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Military & Aerospace Electronics

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Rugged tablets and smartphones

Tough handheld devices are becoming necessities for military operations. PAGE 18

Military batteries

Designers of mobile power systems balance endurance, safety, and power density. PAGE 26

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Networking ground vehicles

Ground vehicles are becoming nodes on the network-centric battlefield.

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COVER STORY

Image: TARDEC, U.S. Army

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BY **JOHN KELLER**, EDITOR IN CHIEF

A sobering assessment on U.S. military's future

The U.S. military today is in trouble. The challenges facing the Pentagon don't just add up to a bit of trouble; this is BIG trouble—perhaps the biggest trouble that U.S. military forces have faced since the end of World War II—and it's going to take time and a lot of money to fix.

This isn't just my opinion; this is the conclusion of the National Defense Panel in its report, entitled "Ensuring a Strong U.S. Defense for the Future." The report accompanies the Pentagon's 2014 Quadrennial Defense Review, a study by the Pentagon that analyzes strategic objectives and potential military threats.

"The defense budget cuts mandated by the Budget Control Act (BCA) of 2011, coupled with the additional cuts and constraints on defense management under the law's sequestration provision, constitute a serious strategic misstep on the part of the United States," says the report summary.

One of the only ways to fix this and many other problems facing the U.S. military is more money in the defense budget—perhaps a lot more.

Defense cuts over the past three years have "caused significant investment shortfalls in U.S. military readiness," the report states, and "have prompted our current and potential allies and adversaries to question our commitment and resolve."

Failure to turn this ship around "will lead to an America that is not only less secure but also far less prosperous," the report states. "In this sense, these cuts are ultimately self-defeating." That's quite a sobering assessment.

The Pentagon's 2014 Quadrennial Defense Review (QDR) makes several recommendations on how to restore U.S. global military dominance. There's just one problem: we can't afford them. "The capabilities and capacities rightly called for in the 2014 Quadrennial Defense Review... clearly exceed the budget resources made available to the Department [of Defense]," the report states. "This gap is disturbing if not dangerous in light of the fact that global threats and challenges are rising."

The trends the Pentagon faces today "mandate increased defense funding," panelists say. In the future, "conflicts are likely to unfold more rapidly. Battlefields will be more lethal. Operational sanctuary for U.S. forces (rear areas safe enemy interdiction) will be scarce and often fleeting. Asymmetric conflict will be the norm. In this rapidly changing environment, U.S. military superiority is not a given; maintaining the operational and technological edge of our armed forces requires sustained and targeted investment."

In particular, the report recommends increased military procurement and research in several areas. "We must have an energetic program of targeted reinvestment in research, development and procurement designed to protect and enhance the technological advantages that are central to U.S. military superiority," the report states. "Priorities for investment should include intelligence, surveillance and reconnaissance (ISR) systems, space architecture, cyber capabilities, joint and coalition command and control, air superiority, long range and precision strike capability, undersea and surface naval warfare, electric and directed energy weapons, strategic lift, and logistical sustainment."

Wow. Has anything been left out? This sounds like the U.S. military across the board is long overdue for a sustained period of revitalization—something that has been severely lacking during the current administration.

Still, the problems are big and complicated. The U.S. government is deeper in debt than ever, and the nation's political resolve is questionable. Here's hoping that will change in the future, because we desperately need the will, sacrifice, and money necessary to bring the U.S. military back up to fighting trim.

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Raytheon to develop UAV-killing laser to fit Marine light vehicle

BY JOHN KELLER

EL SEGUNDO, Calif.—Laser weapons experts at the Raytheon Co. will develop a tactical laser weapon mounted on a humvee-like maneuverable combat vehicle to protect moving U.S. Marine Corps task forces from unmanned aerial vehicles (UAVs), cruise missiles, and other weapons that are difficult to pick up on radar.

The future Joint Light Tactical Vehicle (JLTV), shown above, will host a laser weapon able to shoot down small manned and unmanned aircraft.

Officials of the U.S. Office of Naval Research (ONR) in Arlington, Va., awarded an $11 million contract to the Raytheon Space and Airborne Systems segment in El Segundo, Calif., to develop a vehicle-based laser device capable of defeating low-flying threats, such as enemy drones.

The contract is part of the ONR's Ground–Based Air Defense Directed Energy On-The-Move program (G-BAD DE OTM), which seeks novel subsystems and components for a future UAV-killing laser vehicle that can fire on the move. The Raytheon G-BAD contract will develop a vehicle-mounted laser weapon designed for firing while maneuvering off-road over rough terrain while working together with Marine Corps infantry and combat vehicles that are attacking beaches and other important military targets.

Raytheon will conduct a field demonstration of a humvee-mounted short-range laser weapon system with a minimum power output of 25 kilowatts, using Raytheon's planar waveguide (PWG) technology. A Raytheon high-energy laser uses one PWG the size and shape of a 12-inch ruler to generate sufficient power to shoot down small aircraft.

The G-BAD initiative seeks to mount a short-range air-defense laser at least as strong as 25 kilowatts on a four-wheel Joint Light Tactical Vehicle (JLTV), which the Army, Marines, and Special Operations forces are developing to replace the humvee.

Navy researchers are asking

CONTINUED ON PAGE 6 ➔

IN BRIEF

Navy chooses companies to install CANES shipboard networking equipment

U.S. Navy communications experts are choosing five companies to share as much as $2.53 billion over the next eight years to install advanced command, control, communications, computers, and intelligence (C4I) shipboard networking equipment aboard the Navy's surface warship fleet. The contract is part of the Consolidated Afloat Networks and Enterprise Services (CANES) program. The contractors who will install CANES equipment are: BAE Systems Technology Solutions & Services Inc. in Rockville, Md.; General Dynamics C4 Systems in Taunton, Mass.; Global Technical Systems in Virginia Beach, Va.; Northrop Grumman Corp. in Herndon, Va.; and Serco Inc. in Reston, Va. CANES serves as the bridge to the future of Navy afloat networks, consolidating existing legacy and standalone networks, providing infrastructure for Tactical applications, systems, and services. CANES will consolidate and modernize shipboard network systems to improve operational effectiveness and affordability across the fleet. ➔

K2 Energy batteries to help power Navy electromagnetic railgun

BY JOHN KELLER

WASHINGTON—U.S. Navy hypervelocity weapons experts needed powerful and reliable batteries to power a large modular capacitor bank for the electromagnetic railgun. They found their solution from K2 Energy Solutions Inc. in Henderson, Nev. Officials of the Naval Sea Systems Command in Washington announced a potential $81.4 million contract to K2 Energy for the self-contained battery intermediate energy store system to power capacitor banks for the Navy's future electromagnetic railgun.

K2 Energy specializes in lithium iron phosphate battery technology—a special kind of lithium battery that addresses the four major issues with current lithium technologies: safety, life, power, and environmental friendliness. Navy leaders plan to use electromagnetic railguns aboard future surface warships to shoot non-explosive shells at a speed of Mach 8—eight times the speed of sound, or roughly 6,000 miles per hour. At that speed the weapon does not require explosives; the kinetic energy alone is enough to vaporize vehicle-size objects.

The Navy's electromagnetic railgun, under development by BAE Systems, requires staggering amounts of electricity to operate. The Navy envisions 64-megajoule electromagnetic railguns for future shipboard use. The Office of Naval Research in Arlington, Va., operates a 32-megajoule Electro-Magnetic Laboratory Rail Gun from BAE Systems for research purposes at the Naval Surface Warfare Center in Dahlgren, Va.

The Navy's ability to deploy future electromagnetic railguns will hinge on producing the incredibly large amounts of electricity necessary to operate them. The 64 megajoules of power necessary to shoot the future electromagnetic railgun is equal to about 18 kilowatt hours. Future warships carrying these kinds of weapons will need advanced power plants, and the requirement for electricity production is likely to have a profound influence over future ship design.

K2 Energy will do the work in Henderson, Nev., and should be finished by December 2016.

FOR MORE INFORMATION visit **K2 Energy** online at *www.k2battery.com*.

LASER CONTINUED FROM PAGE 4

Raytheon to develop a G-BAD laser weapon that can fire at full power for as long as two minutes, followed by a 20-minute recharge to 80 percent of total capacity. The laser weapon should not weigh more than 2,500 pounds, and needs to fit in the JLTV's cargo area.

Marine Corps officials say current low-altitude, air-defense systems have weaknesses against UAVs, which are becoming armed threats, and they need something like the G-BAD concept as a new expeditionary mobile air-defense weapon.

