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Military vehicles

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Rugged electronics routers

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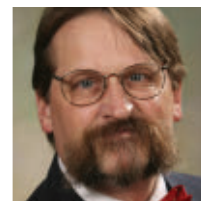
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Race is on to find ways to counter low-cost unmanned aircraft

Small, quadcopter-type unmanned aircraft increasingly are posing a drone menace to civil aircraft operations, as well as to sensitive public, government, and industrial sites like sporting events, prisons, power plants, and military bases.

These small unmanned aerial vehicles (UAVs) can cost as little as a thousand dollars, and are causing problems by their sheer proliferation in numbers. They get in the way of firefighting aircraft and can hamper law-enforcement, to say nothing of invading the privacy of individuals. We haven't even touched on the potential threats of terrorists using drones to deliver explosives and chemical or biological agents, or conduct surveillance of sensitive public, government, or industrial facilities.

The problem is these drones are small and difficult to detect until they're dangerously close. In June, a hobby drone flying over a forest fire in Southern California forced the grounding of helicopters on scene to fight the blaze. The threat of firefighting aircraft colliding with the drone were too great.

Small drones also have caused alarm for those guarding President Obama. In August, the Secret Service noticed a drone hovering near the president as he played a round

of golf in South Florida.

Small drones have been sighted near commercial airports, where they pose a collision risk with passenger jets taking off and landing. Should a loaded passenger plane suck one of these drones into its engines on takeoff, a disaster could ensue.

Remember US Airways flight 1549 back in 2009? An Airbus A320 piloted by Capt. Chesley B. "Sully" Sullenberger encountered several bird strikes shortly after taking off from New York's LaGuardia airport, knocking out both the plane's engines. With skill and luck, Sullenberger was able to land the stricken passenger jet in the Hudson River with no loss of life.

A drone buzzing the departure end of the runway at any of the world's large airports could cause an incident where the crew and passengers might not be so lucky.

The challenge is to develop the capability to counter these small unmanned aircraft when they fly too close to sensitive operations. Industry and government are starting to step up to develop technologies to detect, identify, commandeer, and even destroy trespassing drones, if necessary.

Bligher Surveillance Systems in Great Chesterford, England, has

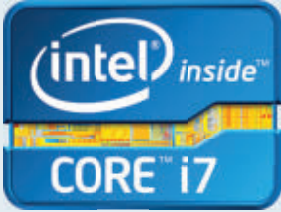
demonstrated an anti-drone system, and other companies are working on technologies to control drone access to sensitive or dangerous areas. *The Wall Street Journal* published a story last month, headlined "Next Step for Drones: Defending Against Them," that outlines some of the progress that has been made toward developing effective and affordable counter-drone technologies.

One of the technological challenges to counter-drone systems is today's sensitive radar technologies. Many radar systems have been fine-tuned to filter out small targets like birds to reduce clutter and false alarms. These filters can make drones invisible to radar.

Still, sensor technologies have been developed to help helicopter pilots sense and avoid high-tension power lines in their flight paths. These technologies can involve radar, ladar, infrared sensors, or other approaches to detect small targets. A growing number of prototype counter-drone systems should be available within a year.

It shouldn't be long before we see counter-drone technologies integrated into perimeter security systems protecting sports stadiums, nuclear power plants, airports, prisons, and military bases. ⬅

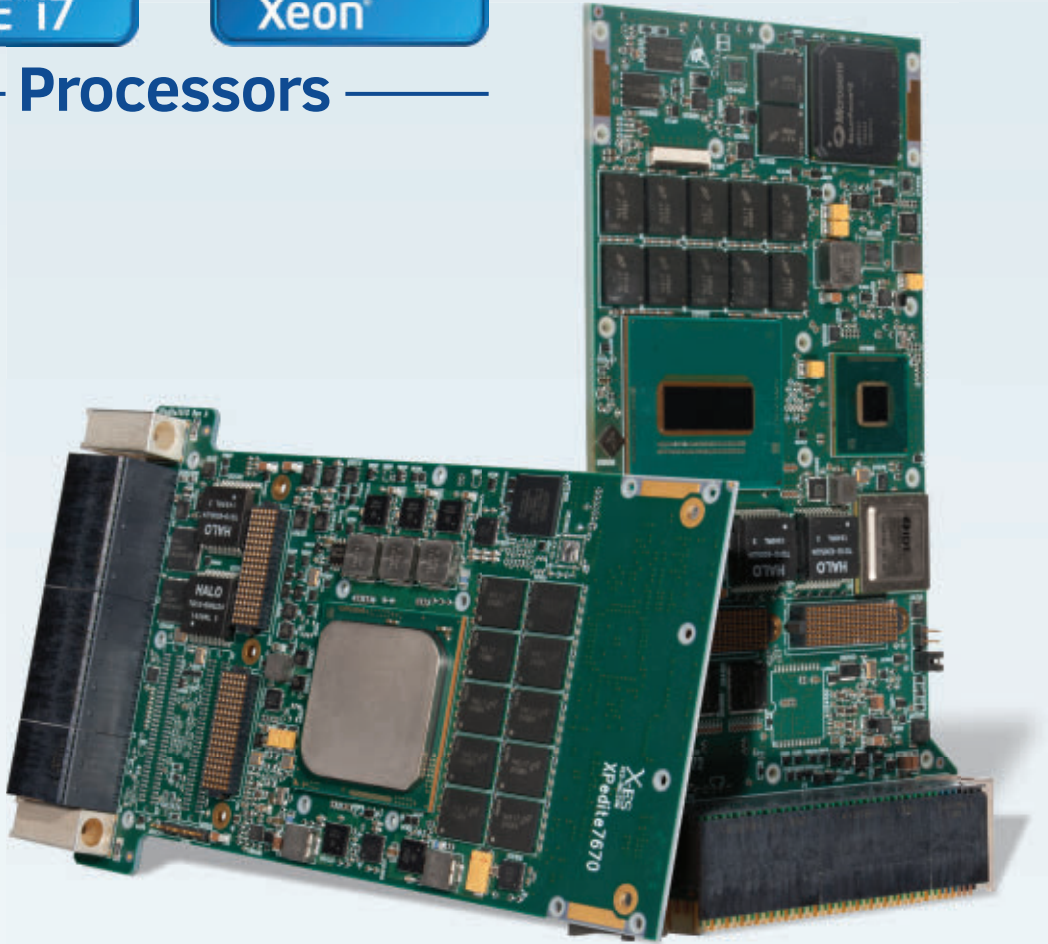
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Three companies to develop multi-warhead-killing, anti-missile weapon

