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High-performance embedded computing

Engineers blending several HPEC components in hybrid architecture for sensor and signal processing. PAGE 16

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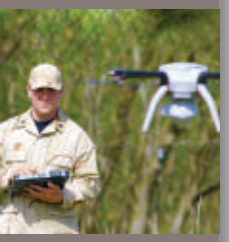

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BY **JOHN KELLER**, EDITOR IN CHIEF

Time to boost the importance of U.S. Cyber Command

Simple question: Are top U.S. government leaders serious about cybersecurity and cyber warfare, or not? It would be simple for anyone concerned to say, "what a silly question; of course we are!" Okay, then, it's time to prove it.

Congress is considering a plan to boost the profile of U.S. Cyber Command at Fort Meade, Md., by elevating the organization to the status of a unified combatant command. Put simply, that would mean that Cyber Command leaders would report directly to the secretary of defense and the president of the United States, unencumbered by other layers of command.

Is cybersecurity high enough on the list of national defense priorities to warrant its own unified command? Clearly the answer is yes. Only nuclear weapons post a more dire threat to the continued existence of the U.S. as a national entity than does cybersecurity.

A catastrophic cyber attack on U.S. military forces and public service infrastructure like power distribution, transportation, water, finance, and the food supply has the potential to trigger millions of deaths in Continental U.S. within a few months. There's a good reason that experts refer to a potential catastrophic cyber attack as a "Cyber Pearl Harbor."

The U.S. House of Representatives just approved a defense authorization bill for federal fiscal 2017. This bill contains a provision to make U.S. Cyber Command the nation's tenth unified combatant command. The Senate has yet to vote on the measure, and it's not clear if boosting Cyber Command's profile might face a presidential veto.

The nine unified combatant commands that exist today in the U.S. Department of Defense (DOD) are: U.S. Africa Command based in Stuttgart, Germany; U.S. Central Command based at MacDill Air Force Base, Fla.; U.S. European Command based in Stuttgart, Germany; U.S. Northern Command at Peterson Air Force Base, Colo.; U.S. Pacific Command at Camp H. M. Smith, Hawaii; U.S. Southern Command in Doral, Fla.; U.S. Special Operations Command at MacDill Air Force Base, Fla.; U.S. Strategic Command at Offutt Air Force Base, Neb.; and U.S. Transportation Command at Scott Air Force Base, Ill.

Placing Cyber Command among these organizations would take it out from under U.S. Strategic Command, where Cyber Command resides today as an armed forces sub-unified command. U.S. Strategic Command primarily is responsible for maintaining and deploying the nation's arsenal of land-, submarine-, and aircraft-based nuclear weapons. The organization also is responsible for missile defense; command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR); and combating weapons of mass destruction. It's an open question whether Cyber Command fits in here.

Still, let's face it, I'm not hearing about another potential global "Pearl Harbor" when it comes to special operations, transportation, or C4ISR. It's time that Cyber Command with its responsibilities for policies, plans, and enabling technologies for offensive and defense cyber warfare stepped out on its own.

There's much to be gained. Cyber activities within the U.S. government and the cyber industry that supports them today are woefully fragmented. Industry doesn't have one clear mission when it comes to developing the most important cybersecurity technologies. Customer bases are scattered, and we have a collection of competing cyber fiefdoms.

Now it's time for one voice and one clear message to industry, and elevating U.S. Cyber Command to a unified combatant command within the U.S. Department of Defense is a crucial first step toward that goal.

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Air Force, NASA to develop radiation-hardened ARM processor for space

BY JOHN KELLER

GREENBELT, Md. — U.S. government space researchers want industry to develop a next-generation, radiation-hardened, general-purpose, multi-core processor within the next four years to meet on-board computing needs of future manned spacecraft and space robots.

Officials of the NASA Goddard Space Flight Center in Greenbelt, Md., have issued the final solicitation for the High Performance Spaceflight Computing (HPSC) Processor Chiplet program for NASA and U.S. Air Force manned and unmanned spacecraft.

This four-year project is expected to deliver a next-generation, rad-hard space processor based on the ARM processor architecture to provide optimal power-to-performance for upgradeability, software availability, ease of use, and cost.

The HPSC project also will use Radiation Hard By Design (RHBD) standard cell libraries, as well as the ARM A53 processor with its internal NEON single instruction, multiple data (SIMD) design. Experts say a heterogeneous multi-core architecture using many different processor core types will not provide the best possible return on investment.

NASA and the U.S. Air Force are asking industry to develop a new rad-hard ARM processor for future space applications.

IN BRIEF

Boeing to upgrade missile guidance systems on Minuteman III ICBMs

Missile guidance experts at the Boeing Co. will continue upgrading guidance systems on U.S. Minuteman III intercontinental ballistic missiles (ICBMs) under an $8.1 million U.S. Air Force contract modification. Officials of the Air Force Nuclear Weapon Center's Intercontinental Ballistic Missile Systems Directorate at Hill Air Force Base, Utah, are asking the Boeing Directed Energy & Strategic Systems segment in Layton, Utah, to upgrade the communications equipment interface unit (CEIU) in the Minuteman III ICBM guidance system. The order asks Boeing to provide engineering and manufacturing development (EMD) for the nuclear missile's CEIU. EMD means full-scale development. Boeing engineers will provide updates to the Minuteman III's legacy CEIU to a more robust software language and change the communication protocol from telephony to Internet protocol to address security concerns. This project is called Performance Assessment Data System Communications Equipment Interface Unit (PADS CEIU), an interface unit using an analog signal over the telephone line using a standard commercial off-the-shelf (COTS) modem.

Applications for the HPSC processor will include military surveillance and weapons systems, human-rated spacecraft, habitats and vehicles, and robotic science and exploration platforms. System applications range from small satellites to large flagship-class missions.

Space computing tasks of the HPSC processor will include command and data handling, guidance navigation and control, and communications like software-defined radio; human assist, data representation, and cloud computing; high-rate, real-time sensor data processing; and autonomy and science processing.

The HPSC processor will include Serial RapidIO (SRIO) for high-bandwidth communications, and several interfaces to high-speed, off-chip memory. The SRIO interfaces also can function as advanced microcontroller bus architecture (AMBA)-bus bridges to tile or cascade several processors to increase bandwidth or improve fault tolerance.

The SRIO interface also can extend the HPSC processor to other SRIO-enabled processing devices such as field-programmable gate arrays (FPGAs), graphics processing units (GPUs), and in the future to other application-specific integrated circuit (ASIC)-based coprocessors.

Future onboard space computers for manned and unmanned missions will require big improvements in vision-based algorithms with real-time requirements; model-based reasoning techniques for autonomy; and high-rate instrument data processing.

A key goal for the HPSC project is the ability to trade dynamically between processing throughput, power consumption, and fault tolerance. The HPSC processor architecture sometimes will be inside a dedicated spaceflight computer, and sometimes may be embedded in a science instrument or spaceflight subsystem.

Companies interested were asked to submit bids by 20 July 2016.

E-mail NASA's Denise Sydnor for more information at denise.y.sydnor@nasa.gov. Program details are online at https://www.fbo.gov/notices/eefe806f639ae00527a13da6b73b3001.

BAE Systems developing advanced EW to counter enemy radar

BY JOHN KELLER

ARLINGTON, Va. — Officials at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $13.4 million contract modification to BAE Systems Electronic Systems in Merrimack, N.H., for phase-three of the Adaptive Radar Countermeasures (ARC) program.

The ARC program seeks to develop electronic warfare (EW) capabilities to identify, characterize, and adapt to advanced, complex radar. The program uses machine learning to learn in real time what adversary radar is doing and create a new jamming profile on-the-fly. The program's goal is to develop ways of countering adaptive radar threats quickly based on over-the-air observable signals.

Threats of particular interest include ground-to-air and air-to-air phased array radars capable of performing several different functions, such as surveillance, cued target acquisition, tracking, non-cooperative target identification, and missile tracking. These radar systems are agile in beam steering, waveform, coding, and pulse repetition interval. Key challenges to the ARC contractors 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 are becoming digitally programmable with unknown behaviors and agile waveforms, so identifying and jamming them is becoming increasingly difficult. Things will get worse in the future as radars develop the ability to sense their environment and adapt their transmission characteristics and pulse processing algorithms to defeat attempts to jam them.

BAE Systems engineers completed algorithm development and component-level testing in phase-one of the ARC program. In the second phase, they completed algorithm integration into an EW payload along with extensive hardware-in-the-loop testing involving thousands of tests against advanced closed-radar simulators.

Now BAE Systems experts move into the third and final phase of the DARPA ARC program in which they will work to increase the complexity and realism of ARC testing. The program is expected to be complete in 2018, and then BAE Systems and U.S. military experts will move ARC-developed technologies into existing EW systems. BAE Systems originally won a 30-month, $36.7 million ARC phase-one contract in March 2013.

In addition to BAE Systems, ARC phase-one contractors are Leidos in Reston, Va.; Vadum Inc. in Raleigh, N.C.; Helios Remote Sensing Systems Inc. in Rome, N.Y.; Michigan Tech Research Institute (MTRI) in Ann Arbor, Mich.; and Systems and Technology Research (STR) in Woburn, Mass.

The six ARC contractors will work to enable EW systems to generate effective countermeasures automatically against new, unknown, or ambiguous radar signals in near real time.

The program will develop 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.

BAE Systems is helping the government develop advanced electronic warfare systems to counter enemy adaptive radar.

The ARC program should be able to isolate agile unknown radar threats in dense, complex electromagnetic environments with friendly, hostile and neutral RF emitters; counter these new radar threats; provide real-time feedback on countermeasure effectiveness; counter several threats at once; support single-platform or distributed, multi-platform operations; support autonomous and human-in-the-loop operation; and use a standards-based, modular, open, and extensible software architecture. The system should also store and download new knowledge and countermeasures for post-mission analysis.

BAE Systems will do the work in Nashua, N.H., and Burlington, Mass., and should finish by June 2018.

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DARPA eyes cybersecurity for Internet of Things and embedded computing

Government researchers are trying to find efficient ways to apply cybersecurity to relatively low-power computers, handheld devices, and embedded systems.

BY JOHN KELLER

WRIGHT-PATTERSON AFB, Ohio — U.S. military researchers are asking cybersecurity experts at Praxis Engineering Technologies Inc. in Annapolis Junction, Md., to find new ways of providing cybersecurity for embedded computing and Internet of Things (IoT) devices.

Officials of the Air Force Research Laboratory (AFRL) at Wright-Patterson Air Force Base, Ohio, announced a $12.6 million contract to Praxis for the Leveraging the Analog Domain for Security (LADS) program.