Raytheon will develop the G-BAD laser weapon from the ground up to prevent reconnaissance, surveillance, targeting, and engagement of expeditionary forces by UAVs. Eventually Navy researchers want a JLTV-mounted 50-kilowatt laser weapon. The G-BAD system will consist of three subsystems: a volume-surveillance radar, command and control (C2), and a high-energy laser weapon. The program aims to develop components and subsystems that not only improve Marine Corps air-defense capability, but also offer reductions in size, weight, and power consumption, and that can operate effectively on-the-move.

On this project, Raytheon laser weapons experts will look into a rugged, lightweight beam director; improved beam control; adaptive optics; an atmospheric characterization and tactical decision aid; thermal storage and management; power generation, storage, and conditioning; weapon station controls and displays; and long range optics.

Other G-BAD technologies Raytheon is being asked to develop include light tactical vehicle-mounted command, control, and communications including high-quality stills and video imagery, as well as fire-control that can acquire a target with its own sensors. The system also will need a light tactical vehicle-mounted volume surveillance radar able to detect and track potential threats.

FOR MORE INFORMATION
visit **Raytheon Space and Airborne Systems** online at *www.raytheon.com*, or the **Office of Naval Research** at *www.onr.navy.mil*.

Aerospace and defense missions require rugged data networking

Military organizations look to outfit myriad vehicles with compact, yet feature-rich networking equipment able to withstand harsh environments.

Modern electronics in ground combat vehicles are proving to be extremely effective tools against insurgent-placed IEDs and explosive devices. (Image courtesy TARDEC, U.S. Army.)

BY **Courtney E. Howard**

Demand for information at the edge, often in harsh environments and in vehicles traversing rough terrain, is driving the need for rugged data networking systems and devices. Aerospace and defense organizations the world over are tapping into the product portfolios and engineering design services of high-tech industry firms to architect, test, implement, and modernize information networks within and among myriad military vehicles, as well as across the network-centric battlefield.

The network is fundamental to every aspect of modern military operations, says Rubin Dhillon, global marketing director of embedded computing at GE Intelligent Platforms in Huntsville, Ala. "You often hear senior military officials talk about their 'network-dependent' forces. Everything in the modern battlefield is interconnected—sensors, vehicles, drones, weapons, and people."

This "connected battlefield" "is driving a huge demand for networking equipment–particularly rugged, size, weight, and power (SWaP)-optimized switches and routers that are deployed at the very edge of the network—the very edge of the battlefield," he says.

Rugged and advanced

"Military tactical networks are becoming far more complex," Dhillon says. "The biggest change we are seeing is the demand for more advanced rugged routers and intelligent switches."

GE Intelligent Platforms network switches and routers take part

in a variety of aerospace and defense land, air, and sea programs. The company has rugged Ethernet switches operating on the International Space Station and installed in unmanned aircraft systems (UAS) to network the various sensors required for autonomous flight, Dhillon explains. "We have switches installed in various ground vehicles, such as the new Scout Specialist Vehicle family of platforms to be deployed by the U.K. Army. The ground vehicle space has been a sweet spot for us as these platforms are becoming smarter and smarter, representing a rolling 'information technology (IT) closet' at the very edge of the battlefield."

General Dynamics UK officials selected GE subsystems for the Scout Specialist Vehicle family of platforms for the British Army under a roughly $5 million contract. The Scout SV family of platforms—designed to deliver a step change in ground-based intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) capability—is a purpose-designed, ground-based intelligence platform coupling high-performance sensors with a Gigabit Ethernet intelligent open architecture. The military vehicle electronics, or vetronics, enable the capture, analysis, manipulation, and storage of more than 6 terabytes of intelligence data, including still and moving images, and the ability to share intelligence in real or very near real time.

The GE subsystems sport rugged processors from GE's MAGIC1 and SBC624 single board computer and rugged Ethernet switches from GE's GBX460 managed rugged 6U OpenVPX data plane switch module to provide information processing capability, manage on-vehicle networks, control data storage, and drive the vehicle's displays.

Serious security

"Some engineers tend to look at networking gear as just a bunch of plumbing," GE's Dhillon says. "Network switches and routers are just simple devices. Don't we all pretty much have a router in our houses these days? The catch is, especially with military tactical networks, as more and more devices become connected, the network becomes more and more complex. And the

more complex the network becomes, the more vulnerable it is to security threats. Networks must be architected with performance, scalability, and security in mind—right from the start." Dhillon says he is seeing greater demand for increased security.

"Because everything is linked in the connected battlefield, we are seeing an increase in demand for firewalling, intrusion detection, virus detection—and these services are getting installed in places you would never have believed are vulnerable to network attack," Dhillon notes. Moreover, given that "network services are required at the very edge of the network—installed in weapons systems, handheld drones, soldiers' backpacks—we are getting challenged by our customers to cram very advanced networking and security services into some of the smallest places."

Solving SWaP-C challenges

"In general, there has been a proliferation of systems at and beyond the tactical edge over the last several years," says Michael W. Schneider, vice president of federal programs and business development at Themis Computer in Fremont, Calif. For example, counter improvised explosive device (IED) systems, gunshot detection systems, 360-degree cameras, remote weapon stations, command and control (C2) systems, satellite antennas, and intelligence, surveillance, and reconnaissance (ISR) sensors.

SWaP has long been a concern among aerospace and defense organizations; over the past two decades, in particular, cost has become a significant concern, resulting in SWaP-C program requirements. "Now there is a need to network these systems in order to realize synergies in these systems working together and to simplify integration on the tactical platform," Schneider continues. "Ultimately, there's a real expectation for dollar cost savings by eliminating redundant components—such as multiple global positioning system (GPS) receivers and inertial measurement units (IMUs)—per platform and by standardizing integration with shared network services such as time, location,

orientation, and so on.

"In the tactical vehicle market, Themis is following the VICTORY architecture standards for our technical networking specs," Schneider says. U.S. Army officials launched the Vehicle Integration for C4ISR/EW Interoperability (VICTORY) initiative to recover lost space on tactical wheeled vehicles and ground combat platforms by reducing the size, weight, and power of vetronics; enable platform systems to share information and deliver an integrated picture to the crews; and provide an open architecture able to accept future technologies without the need for significant re-design.

"There is no question that there is real synergy to be gained through all-in-one systems," Schneider explains. To that end, Themis offers a "small-form-factor tactical Gigabit Ethernet switch that can also include an internal networked shared dual core processor with up to 256 gigabytes of flash storage, a Rockwell Collins Selective Availability Anti-Spoofing Module (SAASM) GPS, an IMU, and a gateway to either CAN Bus or 1553. The physical and electrical integration cost savings across myriad tactical vehicle platforms potentially represents more cost avoidance for the government than the cost of the hardware.

"To date, we've teamed with a variety of major tactical vehicle manufacturers to provide the vehicular digital backbone to enable the full range of 'bolt-on' systems to plug-in to the vehicle's shared network services," Schneider says. For example, Themis offers several variants of its Nano Switch with embedded GPS, IMU, CAN/1553 gateway, and shared processor—"ranging from the basic Layer 3 switch to the 'all-in-one' platform designed to provide the complete platform digital backbone," he says. "Several of our systems have been fielded in prototype vehicles for government test and evaluation."

Schneider predicts that "we'll see the port counts going up, the demand for bandwidth will continue to increase, and there's no doubt the "all-in-one" platform digital backbone is the way of the future. SWaP-C will always be critical."

Consolidation consideration

Aerospace and defense systems integrators are increasingly investigating the consolidation of functionality into single boxes, solutions, and appliances, says David Jedynak, chief technology officer of the COTS Solutions Group at the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va. "In the past, customers had federated architectures where they had many, many different line replaceable units (LRUs). There is a push to reduce SWaP and, in that effort, customers are looking to consolidate the functionality of what used to be separate devices into a single box.

"The DuraWORX product is a perfect example of that, according to company officials. By leveraging a mechanical design and an electrical design that are modular, Curtiss-Wright engineers can mix and match both computing and networking functions in a single box. They married a Cisco router with an Intel Core i7 processor and the ability to add additional I/O and additional switches in one package.

The Parvus DuraWORX 10-10 SWaP-optimized, commercial off-the-shelf (COTS) subsystem is designed to provide system designers with "a scalable, all-in-one computing appliance that simplifies the integration of tactical computing, Internet Protocol (IP) networking, and situational awareness applications, while significantly reducing SWaP and enabling LRU consolidation," according to Curtiss-Wright Corp.'s Defense Solutions division, a Cisco Systems Solution Technology Integration (STI) partner.