BY JOHN KELLER

HUNTSVILLE, Ala.—The Boeing Co., Lockheed Martin Corp., and Raytheon Co. are developing ballistic missile defense multi-warhead killer weapons able to detect, track, and destroy several different incoming enemy missile warheads and decoys with only one counter-missile launch.

Missile Defense Agency (MDA) officials in Huntsville, Ala., announced contracts in August to the Boeing Defense, Space & Security segment in Huntsville, Ala.; the Lockheed Martin Corp. Space Systems Co. in Sunnyvale, Calif.; and the Raytheon Co. Missile Systems segment in Tucson, Ariz., to start designing the Multi-Object Kill Vehicle (MOKV).

Boeing won a \$9.8 million contract, Raytheon a \$9.8 million contract, and Lockheed Martin a \$9.7 million contract to begin MOKV development.

The MOKV could engage several incoming objects simultaneously with kill vehicles that communicate with one another. The three companies will define concepts that can destroy several incoming warheads and decoys by considering advanced sensor, divert and attitude control, and communication concepts.

Boeing, Lockheed Martin, and Raytheon will define proof-of-concept prototypes, demonstrate risk mitigation steps for all critical components, assess the technical maturity of their concepts, and rank en-



abling technologies to minimize design risks.

Boeing, Lockheed Martin, and Raytheon are developing a weapon able to destroy several incoming warheads with only one counter-missile launch.

abling technologies to minimize design risks.

The MDA's ground-based interceptor missile today carries one kill warhead that detects, tracks, and attacks an incoming enemy ballistic missile warhead and attempts to destroy it kinetically by force of impact.

The MOKV, instead, would launch on one air-defense missile, and deploy several kill vehicles that could engage several incoming enemy warheads. MOKV warheads will be designed to communicate with one another to coordinate their attacks.

The MOKV would function similarly to the MDA's Multiple Kill Vehicle (MKV) program, which was cancelled in 2009. The MOKV is likely to launch on rockets like the U.S. Navy Raytheon SM-3 standard shipboard missile. ◀

FOR MORE INFORMATION visit the **Missile Defense Agency** at www.mda.mil.

IN BRIEF

▶ Two companies win \$1.7 billion job to install C4ISR gear aboard ships

U.S. Navy intelligence and communications experts are spending as much as \$1.7 billion to install and certify electronics equipment aboard Navy surface ships, submarines, and shore sites that handles command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR). Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego announced two industry contracts for C4ISR equipment and installation—one contract to Honeywell Technology Solutions Inc., Columbia, Md., and the other to M.C. Dean Inc. in Sterling, Va. Experts from the two companies will handle task orders over the next four years to install and certify C4ISR systems on Navy ships, submarines, and shore sites. Honeywell will receive as much as \$805.2 million and M.C. Dean will receive as much as \$853.8 million. The companies will install C4ISR equipment from the program executive office for C4I, Space and Naval Warfare Systems Command, and other prospective U.S. government and Foreign Military Sales customers. ◀

Oshkosh prevails over AM General and Lockheed Martin to build JLTV armored combat vehicle

BY JOHN KELLER

WARREN, Mich.—U.S. Army armored combat vehicle experts are choosing Oshkosh Defense LLC in Oshkosh, Wis., to build the U.S. military's next-generation light battlefield vehicle and its suite of vetronics to replace the venerable Humvee, in what is expected to be one of the most lucrative military vehicle programs over the next decade.