LADS seeks to develop a new protection paradigm that separates security monitoring from the protected system by focusing on low-resource, embedded, and IoT devices. AFRL awarded the contract on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

Praxis experts will explore technologies to associate the running state of a device with its involuntary analog emissions across the device's electromagnetic emissions, acoustic emanations, power fluctuations, and thermal output variations. The intent is to enable a decoupled monitoring device to confirm the software that is running on the monitored device, to determine which instruction, basic block, or function the software is executing, or which part of memory the software is accessing.

The LADS program seeks to develop new cybersecurity capabilities for embedded and mission-specific devices. These kinds of devices have limitations that larger computer systems do not, such as low storage and memory capacity, slow processor speed, low power consumption, intermittent connectivity, and lack of trustworthy visibility into system status and operation. Compounding these limitations are cost sensitivity, limited ability for these devices to work together, and limited ability to modify and upgrade them once they are in the field. These factors limit the use of cybersecurity developed for bigger devices.

LADS seeks to develop new cybersecurity capabilities by combining analog and digital technologies. The combination of analog signal analysis and program analysis techniques will enable external monitoring devices to detect attempted cyber attacks not only on embedded computing and IoT devices, but also to larger information technology devices.

For this program, DARPA is asking Praxis to provide multi-model analog sensing to determine adaptively what features to compute from signals a device emits during training and testing. Praxis experts also will extract sub-bands of interest, eliminate noise from individual signals, and remove interfering transmissions emitted from other devices in the vicinity.

Praxis will do the work in Annapolis Junction, Md., and should be finished by July 2020.

FOR MORE INFORMATION visit **Praxis Engineering Technologies** online at *www.praxiseng.com*.

Mercury acquisition capitalizes on RF, cyber, and anti-tamper technologies

BY JOHN KELLER

CHELMSFORD, Mass. — Enhancing the company's expertise in RF and microwave, cybersecurity, and anti-tamper technologies are cornerstones of the acquisition by Mercury Systems of the embedded security, RF and microwave, and custom microelectronics businesses from Microsemi Corp.

Mercury completed its acquisition of the Microsemi embedded security, RF and microwave, and custom microelectronics businesses for $300 million. The Microsemi segments that Mercury is acquiring were known as White Electronic Designs in Phoenix; the Endwave Corp. defense electronics and security (D&S) business in Camarillo, Calif.; and Arxan Defense Systems in West Lafayette, Ind.

Microsemi acquired Endwave Defense in 2009, and White Electronic Designs and Arxan Defense Systems in 2010. The core expertise of the business segments passes to Mercury, which has carved out a niche in electronic warfare, RF and microwave technologies, and high-performance embedded computing.

Endwave Defense specialized in high-frequency RF solutions for defense electronics and security applications. White Electronic Designs specialized in secure anti-tamper, solid-state memory; multi-chip-on-board solutions for military appli-

cations; and small size, weight, and power consumption microelectronics. Arxan Defense, meanwhile, specialized in cyber security and anti-tamper software for military applications. These three segments had been folded into the Microsemi embedded security, RF and microwave, and custom microelectronics businesses. "We always are interested in more scale in RF, and are looking for more geographic footprints in RF," says Mercury Chief Technology Officer Ian Dunn.

Mercury executives also are concentrating on SWaP-constrained enabling technologies in RF and microwave, as well as in digital signal processing, Dunn says. "The smaller you go, the more you have to add value at the systems level, and we were interested in companies with multichip modules expertise."

What Mercury calls secure processing, however, is perhaps the most important component of the new acquisition, company officials say. Secure processing involves not only cybersecurity, but also activities, technologies, and tools that involve ways to secure embedded computing.

The term refers to "whatever you are doing to securing processing for mission, ground, and automotive applications, from trust to physical things, information assurance, and to securing the hardware for the target application," Dunn says.

Mercury is gaining secure processing capabilities in a big way from the acquisitions from Microsemi of the former White Electronic Designs and Arxan Defense Systems. In addition, the acquisition from Microsemi is boosting Mercury's expertise in microelectronics packaging, especially integrating digital and RF and microwave components on systems on modules rather than on separate circuit cards. "We're looking at packages that designers can surface-mount, rather than design onto a separate card," says Neal Austin, who is joining Mercury from Microsemi.

The acquisition brings millimeter wave expertise to Mercury that the company previously did not have, Austin says. This will help Mercury play in the smart munitions market, as well as in new electronic warfare applications like the Miniature Air-Launched Decoy.

Small payloads with BIG performance

Military personnel using the SkyRanger system with an EO/IR payload.

Unmanned vehicles are getting smaller and smaller, and so are their sensor payloads, as designers push the limitations on small size, weight, and power consumption for unmanned vehicle sensor payloads.

BY **J.R. Wilson**

A decade and a half of combat in Southwest Asia saw unmanned aerial vehicles (UAVs) grow from an interesting and sometimes useful addition to intelligence, surveillance, and reconnaissance (ISR) in a chaotic battle space to an essential part of U.S. and coalition capabilities. As their value for an increasing number of missions grew, so did research and development of smaller and more capable platforms and sensors.

UAVs that have deployed to the region ranged from the giant Global Hawk to hand-launched Micro UAVs (MUAVs) that are small and light enough to be carried in a single warfighter's backpack. Major advances in miniaturization and reduced power demands saw the variety of sensors and missions increase to where UAVs are not only ubiquitous today, but also essential to the missions of all ground forces.

One area that did not expand rapidly was manpackable UAVs. Stringent size, weight, and power (SWaP) requirements have made it extremely difficult to justify adding new field equipment.

"The soldier can only carry so much weight and only has so much time to think about these things," explains Michael Groenert, deputy director of the science & technology division at the U.S. Army Night Vision & Electronic Sensors Directorate at Fort Belvoir, Va. Today the warfighter's most important job "is to stay alive and deal with the enemy," he says. "If you give them systems that take a lot of time to put together or fly and are twitchy, they won't use them. If a Micro UAV doesn't help the soldier without getting in the way, they won't fly."

In this kind of environment, field tests involving the warfighters are paramount. "Anything that is close to the soldier goes through a lot of iterations before people become comfortable with using it," Groenert continues. "It is an ongoing and continuing conversation with the soldier and these small UAVs must provide something the soldier doesn't have today without increasing the burden, both physical and cognitive. That's something our lab works to support."

The value of manpackable UAVs for individual warfighters or small

units is obvious: an immediate, real-time ability not only to see over the next hill and around the next building, but also for communications and to receive sensor data on possible chemical, biological, or radiological threats.

Payload crunch

The difficulty is packing high-level sensors, power for platform and sensors, onboard processing, guidance and navigation, and communications into a package small enough to fit into a backpack with little assembly required. Using such an MUAV ideally should be no more complicated than a hand grenade: pull it out, turn it on, and throw it toward the target.

"Industry and government labs have continued to provide improved capability — in acuity, range, and SWaP — since the proliferation of manpackable unmanned aircraft systems (UAS). The military continues to seek R&D for advanced sensing capabilities on small UAS that often times are only found on larger UAS or even manned aircraft," notes Col. Paul Cravey, director of the Army Training and Doctrine Command's Capability Manager for UAS.

The Army continues to investigate and support research for improved electro-optical sensors; change detection; chemical, biological, radiological, nuclear, and explosives (CBRNE) detection; electronic warfare; network extension; and signals payloads to push advanced sensing capabilities to the lowest tactical echelon possible, Cravey says.

The military relies heavily on commercial developments, while modifying economically to meet combat requirements and put their subsequent use beyond the capabilities of an enemy who also could buy the base technology on the open market. The first commercial sensor capability to be adapted for MUAVs was imaging, which must meet day/night and all-weather requirements.

"On a small UAV, microelectromechanical systems (MEMS) and uncooled technologies enable a true nighttime capability, using a solid-state silicon camera that is lightweight, low-power, and imaging in the long-wave IR band, so you get the same quality imaging day or night in all weather conditions," says Groenert. "We continue to try to mature and improve image intensifier technology. Current tech isn't appropriate for small UAVs, so the lab has invested in improved low-light intensified imaging, which is not as mature as the uncooled microbolometers used in most Micro UAVs today."

The ability to see at night is a non-trivial proposition. "Being able to see at night is a challenging goal. The commercial solution looks easier than it is because they don't have to worry about data security, compromised networks or the bandwidth limitations soldiers face on the battlefield," Groenert says. "The Army is investing a lot in miniaturizing the processing required to handle these high-resolution sensors and improve their autonomy, so you don't have to send the entire raw image down a pipe. But separating the sensor from all that processing is getting harder."

The power challenge

As with virtually every technology developed for the individual warfighter or small unit, power is one of the most daunting challenges. With

MUAVs, the trade-off between power and payload forces the warfighter to choose between sensors, ammunition, or water — the sensors lose every time. The same applies to cooling small and sophisticated electronics.

"Thermal management — cooling and ruggedization of semiconductors allowing them to be conduction cooled — is one of the R&D drivers in this arena," says Benjamin Sharfi, CEO of General Micro Systems in Rancho Cucamonga, Calif. "Current solar technology is silicon-based and not bendable, so whatever UAV you create would have a shell that is a solar collector, so you can harvest power from the sun from any angle. That means manufacturing a solar cell that is not flat."

A newly evolving application for manpackable UAVs is weaponization. One such platform has been deployed to Afghanistan; the Switchblade from AeroVironment Inc. in Monrovia, Calif., was built as a concept demonstrator for the Army's Lethal Miniature Aerial Munition System (LMAMS) program, although the Army categorizes it as a "tactical missile system" rather than a UAV.

Originally conceived by the Air Force Special Operations Command, the 5.5-pound (including launcher), GPS-guided Switchblade small UAV is armed with a 40-millimeter grenade-like warhead, has a range as far as six miles, and an endurance of about 15 minutes. That gives it limited loiter capability as its electric propulsion systems enable it to search in near silence for fixed or moving targets beyond line-of-sight or hidden behind walls or other obstructions. By identifying and striking a specific target with a relatively small explosive, it is far less likely to harm civilians or property close by.

"[Switchblade] provides a very, very low collateral damage footprint compared to mortars and other weapons at a squad or platoon's disposal," says William Nichols, Army PEO Missiles and Space Close Combat Weapons Systems Program office. "The operator has the ability to wave off this missile within approximately four seconds of detonation."

A SkyRanger unmanned aerial vehicle system complete with an HDZoom30 payload and flight control tablet.

Digital data links

In April 2016, AeroVironment announced development of the Block 10C upgrade to Switchblade, incorporating a digital data link (DDL) to provide stable and secure encrypted communications and more efficient use of existing frequency bands while significantly reducing the likelihood of signal interception.

The Block 10C upgrade also enables users to fly several Switchblades at the same time and place without signal conflict. Operational ranges can increase significantly using another DDL-equipped UAV, facilitating the automatic communication of mission plans from one platform to another, also known as sensor-to-shooter operations.

