will be important to keep Chinese submarine developments in check. China not only is starting to deploy advanced nuclear attack and ballistic missile submarines throughout the world, but also is developing nuclear ballistic missiles designed to destroy U.S. carrier battle groups.

Cyber warfare remains of critical importance as suspect Russian, Chinese, and Iranian computer hackers have gained access to U.S. government agencies, as well as to power grids throughout the U.S. in efforts to probe perceived weaknesses.

UAVs for cargo and shipboard cargo deliver will see increased attention as machine autonomy and optionally piloted helicopter and fixed-wing aircraft technology keep forward-deployed troops and sailors supplied without putting human lives at risk.

Adaptive radar and adaptive EW technologies are progressing such that digital technologies can be exploited to reprogram radar and EW systems on the fly to adapt to changing conditions. Passive radar and sonar technologies in the future, likewise, will be important for their stealth value.

Augmented reality involves superimposing icons to indicate targets, obstacles, and other features on imagery in weapon sights, head-up displays, soldier-worn goggles, and other optical devices. The idea is to blend real-time images with computer graphics to give warfighters an enhanced view of the battlefield.

Laser weapons are poised to take lead roles as fighter aircraft weapons, as well as laser deck guns aboard surface warships. The big advantage to laser weapons — at least in theory — is they never run out of ammunition, so long as a power source is available.

Persistent surveillance is important in the war on terror and conventional warfare. The idea is to look at specific areas for long periods of time, filter out what's routine, and focus on things that are out of the ordinary, which could lead to predicting terrorist attacks or other military events.

Data mining technology will be brought to bear on social media channels next year, helping to identify potential terrorist suspects.

IN BRIEF

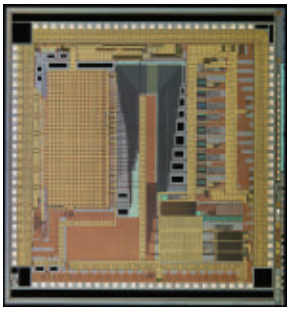
Navy orders additional submarine electro-optical imaging sensors from Lockheed Martin

Lockheed Martin Corp. will provide the U.S. Navy with open-systems submarine electro-optical imaging systems under terms of an order that with options could turn out to be worth as much as $57 million. Naval Sea Systems Command announced a $7.2 million contract to the Lockheed Martin Mission Systems and Training segment in Manassas, Va., to provide two AN/BVY-1 Integrated Submarine Imaging Systems (ISIS) and spare parts. The ISIS provides mission critical, all-weather, visual, and electronic search, digital image management, indication, and warning for U.S. fast-attack and cruise-missile submarines. The order has options that could increase its value to $57 million. ISIS, which interfaces to Virginia-class, Seawolf-class, and Los Angeles-class fast-attack subs, as well as Ohio-class cruise-missile subs, provides a flexible architecture for inserting future capabilities as they become available, Navy officials say. The system has the potential for installation on Ohio-class ballistic missile submarines and other kinds of submarines.

DARPA to revolutionize high-end IC design for military and aerospace uses

BY JOHN KELLER

ARLINGTON, Va. — U.S. military researchers are asking integrated circuit (IC) experts at the University of Southern California (USC) to help revolutionize high-end custom IC design for military and aerospace applications.



DARPA scientists are trying to demonstrate a custom IC design flow and methodology to increase design reuse.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced an $11.8 million sole-source contract to the USC Information Sciences Institute in Los Angeles for the Circuit Realization at Faster Timescales (CRAFT) – FinFET Foundry/Design Aggregation Services military chips program.

The U.S. military is developing systems that require high computational performance in a power-constrained environment; yet, these technologies cannot be manufactured fast enough. Systems designers today must choose between high performance and low power consumption. Often systems designers must choose between a high-performing, custom IC that requires years to design and fabricate, or settle for a lower-performing processor programmed in months.

The DARPA CRAFT program seeks to demonstrate a custom IC design flow and methodology in a leading-edge commercial 16- or 14-nanometer fab, port these designs to new foundry process flows, and increase design reuse by providing a repository for secure storage and distribution of design elements.

The CRAFT has three technical goals: reducing custom IC design and fab cycle time by 10X with new software tools; enabling a 50 percent reuse of critical military IC modules with an intellectual property (IP) repository system; and enabling flexible chip fabrication by porting a technology node from one foundry to another, or migrating from one design node to another design node at the same foundry. To meet these goals, DARPA needs to build custom ICs using the FinFET leading-edge CMOS process node because of this technology's density, performance, and power advantages. To access this technology, the CRAFT program needs FinFET foundry access, and this is where USC Information Sciences Institute comes in.

USC will provide a design aggregation service for CRAFT contractors; collect individual designs, produce an aggregation of these designs to create the floorplan for the full mask set, and insert test structures to provide vital early assessment of the designs; and train military and university designers on using the technology.

Lockheed Martin to develop weapon seeker to attack targets without use of GPS

BY JOHN KELLER

EGLIN AIR FORCE BASE, Fla. — Munitions experts at Lockheed Martin Corp. are developing a small, lightweight weapon seeker prototype to enable smart munitions to engage moving and relocatable targets during the day and at night in contested environments where global positioning system (GPS) satellite navigation may be unavailable.

Lockheed Martin is developing a smart-munitions seeker that can deliver pinpoint accuracy without the use of GPS signals.

Officials of the U.S. Air Force Research Laboratory (AFRL) Munitions Directorate at Eglin Air Force Base, Fla., announced an $8.2 million contract to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., for this experimental seeker work. The AFRL awarded the contract to Lockheed Martin on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., as part of the DARPA Seeker Cost Transformation (SECTR) program.

SECTR seeks to design and demonstrate a low size, weight, power, and cost (SWaP-C) seeker prototype capable of providing day/night navigation and precision terminal homing to a weapon platform which may engage moving, relocatable, and stationary targets in a contested environment where GPS may not be reliably available.

The SECTR seeker will be for use in a heavily contested environment, where laser target designation is unavailable and continuous intelligence, surveillance, and reconnaissance (ISR) support to the kill chain may not be available. The

SECTR seeker will have an open and modular hardware and software system architecture with government-owned interface standards, and will capitalize on the ability low-cost commercial technology to evolve rapidly with the pace of modern innovations.

In addition, the SECTR seeker will have terminal accuracy as good as, or better than, current seekers, DARPA officials say. The seeker will provide high-resolution imaging and range information for target recognition and optimum aim point selection, which will minimize the size and mass of kinetic warhead needed to destroy the target.

The DARPA SECTR program is important because critical gaps exist in U.S. military capability to target and destroy moving, relocatable, and stationary targets under GPS-jammed conditions using low-SWaP-C seekers that can operate during day and night conditions, DARPA officials say.

Moving and relocatable targets in particular pose continual strategic and tactical threats to the U.S. military and the U.S. homeland.

The SECTR seeker will include a sensor for GPS-free navigation and for target and aim point recognition; inertial measurement unit (IMU); GPS receiver; processor; mechanical and electrical systems for power and cooling; and interfaces to weapon guidance and communication systems.

With these elements, the SECTR seeker should contain all elements necessary for precision-guided munition navigation and target homing functions, specifically to estimate its own position, velocity, and orientation to detect and recognize specific targets and aim points.

Although technically challenging, DARPA scientists say they believe Lockheed Martin can develop the low SWAP-C day/night seeker capability with an open and modular architecture. If Lockheed-Martin experts succeed in developing such a seeker, its technologies could be used for advanced, low-cost smart munitions planned or under development.

FOR MORE INFORMATION visit **Lockheed Martin Missiles and Fire Control** online at *www.lockheedmartin.com/us/mfc*.

EO/IR sensors boost situational awareness

Military researchers and industry experts are adapting different EO/IR sensors to work together such that they can become greater than the sum of their parts, and help provide greater situational awareness than ever before.

By J.R. Wilson

A Navy technician performs maintenance on an aircraft electro-optical sensor unit from a Navy attack aircraft. This sensor helps fighter-bombers drop precision bombs.

Situational awareness has been the centerpiece of combat throughout the history of warfare. In the 21st Century's increasingly networked digital, data-heavy battlespace, it has become more crucial than ever to warfighter security and success. This is where electro-optical and infrared (EO/IR) sensors come into play. These sensors and their data processors often serve as the eyes of deployed military forces.

The continuing challenge for the military is maintaining a technological edge in EO/IR sensor systems. Adversaries are becoming more sophisticated in their tactics and technologies, and the U.S. military's efforts to maintain the technological advantage have grown in importance and difficulty.