Selection of Oshkosh and its Light Combat Tactical All-Terrain Vehicle (L-ATV) for the Joint Light Tactical Vehicle (JLTV) program ends a years-long competition that pitted Oshkosh against teams led by AM General, Lockheed Martin for the potential \$50 billion JLTV program to replace the High Mobility Multi-Wheeled Vehicle (HMMWV).

Officials of the Army Contracting Command in Warren, Mich., announced a \$114.7 million contract to Oshkosh in late August for JLTV low-rate initial production (LRIP) and full-rate production. That contract has options that could increase its value to \$6.7 billion.

The U.S. Department of Defense (DOD) wants to buy 54,599 JLTVs: 49,099 for the U.S. Army and 5,500 for the U.S. Marine Corps. The U.S. Government Accountability Office

(GAO) estimates that the DOD will spend more than \$53.3 billion on the JLTV program—\$1.1 billion for research and at least \$52.3 billion for procurement.

The Oshkosh contract has eight options to build the first 16,901 vehicles for the Army and Marine Corps.



The Oshkosh Defense Joint Light Tactical Vehicle (JLTV) will define the new standard for lightweight wheeled military armored vehicles.

As with most contracts of this magnitude, it is likely that losing contractors AM General and Lockheed Martin will protest the award, which could delay production for months. The contract was awarded on behalf of the Army Tank-automotive and Armaments Command (TACOM) in Warren, Mich.

The Oshkosh L-ATV winning entry in the JLTV competition is a light utility and combat multi-role vehicle that is expected to deliver a level of protection similar to that of cur-

rent, but far heavier and less maneuverable, Mine Resistant Ambush Protected (MRAP) class designs, and much tougher than the most heavily armored HMMWVs.

The JLTV has two variants: a two seat and a four seat variant, as well as a companion trailer (JLTV-T). The

Oshkosh vehicle offers the company's Core1080 crew protection for survivability, turret operated systems, remote weapons systems, and tube launched missile system.

The Oshkosh JLTV is based on the company's TAK-4i intelligent independent suspension system that adjusts ride-height type with as much as 20 inches of wheel travel. The vehicle also has the digitally controlled

General Motors Duramax V8 cylinder 6.6-liter diesel engine.

The vehicle can be fitted with light, medium, and heavy machine guns, automatic grenade launchers, smoke grenades, or anti-tank missiles, operated from ring mounts or a remote weapon station.

On this contract Oshkosh will do the work in Oshkosh, Wis., and should be finished by August 2024. ➔

FOR MORE INFORMATION visit Oshkosh Defense online at <http://oshkoshdefense.com>.

Rugged routers

enable the network-centric battlefield



The vetronics architectures of today's military armored combat vehicles are becoming data centers, as well as battle centers, as rugged network routers form the backbone of sharing voice, data, imagery, and video on the move.

BY J.R. Wilson

"If ignorant both of your enemy and yourself, you are certain to be in peril." – Sun Tzu

Ruggedization has always been a key factor in the development, fielding, use, and maintenance of any piece of military gear. As the U.S. has moved toward an increasingly networked battlespace, rugged and advanced routers have become crucial to the success of vetronics and other harsh combat applications.

Today's high-tech, interconnected

military has capabilities rarely even imagined before the turn of the century, yet with that has come a new set of vulnerabilities—natural and manmade. Extremes in temperatures, the presence of contaminants like sand and dust, and corrosive elements like salt water and salt spray pose dire risks to today's ever-shrinking electronics, while the

world's capabilities in electronic warfare (EW) and cyber warfare continue to grow every day.

Maintaining a technological edge will require an always evolving and ever-widening range of advances, not only in weaponry, but also in communications, sensors, data fusion, and transfer. At the top of everyone's list is real-time situational awareness down to the individual warfighter.

All that can be summed up in a single word: information—yet information is useless without the assured ability to move it rapidly, securely, and in real time across all combat and sustainment elements.

Data routers

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The Parvus DuraMAR 5915 from Curtiss-Wright Defense Solutions is a rugged Cisco-based mobile IP router subsystem.

"I feel strongly IP is the wave of the future for military communications," Isaac adds. "It allows

software-defined networks, the next and next-after-next generation of data routers—likely to be increasingly software-defined—will need to combine multi-environment ruggedization with multi-threat survivability. Achieving that is a task now complicated by tight defense budgets, steep force reductions, rapidly changing missions and threats, and the growing technological sophistication of every military, insurgent, criminal, and terrorist force on Earth.

"It comes down to communications, which is what a network is for," says Ronen Isaac, general manager at rugged router designer Mil-Source in El Segundo, Calif. "The more information we can pass along, the more successful the warfighter can be. If you have a full map with great detail on the battlefield, including friend and foe positions, and the warfighter has the commander in his ear, he's no longer alone out there in enemy territory."