Others contending for a future Lethal Miniature Aerial Munition System program-of-record contract include Textron (Battlehawk), Lockheed Martin (Terminator), and Israel's uVision (Hero). Other nations working on weaponized small UAVs include Poland, with WB Electronics Warmate, and Iran. There also have been reports of miniature "flying IEDs" being used by ISIS against Kurdish fighters in Syria, a development that is likely to grow rapidly as commercial UAVs, already carrying cameras of various sizes and resolution, are modified with explosives or even chemical, biological, or radiological weapons.

Just as the weaponized Predator and Reaper have become the best-known UAVs for their "drone strikes" against enemy targets in Southwest Asia, sensor-packed platforms of all sizes will remain the primary type of aerial robots deployed by the U.S. and other militaries. Manpackable MUAVs increasingly will become capable and in growing demand by infantry and special operations forces. Driving research for such platforms will be the need to fly anytime, anywhere, using tablet computer-based control software for day and night missions, an airframe able to tolerate wind gusts as strong as 90 miles per hour, and all kinds of inclement weather at altitudes to 1000 feet.

Imperative for small payloads

From a payload perspective, there needs to be continued advances in robust, durable, small, power-lean sensors and communications, as well as lightweight long-charge or in-flight rechargeable power systems.

"As operators use UAVs more frequently, they uncover new forms of

application, which drives into the sensor and payload technologies," says David Proulx, vice president of product & marketing at UAV specialist Aeryon Labs in Waterloo, Ontario. "All our customers start with relatively simple imaging tasks, then migrate to more complex imaging, then to non-imaging tasks, such as using the UAV as a communications node. So as more people use it, that creates a feedback loop to us to develop new technologies.

"We do see a general trend of driving situational awareness down to the squad, platoon, or even individual operator level," Proulx continues. "We think there is a great trend where situational awareness and ISR become on-demand tools the soldier can deploy from the backpack. That means providing them with easy-to-use UAVs that don't require more than a couple of days training. Putting ISR in the hands of the individual warfighter enables faster and more flexible response. Being self-sufficient in situational awareness and mission plans, allowing the individual operator to make decisions based on that real-time information, enables them to make better decisions based on immediate circumstances."

New requirements

There is no shortage of new requirements coming from end users as a function of increased usage and understanding. Those include real-time system interoperability, where manpackable UAVs operate in concert with ground robots and larger aircraft, getting all that data back in a consistent form to the same user. Another is distributed command and control, shared among several personnel rather than relying on a single individual. Evolving MUAV sensors also are opening a broad range of new possibilities, such detecting specific compounds more safely than a ground unit.

Manpackable MUAVs with advanced sensors and other payloads will significantly change future combat tactics, techniques, and procedures (TTPs), concept of operations (CONOPS), and individual/small unit effectiveness and survivability.

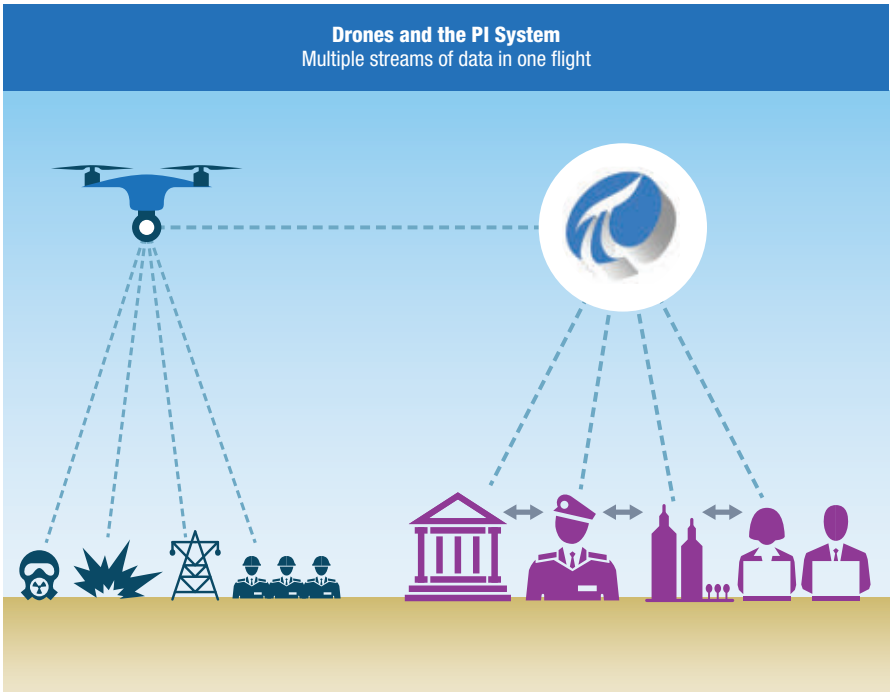
"The goal is to increase soldier situational awareness while decreasing workload and cognitive burden, so increased autonomy, reducing the amount of data the soldier has to handle while improving his awareness and adaptability to evolving conditions on the ground," Groenert says. "There is a big push on the sensor side to not just make higher resolution and frame rate sensors, but sensors that are smarter. There is only so much bandwidth on the battlefield and so much effort the soldier can put into it. The longer it takes for an image to reach the soldier, the less valuable it is. So the closer to the imager that processing occurs, the better," Groenert says.

The SkyRanger with the HDZoom30 payload attached.

Tying sensors together is a special challenge. "Making sensors multifunction is another part of that,

such as enabling the sensor to provide 3D information," Groenert says. "As they move around the battlefield, you get imagery of the same target from multiple sources, so can you infer structure using that. If the soldier can get 3D understanding of the battlefield from passive sensors, that's another piece of leverage. So increasing sensor capability without increasing the workload to interpret that data has been a big push for us."

There has been growing concern among military and industry leaders that the technology gap that has set the U.S. apart from the rest of the world is closing and the nation ultimately may lose that lead. Groenert says he agrees the defense industry will face a shortage of top-grade engineers in the future — with more PhDs going to foreign students who return home rather than working for U.S. companies and Americans who go to work in the commercial sector, including overseas, rather than in what is seen as a diminishing defense industry. But he also sees that largely as a problem for very specific, military-only technologies.



Unmanned aircraft and the PI System work together to deliver surveillance information in real time to the decision makers that need it most.

Market explosion

"The small UAV field is exploding right now, with significant commercial work being done, especially embedded processing," Groenert says. "With targeted investment and guidance, the Army can leverage a lot of that work and make significant advances in areas that already are depending on commercial work. I'm optimistic we can follow the model of leveraging the domestic commercial technology base and not doing everything purely in-house for the military."

With advanced sensors providing increasingly intelligent eyes on the battlefield and embedded processing to reduce the amount of time and effort a soldier must devote to overwatch and situational awareness, MUAVs have the potential to become very important to future tactics and operations.

"The same missions can be done with fewer soldiers or with an enhanced awareness and better response to threats as sensors and processing continue to improve," Groenert continues. "A lot of capability can be added in terms of reduced decision times, enhanced ability to detect and respond to threats and create useful effects with fewer soldiers in harm's way."

Technology trends include automation to reduce the number of UAV operators. "Today a lot of systems require a soldier for every platform, putting a lot of his brainpower into keeping the system flying and interpreting the data coming from it," Groenert says. "In the future, with improved displays and sensor autonomy, moving from imagery to information, the soldier can lift his head up and trust the sensor and aircraft carrying it to tell him when he needs to look at the imagery."

Each new technology that has brought individual warfighters into closer, real-time contact with higher headquarters, such as individual communications gear, has raised the specter of those outside the theater of operations micromanaging those on the inside. Instead, the result has tended more toward a better informed warfighter having greater autonomy to deal with his immediate combat environment.

The future of manpackable MUAVs and sensors is a much broader issue than individual technology developments or even America's ability to maintain a technological edge,

says Steven Sarnecki, vice president of U.S. federal & public sector affairs at UAV software specialist OSIsoft LLC in San Leandro, Calif.

Instead, Sarnecki sees manpackable UAV development as ensuring the U.S. military has the right infrastructure — from command headquarters to field units to the platforms themselves — to aggregate an increasingly heavy data load, transforming raw data to useful information made available to those who need it in real time.

Sarnecki sees MUAVs as remote-sensing platforms, deployed where and when needed, with sensor data then integrated in real time with geospatial data. This can create a mobile sensor that can provide any type of measurement back to its user, then integrate that into a map with data that changes in real time. The challenge, he adds, is to break down the tendency to "silo" problems to fit silos of funding.

"What we have to deal with now is theater-scale situational awareness, which requires a broader perspective rather than very prescriptive funding to solve a past problem," Sarnecki says. "There is an opportunity for video R&D to be enhanced and leveraged with miniaturized sensor technology that has been developing in parallel."

Device miniaturization has been the primary enabling technology of MUAVs because it decouples the size of the sensor as a limiter on the payload. Sarnecki cautions that simply increasing the amount of data available may not be the key to vastly improved systems.

"The one thing we cannot ignore is that more data is not the answer," Sarnecki says. "With ISR and situational awareness, more information is the answer. We need to manage the volume of data coming in, just as we are in society at large with the Internet of Things. We will be able to collect a lot more sensor data with UAVs; the real key will be to determine differences over time."

> "I think the next breakthrough has to be power management, harvesting power from the sun, thus eliminating battery packs, the least reliable part of those systems." — *Benjamin Sharfi, CEO, General Micro Systems*

At the same time, asymmetrical threats from adversaries such as ISIS mean what used to be restricted to government funding now can be tackled by three jihadists.

The pace of change

"The genie is out of the bottle," Sarnecki says. "We have not lost our ability to innovate, but we have lost pace in our ability to educate new scientists and implement new technologies. Other nations and entities have gotten better at being adept at exploiting technology, including some we have developed. Any organization or country has to be a learning organization, both educationally and through adaptation."

U.S. UAV designers also may be facing a requirement to adapt new designs to new applications more quickly than they ever have been able to do before. "I see us right now being out-adapted," Sarnecki warns. "We may still be smarter and work harder, but there are others in the world who can shift a lot more quickly than we can right now. We're starting to see folks from other countries not just coming here to be educated and then returning home, we're starting to see new technologies coming out of those countries, such as Brazil."

The future of manpackable UAVs, then, is an amalgam of factors, from leadership in evolving technologies to restricted funding to global competition to potential data overload. But what has marked 21st century combat to date may make MUAVs with advanced, even multifunctional, sensors as vital to U.S. military success in the future as improved body armor and precision-guided munitions.

"The days of large, pitched battles in a somewhat predictable fashion are in many ways well behind us, so the idea the warfighter is becoming somewhat more autonomous, with more frequent but smaller in scale operations, speaks to the need to put flexible, small ISR capability in their hands," Proulx concludes.