The DuraWORX 10-10 integrates the capabilities of Curtiss-Wright's DuraCOR 80-40 mission computer and DuraMAR 5915 network router LRU subsystems, Intel Core i7-based processing, and Cisco 5915 Internetwork Operating System (IOS)-managed secure network routing in a single, rugged enclosure for extended temperature, high shock and vibration environments. Parvus DuraNET 30-2020 or DuraNET 20-10 Ethernet switches can also be integrated in the system to increase Ethernet port count

and add managed Layer 2 switching capabilities.

Consolidation of features is driven by multiple applications, including unmanned air systems and tactical ground vehicle applications, Jedynak says. "The U.S. Army wants to get rid of stove-piped devices that are isolated from each other and that cannot talk over a common network. The VICTORY initiative is eliminating stovepipes, getting all interfaces out to an Ethernet network, and allowing for scalability. One of the big things that the Army is trying to accomplish: not getting backed into a one-size-fits-all solution, but rather to have solutions based on standards and the scalability to adapt and add on over time according to what each application requires. It is very much that value proposition of scalable I/O architecture, mixing and matching functions in a modular way."

Internal and external data demands

"If you look within military vehicles—whether aircraft, ground vehicles, or shipboard—you're networking various different systems together so they can share data and interoperate," says Curtiss-Wright's Jedynak. "It really is analogous to local area networks (LANs) in a home or office environment. Then there are all the connections on and off these different platforms.

"There are a lot of different ways for the data to move from that platform out to larger networks, whether that is satellite communications, over the air, wire, fiber, or things like dismounted soldier mobile networks," Jedynak continues. "They are all communicating back to a vehicle with networking technology, and enabling soldiers to communicate over that network.

"Routing ends up becoming very important: keeping track of what connections are live, where can you send data, where are you allowed to send data from a security context, all these different things. It really puts a lot of emphasis to be able to not just switch on a platform, but being able to route data on and off that platform," Jedynak says.

"If you have a vehicle platform

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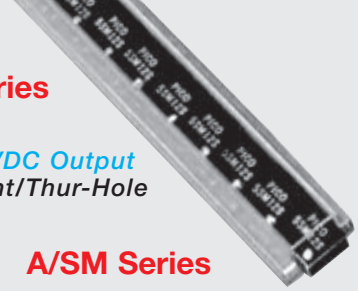

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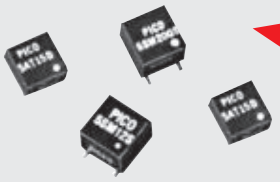

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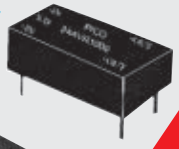

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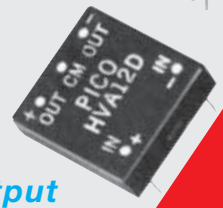

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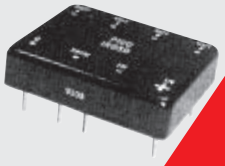

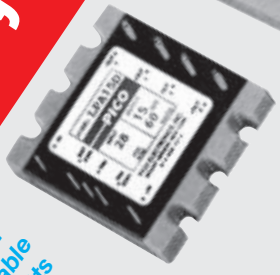

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and on that vehicle you have various types of sensors that are monitoring the actual vehicle itself in terms of maintenance, fuel, or navigation information, those different sensors onboard the vehicle can now be linked together for sharing situational awareness, typically through Layer 2 Ethernet switches," says Mike Southworth, product marketing manager working of the Parvus product line at Curtiss-Wright Defense Solutions in Salt Lake City. "If that information needs to be sent to another vehicle, aircraft, or command center, then you need Layer 3 router functionality.

"Within a backplane-based architecture, cards are designed to interconnect computing engines for sharing of resources. When we are talking about system of systems, we are talking about what in many cases is leveraging the ubiquitous nature of Ethernet for situation-awareness upgrades so that various sensors outside of the boxes can be linked together so information can be shared and the holistic picture of what's going on for the warfighters known that all that sensor data can be tapped into, combined and available on the network," Southworth says.

Within the Curtiss-Wright portfolio are unmanaged switches, Layer 2 plug-n-play type devices; then you move up to the managed switches with much more network configurability; and then you have the network routers which have Layer 3 protocols for a wide area network (WAN) that would enable you to connect to satellite modems, tactical radio links, mobile ad hoc network radio links, or some other wireless means to link up the aircraft, ground vehicle, and command centers to share information outside of the vehicle, Southworth explains.

Features and functionality

The largest U.S. Army program of record that is involved in communications on the move is the Warfighter Information Network-Tactical (WIN-T) program, Southworth says. "It is very much active and fielded, and going through incremental rollouts to bring warfighters such capabilities as texting,

messaging, and sharing information in the field. Curtiss-Wright is delivering Ethernet switch technology into the WIN-T program that supports this architecture today."

Among the more common feature requirements, Curtiss-Wright's Jedynak and Southworth are seeing is the ability to sanitize a device. "Information assurance is very important to customers, and that is not always a standard feature that switches and routers support," Southworth says. "Another commonly requested requirement is the ability to perform self-diagnostics or built-in test (BIT), and 1 Gigabit Ethernet seems to be the sweet spot in terms of bandwidth. There's definitely interest in moving to higher and higher speeds. Looking to the future, we will be investigating ways to increase performance for customers."

Engineers have integrated Lync, enabling warfighters in vehicles to exchange messages and share a common operating picture of the battlefield. (Image courtesy U.S. Army.)

At the same time, engineers are working to reduce SWaP in embedded system designs. "We have demand for the smallest Ethernet switches we have ever designed, which is resulting in a roadmap that will include ultra-miniature form factors that are literally one-tenth the size of what we have traditionally done," Southworth says. "We are actively developing ultra-small form factor designs right now; we will have prototype preproduction units before the end of this year."

Curtiss-Wright engineers are also saving SWaP by layering software-based networking applications available from Cisco on top of their hardware. "We can take a general-purpose computing platform and add a router on top by way of software—and that adds zero size, weight, and power to the computer platform and yet now you have a computer and a router," Southworth says. "Parvus will be rolling out technologies that integrate software-based Cisco technologies; in the past, it has been hardware from Cisco that we integrate, and now we are integrating Cisco software as well."

Services and software

"Our customers don't necessarily come to us because we have the hardware," GE's Dhillon says. "As networks find their way into applications that have never been connected in the past, we find that many military platforms designers just do not have the networking experience required to architect advanced and, more importantly, secure networks. So we built a Network Communications Technology Group in our Edinburgh, Scotland facility and housed in it some of the smartest network geeks we could find. Our experts help our customers architect their networks, often building custom software to meet unique mission requirements."

In fact, Dhillon explains, "the buzz in the commercial networking world has all been about software-defined networks (SDN). This technology virtualizes the network architecture, often replacing physical switches and routers with software versions running on hypervisors in virtual machines. This architecture is deployed in very large data centers—think Amazon and Google. The military network infrastructure also has large data centers and SDN has found its way there, but SDN has not made a large impact at the tactical edge of the military network... yet.

"The push for advanced networking services deployed in very SWaP-constrained environments will drive the adoption of software-based routers and switches at the very edge of the battlefield, and the adoption of compute-dense platforms—high-performance embedded computing (HPEC) and multi-core platforms—will help make this a reality," Dhillon predicts.

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Rugged tablet computers and smartphones for the battlefield

Far from the haphazard use of personal cell phones in military operations of past decades, today's organized use of rugged tablet computers and smartphones is incorporating information security to bring handheld computing to all echelons of the battlefield.

BY **J.R. Wilson**

Soldiers of 2/1AD conducting casualty evacuation operations using smartphones during a recent Network Integration Evaluation at Fort Bliss, Texas.

When the U.S. military first went into Afghanistan and Iraq after 9/11, commanders seemed unaware of the potential dangers inherent in the cell phones (not yet smartphones) many warfighters took with them. After 13 years of combat and generations of technological advances, leaders of the U.S. Department of Defense (DOD) are looking at issuing combat smartphones and tablet computers to some combatants, at least down to the squad-leader level.

Considerable debate remains on the nature of such devices, however, and on what they actually would add to combat missions, their limitations and vulnerabilities, and to whom they should be issued. What is undeniable is how these technologies have turned science fiction into fact. Cell phones surpassed Capt. Kirk's "communicator" in the 1990s and today's smartphones and tablets now have capabilities often exceeding Star Trek's tricorders.

"The types of apps soldiers really wanted initially focused on high-resolution map imagery in the palms of their hands," says Doran Michels, program manager for transformational applications at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. "At that time, before each mission they would print out [terrain] screenshots... and assemble sets of different maps and different frames at different zoom levels, based on what they expected the mission to be. But if there was a change to the mission—or if things didn't go according to plan—then they were completely without a map capability and essentially flying blind.