Reliable communications, including voice, data, video, and imagery, helps warfighters feel like someone is watching over them. "With comms, you always have someone watching over you, so comms and routing of Internet Protocol (IP) packets carrying voice and video data will be more and more important to future combat success," Isaac says.

us to reduce costs, increase flexibility, and be more open to new technologies without having to do massive and expensive upgrades. In general, while there may be some up-front costs moving from proprietary tech, in the long-run IP will be less costly. We want to be on the warfighter's body, up to the UAVs, at the vehicle level, and at the ground stations and command centers. And we can be. We have that tech."

Routers, moreover, no longer are simply about connecting subsystems inside military combat vehicles. Today they increasingly are taking the role of connecting military vehicles operating in the same areas.

"Routers in a tactical deployed environment really are about providing a connection outside the vehicle, connecting your internal LAN [local area network] to the WAN [wide area network]," says Mike Southworth, product marketing manager for small form factor systems at the Curtiss-Wright Defense Solutions in Ashburn, Va.

"The requirements for a router in that use are to provide security, gateway, and filtering functions that provide an intelligent network between the inside system and outside and possibly some encryption features," Southworth says. "Going from the LAN to the WAN means putting in place VPN [virtual private

network] features that allow you to be on an IP-based network. All the requirements you would have for a branch router in the civilian network translate into the routers you would put into a military vehicle."

Shrinking electronics

Driving the current state-of-the-art primarily has been the downward scale of processing into systems that use relatively little power and extremely small space to get all required processing onto a small package. That trend is continuing with the Internet of Things (IoT), with increasing processing power on smaller and smaller devices.

Defense contractors say the smartphone industry has been a driving factor in new technology develop-



Rugged data routers display sensor information for real-time battlefield situational awareness.

ment and improved size, weight, and power plus cost (SWaP-C) due to the tremendous revenues they generate. Still, smartphones, while increasingly sophisticated individual devices, usually are end points in the network, where a router is an interconnecting device for several other devices.

The most common factor in state-of-the-art networking routers is Cisco Systems in San Jose, Calif. Even other router manufacturers depend on the ubiquitous Cisco IOS mobile operating system. Many router suppliers employ Cisco's Mobile Ready Net

capabilities for secure data, voice, and video communications to stationary and mobile network nodes across wired and wireless links. The company brought out its initial mobile access router in the early 2000 timeframe—a PC/104 form factor

board with modest ruggedization.

"The longest pole in the tent for evolving IP into any highly mobile platform wasn't just getting the form factor on the router, but getting the offboard comms capabilities," says Darrel Beach, Cisco consulting

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systems engineer. "Since then, we have done a lot of evolution in cell phone technology and WiFi, and for the military there has been tremendous advancement in the development of different types of waveforms that can transmit IP data. As a result,

we have since come out with a series of ESRs [embedded service routers], essentially cards we build. One is a PC/104 form factor and another is a 3D CompactPCI form factor, built primarily to host our Cisco IOS."

"What you really want to get to



The U.S. Army M2A3 Bradley Fighting Vehicle, shown above, is receiving upgrades that involve rugged data routers to help vehicle crews get their soldiers into battle safely.

the vehicle is a routing functionality for transporting IP, so you need to build out an IP-based network," Beach adds. "We have an embedded services software router with the Cisco IOS designed to run in Linux, so you can have a processor running in bare-metal Linux or a version running out of VM. We built those from the ground up specifically for the ruggedized market, but we also developed software routers that can run on Linux or in virtual machines. In the tactical space, there is a move toward virtualization on some platforms so you can run not just your tactical applications, but also a Cisco IOS router on that processor."

Current rugged and secure routers and supporting technologies include:

- Cisco 5915, a flexible, compact, standards-based PCI-104 form factor optimized for mobile and embedded networks that require IP routing and services;
- Cisco 5921, software router application designed to operate on small, low-power Linux-based platforms to extend the use of the Cisco IOS into extremely mobile and portable communications systems and embedded networks;
- Cisco 5921 ESR Software 3U VPX

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module, which supports Cisco IOS running as a software router, delivering IOS-based enterprise routing in a single embedded slot;

- GE Intelligent Platforms RTR8GE SWaP-optimized secure access router, designed to deliver advanced network routing and firewall with intrusion detection service (IDS) and unified threat capabilities in harsh environments;
- Curtiss-Wright Parvus DuraCOR 80-41, small form factor rugged mission computer with support for Cisco Systems 5921 ESR Software, enabling system designers to deploy a single, compact Line Replaceable Unit combining Cisco network routing and Intel multi-core processing with no additional size or weight to the rugged LRU;
- Curtiss-Wright Defense Solutions DuraDBH-672 second-generation Digital Beachhead Gigabit Ethernet switch/router and vetronics computer subsystem, an all-in-one unit consolidating the network switch, processor, embedded GPS, solid-state storage, and add-in I/O interface support in a single LRU;
- Curtiss-Wright Cisco Systems 5921 ESR Software 3U VPX module, delivering Cisco IOS-based enterprise routing in a single embedded slot;
- Curtiss-Wright Parvus DuraMAR 5915 3X Series, an enhanced version of the COTS Parvus DuraMAR 5915 rugged SWaP-C-optimized mobile IP router subsystem, combining an integrated Cisco 5915 ESR with a high bandwidth, low-power Vitesse Gigabit Ethernet switch in a single compact, lightweight LRU with 23 Ethernet ports;
- Extreme Engineering Solutions (X-ES) XPand6101 small form factor router running Cisco IOS able

to be used as a development platform or a deployed system; and

- X-ES XPedite5205 XMC/PMC-based ESR, when combined with UHF, VHF, WiFi, and other radio platforms, which can create mobile ad hoc military networks without requiring a connection to central infrastructure.