"The value of a UAV is only as good as its ability to collect and distribute needed data. That speaks not only to having flexible sensor payloads — meaning users can affix different payloads in the field, without tools, in a matter of seconds — but ensuring the captured data is available to everyone. So they have individual level intel-gathering capability, but what they gather is easily and securely shared with all who need it."

HPEC enables onboard data processing for persistent surveillance

Engineers blend multiple compute components in hybrid architectures to facilitate sensor and signal processing on ISR platforms.

BY **Courtney E. Howard**

Logos Technologies' Simera wide-area motion imaging sensor can monitor city-sized areas.

"Threats facing warfighters today are more unpredictable than at any time in history," driving the need for data, says Larry Schaffer, director of business development at Abaco Systems in Huntsville, Ala.

"In World War I, the first 'technological' war, forces still fought face-to-face; huge groupings thrust against each other, reminiscent of all wars before," resulting in 11 million casualties, Schaffer explains. Then war entered a new age, fought less by force-on-force conflict, and warfighters needed to know more before they faced the opposition.

"Just as WWI changed our need for information, current stateless asymmetric threats change warfighters' information needs," Schaffer says. "What is needed today is 'situational understanding' or a content-rich, real-time picture as well as historical and predictive information in many domains." Situational awareness refers to knowing what's going on in real time — "knowing where the good guys and bad guys are, what the terrain and potential mission threats are," he explains.

This need for more information is not unique to militaries, and is driving the demand for powerful persistent surveillance systems (PSS) throughout civil and defense organizations across the globe. The warfighter relies on persistent surveillance, but so too do facilities in the electrical and information infrastructure and where large groups of people assemble, such as stadiums, entertainment venues, transportation hubs, and schools, Schaffer says.

"Intelligence, surveillance, and reconnaissance (ISR) is hot and has been hot for some time, and the plunging cost of aerial platforms has brought ISR to the masses," Schaffer adds. "It is unbelievably widespread."

Surveillance sea change

Early wide-area motion imaging (WAMI) systems developed by the U.S. military have been large and expensive to procure, operate, and maintain, and they had a very large processing, exploitation, and dissemination (PED) analyst footprint, explains John Marion, president of Logos Technologies LLC in Fairfax, Va. As a result, many concluded that WAMI is difficult and expensive, but that has changed in recent years. Logos Technologies' Redkite, for example, "is a more capable system at 20 pounds than was Constant Hawk when it deployed at over 1,000 pounds," he says.

"The community is starting to appreciate the value of WAMI," Marion says. "There was a bit of a learning curve, but there is a widening awareness of what WAMI can add to force protection, event security, disaster relief, and asset protection. These assets could range from protecting a nuclear power plant to protecting rhinos from poachers."

Marion compares global WAMI adoption to that of full-motion video (FMV). "A decade ago, FMV was in limited use, but now it's everywhere. I expect the same thing to happen with WAMI. The U.S. military has

been leading on that front, but there has also been a dramatic increase in international awareness and interest in WAMI." Logos has more than a dozen systems offered for sale or under active development, and the uses include disaster relief, border and critical infrastructure protection, force protection, law enforcement, and counter-poaching surveillance. Key characteristics customers seek are low system size, weight, and power (SWaP) and improved analyst tools to reduce the PED burden.

"A key driver for the proliferation of WAMI is reducing system SWaP," Marion says. "Take the 700-pound Gorgon Stare, for example. Not many unmanned aerial vehicles (UAVs) can carry it, but if you drop the weight of the WAMI system to 20 pounds including processing, as we have done with Redkite, then you get a sensor that can go on a large number of platforms, including Group 3 UAVs."

Marion anticipates greater proliferation in mission sets, as well. "The first WAMI systems, Constant Hawk and Angel Fire, were deployed to Iraq in 2006 for ISR. In 2011, Kestrel was deployed on aerostats to protect troops operating in and around forward operating bases (FOBs) in Afghanistan. In the past few years, we've also seen the testing of WAMI for border and event security; and right now, we see it being evaluated for disaster relief supporting humanitarian aid missions as well as to protect megafauna from poachers."

Persistent surveillance, wide-area motion imaging, and wide-area aerial surveillance (WAAS) systems are as varied as the missions they fulfill, if not more so. Some commonality among systems exists, however, given the growing demand for and use of open architectures, commercial off-the-shelf (COTS) rather than proprietary parts, and adherence to industry standards. Logos, for example, "integrates these systems from a mixture of custom and COTS parts," Marion describes. "We are always tracking commercial development in three key areas: cameras, focal planes, and processing components."

More compute power

Persistent surveillance isn't just capturing data anymore; it's now much

Small, low-power, module-based COTS computing solutions such as Kontron's COBALT enable upgrades to the latest advanced processors.

more sophisticated and encompasses "analytics, data fusion, sensor fusion, predictive analysis, including gaze recognition, intent recognition, crowd interaction dynamics, and more," Abaco's Schaffer observes. "As we get more and more sensor modalities (UV, IR, lidar, radar, sonar, spectral, visible) adding to a-priori (geomorphology, past events, weather and climate patterns), the richness of this data added to the need for processing it quickly is driving demand for higher levels of processing power."

This compelling need has brought Abaco many customers seeking high-performance embedded computing (HPEC), according to Schaffer. The company provides the computer that fuses radar, lidar, visible, infrared, and synthetic (a-priori) data into one real-time visualization for helicopter pilot situational understanding — "one single picture that encompasses multiple data streams and sensor modalities. These HPEC systems must [also] be carried on space/power-constrained platforms, giving us a 'sizable' advantage, as the HPEC unit that does this is about the size of a six-pack of beer."

Big data and bandwidth

The past decade has brought not only huge strides in wireless data transmission, to which cell phone users can testify, but also massive arrays of ever-higher-resolution sensors operating in multiple modalities on remote platforms, Schaffer says. "This need for bandwidth has far out-paced the ability of down-links to cope, so we take lots of data and squirt it out over time and, therefore, sacrifice real-time understanding.

"Less than desirable for sure, but far more than the time it takes to transmit data is the problem of aggregating, correlating, and developing an understanding of all this data — which, of course, is useless without knowing what it means," Schaffer adds. "What is increasingly important is a better kind of data compression, where only results, not raw data, are sent. This is the work to be done on the platform. How, you ask? It will be done by 'learning machines' — high-performance computers that can process massive data sets based on experience, or processing based on an understanding of what is important in a multi-domain dataset."

Onboard processing is key, says Logos Technologies' Marion, because it enables users to exploit data in real time, as it is collected, with a data link whose capacity is three orders of magnitude lower than the rate at which data is collected.

Sensor systems

The focus on sensor systems usually involves specifics of the sensor itself, but data processing and analytics are just as important — especially in exploiting the WAMI data with other intelligence sources, Marion says. For the past seven years, Logos engineers have been taking advantage of developments in commercial embedded processing to produce "much more capable WAMI processing systems in ever smaller packages," he says. "For these systems, software development needs to be done in parallel with the hardware development so analytic functions can be performed at these data rates in real time but in SWaP-miniaturized hardware."

In the design of Logos customized processing boards, engineers use a mix of digital signal processors (DSPs), field-programmable gate arrays (FPGAs), and general-purpose processors. The processing stack for the company's Redkite UAV system performs all the processing, yet the weighs only three pounds and draws 100 watts, Marion says. "We have a fully capable WAMI system — including sensor, embedded processing performing all analytics, and data storage — housed in a 20-pound package. Our infrared system for nighttime use is fairly light too: only 50 percent heavier than the daytime WAMI."

Along with the small size of the sensors, it follows that the processing elements must be small as well, Abaco's Schaffer says. "Small size and low mass work well to support something else that is needed: ruggedness. At Abaco, we have a fully rugged, 300 MFLOP computer the size of a credit card that takes less than 10 watts, so we know how to do rugged, small, and powerful."

Ruggedness and operational availability are extremely important, Marion says, because WAMI systems are often used close to 24/7. "For example, the operational availability of our Kestrel systems in Afghanistan has been at 94 percent with over 200,000 operation hours."

"The ability to operate for a long time is a given, but computers produced today will quickly be replaced as sensors demand even higher-performance processors," Schaffer adds.

"In only the past few years, our computers have reduced weight by 75 percent and consume 90 percent less power per MFLOP. This is an unrelenting trend and we are on it daily."

Abaco's computing solutions are "widespread in the processing of video, radar, sonar, and other complex datasets related to PSS/WAAS," Schaffer says. "Go small or go home. Today, it is truly about low SWaP; higher performance and lower consumption in all domains; and doing more with less."

Analyst overload

Myriad surveillance systems are capturing more data now than at any other time in history. Analysts are overwhelmed, and technology firms are helping to lighten the load.

"For years, we've been performing real-time onboard processing to stabilize and geo-locate the imagery as well as provide multiple ground users their own pan and zoom view within the imagery. That was demonstrated for a U.S. government customer nearly a decade ago," says Marion. "More recently, we've added precision geo-registration, automated tracking of all the moving targets in the scene, and other tools that help dramatically reduce the burden on analysts.

"We are now providing tools to organize the WAMI data, along with data from other intelligence sources, in ways that very significantly streamline the analytical process, allowing single analysts to solve problems much faster, and allowing them to solve much more complex problems," Marion continues.

Overcoming past limitations

"Persistent surveillance systems are in high demand, and application areas for such technologies are proliferating wildly," says Mark Littlefield, vertical product manager, defense at Kontron in Poway, Calif. "Persistent surveillance isn't new; systems like this have been deployed by the U.S. as far back as the Vietnam War. However, until relatively recently, persistent surveillance systems have been custom-crafted to meet extremely low SWaP requirements. Extremely small and low-power COTS computing hardware, along

with standardized methods to forming distributed networks, are making low-cost, COTS-based solutions possible."

In the past, significant digital signal processing or image processing was limited to fairly large platforms because extremely small, low-power platforms didn't have the computing horsepower needed for these applications, Littlefield continues. Times have changed with the availability of processors in the sub- or couple-of-watt range capable of performing real-time image processing or DSP.

"When these processors are linked to sensors and ad-hoc networking hardware based on standards, they form an ideal platform for PSS," Littlefield says. The actual deployment platform can vary widely; the common element is that they sense their environment and share data and information with neighboring sensor platforms. "Each platform has its own needs and challenges which drive system design."

Kontron leverages small/low-power computing platforms, the Internet of Things (IoT), and standards-based network communications software to provide COTS-based solutions for the computing and communications portions of the PSS application — leaving the sensors used and the "special sauce" of the applications codes for processing and analyzing the data collected by the sensors to customers, Littlefield says.

Redkite records, stores, and processes all activity within its coverage area for up to eight hours.