"We wanted soldiers to drive the development of the applications so we knew the apps could evolve in real time with dynamic mission requirements," Michels says. "The enterprise device's security comes from the network, but the security of the tactical device must reside within [the device] organically. The two paradigms can't converge until a secure, reliable wireless network exists for tactical environments."

There's an app for that

Even with the hardware advancing rapidly on an almost monthly basis, it truly has become a case of "there's an app for that." Among those already or soon to be available:

- blue force tracking;
- field and training manuals;
- combined with hardware add-ons, collect, analyze and geotag the location of biological samples for pathogens and send the results to a laboratory for further review;

- provide safe and secure intra- and inter-squad communications;
- keep personal and sensitive data securely separated on the same device;
- enable sensitive data to be locked or erased, by remote control or automatically onboard;
- on-device mission planning and updates, including interactive high resolution maps and imagery;
- IED detection and geo-tagging;
- a ballistics calculator app for snipers;
- measurement of radiation levels;

- a basic guide to weapons and munitions;
- real-time text, voice and data communications with higher command; and
- TransHeat, a built-in custom algorithm that passively processes and color-codes travel routes so soldiers can tell how often a given route has been used, then mix up travel to reduce successful roadside bombers or ambushes.

The DARPA Transformative Apps (TransApps) program, initiated in 2010, takes a software approach to developing "a diverse array of militarily relevant software applications using an innovative new development and acquisition process," as described by the research agency. The program has worked on some 50 such applications since its formation.

"A military apps marketplace will be created to enable rapid innovation to meet user needs based on a direct collaboration between a vibrant and highly competitive development community and involved communities of end-users. The program will address all the challenges—technical, business and operational—to make the new capabilities available for use in the field. The objectives are to transition the resulting systems to end-users in the services and to foster a new model for rapidly and effectively acquiring, introducing, maintaining and enhancing software," according to DARPA's Information Innovation Office (I2O).

Rapid evolutions in what has become commodity technologies is making DARPA's founding mission of never allowing the U.S. to be surprised by another nation's technology (as happened with Sputnik) increasingly difficult.

Key Army leaders of the Army Brigade Modernization Command exchange tactical information on secure tablets.

Information revolution

"The Information Revolution has been a huge boon to society, but our growing dependence on information networks also means that information is today's tactical and strategic high ground, increasingly targeted by adversaries from everyday criminals to networked terrorists who would do our nation mortal harm," says I2O Director Dan Kaufman.

"I2O's mission is to ensure the safety and reliability of essential information technologies, against the challenges we face today and also against those we can imagine well into the future. We help make the tools of the Information Revolution more powerful and useful, not just for those who ensure our security but also for the people and nation they protect."

Michels sees TransApps as key to helping warfighters deal with ever more complex tasks without being held back by outdated information-sharing tools. "From a ground soldier's perspective, little has changed in the last 20 years. They rely on inferior paper maps, written notes and reference materials and voice radio transmissions to carry out their missions. Many technology advances that consumers take for granted have not made their way to the battlefield for a variety of reasons, especially security concerns and lack of robust high-bandwidth networks," he says.

"With the TransApps program, DARPA aims to put today's commercial smartphone-grade capabilities in the hands of the soldiers who most need them—those on daily patrols in-theater—making their work much more effective and their lives easier and safer. In the field, the devices are providing soldiers with an integrated ecosystem for situational awareness."

In May 2014, the Army's Program Executive Office-Command, Control and Communications-Tactical (PEO C3T) did field tests at Fort Bliss, Texas, of the Army's new Tactical Network Transmission equipment. TNT includes a new command post 4G LTE/Wi-Fi system that extends communications capability from forward

operating bases, enabling warfighters to access mission data from their smartphones.

"Soldiers and commanders in tactical operations centers need more bandwidth for data-intensive tasks like sending large PowerPoint files, maps and full motion video. The transformational nature of these technologies is increasing situational awareness and effectiveness for soldiers at all echelons," says Lt. Col. Joel Babbitt, product manager for Warfighter Information Network-Tactical (PdM WIN-T), Increment 1.

"Commanders can just pick up their cell phones and directly call or text anyone they need to within the radius. It's a much faster line of communication," adds Cpl. Michael Bullis, B Company, 86th Expeditionary Signal Battalion; the 86th ESB operated the equipment at NIE (Network Integration Evaluation) 14.2. "On the software end, soldiers have a centralized knowledge base on their phones and the Army will continue to add apps to provide a more realistic view of what is going on in operations.

"Medics can use the 4G phones in forward operations, with apps like 'patient tickets'. They put the information directly into their phone while they are right there on the scene, instead of having to come back or give the information to someone over a radio to type it in."

Shrinking size

One area of consensus is great improvements will continue in DOD's size, weight, power, and cost (SWaP-C) requirements, which have become a primary driver for everything in the military, but also commercially.

Significant advances in smartphone and tablet hardware—providing both with faster, higher level computing, lighter weight (and still-declining size for phones), higher resolution and more durable displays, more memory (both RAM and storage), etc.—have marked the past decade. While everyone agrees those areas will continue to improve, they also anticipate a future where current hardware is as antiquated as 1990s "brick" cell phones.

"I see the state-of-the-art as a continuum of getting smaller and

smaller. The current state of the art is wearable technology or what can be embedded into a helmet, vest or existing communications system carried by the soldier. Soon it will look like an earpiece, possibly even implanted—a small, low-power device with a wide range of frequencies," predicts Chip Downing, senior director for aerospace & defense at Wind River Systems in Alameda, Calif.

"As the military downsizes and combat operations continue to decrease, volumes may be smaller and we'll probably see greater use of commercial phones for standard military communications rather than a specialized military phone," Downing says. "It's just smarter to use core technology from the commercial world, then augment that as needed for combat use."

For now and the immediate future, however, the final decision on what to carry in an individual combat kit will be made by the warfighter just before departure on a mission, based on what is considered most important to mission success and personal/unit survival.

Retired Marine Major Rob Anderson, now Chief of the Marine Corps Combat Development Command Vision & Strategy Division, says the value and utility of putting smartphones into warfighters' hands is a combination of factors, some of which may change—if only slightly—in the future.

"I'm not sure there is an actual requirement, due to costs of associating MILS PECs to a commercial product," Anderson says. "In addition, the form factor for a phone is just too small for what the operators need; you have to be able to look at and understand something quickly. That's why they're asking for 8- and 10-inch [tablets]; something with a smaller screen does not meet what they are intending to do from a C2 perspective. "However, I can envision, at least down to the platoon commander, some future smartphone that would set on the arm and provide things like blue force tracker, VMF-like message traffic, call-for-fire, CasEvac [casualty evacuation]—something of an expedient nature that only require a little manipulation and out."

Tablets in the attack: Army leaders coordinate future operations on secure tablets during a recent Network Integration Evaluation at Fort Bliss, Texas.

Battlefield tests

Two Marine Expeditionary Units (MEUs) already have asked to test the utility of tablets in combat. Eight- and ten-inch tablets will be tested at Yuma Marine Corps Air Station, Ariz., running Samsung's Knox suite of mobile security tools.

The MEUs also want to implement the newest version of hypervisor into the tablet tests. Hypervisor (a.k.a., Virtual Machine Monitor or VMM) is hardware, firmware or software that creates and manages virtual machines on a common physical platform, allocating system functions to each VMM as required and ensuring all operate effectively and efficiently. Basic versions have long been available commercially.

VMM is part of a security solution called "dual-persona"—essentially, splitting a mobile device into two separate user environments, one for personal or non-critical information, the other a secure "container" holding military data that can be remotely wiped should the device be lost, stolen or captured (without affecting anything on the personal side of that barrier). Another option is hardware-based "rooting and jailbreaking" capabilities, built into the phone at the factory, that automatically destroy all sensitive date if it detects any tampering.

The dual-persona concept, if software-based or using COTS smartphones with built-in hardware capabilities, would enable the military to take advantage of warfighters' personal handheld devices—a considerable savings in a tight-budget environment—and allow warfighters to have both personal and defense capabilities without adding another piece of equipment to their kits. However, the variety of such devices

on the market, with different operating systems (or versions of the same OS) and connectivity capabilities could make interfacing with other handhelds or government networks or systems problematic.

The Air Force is going the other way—allowing its personnel to install personal data and apps on service-issued phones.

Whether using a personal or government-issued device with dual-persona, they are subject to all the glitches, shortcomings, limitations and failures common to any smartphone or tablet, regardless of operating system, manufacturer or applications installed, as well as some dangers unknown to most users.

"All of the things involved in mobile device management—track a phone, reach in and troubleshoot or lock/unlock it remotely—are going on in the background of every cell phone all the time, whether the user knows it or not," notes Richard Lane, vice president, strategic business development, at rugged laptop specialist American Reliance (AMREL) in El Monte, Calif.