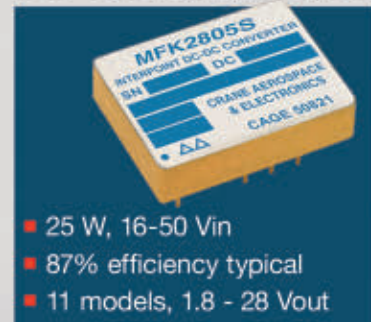
The current generation of routers is the foundation of networks interconnecting all assets, Beach adds. "A customer told me he spends 90 percent of his time integrating and only 10 percent innovating. As we make commercial products applicable to the military, the [DOD] development money that might have gone into those now can go into tech adoption and development of new procedures. Being able to control all those routers and the system you use is an example of doing command and control for the C2 system. If you manage a router and over it manage traditional C2, then managing that router means you're doing C2 on the device. Electromagnetic maneuver means owning the high ground in the RF, which may involve sophisticated jamming, communication around adversary jamming, etc. So having this robust network will provide the sensing to detect that and the ability to orchestrate your assets to achieve some effect, such as jamming."

The future of combat routers, then, is a combination of commercial technology development (further miniaturization, improved power, and consolidation) and economies of scale to upgrade legacy platforms, provide enhanced capabilities to new vehicles, and address increasingly important SWaP-C requirements.

"The systems we now have are quite advanced; we're in an era of

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advanced routing. Routing itself won't get any more advanced, although it may get faster or smaller. The push to IP in the long-run will save the government money, getting



Cisco Systems 5915ESR convection-cooled technology has become standard in military vetronics networking.

away from vendor lock-in and taking things off the shelf at lower cost that are more flexible and more easily integrated with reduced engineering," says MilSource's Isaac. "I think the investment in new or upgraded platforms is there and will continue, but on the networking side, it really depends on what the devices that connect to the routers can do. If sensors start pushing 10 gigabits per second, then we would have to react to that. But if the things connecting to the router don't require 10 gigabits per second or higher, that will be the real driver. We react more than anything else to that requirement, which in turn reacts to the end customer requirement."

The top three customer requirements for the past three years have



Field-programmable gate array technology, from companies like Microsemi, helps keep rugged data routers up to date against the most advanced threats.

remained the same: Cisco IOS, SWaP, and military-rugged, says Bret Farnum, vice president of sales at X-ES.

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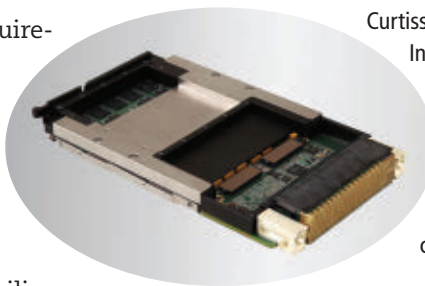
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"The number one requirement from our customers was that it must be Cisco IOS, which one said 99 percent of all networking engineers in industry and the military are trained on and they did not want to retrain on some other OS. That customer had a need for 25,000 routers in the field, so his comments carried a lot of weight.

"Requirement number two came down to SWaP. You can't construct a smaller, lighter router than the 5205, for example, which is as small as you can make it, given all the components required to get up to Gigabit Ethernet. This combination of processor and Ethernet components employed won't fit on a smaller board.

"Requirement three is it had to be ruggedized, meeting military stan-



Curtiss Wright VPX3-621
Intelligent Cisco
IOS-based 3U VPX
modules with dual
Gigabit Ethernet
interfaces add
secure networking
capabilities to vehicles.

has evolved in just the past year for more Ethernet ports in the system than just the basic four router ports. "In response, we combined the Xpedite 5205 router with a 3U or 6U VPX switch, such as the Xchange 3013, which has 10 or 12 external Gigabit Ethernet ports plus three router ports. It is a managed Ethernet switch—it has a processor on-card and is running management software, which in this case is ZebOS from IP Infusion. This combination then becomes router-plus-switch in a single 3U VPX slot," he explains. "The Xchange 3018 is our next generation with 10-Gigabit Ethernet ports, combined with the 5205.

"Then people began to ask for systems incorporating these, rather than individual circuit cards, which is when we came up with the Xpand 6206. It takes the combined 5205 and 3013 and puts it into a two-slot VPX chassis—a COTS product and deployable from the get-go."

As with everything else related to the military in an era of tight budgets, downsizing, and changing missions after nearly 15 years of constant war, the most important factor in next-generation military technology is not technology, but SWaP-C.