Kontron engineers marry standards-based COMe Mini and SMARC small-form-factor hardware components with software tools like MQTT to create an application platform for persistent surveillance. Littlefield advises engineers against spinning their "own hardware and software frameworks. There are COTS solutions out there; engage the market. Even if there is not a product that is 100 percent suitable for your application, there may be something that could be adjusted slightly to meet your specific needs. That's the power of COTS."

Popular processing trio

Processors today — multicore chips, GPUs, FPGAs, and a combination — are very efficient in performance per unit of power and capabilities, supporting the unmanned vehicle doing the processing in the sky, explains Marc Couture, senior product manager at Curtiss-Wright Controls Defense Solutions in Littleton, Mass.

"The Achilles heel is typically the common data link to the ground, not a lot of bandwidth," Couture says. "Instead of sending whole images from an MQ-9 Reaper type of unmanned aircraft, just sending the information — that capability exists now, and not just for the biggest UAVs like Global Hawk, but also for smaller [platforms], including the Shadow, because we're able to pack a lot of processing in a small footprint."

A magic trio of processing technologies is popular now, Couture describes. "Often FPGAs are closest to the electro-optic/infrared (EO/IR) sensor, typically seated right behind it. They are input/output (I/O) chameleons that adapt to sensor output and perform image compression; they

are good at doing repetitive things in parallel quickly."

Further, a multicore Intel device is the general-purpose processor of choice and well suited to identifying threats on the ground. The third device, a general-purpose graphics processing unit (GPGPU), is very good at very compute-intensive tasks, Couture says. "They provide teraflops (floating-point operations per second) of computing power for stitching together images from multi-gigapixel cameras, matching and correlating data, orthogonal rectification, intensive algorithms, and so on. When the Intel processor gets overwhelmed, work is offloaded to GPUs.

"This heterogeneous trio enables big capabilities for WAAS/PED while keeping SWaP-C low. It can scale the processing for big UAVs or smaller ones. Now it's open to all different size birds," Couture adds.

The goal is to have multiple UAVs with very high-resolution cameras and processing covering the surface area on the Planet Earth, says Couture. "A platoon leader just wants to get troops over a dune. Now he can call up and say 'I need specific imagery for this area.' The UAV will beam down an image of that area to him," Couture says. "A two-star general might want [data about] 30 square miles; the same UAV can give an overall snapshot of that. It's like having a server in the sky, capturing data in real time and in no time beaming it to the ground to have analysts look at it. They have real-time access to data in the midst of it — in-theater data.

"High-level processing on the platform is possible because of the availability of Intel Xeon D, the processor of choice in the supercomputing realm we're bringing into the mil-aero realm," Couture continues. "WAAS is one of the most compute-intensive applications there is. Customers are asking how much they should prosecute with FPGAs, processors, and GPUs. Now we're down to the chip level, and the tricky thing is how to build boards and enclosures to make use of these massive efficiencies. Infrastructure technologies and hybrid processing may change how we architect systems in the future, and enable new ways to do things." ←

Harris wins potential $1.7 billion radio contract

U.S. Army communications specialists finalized a potential $1.7 billion contract with Harris Corp. to provide military radio equipment to Afghanistan and other U.S. allies under the Foreign Military Sales program. The indefinite-delivery/indefinite-quantity (IDIQ) contract with Harris RF Communications in Rochester, N.Y., will involve a wide range of secure radio communications, tactical communication networks, and embedded, high-grade encryption solutions, as well as ancillaries, spare parts, and services.

Marine Corps seeks wearable IMUs to measure fatigue

U.S. Marine Corps researchers are reaching out to industry for wearable inertial measurement units (IMUs) small enough to attach to the feet, legs, backs, and chests of Marine infantrymen. Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., issued a source-sought notice (M67854-16-N-0510) for small, lightweight IMUs to help with infantry mobility research. Researchers want to gather IMU data to evaluate the fatigue and performance of Marines operating in the field over a variety of terrain and carrying different kinds of warfighter equipment. ←

Special Ops readies industry competition to develop new manpack radio

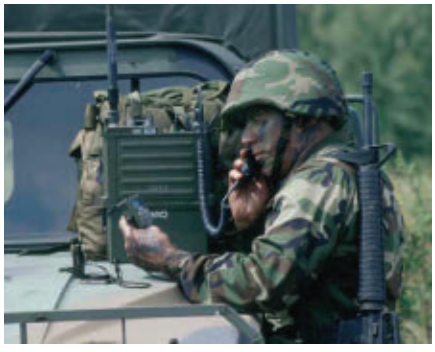
BY **John Keller**

MacDILL AIR FORCE BASE, Fla. — U.S. Special Operations Command (SOCOM) at MacDill Air Force Base, Fla., is finalizing plans to buy a next-generation manpack (NGMP) radio in a potential $290 million program.

The NGMP radio will enable Special Operations teams to communicate on selected frequencies from 30 to 2,600 MHz with embedded communications security. It will have an open-systems architecture to enable periodic hardware, firmware, operating software, and radio waveform upgrades. The future Special Operations Next-Generation ManPack (NGMP) Radio will replace SOCOM's current radio communications equipment like the AN/PRC-117F and PRC 117G multiband multimission radios, as well as the AN/PRC-150 multiband radio.

SOCOM radio communications experts are trying to determine if industry can meet their requirements primarily with existing radio technology. The radio — with National Security Agency (NSA) and Joint Interoperability Test Command (JITC) certifications — should be available for purchase no later than 12 months after contract award. The contract will span six years of radio deliveries and could be worth as much as $290 million, SOCOM officials say.

The new radio should be capable of simultaneous two-channel



U.S. Special Operations Command is reaching out to industry to develop a new manpack radio system.

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 NGMP must be able to cross-band 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.

For this radio SOCOM needs Special Forces 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-counter measures (ECCM) waveforms.

The contractor chosen to provide the new SOCOM radios also must provide program and configuration management, systems engineering to include software, logistics support, operational and depot-level maintenance, data, and training.

Companies interested should e-mail comments, questions, or concerns to NGMP Program Manager David Tenebaum at david.tenenbaum3@socom.mil and Leatrice Frederick at frederl@socom.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/USSOCOM/SOAL-KB/H92222-16-R-XXXX/listing.html*.

GD upgrading Navy shipboard radio with HF automatic link establishment

BY **John Keller**

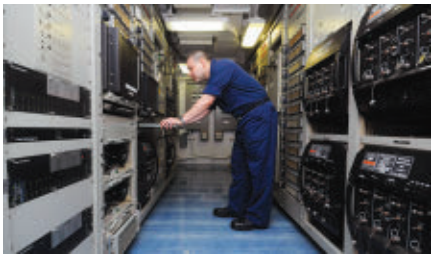
SAN DIEGO — Military radio experts at General Dynamics are upgrading the U.S. Navy AN/USC-61(C) maritime radio system to high-frequency (HF) capability and automatic link establishment (ALE) to enhance shipboard over-the-horizon communications.

U.S. Space and Naval Warfare Systems Command (SPAWAR) officials in San Diego announced a $7.3 million contract modification to General Dynamics Mission Systems in Scottsdale, Ariz., to update DMR software to add HF and ALE capabilities.

The General Dynamics AN/USC-61(C) shipboard radio enables surface ships and submarines to communicate over high frequency (HF), ultra-high frequency (UHF) line of sight, UHF satellite communications (SATCOM), and very high frequency (VHF) radio bands. HF radio operates on frequencies between 3 and 30 MHz using radio waves that can bounce off the ionosphere layer of the Earth's atmosphere to achieve long-range communications. HF also is capable of line-of-sight communications, as well as ground-wave over-the-horizon communications.

Using HF can be tricky because changes in the ionosphere can cause RF interference and communications dropouts. It also is susceptible to interference from lightning storms, and propagates differently in the daytime, at night, and during different seasons.

Automatic link establishment seeks to overcome deficiencies by enabling radio operators to choose the best frequencies on which two stations or a network of stations can transmit and receive. ALE is the de-facto worldwide standard for initiating and sustaining HF communications for voice, data, text, instant messaging, internet messaging, or image communications. ALE alerts radio operators audibly and visually so they can begin communicating with each other immediately, and helps eliminate the longstanding need for repetitive calling on pre-determined time schedules and monitoring static on HF radios.



Radio rooms on U.S. Navy surface warships are getting an upgrade to enable more clear and easy-to-use HF radio signals.

An ALE-equipped radio uses a callsign or address in an ALE controller, which scans through a list of frequencies listening for other ALE radio callsigns. To reach a specific station, the caller simply enters the callsign just like dialing a phone number.

The ALE controller selects the best available frequency and sends out brief digital selective calling signals containing the callsigns. When the distant scanning station detects the first few characters of its callsign, it stops scanning and stays on that frequency. The two stations' ALE controllers automatically handshake to confirm that a link is established and they are ready to communicate. If changes in the ionosphere break or interfere with communications in progress, the system quickly can re-establish communications by finding other clear frequencies.

AN/USC-61(C) uses open-architecture standards and includes embedded type 1 encryption; embedded red/black baseband switching and routing; co-site performance; single point of control for radio communications; and built-in test (BIT).

General Dynamics will do the work in Scottsdale, Ariz., and should be finished by April 2018.

Northrop Grumman to build second TERN prototype UAV

Unmanned aircraft designers at Northrop Grumman Corp. are developing a second prototype unmanned air vehicle (UAV) and shipboard launch and recovery system to enable the UAV to fly from relatively small surface ships like destroyers, frigates, and freighters. U.S. Defense Advanced Research Projects Agency (DARPA) officials in Arlington, Va., announced $17.8 million contract modification to the Northrop Grumman Aerospace Systems segment in Redondo Beach, Calif., for phase-3 work on the Tactically Exploited Reconnaissance Node (TERN) program, which seeks to overcome limitations of Navy shipboard aircraft surveillance. Helicopters are relatively limited in maximum distances and flight times, for example, while fixed-wing manned and unmanned aircraft must operate from aircraft carriers or large land bases with long runways, although they can fly farther and longer than helicopters. The ultimate goal for a TERN UAV and launch system is to enable persistent intelligence, surveillance, and reconnaissance (ISR) and strike capabilities with payloads as large as 600 pounds while operating at ranges as long as 900 nautical miles from a host vessel. ←

MORSECORP joins DARPA program for melting air-drop unmanned aircraft

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers have chosen a third company to develop small, unpowered, and unmanned aircraft to air-drop small packages for forward-deployed forces. After delivery, the unmanned aircraft melt without any detectable trace to keep them out of enemy hands.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have added MORSECORP Inc. in Cambridge, Mass., to the Inbound, Controlled, Air-Releasable, Unrecoverable Systems (ICARUS) program.

MORSECORP joins the Xerox Palo Alto Research Center (PARC) in Palo Alto, Calif., and DZYNE Technologies Inc. in Fairfax, Va., on the ICARUS program, which seeks to design and demonstrate a precision, autonomous, guided, air-delivery vehicle that vanishes on command.