"Even if your carrier isn't doing that, you'd be amazed how much information is being sent from your phone to third parties, including the manufacturer," Lane says. "All that is done out of ports on the core processor, such as the one used for logging on the phone. And there's no way for the user to disable that."

Tablets vs. smartphones

Mike McCarthy, director of operations at the Army Brigade Modernization Command and lead on the Army's Connecting Soldiers to Digital Applications Project, sees more utility for combat smartphones than the tablet-oriented Marines. But he says his project had to dispel rumors surrounding Army use of COTS devices—such as paying personal cell phone bills as a retention and recruiting scheme—before they could concentrate on real issues.

"We made a conscious effort to look at holistic solutions because our initial analysis showed it was not about hardware, software, applications, security measures, lifecycle, etc., in isolation. You have to bring all those elements together and look at it as a system-of-systems," McCarthy explains. "That drove us toward looking at things in terms of answering questions: Is there utility in using these devices? Yes. How so?"

The first and most obvious advantage of COTS is cost.

"Instead of developing an acquisition strategy to buy 1.2 million copies of one phone, when that technology will be superseded in 9 months, we took an approach of being device- and OS-agnostic. We want to be able to buy the best we can afford, which drove us to not placing mega-orders for something that would be obsolete by the time we got them, but buying smaller numbers more frequently, so each buy can leverage the technology that is best at the time," McCarthy continues.

"Early on, there was talk of developing an Army smartphone that weighed less than three pounds, ran on the Android OS, could still work after being submerged in three feet of water for five days or dropped three meters, cost less than $5000 a unit, and could be fielded in five years. Unrealistic. How many $200 units can you buy as disposable items rather than something that had to last 15 years using technology that was obsolete before we could field it and had been out of production for most of that time?"

With each new generation of electronics lasting months rather than years, the entire research-to-acquisition-to-fielding chain must adapt if U.S. warfighters are not to lose the technology edge they have enjoyed for decades. And with information, situational awareness, and data flow in the battlespace becoming more dependent on secure, multifunction devices the warfighter carries into battle, combat smartphones, tablets, and whatever follows them in coming years will become an increasingly important part of that change.

Information security

Advances in technology and capabilities are being announced worldwide almost daily. For example, xG Technology Inc. in Sarasota, Fla., recently was awarded a patent for "Interference Mitigation Method for Single or MIMO (Multi-Input/Multi-Output) Receiver Devices"—essentially, a new approach to enhanced protection against interference in shared and crowded spectrum environments that can be built into an LTE-compliant system.

"As the reuse and sharing of spectrum become increasingly attractive options to alleviate the challenge of crowded frequencies, the risk of damaging interference grows. This interference mitigation innovation reduces that risk, thus enabling more reliable and efficient wireless communications," says xG CEO John Coleman. "The ability to also support devices on LTE systems is especially significant, since LTE operators are deploying increasing

numbers of small cells (micro-, pico-, and femtocells) which can increase the possibility of interference."

Lockheed Martin Corp. has been pursuing new and evolving technologies to provide faster, smaller, more efficient electronics for applications from spacecraft to smartphones, including low-energy, low-heat bandgap semiconductors in place of silicon-based semiconductors.

"The current state of the art for smartphones and tablets, in a tactical setting, is where the warfighter, with little training, can download apps and security to make it secure," says Alex Moore, C4ISR Business Development chief at Lockheed Martin Information Systems & Global Solutions in Alexandria, Va. "The Army wants the best of breed in COTS technology, but it is difficult to work that out in their CONOPs—secure mobility, mission command apps, easy-to-use tools for the warfighter.

"On the battlefield, information is accessed through common points, but you really can't do that with smartphones. You don't want the enemy hacking in through the Internet or 3G or 4G networks. When things get chaotic and a device gets lost, you need a security level that can zero out a capability or segregate the device captured by the enemy."

Every new device, additional sensor, etc., going into the battlespace also puts more demand on the available spectrum.

"It will be difficult and the network will be burdened. It's very difficult to get LTE in the field and any new apps will be a drawdown on the net, so that will be a major problem with which the military will have to deal," Moore says. "We can utilize a lot of COTS technology in building the network and infrastructure. The military has some difficult requirements and a difficult budget environment, but is being called on to take on more missions, security as well as force-on-force."

Broadband issues

On the other hand, Wind River's Downing adds, small-form handheld communications devices may provide a solution rather than enlarge the broadband problem.

"This actually is the cure for that. The old way was to have a sensor not do any filtering but send all its data upstream, then another system filters it and sends more pertinent information to the next level. Unmanned systems now are beginning to do some filtering, showing what has changed because people don't need to know everything looks exactly the same way it did last time," Downing says.

"So the bandwidth problem is solved with device intelligence, where it collects and filters information before sending it on. Current generation smartphones don't transmit all their data, only changes. In combat, the warfighter then can turn on a separate capability to send new information upstream."

Bandwidth is not the only area where smartphone/tablet "add-ons" may become a problem—or a solution. Of equal importance,are the number, size, and weight of items warfighters must carry—and the batteries to power them.

"There is a whole range of equipment warfighters can carry into the field today, but it has to be carried, so they determine what they really need to accomplish the mission and survive. That choice becomes easier as devices get smaller and the sensors are no longer on your back but flying or driving around you. Having robotic 'mules' to carry more batteries also will help that," Downing says. "And combining multiple capabilities into a single, light-weight device also will make the choice simpler.

"Today's soldier also has to determine how many battery packs to take. In the future, hopefully, devices will be very low power and able to collect energy from the environment. I also expect them to become wearable—not just a tablet on a sleeve, but have the sleeve itself be the device. We're working on that today, having the function of a smartphone in your ear rather than a device you have to carry. And we may see them become embedded, especially a non-obtrusive, embedded, self-powering microphone or speaker. SWaP will be the major driver, for both commercial and military."

That also is integrated into the flexibility to change devices and incorporate new technologies as quickly and cheaply as possible, especially to address some of their long-inherent problems. Lane adds, "modularity is the solution to obsolescence; there are a lot of useful things that can be adds to these smartphones and tablets and I think that will be a major future growth activity.

"What technology is today will be different in three months, but you have to work with what you've got," Lane says. "But whatever that is, when the battery dies, you don't have anything, no matter how great the technology—or if it weighs too much to carry a spare battery or if the screen flares and reveals your location to the enemy.

"Also important is the future of networking technology. Commercial carriers are not in the jungles of Asia or mountains of Afghanistan, but our warfighters are or may be," Lane says. "Programs such as WinT have tried to bring greater broadband to all aspects of combat, from warfighters to logistics, but just can't keep up with what's happening in the consumer world. If you look at the last five or ten years, the magnitude of change was exponential. Moore's Law tells us that is going to continue and the next five will see another order of magnitude—and twice that in ten. I'm not sure I can even begin to predict where technology will be in 10 years."

Foiling eavesdropping

Security for smartphones and tablets has been on the increase in recent years, especially for commercial users who do not—cannot—risk their conversations or files falling into the wrong hands. That has been a boon for the military, but DOD security requirements far exceed what is found in a standard smartphone—or required by the vast majority of civilian users—so the military is still driving the upper end of security, internal and external.

"How do you use the device to do multiple levels of security, including when connecting to coalition partners? Using multilevel communications devices, while more vulnerable, has become a requirement. The military is driving that," Downing says. "That includes dual-persona capabilities. And now you don't have to reboot to switch from the personal side to the corporate side, separating both communications data and data-at-rest.

"The highest priority is making sure classified data is separate from other communications and does not bleed into those channels, so you need a way to robustly secure those channels and the software that transmits them. As you do that, you then want a device that is highly flexible. You may want to take the same phone on different missions and have the ability to download new apps with a high confidence those will work well. [That includes] the drive for higher security and validation of the phone, doing boot-up security checks and verification of the high integrity of the data," Downing says.

Another concern with using COTS devices is the supply chain, no matter how well policed. While Intel has brought a lot of its chip manufacturing back to the United States, most research is still done overseas. And China has become the world's largest manufacturer of electronics—PCs, tablets, smartphones, etc.

But technologies to validate the supply chain may themselves be compromised, as demonstrated recently when a Chinese manufacturer was found to be embedding malware in mobile scanner firmware, which then moved to targeted enterprise servers.

"China definitely has their fingers into more of our information than we realize," Lane says. "And unless you can take any hardware they make, understand every small bit of it and shut down such things, you really can't be sure you've fully succeeded. That has yet to be fully addressed. From a hardware manufacturing standpoint, Asia is strong, but creative ways to use them is very, very strong in the U.S. Do we need to worry about what potential foes may have? Not so much about having something better, but knowing what they have and how to neutralize it. And the way you defeat an adversary's capability is of major importance.