"If you see the gap between potential in performance and where we are in delivering performance, that gap is just starting to open," Chief of Naval Operations Adm. John Richardson told the U.S. Naval Institute's annual Defense Forum in December. "It's not a huge gap right now; it's probably small enough that on our best days we can convince ourselves we're doing OK. But you can see, going forward, that gap is only going to widen at ever-increasing rates."

Often the real value of EO/IR sensor develop-

ment only becomes apparent during demonstrations in actual military environments. "The real magic happens when you put [technology] with the developers and they meet the sailors out there and they watch their idea come to life," Richardson says. "The amount of creativity out there in the fleet is tremendous."

Keith Lannan, technical warrant holder for surface EO/IR sensing systems at Naval Sea Systems Command (NAVSEA) in Washington, says the Navy fleet recognizes the value of EO/IR sensors, so the demand is strong and growing stronger.

"The current naval missions driving work in NAVSEA primarily cross different missions and functions, such as navigation, force protection, surface warfare, anti-air, and other support areas," Lannan says. "The key driver is motion imagery from EO/IR sensors that provide day-night, long-range eyes on target, which improves the user's ability to identify targets, perform threat assessment, assess intent in accordance with the rules of engagement, and support weapons engagement through automatic tracking and fire control solutions through line-of-sight. The sensors also support assessment of engagement effectiveness."

Future capabilities

For future capabilities, naval experts are concentrating on how new EO/IR technologies can make existing sensors even better. "The situational awareness driver currently is focused on augmenting the current sensors, which were primarily driven in the past by requirements for specialized weapons sensors, with adjunct sensors for situational awareness that will enhance that for the ship," Lannan says. "There are some differences, but also similarities, across ship classes. We are performing analyses on requirements for standardizing sensors to improve capabilities and reduce total ownership cost."

One way sensors are evolving is dual-purpose use for weapons and situational awareness. Navy leaders want targeting and surveillance sensors to be operationally available for intended missions, so NAVSEA is augmenting them for situational awareness to alleviate the wear and tear on special-purpose sensors.

"Today our sensors are intended to be a point-solution for various weapon systems, so one thing that is evolving is looking hard at how to integrate sensors into an integral part of the ship's combat system and streaming video dissemination, for example, for overall improved interoperability. Standards will help facilitate that in an open-systems approach and will enable us to have better integration with other combat system elements," Lannan says. "If we can standardize sensors and use common modules for situational awareness and engagement support, that is a major benefit. So a lot of the emphasis is on things we can do, such as standardizing interfaces at the system and module levels and other technology refresh cycle and maintenance modules so they can be used across multiple platforms and systems. When standardized, it will help achieve the Navy's open architecture goals and maintain competition throughout the life cycle."

Maintaining the technological edge depends not just on improving individual sensor technologies, but also on merging two or more sensors into a single device, fusing raw data,

The Navy's experimental Situational Awareness System (SAWS) uses two EO/IR sensors placed forward and aft of an aircraft carrier's island to provide 360-degree surveillance capability.

on-platform processing of data into useable information, and real-time sharing of that information across all assets, from theater commanders to individual warfighters.

"A general trend, toward which we're already progressing, is full situational awareness distributed across the battle network," says Andrew Saxton, marketing director for surveillance at EO/IR specialist FLIR Systems Inc. in Wilsonville, Ore. "In the next five years, you will see marked progress in the ability of every asset in the field to share what is being seen to one central command but also sending that out to the rest of the battlespace I think the uses [of related sensors] will remain relatively stable, but different assets will be called upon to conduct them."

Shrinking size

One pervasive trend in EO/IR sensors is shrinking size, weight, and power consumption (SWaP). "As you get better performance out of smaller systems, you can send a small UAV [unmanned aerial vehicle] rather than a large manned aircraft or light tactical vehicle instead of a large platform. As more of them become man portable, more tasks can be accomplished from the ground rather that the air. Distance and operating conditions will see new systems providing commanders with greater flexibility in achieving their objectives."

A leader in that evolution is the merger of EO/IR sensors into new applications, ranging from Navy ships to special operators. "EO and IR are more or less permanently bonded now," says Peter Zinsli, a sensors expert with the U.S. Army's Intelligence and Electronic Warfare & Sensors program executive office at Fort Belvoir, Va. "The EO provides day capability, IR day and night, but EO has better range capability; it is more interpretable. Long-term, we're looking at better sensors and more sensor fusion and AITR [aided target recognition]. We will see a continuation of wanting more resolution, more stand-off, which will require larger,

better FPAs [focal plane arrays]. I'm skeptical of truly novel optical enablers; the big thing will be putting a larger aperture on these sensors."

Sensor fusion is a big trend in military EO/IR sensor technology. "A fusing of multiple sensors, of all types, and building software that provides products as opposed to data, is going to be key in the long-term. As expensive as the sensors are, it also is expensive to have more eyeballs looking at each sensor. With more data to parse, unless you put more and more people on it, you need to shorten the timeline between raw data and actual usable information."

The Navy SAWS aboard the aircraft carrier USS Dwight D. Eisenhower uses two EO/IR sensors, a laptop control station, and digital video recorders to provide 360-degree visual coverage around the ship for force protection, navigation, and search and seizure operations.

The vast variety of platforms built by several different prime contractors incorporate a lot of FPAs, EO/IR sensors, different frame rates, and number of channels that spew out an ever-growing volume of data. Companies such as Curtiss-Wright Defense Solutions in Ashburn, Va., build digital signal processing, high-performance embedded computing modules for subsystems to capture that data, often pre-digitized, some in high bandwidth formats. Some primes buy individual modules, some preconfigured subsystems.

Sensor processing

"There is not typically one type of processing technology that can do the whole application," says Marc Couture, senior product manager of digital signaling at Curtiss-Wright Defense Solutions. "The most popular mix is FPGAs [field-programmable gate arrays], the first to capture the fiber-optic stream, that does some preprocessing, then hands off

to GPGPUs [general-purpose graphics processing units] — teraflop floating-point-per-second, very high throughput processing and Intel devices, such as the new Xeon D that is a bit more cognitive, can analyze data and change modes, kind of a director/conductor that also does processing."

It takes a special blend of different processing technologies to handle fast streams of high-resolution imagery from EO/IR sensors. "That trio is the mix du jour, (but) every application uses a different combination of FPGAs, GPUs, etc., and different primes are more partial to different combinations," Couture says. "The form factor most popular in defense is VPX; there are smaller form factor implementations when needed. We often take industrial versions of those chips and ruggedize them for extreme temps, different vibration profiles, and sealing against foreign particulates."

The SAFIRE 380-HD EO/IR sensor pod is mounted to an Augusta Westland AW189 helicopter.

The Army is pursuing similar efforts to enhance battlefield situational awareness. "The Army operating concept of winning in complex environments with complete situational understanding creates requirements for EO/IR sensors doing a targeting mission. You also need wider situational awareness, which you can cover with picture-in-picture and Step-Stare, which essentially is mosaicing, where you move your sensor around and take multiple images, then stitch those together," Zinsli says. "As we move forward, we hope to have better integrated payloads. You may have sensors covering a lot of different bands, but with some sort of AITR with a software component that turns all the incoming data into information or at least cues for the operator."

Technology insertion

For the near- and mid-term, the military is looking at upgrading legacy platforms and systems. One difficulty is the research budget, which has led the Army, for example, to look at partner labs to come up with good ideas, and work on related technologies they eventually can transition.

"We have moved away from the quick reaction capability mode of operating, which leads to longer timeframes to develop technology. QRCs were the product of urgent needs in the battlespace and, during the Bush years, having the money to solve the problem of people dying," Zinsli says.

As with more and more military technology, cutting-edge research is coming from the commercial world, modified to meet the needs of warfighters but advancing what they have far more quickly than would be possible with specialized military hardware. Hand-in-hand with that is a heavy focus on making new systems easy to use and intuitive for the warfighter in the field.

"There is always pressure to provide more resolution, more standoff, and more imaging capability. One of the new groundswell trends has been on the intel those systems can provide in addition to a high-definition (HD) image. Other than just seeing a pretty picture, the technology has reached the point where the field equipment must make other decisions," says FLIR's Saxton. "All our airborne, man-portable, and vehicle systems provide precise target locations to the operator, which they can share to the regional command."