MORSECORP specializes in vehicle guidance, navigation, and control; mission planning; multi-vehicle autonomy; computer vision; and mobile computing.

The ICARUS approach is similar to the DARPA Vanishing Programmable Resources (VAPR) program to develop sensitive electronic components able to self-destruct on command to keep them out of the hands of potential adversaries. PARC also is involved in the VAPR program.

ICARUS is asking MORSECORP, PARC, and DZYNE to develop a vanishing unmanned aerial vehicle (UAV) able to deliver a small package no larger than three pounds to a GPS-programmed location with 33-foot accuracy.

MORSECORP is joining the DARPA ICARUS program to develop air-drop unmanned aircraft that melt for stealth and secrecy.

The small aircraft, which the companies will develop to operate at night, must be able to vanish within four hours of landing, leaving remnants no larger than 100 microns — or about the width of a human hair.

The vanishing vehicles that MORSECORP, PARC, and DZYNE will develop must be no larger than 10 feet in their largest dimension, and be able to glide for nearly 100 miles when released from altitudes of 35,000 feet.

DARPA researchers primarily want to determine whether a large structure can be made transient cheaply enough to be disposable, such that they limit the logistics trail and make the most of range.

Critical technical challenges facing the ICARUS program cover two major categories: aerodynamics and materials.

CONTINUED ON PAGE 25 →

NASA to determine state of the art in UAV sense and avoid avionics

BY **John Keller**

EDWARDS AIR FORCE BASE, Calif. — U.S. aviation authorities are reaching out to industry for help in formulating avionics performance standards for medium-sized unmanned aerial vehicles (UAV) that must be able to sense and avoid other aircraft in controlled airspace.

Officials of the National Aeronautics and Space Administration (NASA) have issued a sources-sought notice (NND16828627L) for the Alternative Airborne Surveillance Systems for Beyond Visual Line of Sight Unmanned Aircraft Systems (UAS) Detect and Avoid project.

This survey — part of the NASA UAS Integration in the National Airspace System (UAS-NAS) project — seeks to determine industry's ability to design and integrate airborne sensors of relatively small size, weight, and power consumption (SWaP) for medium-size UAVs.

Of primary concern are unmanned aircraft operating under instrument flight rules (IFR) at altitudes higher than 500 feet at beyond-line-of-sight distances from their control centers.

The FAA is asking industry's help in formulating sense-and-avoid standards for medium-sized unmanned aerial vehicles operating in controlled airspace.

These unmanned aircraft are not able to carry large surveillance sensors, yet still need to watch their surroundings for other aircraft. Candidate sensors include electro-optical/infrared (EO/IR), light detection and ranging (LIDAR), relatively small radar systems, or small Automatic Dependent Surveillance-Broadcast (ADS-B) avionics.

NASA experts will use industry responses to help formulate RTCA Special Committee-228 Minimum Operational Performance Standards (MOPS) for medium-sized UAVs. The request for information was released on behalf of the NASA Armstrong Flight Research Center at Edwards Air Force Base, Calif.

Of particular interest to NASA are UAVs expected to operate side-by-side with manned commercial and general-aviation aircraft flying in FAA Class D, E, or G airspace.

FAA Class D describes controlled airspace that extends from the surface to 2,500 feet surrounding airports with operational control towers. In this airspace, each aircraft must establish two-way radio communications with the tower.

Class E describes airspace between 14,500 and 18,000 feet over the U.S. and over the ocean within 12 nautical miles of the coast. It also describes U.S. airspace above 60,000 feet. Class G, meanwhile, is uncontrolled airspace. NASA experts also would like to hear from manufacturers of optionally piloted aircraft expected to operate in these kinds of conditions.

Makers of relevant airborne sensors or aircraft should respond to NASA by e-mail at afrc-uas-nas@mail.nasa.gov, or by post at NASA-Armstrong Flight Research Center, P.O. Box 273 M/S S323, Edwards, CA 93523. For questions or concerns, contact NASA's Rosalia Toberman by e-mail at rosalia.toberman@nasa.gov, or by phone at 661-276-3931. ←

MORE INFORMATION IS online at *https://www.fbo.gov/spg/NASA/DFRC/OPDC20220/NND16828627L/listing.html*.

DARPA CONTINUED FROM PAGE 24

The ICARUS program will span two phases and 26 months, culminating in a field-test of vanishing precision air delivery prototypes.

MORSECORP, PARC, and DZYNE are involved in the first phase, which will develop and demonstrate an air delivery vehicle using nontransient materials. The optional second phase will fabricate a field testable, vanishing air delivery vehicle. ←

FOR MORE INFORMATION
visit **MORSECORP** online at *www.morse-corp.com*, **PARC** at *www.parc.com*, **DZYNE Technologies** at *www.dzynetech.com*, or **DARPA** at *www.darpa.mil*.

Navy orders six Blackjack UAVs for naval and Marine Corps surveillance

U.S. Navy officials are buying six new RQ-21A Blackjack small tactical unmanned aerial vehicles (UAVs) to provide surveillance capability for U.S. Marine Corps and Navy tactical commanders. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $71.6 million contract to Boeing Insitu Inc. in Bingen, Wash., for six low-rate initial production lot-5 Blackjack unmanned aircraft systems, which include air vehicles, ground control stations, launch and recovery equipment, and spare parts. The Boeing Insitu RQ-21 is a twin-boom, single-engine, monoplane UAV for surveillance and reconnaissance. It can be launched and recovered on land or at sea without runways, using a pneumatic launcher and net-type recovery system. The 81-pound Blackjack is eight feet long with a 16-foot wingspan designed to carry multi-sensor payloads in a large pod below its nose. The UAV can fly as quickly as 104 miles per hour, cruises at 63 miles per hour, and can fly as long as 24 hours and as high as 19,500 feet. It is a version of the Insitu Integrator UAV. The multimission RQ-21A Blackjack's open-architecture payload bays can be customized with visible-light and infrared cameras, communications and other tools to give warfighters on the forward

Lockheed Martin, Raytheon tackle DARPA project to enable cooperating UAVs

BY **John Keller**

ARLINGTON, Va. — The U.S. military is moving forward with a program to enable cooperating surveillance and attack unmanned aerial vehicles (UAVs) to work together on missions involving electronic jamming, degraded communications, and other difficult operating conditions.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $7.4 million phase-two contract to the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla., for the Collaborative Operations In Denied Environment (CODE) program.

DARPA officials also awarded a CODE phase-two contract to the Raytheon Co. Missile Systems segment in Tucson, Ariz., but did not specify the contract amount.

The CODE program seeks to expand the mission capabilities of existing UAVs through increased autonomy and inter-platform collaboration. Collaborative autonomy has the potential to increase capabilities and reduce costs of today's UAVs by composing heterogeneous teams of UAVs that can capitalize on the capabilities of each unmanned aircraft without the need to duplicate or integrate capabilities into one UAV, DARPA officials say.

Companies working with Lockheed Martin and Raytheon on the CODE phase-two contract are Daniel

U.S. military researchers are trying to blend sensors and multi-sensor fusion technologies to enable unmanned aircraft to work together.

H. Wagner Associates in Hampton, Va.; Scientific Systems Co. in Woburn, Mass.; Smart Information Flow Technologies LLC in Minneapolis; Soar Technology Inc. in Ann Arbor, Mich.; SRI International in Menlo Park, Calif.; and Applied Communication Sciences in Basking Ridge, N.J., DARPA officials say.

The program's first phase focused on the design, development, and delivery of the system requirements definition and preliminary system design for a CODE prototype. The second phase is to mature the algorithm suite necessary to enable new services.

Although today's UAVs have proven themselves in a wide range of missions, most current UAVs are not well matched to the needs of future conflicts, DARPA officials say. Compared to today, future conflicts will be much less permissive, very dynamic, confront U.S. and allied forces with more dangerous threats, and involve contested electromagnetic spectrum and relocatable targets, researchers say.

In these future conflicts, UAVs could use collaboration algorithms

to help each other with tasks like geo-locating targets with long-distance sensors, as well as guiding less-capable UAVs to within their sensor ranges.

Collaboration algorithms could help UAVs work together to provide multi-modal sensors and diverse observation angles to improve target identification, transmit important information through the network, provide navigational aide to low-tech or damaged UAVs, and protect each other by overwhelming defenses.

Goals of the CODE program are to develop and demonstrate the value of collaborative UAV autonomy in tactical situations; rapidly bring that capability to the warfighter; develop ways to expand the range of collaborative UAV missions; and help researchers contribute to collaborative autonomy technologies.

DARPA researchers primarily are interested in four areas. First, they want to develop autonomy for the subsystems, equipment, and flight trajectories of UAVs working alone under routine and abnormal conditions.

Second, DARPA researchers want to develop interfaces to enable mission commanders to maintain situational awareness, dynamically define mission objectives and problems, monitor progress, and provide important inputs as necessary to several UAVs simultaneously.

Then researchers want to develop UAV team-level autonomy, including developing and maintaining a common representation of the operating environment to help formulate collaborative action plans that make the most of the strengths of each participating UAV.

Lastly, DARPA wants to develop an open architecture for UAV collaboration to help commanders maintain situational awareness and control of the UAVs in electronic jamming, poor communications, bad weather, and other adverse conditions. DARPA briefed industry on CODE program details earlier this month.

The program is divided into three phases. The first phase focused on system analysis, architecture, design, and critical technologies. The first phase also had two tracks, one for system integrators and the other for technology developers.

In addition to Lockheed Martin, Leidos Inc. in Reston, Va., participated in the CODE program's first phase. Leidos won a $4.2 million CODE phase-one contract in November 2014.

The second phase involves detailed design of the CODE system and in-flight demonstrations. The third phase will develop and demonstrate full mission capability during three series of flight tests.

The CODE program's first phase ran through early this year. The second phase runs from early 2017 to mid-2017, while the third phase runs from mid-2017 through the end of 2018.

On this contract modification Lockheed Martin will do the work in Orlando, Fla.; Cherry Hill, N.J.; Fort Worth, Texas; Minneapolis; Ann Arbor, Mich.; Exton, Pa.; Pittsburgh; and Philadelphia, and should be finished by May 2017.

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

edge of battle situational awareness information. It can integrate new payloads quickly, offers roll-on, roll-off capability to move the system quickly from ship to shore, and aboard cargo aircraft. The UAV can carry sensor payloads as heavy as 39 pounds.

FOR MORE INFORMATION visit **Boeing Insitu** online at *www.insitu.com*.