Fortunately, the Vehicle Integration for C4ISR/EW Interoperability (VICTORY) standards are being pursued for a common architecture. A heavy reliance on the economies of scale stemming from COTS



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dards 810F/G, 461E, and DO-160E governing shock, vibration, temperature, humidity, and EMI [electromagnetic interference]. You always have to satisfy the requirements of the specific place it is going, such as carrier take-offs and landings or a vehicle on a rough road."

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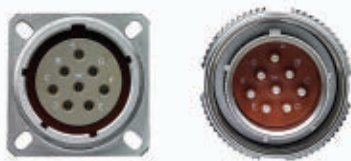
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components developed for the far larger commercial markets make next-gen routers and battlespace networks immune to the vagaries of military research funding. That includes moving from proprietary communications to IP comms, and a push away from custom-made products designed specifically for a vehicle or program to COTS-based products that can be integrated into platforms for lower



The interiors of many of today's armored combat vehicles are becoming information network centers on the battlefield, as well as weapon systems.

cost, faster rate, and greater interoperability upgrades. Some vetronics programs also are designed to give more room to the soldier by removing proprietary elements and collapsing everything into an IP structure that promotes multiple protocols, using adapters to convert from serial or USB to IP.

"The military is only one consumer of networking products and is buying COTS as much as possible, so the products offered by Curtiss-Wright are designed and sold for a general market need rather than a specific military application," notes Andrew McCoubrey, product marketing manager for switching & routing modules at Curtiss-Wright. "There are some less common software feature sets that might be encouraged by the

military, but where we are seeing influence is a SWaP-C tradeoff analysis and a significant push to reduce that."

The desire for network-centric operations across the DOD is tempered by a drive to achieve lower SWaP characteristics so new equipment can be installed on vehicles to gain the situational awareness capabilities enabled by Ethernet networking, McCoubrey adds.

"Having standards-based architectures so that everything is compatible and not saddled with proprietary interfaces is a big push. One way the government is doing that is implementing software-defined radio on computing platforms, which now becomes a router as well as whatever other functions it does," McCoubrey says. "That is typically done through a virtual machine hypervisor environment, with a VM-compatible application loaded on top of the hypervisor."



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The trend toward multifunction devices also will influence how next-generation routers and networks are designed and implemented.

"From a modular software standpoint, we bolt on software-based networking tools to processors and hardware that combines switching, processing, routing, and traditional data acquisition, all on one device,"



TE Connectivity MC6 is an MT-based, high-density, fiber-optic connector series is making its way into vetronics networking equipment.

says Curtiss-Wright's Southworth. "When you stick with architecture standards, you can consider up front the need to scale the device as needed. In some cases, there needs to be a tradeoff analysis between a consolidated solution and a distributed architecture, due to use cases, budget constraints, and SWaP-C. Those are options we enable now and will in the future through various COTS products."

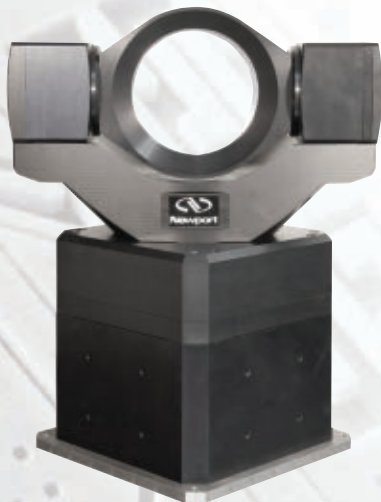
The successful implementation of multifunction data-gathering and -generating devices, the final elimination of stovepipes and proprietary components and software, the adoption of true standards and the adaptation of COTS components while maintaining technological leadership in the battlespace all



The X-ES XChange3018 is a 3U VPX, 10 Gigabit Ethernet switch module with four 10GBASE-T or XAUI ports, six backplane 10/100/1000BASE-T Ethernet ports, and six backplane network 1000BASE-X Ethernet ports.

have a heavy dependence on next-generation combat routers.

"What's really driving [next-gen routers] is the tactical network, composed of the underlying radio systems that interconnect the different platforms," says Cisco's Beach. "In the past, those were very stovepiped, but today are becoming IP-based." ◀



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Widespread use of wearable technology

Aerospace and defense professionals embrace the latest wearable electronics devices to improve efficiency and productivity.

BY Courtney E. Howard

Wearable electronics is a technological phenomenon on the cusp of widespread, worldwide adoption. Commercial off-the-shelf (COTS) wearable technologies like smart watches, smart glasses, health monitors, and activity trackers are popping up and intriguing even those who have refrained from adoption.

International Data Corp. (IDC) analysts in Framingham, Mass., estimate that 72.1 million wearable devices will be shipped this year, up from the 26.4 million units shipped in 2014. Wearable computing devices are “moving ahead with improved user interfaces, user experiences, and applications. These will raise the expectations of what a smart wearable can do. We’re not there yet, but we’re seeing the building blocks of what is to come,” says Ramon Llamas, wearables research manager at IDC.