It was the commercial world that first developed HD imaging affordable enough for widespread deployment. "HD imaging was available to the consumer electronics base before it was widely adopted throughout the military, but HD thermal imaging of targets is a much harder and more difficult technology to stand up," Saxton says. "Last year we debuted the HISS-XLR, an HD thermal imager mountable to a rifle, a capability that previously only existed at high-end airborne and vehicle levels that now is available to the soldier."

NAVSEA experts have been examining the potential future capability of wide field-of-view (FOV) distributed-aperture sensors or persistent 360-degree surveillance. That includes the transition of large-format, small-pixel FPA technology, stitching sensor images together, and integrating wide FOV sensors with more conventional sensors for long-range target identification and classification.

Increasing fields of view

"The intent with wide FOV is to add an auto-detection and multi-target tracking capability to achieve wider situational awareness and for weapons systems and engagement support. There is a big focus on adding wide FOV and interoperability between those and narrow FOV sensors, with the latter taking a closer look for identification, threat assessment, determining false alarms, etc.," says NAVSEA's Lannan. "Another thing we're looking at is shortwave IR sensors for improved performance over visible band sensors in the maritime environment to help with degraded visual environments and for in-band laser imaging," Lannan continues. "The imagery will relieve some of the workload and improve situational awareness in cluttered environments. With all that imagery, we have to be smart about

how it is managed and displayed to avoid information overload."

As evidenced by attacks on vessels operating along coastlines and in harbors, situational awareness afloat is not limited to radar scans for hostile aircraft or sonar for submarines. That is especially true for the next generation of Air Cushion Vehicles, designed to conduct day/night off-shore, near-shore, and on-shore missions. ACV operators must have the highest level of situational awareness in all those mission environments. That includes not only time-of-day visibility, but sea spray, high humidity, haze, smoke, even sand and dust. The current trio of radar, night-vision devices, and visual watches — relatively unchanged since World War II — on the Navy's Landing Craft, Air Cushion (LCAC), is no longer adequate, prompting the Navy to seek a new durable, low-cost EO/IR imaging device for such vessels.

"An EO/IR system (or similar hyper-spectral imaging sensor) should greatly increase operator situational awareness by providing the ability to discern land terrain, sea and waterway features and contacts, such as small boats and patrol craft in the near-shore environment where surface radar performance is limited," according to a 2015 Navy solicitation. "A hyper-spectral imagery system with thermal contrast, such as an EO/IR sensor, will provide capability to detect and identify surface contacts and beach-borne and land-based threats that have very low radar signatures. The unique capabilities of a combination of EO imagery, IR imaging, NV systems, and laser and range-finding tools will enhance ACV combat operations."

The solicitation notes such a system also could have dual-use applicability for commercial hovercraft, ferries, pilot boats, or any other watercraft operating in the near- or on-shore environment, as well as Army riverine vessels and military vehicles operating on-shore.

Reclaiming the night

Meanwhile, the Army Communications-Electronics Research, Development and Engineering Center's Night Vision & Electronic Sensors Directorate (CERDEC NVESD) at Fort Belvoir, Va., is working to move beyond

the night-vision systems that enabled U.S. warfighters to "own the night" in the 1990s and 2000s when night-vision goggles became readily available to everyone. While still key parts of the warfighter's kit, reclaiming the night will require new and more advanced technologies.

"Today's average soldier out in the field has a pair of image-intensified goggles," NVESD director Dr. Donald Reago said at the 2015 SPIE Defense Security and Sensing Conference. "He or she has a night-vision goggle that works in the near infrared. The technology has been around for 40 years; it works phenomenally well in terms of amplifying starlight and ambient light and producing it within your eye. There's no analog, there's no digital; light comes in, light comes out."

NVGs always have had operational limitations: no thermal capability, no seamless transition from day to night, and no close-up to long distance viewing. NVESD's Enhanced Night Vision Goggle (ENVG) incorporates an image intensified channel, a thermal channel, and an optical overlay that can be combined with the camera's output and the image intensified on a small display. The current ENVG still does not have full digital capability.

We would like to go to "something which is more of a digital sensor, the helmet-mounted display or helmet-mounted imager, and then digital sensors beaming that display," NVESD's Reago added. His goal is to move to a system with a camera in the back, a sensor, light display, storage and memory capabilities, and which runs software applications. "This is what our soldiers are growing up with and this is the future."

A return to near-peer/peer adversaries is driving the development of EO/IR sensors and other enhanced situational awareness technologies.

"Across the Pacific, we have adversaries far more sophisticated and agile than we've faced the past 15 years," says Curtiss-Wright's Couture. "Because things have sped up, I think we will be more agile, as well, but you can never assume we will always be king of the hill. You have to work for that. As we got into the Gulf wars, we got a lot of requests for protection against fine particulates, heat rather than cold."

Rugged computers look to the data center

Virtual-machine technology, fast interconnects, innovative thermal-management techniques, and modular architectures bring data-center power to embedded computing.

The Aitech RediBuilt A172 rugged computer is developed around a standard Type 6 COM Express module, the Intel Core i7 processor, an industry-standard pin-out, and the ability to support several processor options.

BY **John Keller**

Rugged computers for aerospace and defense applications have come a long way from the days of heavy boxes that could be dropped off the backs of trucks, run over in the mud, and then put back into operation as if nothing bad had ever happened.

Make no mistake: tough, rugged designs are just as important now as they've ever been — the military still demands drop-in-the-mud computers — yet today's rugged computers increasingly are taking lessons from sophisticated server computing, with fast interconnects, virtual-machine technology, and open-systems modular architectures rolled into tough mobile machines that would be just as at home in the back of a Humvee as they would in the data center.

Some issues involved in military rugged computing are just as important today as they were years ago, such as small size, weight, power, and cost (SWaP-C), and innovative electronics cooling approaches. Small powerful processors such as the Intel Xeon-D and even full Xeon processors are pushing thermal management schemes to the limit, and the rise of wearable computing, unmanned vehicles, and other SWaP-C-constrained applications demands computers that are smaller and more powerful than ever before.

Need for SWaP

"The major keyword is SWaP-C optimization," says Herve Garchette, business development manager at Creative Electronic Systems (CES) in Geneva, Switzerland. "SWaP-C means more and more complex systems integration of high-performance computing, systems on chips, and optical interfaces."

Often the notion of reducing cost, size, and weight run hand in hand. "Everyone is trying to get more features into a smaller form factor using SWaP-C methodology," says Jason Shields, product manager for 3U VPX systems at Curtiss-Wright Defense Solutions in Santa Clarita, Calif. "We are seeing a lot of consolidating of features; on current platforms we may have several functions in one platform. We are seeing a major consolidation effort; it reduces power and size with the reduction in cabling."

Inevitably, however, the tradeoff with SWaP-C typically involves hotter and hotter operating temperatures, which puts pressure on systems designers to come up with ever-more innovative cooling techniques. "Everybody is dealing with more and more compute density. We used to struggle to get 40 to 50 watts per slot in the old VME days. Now we have 50 watts at the CPU in 3U VPX," says David Pepper, product manager of core computing at Abaco Systems (formerly GE Intelligent Platforms) in Huntsville, Ala.

"People are putting more and more compute density in smaller and smaller space," Pepper continues. "We can have boards at the 3U form factor that are approaching 100 watts. Cooling is a pretty big challenge, and people are starting to look at whether conduction-cooled solutions are

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adequate, and asking if they might need something more exotic. Do we need more air-flow-through and liquid-flow-through cooling to handle the heat? Will the cooling technologies we have today accommodate the silicon of tomorrow?"

The answers to those questions can be elusive, and may involve not only new innovations in conduction, convection, and liquid cooling, but also new materials to better conduct heat away from critical components. "Heat management is very critical," says CES's Garchette. "Heat management can involve new materials; it is hard to follow some generic strategy."

The Themis Computer Hyper-Unity all-flash, hyper-converged, scalable rugged server computer infrastructure is for compute-intensive military and aerospace virtualized rackmount applications.

Getting the heat out

Dealing with heat is a central design issue when it comes to today's rugged high-performance computers. Heat essentially is a consequence of shrinking processor and circuit card size while improving computing performance. With more heat generated in a smaller area, techniques for getting the heat out have become critical parts of the design process.