Rugged smart camera for industrial environments introduced by ADLINK

ADLINK Technology in San Jose, Calif., is introducing the NEON-1040 x86 rugged smart camera for harsh environments. The NEON-1040 has an IP67-rated housing, M12 connectors, quad-core Intel-based processor, field-programmable gate array (FPGA) co-processors, and graphics processing unit (GPU) for high-speed, high-resolution imaging applications. The NEON-1040 features a 4-megapixel, 60-frame-per-second global shutter sensor and the Intel Atom quad core 1.9 GHz processor, featuring minimal footprint and rugged IP67-rated construction. The quad-core CPU increases computing power, and FPGA coprocessors and GPU deliver advanced image processing. Software support and API compatibility enable migration from original x86 platforms. The NEON-1040 offers as much as 32 gigabytes of storage for image processing, programs, and archiving.

FOR MORE INFORMATION visit **ADLINK** online at *www.adlinktech.com*.

PRODUCT applications

NAVIGATION AND GUIDANCE

Air Force looks to Rockwell Collins to provide handheld GPS navigation

U.S. Air Force navigation and guidance experts are readying a potential five-year contract to Rockwell Collins in Cedar Rapids, Iowa, to build and maintain military handheld GPS receivers.

Officials of the Air Force Materiel Command at Robins Air Force Base, Ga., are revealing plans to award a sole-source contract to Rockwell Collins for the Defense Advanced Global Positioning System (GPS) Receiver (DAGR). These purchases will be for U.S. and foreign military customers.

The DAGR is the approved handheld GPS receiver for all U.S. military services and is integrated or embedded in more than 150 military platforms, Air Force officials say.

DAGR is a small, lightweight GPS receiver for vehicular, handheld, sensor, and gun laying applications. It provides moving map and situational awareness capabilities, and it meets military environmental requirements.

The DAGR provides enhanced protection against jammers and was among the first handheld GPS receiver programs in the U.S. to include selective availability anti-spoofing module (SAASM) security technology, Rockwell Collins officials say.

The Air Force will solicit and negotiate with Rockwell Collins on a sole-source basis to build, repair, and de-militarize DAGR units. The Air Force will award the contract to Rockwell Collins sole-source because the government does not own rights to the unit's technical data to support a competitive procurement from any other source, officials say.

The proposed contract is for a one-year basic period plus four one-year ordering periods. The value of the upcoming contract has yet to be negotiated.

FOR MORE INFORMATION visit **Rockwell Collins** online at *www.rockwellcollins.com*.

DISPLAYS

Navy chooses Honeywell for cockpit displays on carrier-based combat jets

U.S. Navy avionics specialists are looking to the Honeywell International Inc. Aerospace segment in Albuquerque, N.M., for several sizes of advanced multipurpose displays (AMPD) for the avionics systems of the Navy F/A-18F jet fighter-bomber and EA-18G electronic warfare aircraft.

Officials of U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $9.1 million contract to Honeywell to provide 101 advanced multipurpose avionics displays for the F/A-18F and EA-18G aircraft.

The AMPD rugged display family consists of 5-by-5-inch forward avionics displays, 5-by-5-inch aft displays, and 8-by-10-inch avionics displays.

The AMPD replaces obsolete cathode ray tube (CRT)-based displays in legacy aircraft, and uses state-of-the-art active matrix liquid crystal display (AMLCD) technology.

The displays are full color, high density, and can be used during the day, at night, and with the night vision imaging system (NVIS). Of the AMPD family, the 5-by-5-inch versions are for the F/A-18E/F/G models, and the 8-by-10-inch versions are for the F/A-18F/G aft cockpit. The 8-by-10-inch model includes a direct digital video input. The displays

provide symbology, raster, and hybrid display formats, and support mono and full-color modes.

Honeywell will do the work in Albuquerque, N.M., and should be finished by October 2017.

FOR MORE INFORMATION visit **Honeywell Aerospace** at *http://aerospace.honeywell.com*, or **Naval Air Systems Command** at *www.navair.navy.mil*.

VETRONICS

Oshkosh chooses Telephonics NetCom vetronics communications system for JLTV program

Vetronics designers at Oshkosh Defense LLC in Oshkosh, Wis., needed an in-vehicle communications system for the Joint Light Tactical Vehicle (JLTV) that Oshkosh is developing for the U.S. Army and Marine Corps. They found their solution from Telephonics Corp. in Farmingdale, N.Y.

Oshkosh awarded a contract to Telephonics to provide its NetCom Vehicle Intercommunications Systems for the JLTV, which will replace a portion of the military's current fleet of up-armored HMMWVs.

With the additional capabilities of NetCom, these vehicles will further enhance the situational awareness and safety of U.S. troops via clear and secure communications. NetCom will be integrated onto the Oshkosh JLTV starting in 2016.

Telephonics is a subsidiary of Griffon Corp.

The Telephonics NetCom offers crew intercommunications and radio management, and can support as many as 20 users. The system offers adaptive noise cancellation technology at each microphone input, enhances audio intelligibility, and protects user hearing.

The system's low size, weight, and power consumption help simplify installation and integration onto the JLTV, Telephonics officials say.

NetCom's system in a box dual-operator design functions as a vehicle intercom with secure, digital communications for all internal and external communications. As an IP-based system, NetCom integrated into the networked digital backbone of the vehicle and digital battlespace.

The system offers an integrated capability for infantry and vehicle crew members to maintain communications among themselves and with higher-echelon commanders.

It uses the Telephonics TruLink wireless intercommunication system with common line-replaceable units across all ground vehicles, and enables many vehicles to keep in touch using one crew station.

FOR MORE INFORMATION visit **Telephonics** online at *www.telephonics.com*.

RADIO EQUIPMENT

Navy orders networking radios for network-centric warfare from Rockwell Collins

Military radio designers at Rockwell Collins in Cedar Rapids, Iowa, will provide advanced networking radios for network-centric warfare under a $24.9 million U.S. Navy contract.

Officials of the Naval Air Warfare Center Weapons Division-Point Mugu at Ventura County Naval

Base, Calif., are asking Rockwell Collins to provide as many as 194 Quint Networking Technology (QNT) radios. The contract also calls for Rockwell Collins to provide 379 parts of associated hardware, as well as 36,482 hours of incidental equipment modification services for the AN/ALQ-231(V) Intrepid Tiger Electronic Attack System in support of the Joint Electronic Attack Compatibility Office.

The QNT program, supervised by the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., is developing a modular network data link to establish multiband communications among manned aircraft, unmanned combat air vehicles (UCAVs), weapons, tactical unmanned aerial vehicles (UAVs), and infantry ground forces.

QNT technology seeks to use data links to integrate tactical UAVs, infantrymen, and weapons into the future digital battlefield for network-centric warfare operations that use distributed sensor platforms to find, fix, track, and engage important stationary and moving targets in real time.

On this contract Rockwell Collins will do the work in Cedar Rapids, Iowa, and Yuma, Ariz., and should be finished by May 2021.

FOR MORE INFORMATION visit **Rockwell Collins** online at *www.rockwellcollins.com*, or **Naval Air Warfare Center Weapons Division-Point Mugu** at *www.navair.navy.mil*.

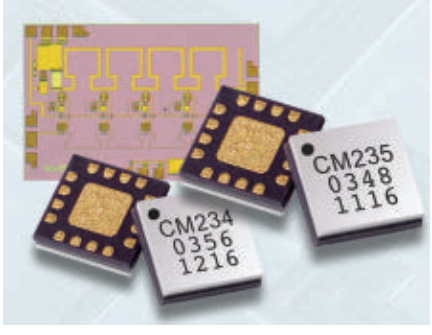
new PRODUCTS

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

RF AND MICROWAVE

RF amplifiers for military and telecommunications introduced by Custom MMIC

Custom MMIC in Chelmsford, Calif., is introducing a range of high-performance RF and microwave amplifiers and switches with ultra-wideband operation for military, test and measurement, and telecommunications applications. The SP3T CMD234C4 provides high isolation of 40 dB at 10 GHz and low insertion loss of 2 dB. The CMD234C4 includes an on-board binary decoder circuit that requires two complementary control voltage logic lines of 0/-5 volts. The SP5T CMD235C4, similar to the SP3T design, features a low-power, integrated 3:8 TTL decoder for enhanced digital control. The CMD235C4 provides an insertion loss of 2.5 dB and a high isolation of 40 dB at 10 GHz. The gallium arsenide CMD235C4 and CMD234C4 switches come in small size and lead-free, RoHS-compliant 4x4 SMT QFN packages, and have a switching speed of 66 nanoseconds. The DC-22 GHz and 2-22 GHz gallium arsenide MMIC distributed amplifiers offer ultra-wideband performance from DC to 22 GHz, with a noise figure down to 2.2 dB and gain of 15 dB. Also linear, the CMD240 demonstrates a 1 dB compression point of 19 dBm at 10 GHz and an output IP3 of 28 dBm with 80 milliamps supply current.



FOR MORE INFORMATION visit **Custom MMIC** online at *www.custommmic.com*.

POWER ELECTRONICS

Crane qualifies DC-DC converters to MIL-PRF-38534 Class H

Crane Aerospace & Electronics in Redmond, Wash., is introducing mil-spec qualification for the Interpoint MFK series DC-DC converters for military and aerospace power electronics applications. The devices now meet MIL-PRF-38534 Class H. This performance specification for hybrid microcircuits, administered by the U.S. Defense Logistics Agency's Land and Maritime segment in Columbus, Ohio, describes a standard military quality level for use in the U.S. Department of Defense (DOD). This document is a performance specification for hybrid microcircuits, multichip modules (MCM), and similar devices, and provides a manufacturing baseline to support government microcircuit applications. Adhering to MIL-PRF-38535 Class H ensures that these devices meet performance requirements per the U.S. military's qualified manufacturing list (QML). It's an assurance of quality without additional parts tests and screening. Crane offers MFK Class H DC-DC converters with two SMD numbers: SMD 5962-14210 for MFK singles, and SMD 5962-14211 for MFK duals.

FOR MORE INFORMATION visit **Crane** online at *www.craneae.com*.

CONNECTORS

Small rugged connector for handheld defense and UAV uses introduced by Fischer

Fischer Connectors in St-Prex, Switzerland, is introducing the MiniMax 06 small ultra-miniature connector for space-limited, body-worn, or handheld applications in defense and security, instrumentation, test equipment, and unmanned aerial vehicles (UAVs). The MiniMax 06 connector can include as many as 12 power and signal contacts in a footprint of 10 millimeters, corresponding to a density factor of 0.83. The MiniMax 06 connector also includes a configuration with two signal and two high-power, 1.3-millimeter contacts for applications that need 10 amps or more power. MiniMax 06 is easy to use and ensures premium performance even in harsh environments. MiniMax 06 integrates into the ultra-miniature, high-performance Fischer MiniMax series, known for its use in limited space

and lightweight applications, and for meeting the combined needs of signals and power. Tested for high-speed protocols such as HDMI and data transfer of up to 10 gigabits per second, the series also addresses the growing market need for higher data transmission rates.