"I think relatively low-cost [small-form handhelds], that can be replaced easily, will be the one and only electronic tool on the battlefield, whether a shooter or supporting a shooter," Lane continues. "They're already everywhere in civilian society and will be everywhere in the military. We'll stand up highly secure data networks to which they will connect. And they will be used to control weapons and robotics."

The future of smartphone and tablet technology in the battlespace, near-term, is far beyond anything anyone in the military could have imagined as the 20th Century came to a close. Long-term, warfighters and engineers can speculate, but technology is likely to quickly supercede even the best prognostications.

"Future combat will be more electronic in nature, a battle to control information," Wind River's Downing says. "You may be controlling a million devices, half of those sensors, in the battlespace, others that take that information and allow future commanders to make intelligent decisions. But they must know they still own all those and can constantly determine what systems have been compromised and, if they don't shut themselves down, other systems that verify them can filter out untrusted data. That's the ultimate in electronic warfare—commandeering information."

Military seeks to balance energy, weight, and safety in battery technologies

BY **John Keller**

Rugged, reliable batteries are more important for aerospace and defense applications than ever before because of the growing number of wearable computers, remote sensors, radios, rifle sights, and countless other applications that require electricity. Battery technologies are following the same trajectory as far as size, weight, and power consumption (SWaP) is concerned—smaller is better.

With growing demands for power-dense batteries and low SWaP, the obvious choice for a many aerospace and defense applications are lithium-based batteries. Unlike lead-acid batteries, lithium-based batteries are lightweight, pack a lot of power, offer new technologies with long life cycles, and are decreasing in price.

The Tadiran U.S. Battery Division in Lake Success, N.Y., offers the TLI series of industrial-grade rechargeable lithium ion (Li-ion) batteries that officials say outperform consumer-grade Li-ion rechargeable batteries.

"Consumer-grade rechargeable Li-ion batteries were designed to operate for approximately five years and 500 full recharge cycles because the devices they power are normally discarded every few years," says Sol Jacobs, vice president and general manager of Tadiran Batteries. "TLI series rechargeable Li-ion batteries are far more robust, offering advanced performance characteristics such as a 20-year operating-life, a low self-discharge rate, the ability to withstand 5,000 full recharge cycles, and the ability to operate and be recharged at extreme temperatures from -40 to 85 degrees Celsius."

Lithium batteries today power countless items, from cell phones and tablet computers, to laptop computers and two-way radios. They are more expensive than lead-acid batteries, but they offer big advantages in power density—or the amount of electricity they can hold—as well as in variable discharge rates to provide electricity for devices that need only a trickle of electricity to those that require periodic large bursts of energy. Still, lithium-based batteries have disadvantages where aerospace and defense applications are concerned: the threat of overheating and fire.

"Take a lithium battery in a laptop computer," says Lysle Oliveros, marketing manager at battery specialist K2 Energy in Henderson, Nev.

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"It has a lot of energy density, but the problem is if you puncture a laptop battery, they get involved in thermal runaway. If oxygen gets into it, it catches fire immediately." The threat of puncture is a big threat in aerospace and defense applications, particularly on front-line battlefields with bullets and shrapnel flying. K2 Energy relies on a proprietary battery design involving lithium iron phosphate (LFP). "We are great for military applications because we have no thermal runway, and we pass puncture and bullet tests," Oliveros says.

"The military is taking a closer look at what we do," says Randon Hansen, chief counsel at K2 Energy. "The military is trying to balance energy, weight, and maintainability, and thermal runaway and those types of things the military can't afford."

Compared to lead-acid batteries, LFP technology is about one-third the size and weight, and has a very slow power loss over time during storage, Oliveros says. "Our shelf life is we lose only about 1 percent per month, and last 10 times longer than lead-acid." A big difference is price. LFP costs at least three times as much as lead-acid, and can be more expensive than lithium batteries.

LFP batteries can work reliably in a wide variety of environments and temperatures. "Our batteries work in space, in the desert, and in arctic climates," K2's Hansen says. The company won a Navy contract to provide batteries for the experimental electromagnetic railgun project.

For the time being, lithium batteries are king for aerospace and defense applications. One growth area involves batteries for wireless sensor technology, says Tadiran's Jacobs.

"With demand exploding in all types of civilian and military applications, the growth curve for wireless sensors will continue to accelerate as this technology evolves," Jacobs describes. "We are seeing exciting developments in underground sensing systems that will be utilized to enhance the perimeter defense of military facilities, protect encamped troops from surprise attacks, and provide immediate warning to key government facilities and infrastructure in case of a terrorist invasion."

Infrared sensor payload for UAVs and light jets introduced by Elbit

Elbit Systems Ltd. in Haifa, Israel, is introducing the DCoMPASS FHD iMEP all-in-one integrated surveillance sensor payload for lightweight platforms like light attack and search-and-rescue helicopters, medium-sized unmanned aerial vehicles (UAVs), and special-mission light jets. The iMEP integrates mission systems and capabilities in a standard 15 inches, 88-pound electro-optical and infrared (EO/IR) sensor payload. The iMEP introduces an integrated digital map, digital video recorder, navigation and data link system with an open architecture.

FOR MORE INFORMATION visit **Elbit** at *www.elbitsystems.com*.

U.S. spending for UAVs to reach $15 billion by 2020

The U.S. market for unmanned aerial vehicles (UAVs) will triple in size over the next five years, and should grow from $5 billion in 2013 to $15 billion in 2020, predict analysts at market researcher Information Gatekeepers Inc. (IGI) in Boston. The 2014 UAV Market Research Study looks at the total UAV market from large military UAVs to do-it-yourself UAVs for amateurs.

FOR MORE INFORMATION visit **IGI** at *www.igigroup.com*.

Northrop Grumman to correct software deficiencies in Global Hawk surveillance radar

BY **John Keller**

HANSCOM AIR FORCE BASE, Mass.—The cost of a Northrop Grumman Corp. project to develop a next-generation airborne radar to track slow-moving ground vehicles and low-flying cruise missiles has grown to $1.53 billion after a contract modification to make software corrections.

Officials of the U.S. Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., awarded a $17.1 million contract modification to the Northrop Grumman Aerospace Systems segment in Redondo Beach, Calif., for the Multi Platform Radar Technology Insertion Program (MP-RTIP). It is for radar software deficiency corrections in MP-TRIP radar system development and demonstration alignment with the program schedule of the Global Hawk Block 40 long-range unmanned aerial vehicle (UAV) program, which also is being developed by Northrop Grumman.

The Air Force's MP-RTIP program is developing a modular, active electronically scanned array (AESA) radar system scalable for different aircraft, specifically for the Global Hawk and the Air Force Joint Surveillance Target Attack Radar System (Joint STARS). The Raytheon Co. Space and Airborne Systems segment in El Segundo, Calif., is a primary subcontractor on the program MP-RTIP, and is in charge of the radar system's hardware development.

The MP-RTIP surveillance radar will go aboard a Global Hawk Block 40, which has a longer fuselage, larger payload capacity, larger electrical output, and longer wingspan than the original Global Hawk.

The MP-RTIP system is being created from previous Northrop-Grumman radar technology, including the Air Force's E-8 Joint STARS aircraft—a Boeing 707 jetliner converted to a ground-surveillance role—and the existing Global Hawk radar system. Northrop Grumman and Raytheon radar experts will demonstrate MP-RTIP aboard the latest model of the Global Hawk UAV to augment manned E-8 Joint STARS aircraft and other airborne surveillance systems.

The MP-RTIP radar will be able to track slow-moving ground vehicles and low-flying cruise missiles. Compared with existing ground-surveillance radar systems, the MP-RTIP will have enhanced resolution and will be able to collect ground moving target indicator imagery and synthetic aperture radar still images simultaneously. Work should be finished by September 2015.

FOR MORE INFORMATION visit *northropgrumman.com* and *raytheon.com*.

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Lockheed Martin to complete fifth and sixth SBIRS GEO satellites

Missile defense experts at the Lockheed Martin Corp. Space Systems segment in Sunnyvale, Calif., will build two Space-Based Infrared System (SBIRS) Geosynchronous Earth Orbit (GEO) satellites under terms of a $1.86 billion U.S. Air Force contract modification. Officials of the Air Force Space and Missile System Center at Los Angeles Air Force Base/El Segundo, Calif., are asking Lockheed Martin to complete SBIRS GEO satellites 5 and 6. The contract includes options for acoustic testing, launch vehicle integration, and launch and early on-orbit testing. The SBIRS GEO satellites provide continuous early warning of ballistic missile launches and other tactical intelligence with infrared surveillance information.