Typically rugged computers for military applications use conduction cooling, which conducts heat away from hot components like processors over the circuit card, through the card edges, and through the enclosure to the outside air. Designers use a variety of techniques for conduction cooling, including conductive heat pipes, which act as efficient channels to conduct heat quickly over the card to the card edges. Convective cooling also can be effective as fans move heat over cards and through enclosures to the outside air. Fans can be a problem, however, as they represent a single point of failure in the design. Sometimes more

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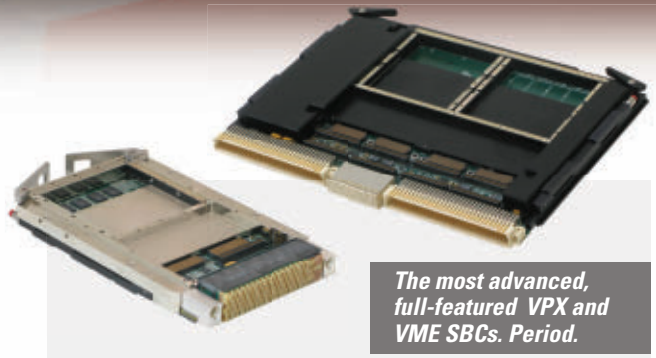

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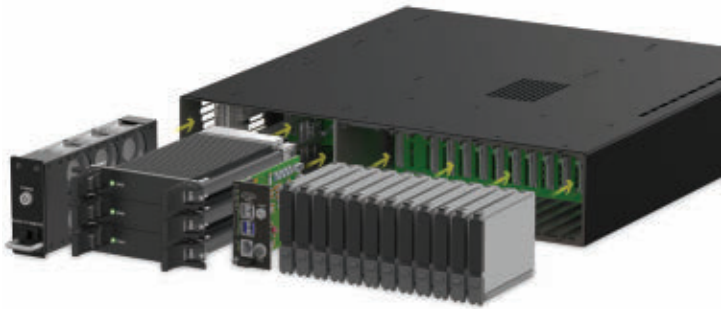
drastic measures are necessary.

When conduction and convection are inadequate for removing heat from high-performance rugged computers, designers often resort to liquid flow-through cooling, which channels heat through liquid that flows through the circuit cards and chassis. While effective, liquid flow-through cooling can add expense and weight to a design.



Today's military rugged high-performance computers are taking a modular design approach to facilitate future system upgrades and technology insertion.

Sometimes even more exotic thermal-management techniques are necessary, including refrigeration in which chassis are air-conditioned. Designers at General Micro Systems (GMS) in Rancho Cucamonga, Calif., are taking an entirely different approach with RuggedCool computers.

GMS engineers are using the full server-class Intel Xeon processor in the RuggedCool line which can generate heat as high as 135 watts, explains Ben Sharfi, CEO of General Micro Systems. "Cooling of the processor gets significantly more difficult when you deal with 135-watt processors," Sharfi says.

GMS designers use a thermal-management technique that mounts the processor to a copper plate, and floats the copper plate and processor in a tub of liquid silver. "The heat from the processor dissipates through the copper plate, which is suspended in a liquid-silver chamber," Sharfi says. "The silver melts and makes a perfect-thickness media, and next to gold, silver is the best thing for transferring heat."

An added benefit of this approach is the processor's ability to withstand the effects of shock and vibration. "Our shock resistance jumps up to 160 Gs because the processor is never touching the case," Sharfi says.

Moving away from standards

With all its benefits, there's a price to be paid for such a design, and the biggest one is the cost. "It is very expensive and very messy," Sharfi says. In addition, the RuggedCool approach represents a custom design, which many call into question in this era of open-systems standards.

A move away from open-systems standards is fine with Sharfi. "There are no standards in today's market in any platform," Sharfi declares. "There is no interchangeable standard that anybody can claim that is in the market today. It isn't VPX; VME was the last platform that did that. No two manufacturers use the same number of pinouts and lanes for VPX; the only standard is where the power pins are. Everything is custom; it's a single-manufacturer architecture."

While there is a noticeable move away from some open-systems standards in today's high-performance rugged computing designs, it's nothing like a wholesale rejection of standards that embraces full-custom designs — far from it.

Design trends involve standard interfaces from computer box to computer box, but less of an emphasis on interchangeable standards inside the box. "There's a trend in the market to look at an LRU [line-replaceable unit] as a boxed solution, and not based on a particular standard on the inside," says Mike Southworth, product marketing manager for small-form-factor systems at Curtiss-Wright Defense Solutions in Salt Lake City. "The trend we are seeing is customers are not tied into a specific standard or architecture." Some are even considering removing computing electronics from the enclosure altogether to save on size and weight.

No NRE required

A re-evaluation of rugged computer design that considers computing enclosures as building blocks with standard interfaces but with no particular adherence to standards inside the box presents some opportunities for budget-conscious customers in the aerospace and defense industry who are reluctant to pay non-recurring engineering (NRE) costs.

"Because of budget constraints there is a reluctance to having funding approved for custom solutions,

and lack of desire to pay for NRE," Southworth says. "Curtiss-Wright has a modified COTS [commercial off-the-shelf] business model to take modular systems and integrate off-the-shelf I/O modules without NRE costs."

This design approach also tends to be forward-looking because relying on industry-standard interfaces can help accommodate systems upgrades and technology insertion in the future. "There is no NRE today or in the future," says Curtiss-Wright's Shields. "We are designing for that flexibility so that when new boards come out on the market, designers can upgrade their systems without NRE."

The General Micro Systems SB1102-HDVR Eagle is a small-form-factor rugged video recorder and workstation processor able to capture four independent HD-SDI 1080p video channels at 60 frames per second.

Designers at Aitech Defense Systems in Chatsworth, Calif., take a no-NRE design approach and call it RediBuilt. "Going back a couple years, Aitech introduced the concept of RediBuilt that came to market in a couple different form factors to offer something to the customer that doesn't require any NRE," says Doug Patterson, vice president of the military & aerospace business sector at Aitech.

"The customer gets a box with cables for all his I/O on two 128-pin circular connectors," Patterson explains. "He gets his box with Intel- or PowerPC-based platforms, all configured, all his drivers, all done. All the customer has to do is put in his Ethernet address and go."

Aitech products in this category revolve around the company's RediBuilt A190 and A172 rugged computers. "These are fairly complex systems," Patterson says. "This can be used as a main mission computer for a large manned or unmanned aircraft. For example, we delivered an Intel-based solution and dropped it off with the customer. He loaded the program he had created on his laptop computer, and it all worked."

The smaller RediBuilt A172 rugged computer is being designed into unmanned ground vehicles — particularly one for airports that functions as an unmanned tug that tows aircraft from the gate to the runway to save on the plane wasting fuel while idling and taxiing.

"The already-built idea came into fruition because we were getting a lot of pushback from customers saying give us less NRE," Patterson says. "It was just about budgets as everything was sequestered. That rippled through the defense contractor base."

The RediBuilt approach enables designers to replace boards inside the box if they want, or customers can ask Aitech engineers to make the alteration. "Customers still want to add stuff, but they want to do it cheaply," Patterson says. "We put in the COM Express port for that, or add wireless to the module. Using Linux or Windows, people can work right out of the chute."

Virtualization in rugged computing

The need to accommodate legacy software in modern military computing architectures, together with the imperative to shrink the size and weight of computer hardware, are giving rise to the use of virtual machine technology in high-performance rugged computing.

Virtual machine refers to the ability to emulate one or more different kinds of computers on one architecture. Virtual machines operate based on the computer architecture and functions of a real or hypothetical computer, and their implementations may involve specialized hardware, software, or a combination of both.

"Everybody accepts that the virtual machine is key," Sharfi says. "A lot of imagery, payloads, and night-vision systems are written in Windows XP. You cannot just go run them on the latest multicore Intel i7 or Xeon processors. Microsoft does not support XP anymore, and the new hardware does not support those old drivers."

Virtualization technology, however, enables systems designers to run military software written in the 1980s alongside newly written software in the same system. "It takes the driver issue out," Sharfi says. "You take the image of a system you have from 30 years ago."

3U VPX single-board computers like the Abaco Systems SBC328 are building blocks for many of today's rugged military high-performance computers.

Virtual machine technology enables designers of large and complex computers for military surveillance and reconnaissance to size them appropriately for tight applications like unmanned vehicles, says Rick Studley, chief technology officer at Themis Computer in Fremont, Calif. "We are seeing much more virtualization, and collapsing the whole infrastructure to the next level of integration. We see a big embrace of hyper-convergence; it's like taking a data center and converting it into a small box. By adding more boxes to it you can grow your data center.

Interconnect challenges

Today's military rugged computers are pushing the bounds of data interconnects and I/O such that the industry as a whole may have to re-evaluate the need for optical interconnects to replace copper interconnects.