FOR MORE INFORMATION visit **Fischer Connectors** online at *www.fischerconnectors.com*.

RUGGED SERVERS

Rugged servers for radar signal processing introduced by Crystal

Crystal Group Inc. in Hiawatha, Iowa, is introducing the RS4104 and RS4198L24 high-performance and configurable rugged servers for use in harsh-environment applications that require storage, removal, and instantaneous processing of critical data. Crystal Group has designed these units to accept GP/GPU engines such as the Xeon Phi, AMD FirePro, or the Nvidia Tesla for data-intensive applications, including digital signal processing (DSP); intelligence, surveillance, reconnaissance (ISR); radar signal processing; training; and oil & gas exploration. These machines are rack-mounted servers designed to have dual Intel Haswell or Broadwell E5 Xeon processors paired with coprocessors like the Xeon PHI or Nvidia's Tesla products. The RS4104 and RS4198L24 are driven by Intel Haswell or Broadwell E5-2600 V3 or V4 processors and can be configured with as much as 1.5 terabytes of Registered DDR4 memory. The RS4104 also supports as many as 10 PCI Express 3.0 x8 or 5 PCI Express 3.0 x16 expansion slots for add-in cards and is powered by a 1780-watt power supply. The unit is 20 inches deep, 17.5 inches wide, and fits onto an EIA-310 rack. The RS4198L24 supports as many as 10 PCI Express 3.0 x16 expansion slots (8 of which can support double-width cards) for add-in cards and is powered by 3200-watt 2+2 power supplies.

FOR MORE INFORMATION visit **Crystal Group** online at *www.crystalrugged.com*.

BOARD PRODUCTS

Single-board computer based on DMP Vortex86DX3 introduced by Diamond Systems

Diamond Systems Corp. in Sunnyvale, Calif., is introducing the compact, rugged HELIX PC/104 single-board computer based on the DMP Vortex86DX3 system-on-chip (SoC) processor. The Helix board provides optional integrated data acquisition circuitry, PCI Express MiniCard I/O expansion, and rugged construction. Helix is for applications needing a stable, low-cost board platform with many years of availability. Two standard Helix models are available off-the-shelf: one aimed at low-cost basic applications and the other targeting data acquisition applications.

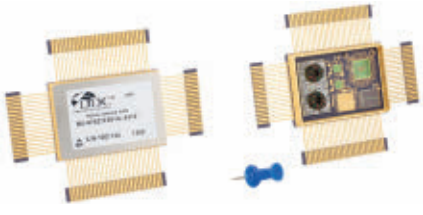
The data acquisition model adds a data acquisition circuit as well as other I/O. Customization options are available allowing customers to match the specific needs of their application with on-board has of the Helix board. Using an expanded PC/104 form factor measuring 102-by-102-millimeters, the rectangular shape provides more coastline for I/O connectors. The board combines the 1 GHz DMP Vortex86DX3 dual core SoC with PC I/O and on-board data acquisition circuitry.

FOR MORE INFORMATION visit **Diamond Systems** online at *www.diamondsystems.com*.

DATABUSES

Rad-hard MIL-STD-1553 databus terminals for space introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y., is introducing two 3.3-volt, integrated, radiation-tolerant, MIL-STD-1553 databus terminals that include transceivers, transformers, protocol, and memory for rad-hard, mission-critical space applications. Total-Space ACE offers BC, RT, MT, and RT/MT functionality to interface to a host processor, while the Total-Space RT is an RT only terminal for interfacing with systems without a host processor, such as FPGA and simple logic. Both versions feature an extended -55-to-125-degree-Celsius temperature range, 300 kilorads total-dose radiation hardness, and more than



85 MeV single-event-effects radiation hardening. The device replaces two transceivers, two transformers, protocol, and memory; simplifies layout; and improves reliability. Its transformers and transceivers are trimmed and tested as a set, and provide MIL-STD-1553 compliance. The two configurations are available in gull-wing and flat packages, and are qualified DSCC MIL-PRF-38534 Class H or K.

FOR MORE INFORMATION visit **DDC** online at *www.ddc-web.com*.

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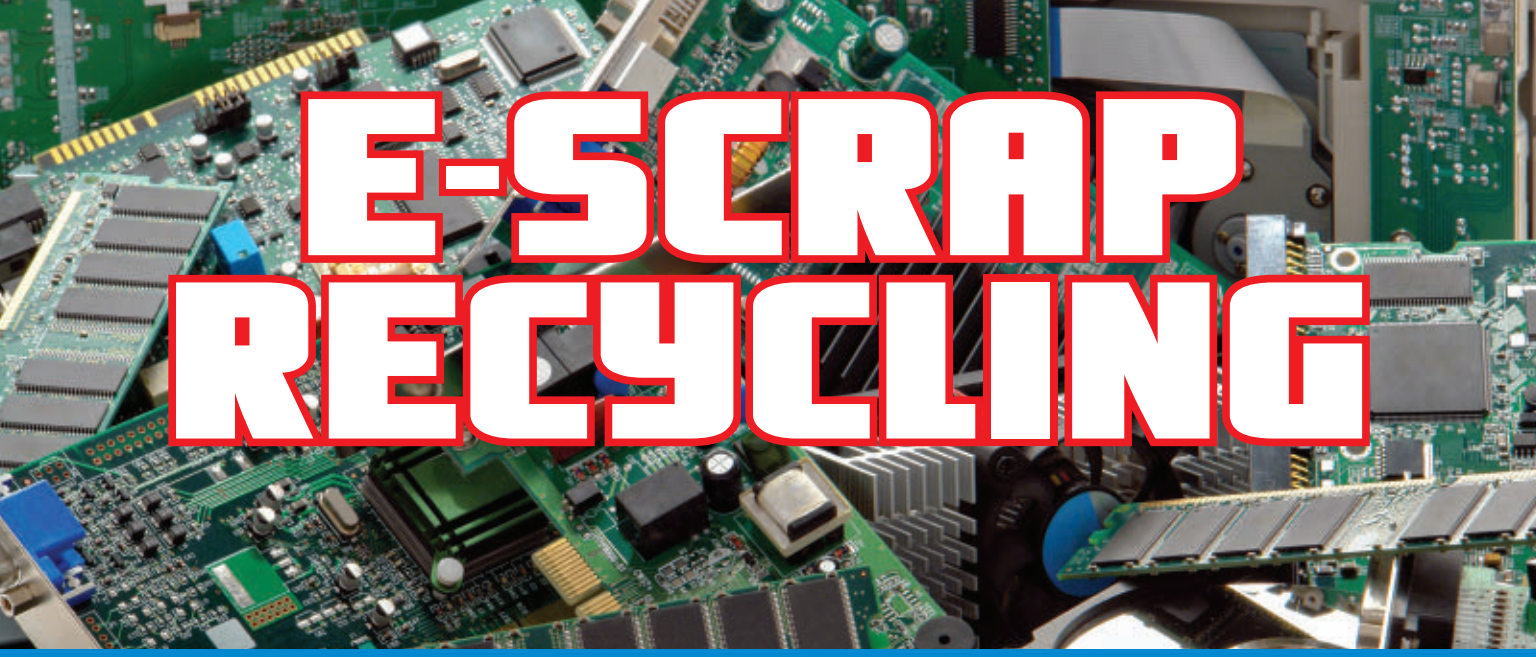

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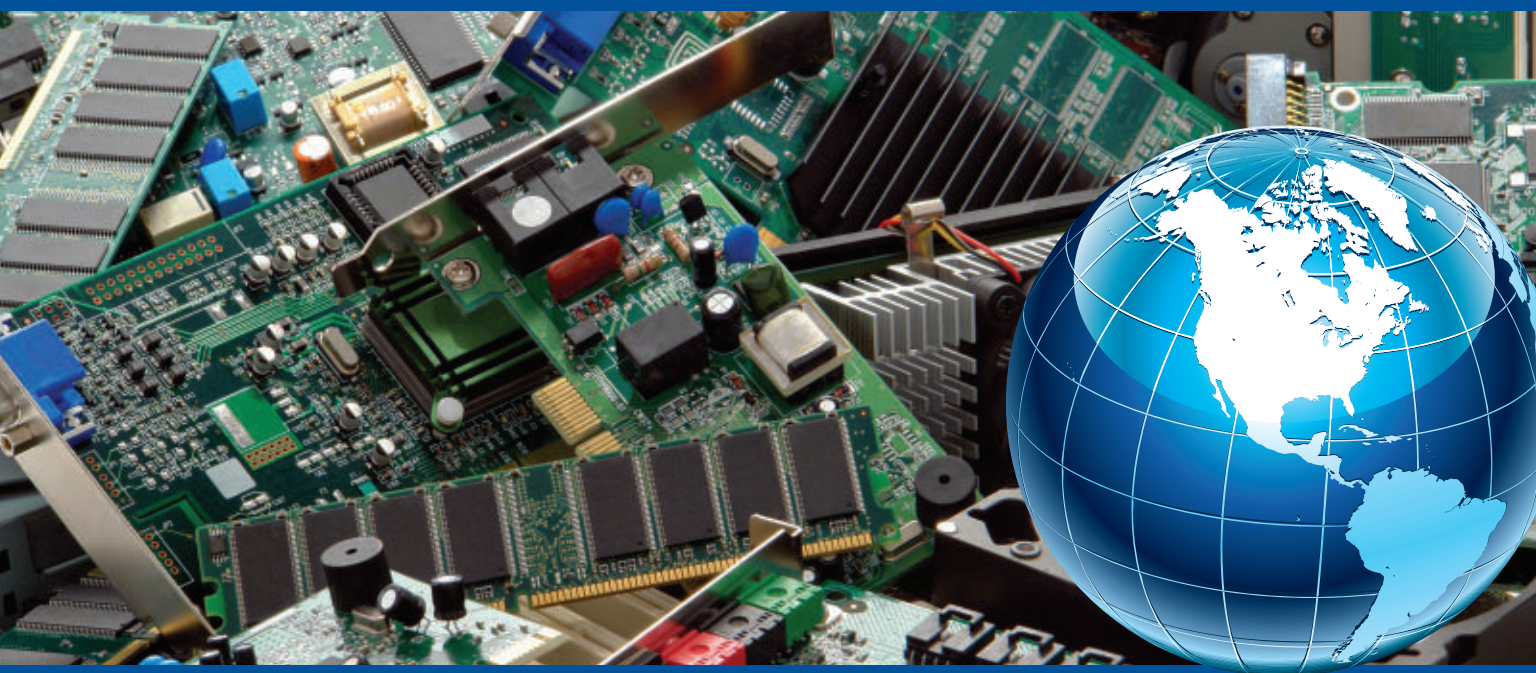

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