Long-range observation, target acquisition, and laser designation system introduced by Elbit

Elbit Systems Ltd. in Haifa, Israel, is introducing the Long View CR-D (LVCR-D) long-range observation, target acquisition, and laser designation system. The LVCR-D electro-optical system is for minimizing collateral damage through optimal guidance of munitions with coverage of laser-spot o n the target by automatic detection, analysis, and correction to avoid laser-spot spillover from the target for short and long ranges. The LVCR-D offers the ability to acquire long-range targets and to observe small targets.

Raytheon to provide multi-spectral sensors for Navy reconnaissance aircraft

BY **John Keller**

CRANE, Ind.—Electro-optics designers at the Raytheon Co. Space and Airborne Systems segment in McKinney, Texas, will build advanced multi-spectral sensors for U.S. Navy long-range reconnaissance aircraft under terms of a $19.7 million contract modification.

Officials of the Naval Surface Warfare Center in Crane, Ind., are asking Raytheon to produce MTS-C Multi-Spectral Targeting Systems and spare parts for Navy Special Projects Aircraft (SPA), a secretive version of the P-3 maritime patrol four-engine turboprop outfitted for sensitive surveillance missions.

The Raytheon MTS-C airborne, electro-optic, forward-looking infrared, turreted sensor system provides long-range surveillance to support the Navy SPA mission. The MTS-C provides high-altitude target acquisition, tracking, range-finding, and laser designation, and can provide guidance for all tri-service and NATO laser-guided munitions.

The MTS equips aircraft such as the SPA, C-130 utility turboprop, SH-60 helicopters, Predator drones, and several other aircraft types with an electro-optical and infrared full-motion video camera system that permits long-range surveillance and high-altitude acquisition, tracking and laser designation. The Raytheon MTS family of turreted sensors can be fitted with multiple wavelength sensors, near-infrared and color TV cameras, illuminators, eyesafe rangefinders, image merging, spot trackers, and other avionics.

The multi-use system offers surveillance, target acquisition, tracking, rangefinding, and laser designation for the Hellfire missile and for all tri-service and NATO laser-guided munitions, such as the Paveway Laser Guided Bomb. The Advanced Targeting Forward Looking Infrared (ATFLIR) pod is used with Paveways, JSOWs, and HARMs, officials say.

The Navy's Special Projects Aircraft will receive multispectral sensors for long-range reconnaissance.

To ensure operational reliability, the MTS was designed to meet environmental testing extremes. Its advanced electronics and optical design allow for capability and performance enhancements through add-in circuitry.

Raytheon will do the work in McKinney, Texas, and should be finished by May 2016.

FOR MORE INFORMATION visit **Raytheon Space and Airborne Systems** online at *www.raytheon.com*.

PRODUCT applications

POWER ELECTRONICS

Army chooses solid-state power controller boards from DDC

U.S. Army vetronics experts needed rugged power-controller circuit boards for upgrades to the power-distribution system in the turret of the M2A3 Bradley Fighting Vehicle. They found their solution from Data Device Corp. (DDC) in Bohemia, N.Y.

Officials of the Defense Logistics Agency (DLA) in Warren, Mich., announced their intention to award a contract to DDC worth an estimated $1.9 million for 187 power-controller circuit card assemblies for the Bradley turret system. DLA-Warren officials are awarding the contract to DDC sole-source because the company is the only responsible source for the power-controller board. DLA-Warren is awarding the contract on behalf of the Army TACOM Life Cycle Management Command (LCMC) in Warren, Mich. Officials quote the per-board cost of the DDC devices at $5,192.15.

The DDC-designed card is a 28-volt, 14-channel, solid-state power controller based on DDC's latest generation of multi-channel, solid-state power controller boards and can distribute and control power to as many as 14 independence subsystems. The DDC power controllers feature automated power control to simplify crew operation; automated load shedding; diagnostic and prognostic data; automated and preventive maintenance; improved mission safety and longevity; power quality profiling and analysis; increased system up-time and reliability; reduced power dissipation; and reduced electro-magnetic interference.

DDC engineers developed and tested the board at the company's own expensive, and its design data is considered proprietary to DDC, Army officials say.

Opening the procurement to competition from other potential sources would take longer than two years, Army officials estimate, and would impose delays unacceptable to TACOM and would have significant detrimental impact on TACOM's ability to support the soldier in the field, Army officials say.

FOR MORE INFORMATION contact **DDC** online at *www.ddc-web.com*, or the **DLA-Warren** at *www.landandmaritime.dla.mil*.

BOARD PRODUCTS

Navy asks North Atlantic to supply synchro-to-digital cards

U.S. Navy shipboard electronics experts needed spare VME synchro-to-digital converter (SDC) circuit card assemblies (CCA) for the AN/UPX-29(V) Interrogator System Mode 5 shipboard identification-friend-or-foe (IFF) system. They found their solution from North Atlantic Industries (NAI) in Bohemia, N.Y.

Experts from the Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station, Md., intend to purchase synchro-to-digital cards, as well as card repair services. This subsystem is the core IFF processor of the AN/UPX-29(V) shipboard interrogator system. The AN/UPX-24(V) identifies aircraft and surface vessels equipped with selective identification feature (SIF) modes 1, 2, 3A, and C, and provides secure identification of cooperative mode 4 targets. IFF data from one AN/UPX-24(V) can be synchronized with as many as four individual radars, and provides the operator with synthetic IFF symbology for target recognition and tracking.

NAI will provide 10 synchro-to-digital cards and repair four others. Synchros and resolvers are transformer-type voltage and current transducers that convert a shaft or other rotating device's angular position and velocity to a multi-wire AC electrical signal.

FOR MORE INFORMATION visit **NAI** online at *www.naii.com*.

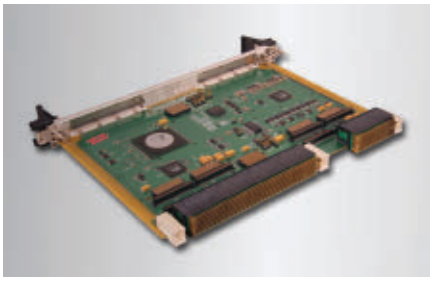
new PRODUCTS

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

BOARD PRODUCTS

6U OpenVPX XMC carrier card introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the VPX6-218 rugged 6U OpenVPX XMC carrier card for deployed applications intended



for harsh defense and aerospace environments, including ground combat vehicles, and manned and unmanned airborne platforms. The rugged embedded computing carrier card, which supports eight lanes of PCI Express Gen2, enables designers to expand their system architectures with the I/O their application requires. Its high-speed, low latency PCI Express interface communicates with the host processor over the VPX backplane. The VPX6-218 can host two 25 watt XMCs and is designed to support today's mezzanine modules that require more power than typical I/O modules.

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

RACKMOUNT COMPUTERS

Embedded computer for rackmount applications introduced by Crystal

Crystal Group Inc. in Hiawatha, Iowa, is introducing the RS111S13 rugged embedded computer for rackmount applications in tight confines like airborne command centers, unmanned vehicles, ships and submarines, server rooms, and process control centers. The shallow depth computing system operates in harsh environments where size, weight, power, and moving part limitations are a concern. Weighing between 6 and 14 pounds, the embedded computer has a 13-inch chassis depth and offers standard rack mounting options. The RS111S13 is fanless and operates in temperatures from -15 to 55 degrees Celsius with rotating hard disks, and in -40 to 55 C with solid-state hard drives. Compact construction of the RS111S13 supports two removable 2.5-inch SATA drives or one 3.5-inch

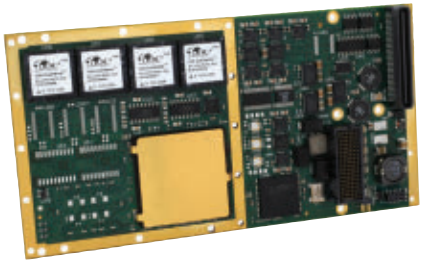
hard disk drive, one mini PCI Express w/mSATA internal slot, two Ethernet ports, two front USB ports, as many as four back USB ports, as many as four Ethernet ports, DVI/I or VGA, HDMI, and VESA display port.

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

DATABUSES AND NETWORKING

Multi-protocol XMC and PMC databus interface cards introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y, is introducing the BU-67118 multi-protocol data bus networking XMC and PMC cards capable of supporting all avionics I/O



requirements. The embedded computing card's high channel mix enables this compact solution to replace several individual I/O cards for size, weight, power and cost (SWaP-C) savings. The BU-67118 XMC/PMC cards use the advanced data bus networking technology to deliver low power dissipation, high mean time between failures, and high performance for rugged environments. Unique features include onboard DMA and 4 kilobytes of address space boundaries for critical real-time applications.