Fourth-generation PCI Express, which will move data as fast as 16 gigabaud, is expected to stabilize around 2017. "Can we accommodate this with our electronic backplanes, or is that the tipping point that will drive us to all-optical backplanes?" asks Abaco's Pepper. "We usually can find a way to do it, and we will keep trying to push that boundary, but in 2017 or 2018 we may have to face a change. We might not be able to go to the next step." ←

Raytheon to upgrade latest production lots of AMRAAM missiles

Missile designers at the Raytheon Co. will provide special tooling and test equipment, as well as technology refresh and upgrades of the latest batch of the AIM-120 Advanced Medium Range Air to Air Missile (AMRAAM) for the U.S. Air Force, Navy, and foreign militaries. Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., announced a $25.7 million contract modification to the Raytheon Missile Systems segment in Tucson, Ariz., to provide special tooling and special test equipment for the form, fit, function, refresh (F3R) transition to full-rate production, testing of F3R test software, fixtures, and equipment modifications for AMRAAM missiles production lots 28 to 30. The contract modification is related to a $491.5 million contract awarded to Raytheon last December for lot 28 AMRAAM production. Lot 28 involves federal fiscal year 2014 AMRAAM procurement, in which Pentagon officials plan to buy 227 AMRAAM missiles — 183 AIM-120D missiles for the Air Force, 44 for the Navy, and the rest for foreign military sales.

FOR MORE INFORMATION visit **Raytheon Missile Systems** online at *www.raytheon.com*.

Leidos moving ahead in EW effort to counter adaptive radar

BY **John Keller**

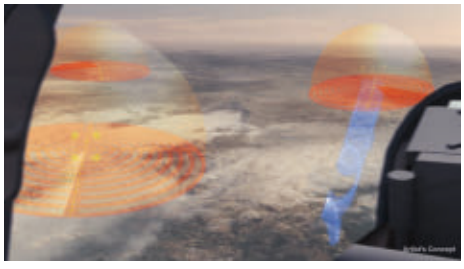
ARLINGTON, Va. — Electronic warfare (EW) experts at Leidos Holdings Inc. in Reston, Va., are continuing their work to find ways to detect and counter digitally programmable adaptive radar systems that have unknown behaviors and agile waveform characteristics.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $12.9 million contract modification to Leidos for the DARPA Adaptive Radar Countermeasures (ARC) program, which seeks to develop EW capability to counter hostile adaptive radar systems based on their over-the-air signals.

Leidos originally won a DARPA ARC contract in March 2013. Vadum Inc. in Raleigh, N.C.; Helios Remote Sensing Systems Inc. in Rome, N.Y.; Michigan Tech Research Institute (MTRI) in Ann Arbor, Mich.; BAE Systems Electronic Systems in Merrimack, N.H.; and Systems and Technology Research (STR) in Woburn, Mass., also are involved in the ARC program.

Adaptive radar uses digital technology to change its characteristics dynamically to adapt to changes in its environment. In particular, adaptive radar is being designed to counter the effects of EW countermeasures and other RF interference.

Leidos has been working with Exelis Inc. in Clifton, N.J., on evolving advanced technology development



DARPA is working with industry to develop ways of countering enemy digitally programmable adaptive radar.

in the DARPA ARC program. Harris Corp. completed its acquisition of Exelis last May.

Exelis is demonstrating Leidos software algorithms with an Exelis EW hardware-in-the-loop test environment as an enhanced capability to electronically defend against emerging radar threats.

Today's airborne EW systems are proficient at identifying analog radar systems that operate on fixed frequencies, experts say. Once they identify a hostile radar system, EW aircraft can apply a preprogrammed countermeasure technique. Yet the job of identifying modern digitally programmable radar variants using agile waveforms is becoming more difficult. Leidos and the other ARC contractors are working to enable systems to generate effective countermeasures automatically against new, unknown, or ambiguous radar signals in near real-time.

The goal of the DARPA ARC program is to develop ways to counter adaptive radar threats quickly based on over-the-air observable signals.

Key challenges are how to isolate signals clearly amid hostile, friendly, and neutral signals; figuring out the threat the signal poses; and jamming the signal. Modern enemy radar systems, however, are becoming digitally programmable with unknown behaviors and agile waveform, so identifying and jamming them is becoming increasingly difficult.

Leidos is developing processing techniques and algorithms to counter adaptive radar threats through real-time analysis of the threat's over-the-air observable properties and behaviors.

The program is developing a closed-loop system with signal analysis and characterization, countermeasure synthesis, and countermeasure effectiveness assessment. The system not only will be able to learn automatically to counter new radar threats, but also will enable human operators to command and receive feedback from the system.

DARPA officials say that software algorithms developed under the ARC program most likely will be used in existing or planned EW systems.

FOR MORE INFORMATION visit **Leidos** online at *www.leidos.com*.

Air Force reaches out to industry for fresh ideas on cyber security, SIGINT, and EW

BY **John Keller**

ROME, N.Y. — U.S. Air Force researchers are reaching out to industry for new ideas in cyber security, signals intelligence (SIGINT), electronic warfare (EW), and spectrum warfare.

Officials of the Air Force Research Laboratory's Information Directorate in Rome, N.Y., have released a request for information (BAA-AFRL-RIK-2015-0023) for the Full Spectrum Signals Intelligence (SIGINT) and Cyber Operations Technology program.

Electronic warfare, signals intelligence, and cyber security of primary thrusts of the Air Force Full Spectrum Signals Intelligence and Cyber Operations Technology program.

The RFI is soliciting industry for white papers that outline new technologies in cyber operations involving EW and SIGINT. Areas of interest include cyberspace operations that involve planning, technology, and new equipment for the warfighter with SIGINT, EW, and cyber capabilities.

Researchers expect the Full Spectrum SIGINT and Cyber Operations Technology program to result in experimental capabilities, concepts, theories, and applications in SIGINT and EW cyber operations to support the 24th Air Force, 25th Air Force, and other government agencies.

Topics of interest include applying machine learning, mission platforms, and spectrum issues to cyber operations, and improving cyber exercise technology, Air Force researchers say. Researchers are looking for classified and unclassified responses.

Funding for the program is roughly $49.8 million through 2020: $9.8 million in 2016; $11 million in 2017; $10 million in 2018; $10 million in 2019; and $9 million in 2020.

Air Force researchers are asking industry to send white papers no later than 8 Jan 2016 for the fiscal 2016 part of the program, 1 Dec. 2016 for fiscal 2017, 1 Dec. 2017 for fiscal 2018, 30 Nov 2018 for fiscal 2019, and 6 Dec. 2019 for fiscal 2020. White papers will be accepted until 30 Sept. 2020.

Additional technical information is available in a classified document at the Secret level. To request a copy of the classified document, as well as to submit white papers, e-mail either Air Force Capt. John Cobb and 1st Lt. Richard Agbeyibor at afrl.rigd.baa13-02@us.af.mil. Phone Cobb at 315-330-4315 or Agbeyibor at 315-330-3097 for questions or concerns.

For contacting questions, contact the Air Force's Gail Marsh by e-mail at Gail.Marsh@us.af.mil.

More information is online at https://www.fbo.gov/spg/USAF/AFMC/AFRLRRS/BAA-AFRL-RIK-2015-0023/listing.html.

Insitu to provide ScanEagle UAVs and training facility for Afghanistan

U.S. Navy unmanned vehicle experts are establishing an in-theater training facility in Afghanistan to help Afghan military forces learn to use Insitu ScanEagle small unmanned aerial vehicles (UAVs) under terms of a $70.9 million contract. Officials at the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., are asking Insitu Inc., a Boeing Co. subsidiary in Bingen, Wash., to provide the Afghan military with 65 ScanEagle UAVs, spare parts, field support, and training. The contract is for eight ScanEagle unmanned aircraft systems for the government of Afghanistan under the Foreign Military Sales program. These systems consist of 65 ScanEagle Air Vehicles, spares, support equipment, field service support, an in-theater ScanEagle training facility, and training. The mission of ScanEagle is to provide persistent surveillance and reconnaissance imagery on land or at sea at lower costs than other surveillance methods for military and agriculture missions.

FOR MORE INFORMATION
visit **Insitu Inc.** online at *www.insitu.com* and the **Naval Air Warfare Center Aircraft Division-Lakehurst** at *www.navair.navy.mil.*

Hydroid to ramp-up production of MK 18 Kingfish unmanned underwater vehicle

BY **John Keller**

INDIAN HEAD, Md. — Unmanned underwater vehicle (UUV) experts at Hydroid Inc. in Pocasset, Mass., are ramping-up production of the company's MK 18 Kingfish family of unmanned submersibles under terms of a $8.7 million contract.