New technology needs time to mature; yet, the path from innova-

tion to mainstream adoption can be a long road, especially in aerospace and defense. It is not uncommon for members of military and aerospace organizations, including warfighters in the field, to want (and wait exceedingly long for) the same high-



The Canadian Armed Forces test a mobile ad-hoc network with Google Glass head-up displays and smartphones for dispersed operations.

tech devices they use in their personal lives to be accessible to them in their professional lives. Today’s aerospace and defense professionals want portable, powerful computing devices at their fingertips.

Wearables are starting to be more widely adopted in aerospace and

defense, and this trend “is likely to pick up momentum during the next few years as the technology continues to mature,” says John Schmidt, managing director of North American aerospace and defense business at Accenture in Chicago.

Schmidt is seeing significant interest from defense contractors and aerospace manufacturers wanting to exploit the technology.

“The industry is rapidly coalescing toward an all-digital mindset across the board, and wearable devices and technologies are one key driver of this major industry trend. Wearable technology provides instant access to critical information, improves

quality, and helps increase collaboration. This technology enhances existing workflows and opens new opportunities in many aspects of this industry,” Schmidt adds. “The technology may also increase workforce productivity, reduce the risk of errors, and eliminate the need

for travel. Use of this hands-free technology also improves safety in complex assembly or maintenance activities.”

Commercial aircraft designer Airbus in Toulouse, France, provides a real-world example of how wearable technology is being used—a trend that will only accelerate during the next few years, Schmidt predicts.

Airbus adoption

“Accenture and Airbus have developed one of the most intriguing and current applications for wearables in aerospace and defense,” Schmidt says. The two companies delivered a proof of concept using the latest wearable technology to help Airbus reduce the complexity of assembling cabin seats as well as decrease the

time required to complete this task.

“In this achievement, a manufacturing professional can use digitally enabled, industrial-grade smart glasses to improve the accuracy and reduce the time required



Rufus Labs’ Rufus Cuff advanced wearable computing device helps to increase efficiency and productivity.

to complete the cabin seat marking process. Using contextual marking instructions, the smart glasses display all required information for

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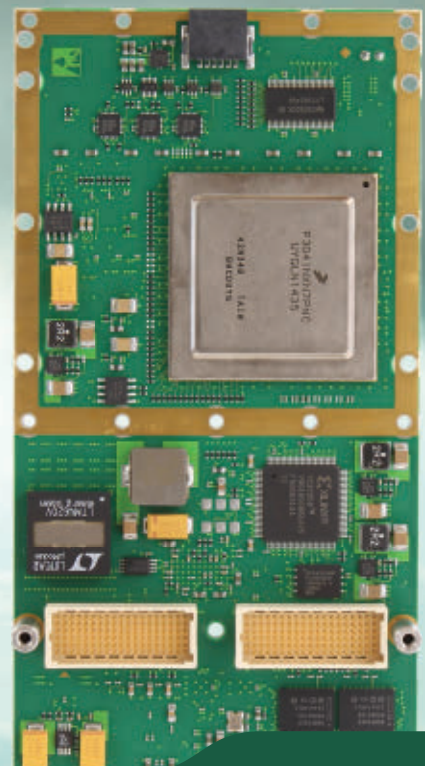
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TE Connectivity metal-shell micro circular connectors are IEEE 1934 compatible and can perform to the latest signaling requirements.

an operator to help mark the floor faster and reduce errors to zero,” Schmidt adds. “The eyewear technology, implemented by Accenture, also offers interactivity by granting the professional access to features, including barcode scanning, data retrieval from the cloud, voice command, and augmented reality.”

Armed with wearable electronics, personnel marked all aircraft seat locations down to the last millimeter, as well as checked for accuracy and quality. For Airbus, time spent per aircraft was divided by six, error rate reduced to zero, and marking operations revalued.

“This proof of concept shows how wearable technologies offer new and important benefits in the aerospace and defense industry,” Schmidt says. The project was launched in January 2015, and the first prototype was completed less than a month later.

To accelerate the timeline, Airbus and Accenture worked in start-up mode, enabling rapid iterations by engineers at both companies. The technology is currently being industrialized for cabin furnishing on the Airbus A330 wide-body jet airliner. The airframe manufacturer’s

other final assembly lines should quickly follow, as well as other Airbus divisions, such as Airbus Defense and Space, Schmidt predicts.

Wearable smart glasses are being used for airplane manufacturing applications, and can benefit other functional areas, such as quality and field service, Schmidt explains. “Potential use cases involve processes that are

time-consuming and error-prone, and that involve complicated assembly procedures.

“Smart glasses can be a catalytic tool to accelerate the industry’s momentum toward being completely digital—from both business and technology perspectives,” Schmidt continues. “Wearables can be a game changer especially because they are instrumental in taking the industry to where it is going on a massive scale: to an all-digital mindset all the time.”