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

RF AND MICROWAVE

Four-way Iso-divider from Crane combines power and isolators

Crane Aerospace & Electronics Microwave Solutions in West Caldwell, N.J., is introducing the Ku-Band four-way Iso-divider for satellite applications. This RF and microwave unit combines the functions of high-performance power dividers with ferrite isolators to provide a high-isolation

power divider solution, making the external isolators redundant, for satellite receiver applications, without introducing complex switch-based solutions. Integration of the two functions into one package provides enhanced product reliability due to fewer external components, interconnects, and switches. It marries the power divider and isolators in the same package. Size and weight of the product are considerably less than an equivalent discrete assembly.

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

EMBEDDED COMPUTING

Rugged XMC single-board computer introduced by GE

GE Intelligent Platforms in Huntsville, Ala., is introducing the rugged XMCM01 XMC single-board computer for aerospace and defense applications that require small size, weight, and power (SWaP). The XMC form factor enables designers to take advantage of a drop in processing capability. It comes with a range of CPU core and memory options that enables technology insertion, or the ability for the same carrier board to have different levels of processing power. Optionally available is the MCC601 6U CompactPCI carrier card, which does not need a 6U CompactPCI chassis to function, as it can be powered via an on-board ATX connector. The Marvell ARMADA XP CPU is equipped with to four ARMv7-compliant 1.6 GHz CPU cores and 2 megabytes of L2 cache. With advanced power management and waking options, this CPU enables the XMCM01 to maintain high performance within a low-power envelope.

FOR MORE INFORMATION visit **GE** online at *http://defense.ge-ip.com*.

POWER ELECTRONICS

IR introduces rad-hard DC-DC converters for spacecraft power

International Rectifier (IR) in El Segundo, Calif., is introducing the M3G120 series of 40-watt radiation-hardened (rad-hard) 120-volt input DC-DC converters for a wide range of digital and analog spacecraft power systems requiring as long as 15 years of mission life. The design includes reliability and radiation performance components de-rated to NASA EEE-INST-002 and MIL-STD-1547B requirements. Available in single- and dual-output configurations, the DC-DC converters feature standard single-output voltages of 3.3, 5, 12, 15, and 28 volts and dual-output voltages of ±5, ±12, and ±15 volts.

Key features include total ionization dose (TID) of more than 200 kilorads (Si), single-event effect (SEE) (heavy ions) with rated LET greater than 83 MeV-cm²/mg, integrated EMI filter, and weight of less than 110 grams in a hermetic 3.5-by-2.5-by 0.475-inch package including I/O pins and mounting tabs.

FOR MORE INFORMATION visit **Micro** online at *www irf.com*.

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Dan Kinney

Aerospace industry executive discusses trends in thermal management.

What is the greatest thermal management challenge today?
Aerospace and defense engineers and designers have access to incredible technology these days, whether it is gallium nitride (GaN) power amplifiers or solid-state lasers for directed-energy weapons. Yet, it is becoming increasingly clear that thermal management is one of the limiting factors when using such devices.

Thermal issues are raised when a customer is trying to keep a certain device or array of devices at an acceptable and/or uniform temperature. Thermal challenges also arise at the platform level, where large amounts of heat need to be dissipated but there are limits in terms of size, weight, and power (SWaP).

What thermal management solutions are aerospace and defense customers requesting, and for what types of applications?
One of our big thrusts is into thermal management systems as opposed to just components. Parker Aerospace still sells cold plates, liquid-cooled conduction (LCC) enclosures, and SprayCool enclosures, but we are also now leveraging the broader portfolio of Parker capabilities.

A case in point is the thermal management system delivered to Kongsberg Defence and Aerospace (KDA) for its Joint Strike Missile (JSM). By working with engineers at Kongsberg, we are using fuel to cool and heat avionics throughout the missile.

What does the future hold?
The primary focus for many is to do as much as possible with air. We support that, and help wherever we can. The industry is certainly pushing the envelope with what can be done with air, but ultimately the practical efficiency of air is limited compared to liquid. This is especially true when you factor in capacity for growth down the road.

Our emphasis is working with customers once they cross that liquid threshold, whether they want to work with a single-phase liquid, such as PAO, EGW, or PGW, or maybe investigate a two-phase solution using a variety of refrigerants or even methanol in extreme cases.

Our goal is to enable comprehensive thermal management solutions so customers can focus on what they do best, whether it is building a radar, an electronic warfare (EW) system, or a directed-energy weapon.

What thermal management advice would you like to offer?
Well, it's a broken record with me. The best solution will come from early involvement, especially when we can work with the system provider and the integrator. For example, the SWaP of a radar or EW system will be reduced if the thermal-management approach can be treated as a "system," where you can influence how the heat is collected and ultimately how the heat is rejected. ←

Don't miss a word

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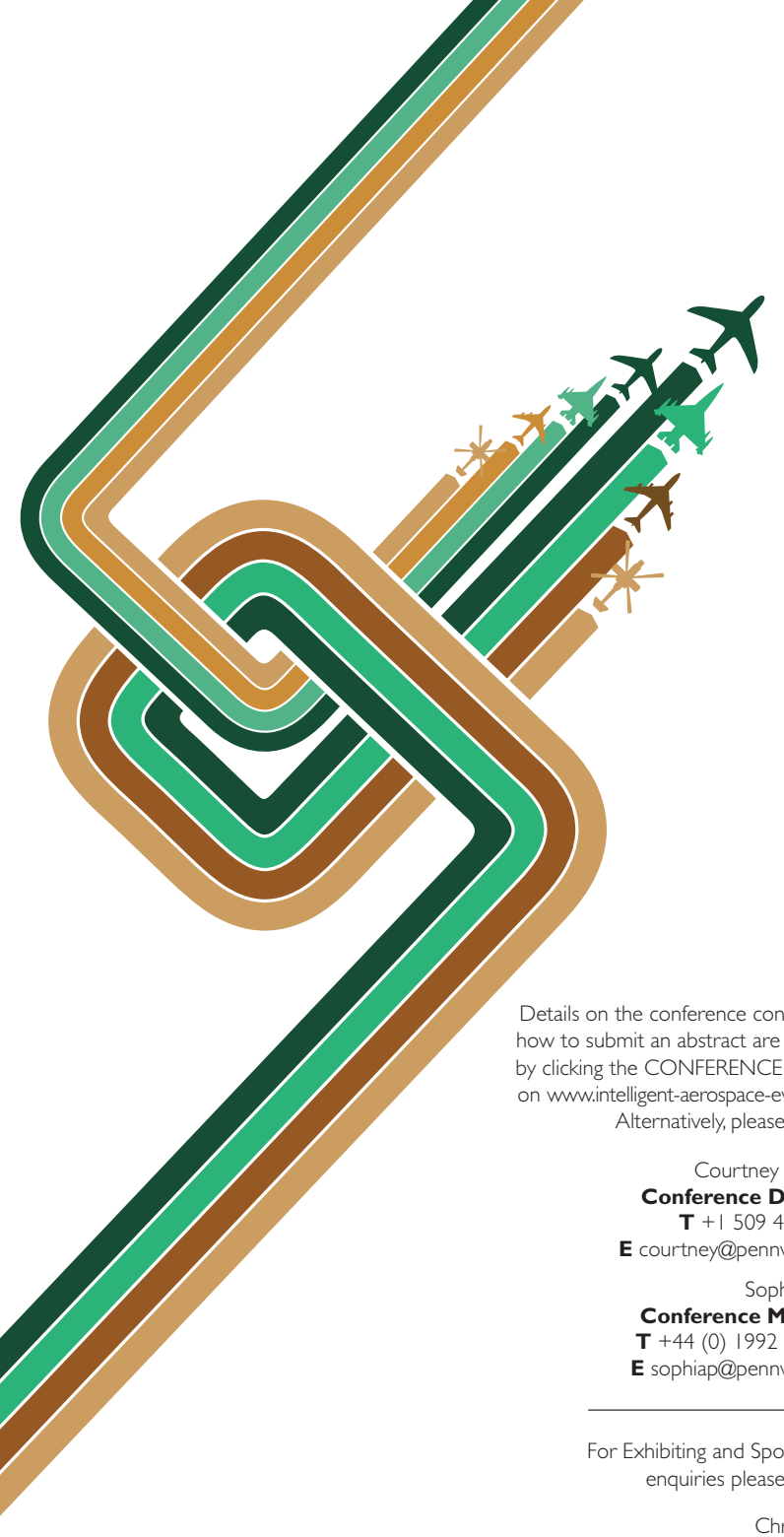

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