Officials of the Naval Surface Warfare Center (NSWC) Indian Head Explosive Ordnance Disposal Technology Division in Indian Head, Md., are asking Hydroid to increase quantities for the procurement of additional MK 18 family of system assets.

The Navy's MK 18 UUV is a variant of the Hydroid REMUS 600, which Hydroid originally developed through funding from the Office of Naval Research (ONR) in Arlington, Va., to support the Navy's UUVs with extended endurance, increased payload capacity, and greater operating depth.

The REMUS 600 can dive to depths of nearly 2,000 feet, and can operate on one battery charge for as long as 24 hours. The UUV is for mine countermeasures; harbor security; debris field mapping; search and salvage; scientific sampling and mapping; hydrographic surveys; environmental monitoring; and fishery operations. REMUS is short for Remote Environmental Measuring Unit S.

The torpedo-shaped REMUS 600 is nearly 13 feet long and two feet in diameter. The unit weighs 622 pounds. It has dynamic focus side look sonar (SLS), a Neil Brown conductivity and temperature sensor (CT), WET Labs beam attenuation meter (BAM) optical sensor, Imagenex 852 pencil beam sonar for obstacle avoidance, and a WET Labs ECO fluorometer and turbidity measurement sensor.

The Hydroid MK 18 Kingfish unmanned underwater vehicle, shown above, will help the U.S. Navy with mine countermeasures, harbor security, debris field mapping, search and salvage, and scientific sampling.

Its communications suite consists of long baseline acoustic communications, WiFi, Iridium satellite communications, and radio modem via gateway buoy. The UUV navigates by up- and down-looking acoustic Doppler current profiler; Doppler velocity log; Kearfott inertial navigation unit; compass; and GPS.

The REMUS 600 has a modular design to meet a variety of payloads. The UUV has a series of hull sections that can be separated for vehicle reconfiguration, maintenance, and shipping. It uses the Hydroid Vehicle Interface Program (VIP) for maintenance, checkout, mission planning, and data analysis.

Hydroid will do the work in Pocasset, Mass., and should be finished by September 2017. Hydroid is a subsidiary of Kongsberg Maritime AS in Kongsberg, Norway.

L-3 to install components of Navy Atlantic underwater warfare range

BY **John Keller**

ORLANDO, Fla. — Officials of the Training Systems Division of the U.S. Naval Air Warfare Center in Orlando, Fla., are asking L-3 Communications MariPro in Goleta, Calif., to install the Ocean Sensor Subsystem (OSS) and the Shore Electronics Subsystem (SES) of the Undersea Warfare Training Range (USWTR) off the coast of Jacksonville, Fla., under terms of a $12.6 million contract modification.

The USWTR will help train ship, submarine, and aircraft crews to track targets on the surface and under water, and enable unmanned underwater vehicles (UUVs), manned submarines, surface ships, and aircraft to work together. The USWTR, which L-3 MariPro is building 50 nautical miles east of Jacksonville, Fla., will be a high-fidelity underwater tracking and communications range for anti-submarine warfare (ASW) and anti-surface warfare (ASuW) training.

By the time the underwater training range comes online in 2019, it will process and display on-range tracking data for ships, submarines, weapons, targets, and unmanned undersea vehicles (UUVs) to help naval surface and submarine forces plan and carry out attacks on submerged targets that simulate enemy submarines.

The contract modification calls for L-3 MariPro to install two components of the USWTR. The wet end, or Ocean Sensor Subsystem, will consist of as many as 300 underwater acoustic devices located throughout the 500-square-mile range. The OSS will have more than 600 nautical miles of node cable; two junction boxes; and shore-based display, processing, and control subsystems. The range's dry end, or the shore electronics subsystem, is located on the shore at Jacksonville, Fla., and interfaces with a digital signal processor (DSP).

Some undersea nodes in the OSS ping active sonar signals through the water where other receiver nodes pick them up. The SES detects and time tags the ping signals, which then go to an underwater tracking subsystem that calculates the positions of underwater targets through triangulation.

The OSS consists of hydrophones and other electronics mounted on the ocean bottom throughout the tracking range area that are integrated with a cable system to bring the signals back to the SES on shore. The OSS will have a projector that acts as an underwater telephone to enable operators to communicate with submarines on the range.

The SES, meanwhile, serves as the shore termination component for the OSS, providing power to the OSS, and interfaces with the OSS by coaxial or optical cable to receive signals from the hydrophones and transmit signals to the projectors.

The USWTR will enable Navy training scenarios ranging from one fixed-wing aircraft or helicopter vs. one submarine; one ship and one helicopter vs. one submarine; one submarine vs. one submarine; and two surface ships and two helicopters vs. one submarine.

Those training on the range will be able to use a variety of practice torpedoes, active and passive sonobuoys, dipping sonar, torpedo sonar, underwater communications, submarine acoustic countermeasures, expendable bathythermographs, and anti-torpedo decoys. Training scenarios can last from two to six hours.

The Navy's Atlantic underwater warfare training range off the coast of Florida will help manned and unmanned submarines work together with aircraft and surface ships to pursue enemy submarines.

The Navy finished installing ocean cables under the seafloor on the training range last summer. The USWTR ultimately will have a cable termination facility at Mayport Naval Station in Atlantic Beach, Fla., and a range operations center at Jacksonville Naval Air Station in Jacksonville, Fla.

L-3 MariPro initially won a potential $127 million contract in 2012 to design the USWTR. The program's first phase provides the initial infrastructure, including shore facilities and equipment, as well as near-shore cable and sea bed sensors to instrument an area of approximately 200 square nautical miles. The second phase will instrument the remaining 300 square nautical miles.

L-3 MariPro will do the work on this contract in Goleta, Calif.; Newington, N.H.; and Mayport, Fla., and should be finished by May 2019.

FOR MORE INFORMATION visit **L-3 MariPro** at *www.l-3mps.com/maripro*.

Raytheon to build anti-tank turrets for Marine Corps Light Armored Vehicle

Vetronics experts at Raytheon are building 22 new anti-tank turrets for special variants of the U.S. Marine Corps General Dynamics Light Armored Vehicle (LAV). Officials of the Army Contracting Command in Warren, Mich., announced a $32.7 million contract modification to the Raytheon Co. Missile Systems segment in McKinney, Texas, to build the new anti-tank turrets, which enable Marine Corps LAV crews to fire the Raytheon tube-launched, optically tracked, wireless-guided (TOW) anti-armor missile. Raytheon will provide the LAV anti-tank version (LAV-AT) with an improved thermal sight and advanced fire-control system to enable the combat vehicle to acquire targets while on the move, fire current and next-generation heavy anti-armor missiles, and provide multi-shot capability. These improvements are expected to improve the reliability, availability, maintainability, supportability, and mission effectiveness of the LAV-AT. The $32.6 million contract modification is an addition to Raytheon's original $19.7 million contract, awarded in April 2012, for the engineering and manufacturing development (EMD) phase of the LAV-AT Modernization Program.

FOR MORE INFORMATION visit **Raytheon Missile Systems** online at *www.raytheon.com*, and **Army Contracting Command-Warren** at *http://contracting.tacom.army.mil*.

Northrop Grumman eyes new Navy shipboard navigation to replace aging AN/WSN-7

BY **John Keller**

WASHINGTON — U.S. Navy shipboard electronics experts are moving forward with a project to replace the aging AN/WSN-7 ring laser gyro for shipboard navigation with a new inertial sensor module to enable surface vessels to navigate accurately without GPS satellite navigation.

Officials of the Naval Sea Systems Command in Washington announced a $19.8 million contract to Northrop Grumman Corp. in Charlottesville, Va., to develop the Inertial Navigation Systems Replacement (INS-R) Inertial Sensor Module (ISM). The INS-R ISM will serve as the Navy's primary position source in the absence of a Global Positioning System (GPS). The INS-R will provide mission-critical ship positioning, velocity, and altitude data to shipboard sensors, combat systems, guns, and missile systems.

The contract calls for Northrop Grumman to develop and build the INS-R ISM, as well as to provide spare parts and technical support. The contract has options that could increase its value to $47.8 million. The company will provide engineering development models, pre-production units, low-rate initial production, and two years of full-rate production.

The INS-R will replace the AN/WSN-7 ring laser gyro navigation system, which uses 25-year-old technology based on the NATO MK49 inertial navigation system deployed in the late 1980s. The INS-R will provide improved real-time navigation for Navy surface warships, and enable future technology growth. An INS-R ship set will consist of two dual-redundant navigator units — one in the aft section and one in the forward section — that will operate independently of one another for survivability.

Northrop Grumman is developing a new shipboard inertial navigation system to replace the aging AN/WSN-7 ring laser gyro.

Northrop Grumman engineers will use an open-systems architecture using a modular design, standards-based interfaces, and standards to facilitate future technology insertion and technology refresh.

The contract calls for Northrop Grumman to use as many commercial off-the-shelf (COTS) components as possible in the INS-R ISM design.

On this contract Northrop Grumman will do the work in Charlottesville, Va.; Woodland Hills, Calif.; and Salt Lake City, and should be finished by November 2016.

FOR MORE INFORMATION visit **Northrop Grumman** at *www.northropgrumman.com*.

DARPA considers small optical sensor using free-space optical technology

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking for industry's help in developing a small, lightweight electro-optical sensor using free-space optical technology with ultra-low size, weight, and cost with much faster beam scanning speeds than are available today.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have released a broad agency announcement (DARPA-BAA-16-13) for the Modular Optical Aperture Building Blocks (MOABB) project.

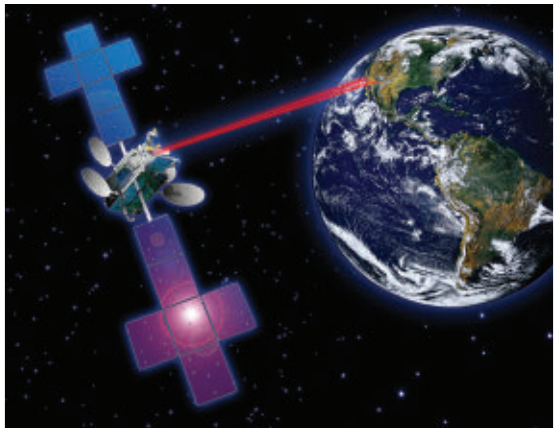
MOABB seeks to develop technologies for an integrated photonic device that can generate, amplify, transmit, and receive free-space optical radiation over a wide angle. Researchers eventually would like to demonstrate this technology in a light detection and ranging (LIDAR) system.

DARPA researchers want to build planar, millimeter-scale transmit/receive units with a high fillfactor aperture, non-mechanical beam steering, and integrated amplification. Their goal is to tile the unit cells to assemble a large coherent higher-power aperture.

The program ultimately seeks to fabricate a coherent 10-centimeter transmit/receive array with distributed gain built with wafer-scale processing, and demonstrate the coherent array in a packaged LIDAR system capable of 3D imaging from as far away as 100 meters.

Free-space optical systems have tremendous potential for sensing, illumination, and communications, DARPA scientists say. The micron-scale wavelength allows for 0.001-degree angular resolution and antenna gain of more than 100 decibels from a modest 10-centimeter aperture.

The frequency in the hundreds of terahertz range and wide operating bandwidths enable high-speed data transmission and 3D imaging with sub-millimeter range resolution.



DARPA wants to develop a small, lightweight electro-optical sensor using free-space optical technology for 3D mapping, foliage penetrating LIDAR, navigation, and long-range communications.

Optical beams also have wide windows of low atmospheric absorption for long-range propagation over terahertz of open bandwidth.

Applications for these features span the space from 3D mapping, foliage penetrating LIDAR, navigation, and long-range communications.

While free-space optical systems offer compelling capabilities, they are too big, heavy, and expensive for many applications. Above a 10-centimeter aperture, their size and weight are dominated by the bulky lenses, mirrors, stabilized mechanical components, and large volume of empty space of the telescope or imaging system.

On the other hand, aperture smaller than 10 centimeters still require bulky mechanical gimbals to steer the telescope and the back-end optics like lasers and detectors.

Instead, DARPA scientists want to capitalize on recent developments in integrated photonics that offer the potential for high-speed, non-mechanical beam-steering. Researchers believe that efficient sources, detectors, amplifiers, and low-loss waveguides can be fabricated on one planar platform for high-power, large-scale apertures.

The MOABB program has two technical areas: technologies for a tileable optical array element for operation in the short-wave infrared band, and a packaged LIDAR system that demonstrates the utility of this kind of technology.

The 21-month first phase of the MOABB program will address the modular transmit and receive unit cells. The second, 18-month phase will develop the unit cell efficiency and fill-factor. The 21-month, third phase will 100-square-inch transmit and receive apertures. Several contract awards are expected.

Companies interested should submit proposals no later than 16 Feb. 2016 to the DARPA website at https://baa.darpa.mil. E-mail questions or concerns to DARPA's Joshua Conway at DARPA-BAA-16-13@darpa.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-BAA-16-13/listing.html*.

PRODUCT applications

RF AND MICROWAVE

Backpack jammers help Marines counter roadside bombs, disrupt enemy communications

Sierra Nevada Corp. in Sparks, Nev., won a $73.2 mil-lion U.S. Marine Corps contract to provide Marine Expeditionary Units with the Sierra Nevada Modi II backpack electronic warfare (EW) system to defeat improvised explosive devices (IEDs) and disrupt enemy communications on the battlefield.

The order is for 581 systems, including spares and training. Sierra Nevada's EW products are fielded to protect U.S. and allied forces against radio-controlled improvised explosive devices (RCIEDs). The Modi II represents an evolution of the company's Thor II/AN PLT-5 and Thor III AN/PLQ-9.

The AN/PLT-5 man-packable ECM system, known as Thor II, was developed for joint Explosive Ordnance Disposal forces and AN/PLQ-9 was developed for joint conventional forces.

Sierra Nevada's software-definable EW systems are configured for backpack, vehicular, fixed-site, and airborne applications. The Modi II system is a potential multifunction, networked, military system of systems architecture.

FOR MORE INFORMATION visit **Sierra Nevada** online at *www.sncorp.com*.

EMBEDDED COMPUTING

BAE Systems chooses embedded computing from Abaco Systems for Spearfish torpedo

Torpedo designers at BAE Systems needed rugged embedded computing to control the United Kingdom Royal Navy submarine-launched Spearfish heavyweight torpedo. They found their solution at Abaco Systems (formerly GE Intelligent Platforms) in Huntsville, Ala.

Officials of BAE Systems Maritime Services in Portsmouth, England, have placed $11.5 million in orders with Abaco Systems for rugged embedded computing within the electronic system computer unit (ESCU) that controls the Spearfish torpedo in deployment. The Abaco ESCU provides advanced, real-time signal processing of the Spearfish's

onboard sonar to enable it to reach its target, and networking to enable the torpedo to communicate with its host submarine.

The Spearfish ESCU has several 3U VPX Power Architecture- and 4th generation Intel Core i7-based single-board computers from Abaco Systems that provide control, tactical, and real-time digital signal processing. An Ethernet switch provides communications and networking.

Abaco Systems and BAE Systems experts worked together for five years to craft a feasibility study and prototype ESCU using a 6U VME architecture, Abaco Systems officials say. The team migrated to 3U VPX technology for torpedo deployment.

"Our ability to provide a solution that met the requirement for rugged, high-performance embedded computing in an environment in which space and power are constrained, and our ability to evolve our offering over the course of the last five years in response to BAE Systems' requirements were important factors in securing this business," Abaco Systems CEO Bernie Anger explains.

BAE Systems won a $550 million order from the U.K. Ministry of Defence to upgrade the Spearfish torpedo. The upgrade, known as Spearfish Mod 1, extends the life of the torpedo, and improves safety with an insensitive munitions warhead and a single-fuel system.

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

DISPLAYS

Coast Guard chooses night-vision displays from Daisy for C-130H aircraft

U.S. Coast Guard officials needed flat-panel cockpit displays compatible with night-vision goggles in the Lockheed Martin C-130 four-engine turboprop aircraft. They found their solution at Daisy Data Displays in York Haven, Pa.

Coast Guard officials are acquiring Daisy displays for the service's fleet of C-130H aircraft. The plane's two-pilot flight station has digital avionics, head-up displays, and a navigation system that flight crews must be able to read in all degrees of light.

The Coast Guard's purchase includes the Fleetmate 7171CA series thin-client, panel/rack-mount X-Terminal with a commercial off-the-shelf (COTS) design for military applications and Coast Guard and airborne equipment. The display weighs less than 10 pounds and has a 10/100 Base-T network port, integrated LCD heater for operating in cold temperatures, on-screen virtual keyboard for set-up and data entry, brightness to 500 nits with brightness setting from bright to zero, and a viewing cone to 85 degrees.

The 10.4-inch display is packaged in aluminum 6061-T6, cold rolled steel, and nickel plating. It measures 7.94 inches high, 10.68 inches wide, and 3.5 inches deep; weighs eight pounds; operates in temperatures from -30 to 50 degrees Celsius; and offers 640 by 480 pixel resolution.

Daisy monitors use a night-vision imaging system (NVIS) technology that providers users color readability in daylight and with night-vision goggles without the need for add-on filters. ←

FOR MORE INFORMATION visit **Daisy Data Displays** online at *www.makeitdaisy.com*.

new PRODUCTS

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

AVIONICS

Interface cable for ARINC 429 avionics databus analyzer applications introduced by AIM

AIM USA in Trevose, Pa., is introducing the AIM SmartCable to interface with ARINC 429 avionics databus analyzer and data loader applications. The first in the AIM SmartCable cable and connector family is the

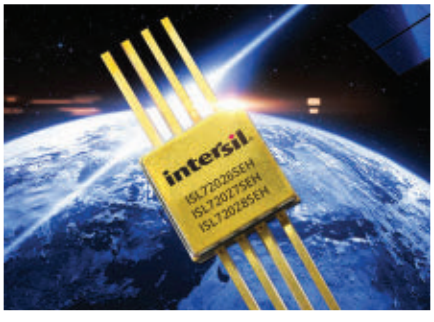
ASC429 for ARINC 429 testing, designed to offer a USB-based interface solution operating on one USB 2.0 port (or higher). The low-power hardware design enables a half-pocket sized interface for ARINC 429 test, simulation, monitoring, and data loading applications. Data bus protocol-related, real-time capabilities over the USB interface come from having the necessary hardware, firmware, and processing resources directly integrated within the almost standard D-Sub connector-sized housing. Additional processing capability is offered by the use of a dual-processor system-on-chip (SOC) device inside the ASC.

FOR MORE INFORMATION visit **AIM USA** online at *www.aim-online.com*.

RAD HARD

Radiation-hardened multiplexers for space introduced by Intersil

Intersil Corp. in Milpitas, Calif., is introducing three radiation-hardened ISL7202xSEH controller area network (CAN) transceivers for databus control in orbiting satellites. The radiation-tolerant, 3.3-volt CAN bus transceivers are QML-V qualified and compliant with the ISO11898-2 physical layer standard. The devices provide serial data transmission between a CAN controller and CAN bus at speeds to 1 megabit per second. Systems designers can connect as many as 120 of Intersil's ISL7202xSEH transceivers to one CAN bus to reduce cabling and harness size, weight, and power (SWaP). The ISL72026SEH, ISL72027SEH, and ISL72028SEH 3.3-volt CAN transceivers capitalize on Intersil's proprietary



silicon on insulator process, which provides single event latch-up (SEL) and single event burn-out (SEB) robustness in heavy ion environments.

FOR MORE INFORMATION visit **Intersil** at *www.intersil.com/products/isl72026seh*.

POWER ELECTRONICS

6U OpenVPX power supply for military applications introduced by Behlman

Behlman Electronics Inc. in Hauppauge, N.Y., is introducing a 6U OpenVPX power supply called the VPXtra 1000CM-IQ for communication, measurement, and control functions in military applications.

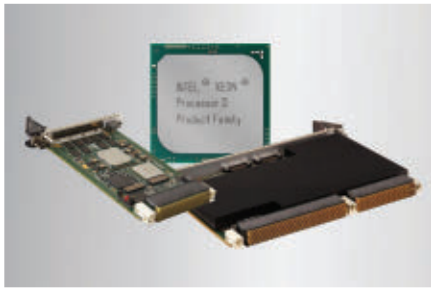
The intelligent VITA 62-compliant, embedded computing power supply delivers 700 watts of DC power via five outputs. It can use input power ranging from 18 to 36 volts DC to operate in variable conditions. VPX embedded computing system designers can have 12 volts DC at 40 amps, 5 volts DC at 24 amps, 3.3 volts DC at 15 amps, -12 volts DC at 2 amps, and +12 volts DC at 1 amp. In addition, 12 volts DC output can be paralleled. Other features include low noise and ripple; input-output isolation; over-current, over-voltage, and over-temperature protection; load regulation; high power density; and 90 percent typical efficiency.

FOR MORE INFORMATION visit **Behlman** online at *www.behlman.com*.

BOARD PRODUCTS

OpenVPX computing boards for radar and EW offered by Curtiss-Wright

The Curtiss-Wright Defense Solutions Division in Ashburn, Va., is introducing the 3U OpenVPX CHAMP-XD1 and 6U CHAMP-XD2 digital signal processing (DSP) embedded computing modules for deployment in compute-intensive, harsh-environment military electronic warfare



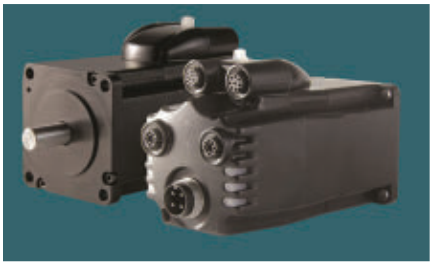
(EW), radar, surveillance, and reconnaissance applications. The modules use the Intel Xeon processor D-1500 product family. The modules, which are available with 8-core versions of the processor, also will be available with 12 and 16-core versions of the processor, which Intel will make available in the first quarter of 2016. The 12-core version will offer extended-temperature support, and all the variants offer 7-year availability. The 3U CHAMP-XD1 is scheduled to ship in December 2015, with the 6U CHAMP-XD2 to follow in early 2016.

FOR MORE INFORMATION visit **Curtiss-Wright Defense Solutions** online at *www.cwcdefense.com*.

MOTION CONTROL

Smart motor for motion control in test equipment offered by Moog

Moog Animatics in Milpitas, Calif., is introducing the standard Class 6 SmartMotor for material handling, testing equipment, packaging ma-



chinery, manufacturing equipment, and spooling and winding machinery. The Class 6 Ethernet/IP SmartMotor is available in standard servo and hybrid smart motor versions, includes PROFINET and EtherCAT versions, and extends the industrial Ethernet SmartMotor with Ethernet/IP position controller capability. The Class 6 Ethernet/IP SmartMotor integrates as a position controller device for access to SmartMotor commands and parameters, improved uptime and optional redundant cabling through device level ring (DLR); and simplified, modular programming through add on instructions (AOI).

FOR MORE INFORMATION visit **Moog Animatics** at *www.animatics.com*.

DATA ACQUISITION

FMCs for data acquisition in radar introduced by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing the FlexorSet model 5973-324 for 3U VPX and model 7070-324 for PCI Express data acquisition for radar, communications, and general data acquisition applications. They consist of the Flexor model 3324 four-channel A/D and four-channel D/A embedded computing FPGA mezzanine card (FMC) installed on either of two carriers. The carriers contain Pentek field-programmable gate array (FPGA) intellectual property (IP) for A/D acquisition and D/A waveform playback, which is matched to the four 500 MHz, 16-bit A/Ds and the four 1.5 GHz, 16-bit D/As with digital up-converters (DUCs) on the FMC.

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

RUGGED TABLET COMPUTERS

Rugged Android rugged tablet computer introduced by Handheld USA

Handheld USA Inc. in Corvallis, Ore., is introducing the ALGIZ RT7 mobile Android rugged tablet computer for reliable performance in demanding environments. The AL-

GIZ RT7 is a lightweight, ergonomic, 7-inch tablet that runs Android 5.1.1 (Lollipop), provides a wide range of features to mobile work forces, and meets MIL-STD-810G military standards for protection against drops, vibration, and extreme temperatures. The rugged tablet also is IP65-rated for waterproofing as well as sealed against sand and dust. The tablet weighs less than 1.5 pounds, and features an MSM8916 (Snapdragon) chipset and 1.2 GHz quad-core processor. It comes standard with LTE data and voice capabilities as well as 802.11 b/g/n WLAN, BT Class 1 and Class 2, and NFC functionality. It also has dual cameras and dual SIM card slots. The unit comes with a built-in accelerometer, gyroscope, and e-compass and a stand-alone u-blox GPS receiver for navigation.

FOR MORE INFORMATION visit **Handheld USA** online at *www.handheldgroup.com/RT7*.

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