IoT and security

“Wearables are one great example of a major technology trend called the Internet of Things (IoT), which is all about more devices connecting to more different devices loaded with more information running over more networks,” Schmidt explains. “Digital is driving all this exponential and multi-faceted growth. The aerospace and defense industry will evolve in sync with this mega-trend.”

Increased adoption of wearables is not without its challenges, however. “As the industry uses more [wearable devices], more data will be stored, sent, and retrieved from

them. Ensuring that this growing amount of information remains secure is going to become more challenging than ever,” Schmidt says.

“The data must be secure,” insists Schmidt. In the Airbus airplane manufacturing application, for example, data the technician can access using the smart glasses needs to be secure enough that competitors cannot access it from any IoT devices or networks to which they connect. With this in mind, Accenture has taken a deliberate and phased approach.” Once the use case has been validated, integrating to the back-end systems and scaling to more users will be a critical next step during the pilot phase, after which full-scale implementation occurs, he describes.

It is becoming important to take a holistic approach, beyond wearables, and consider all aspects of the connected worker, Schmidt says. “Bringing together contextually relevant information for manufacturers and the military, the connected worker provides a suite of capabilities for manufacturing management and operators, through wearable devices, beacons, and sensors.”

Examples include:

- providing smart glasses so the operator can complete a guided procedure;
- through “over the shoulder” coaching, enabling remote personnel to connect with experts, via voice and video links, to improve response time to questions and improve first time fix processes;
- using digital match to confirm first-time quality for an installation and using a digital image to record the completion;
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Military and commercial pilots increasingly rely on wearable devices, including head-up displays and systems—such as Elbit Systems' ClearView Heli and Skylens, shown above and below—in real-world and training scenarios.

health and safety characteristics such as fatigue and/or repetitive activities; and

- placing sensors on assets such as forklifts to know where the asset resides within a manufacturing plant.

All these capabilities extend the value of wearable devices within aerospace and defense, Schmidt affirms. "This trend is not just coming. It's real already. And it's going to pick up momentum and remain in sync with the industry's push towards becoming digital in every way."

Connectivity conundrum

In defense applications, wearable computing devices are an integral part of connected soldier systems that provide a tactical advantage and improve troop safety. Connected soldier systems make troops on the ground part of the vast network



Hands-free, wearable devices are an integral part of modern flight training.

of equipment that provides better data and situational awareness for decision-makers.

TE Connectivity, with headquarters in Schaffhausen, Switzerland, is working on a number of advancements for the connected soldier, including lightweight electronics, smaller and lighter antennas, and new radio-frequency technology for communications.

"The use of wearable computers supports tactical communications, 'perishable data' for situational

awareness, and 'every soldier a sensor' applications," says Earle Olson, business development manager, high-bandwidth solutions at TE Connectivity in Berwyn, Pa. "The ability to access immediate intelligence via 'perishable data'—having immediate access and benefiting from this information before the opposition or threat—can literally be lifesaving."

Growth in the use of wearable technologies "is a key indicator of the market potential and importance for continued industry innovation," says James O'Toole, president of consumer solutions at TE Connectivity. "We seek to truly iterate and collaborate—engaging earlier in the process—to support customer innovation with the goal of delivering the best antennas, smart connectivity solutions, and sensors."

To that end, TE Connectivity officials opened the TE Wearables Lab in Menlo Park, Calif., to focus exclusively on wearable technologies across defense, consumer, medical, and industrial businesses. The lab serves as a collaboration center for TE's team of engineers and its customers throughout the design process.

One of the first products to come out of the TE Wearables Lab is a wireless power development kit for wearable devices that addresses the need for miniaturization and low power requirements. The kit includes a small, 2.5-watt charger with integrated magnet for attachment to a wearable device, as well as a complete RX coil and electronics for integration. TE engineers miniaturized the electronic system and the coil to make it possible for wearable designers to prototype products quickly and develop a customized solution

to meet design requirements.

“The reality of an added weight for the warfighter to carry in addition to an already burdened soldier can prevent the use of wearable computing if the item is too heavy,” Olson admits. “Size, weight, and power plus cost (SWaP-C) are imperatives that must be reduced, while the performance of the solutions must increase in capacity, reliability, and capability.”

Space in spacecraft

Space is virtually always at a premium in aerospace and defense vehicles, whether on land, at sea, or in air and space; but, weightlessness provides opportunities for astronauts to expand their working and living environment because they are not constrained by being bound to a floor. NASA engineers and scientists want to map how astronauts take advantage of weightlessness to expand the useable area of their vehicles.

NASA officials selected Draper Laboratory, an independent, not-for-profit engineering research and development organization in Cambridge, Mass., to develop a wearable device to track astronauts' location and orientation as they move around the International Space Station (ISS). Information gleaned from these devices enables the production and validation of three-dimensional (3D) models of the crew's use of the habitat, helping engineers improve the designs of future spacecraft to maximize astronauts' work space.

“The habitable volume of the ISS is 13,696 cubic feet—nearly that of a 2000 square-foot home,” says Jana Schwartz, Draper's Human Centered Design & Engineering group leader. “That's a lot of room up in space,
www.militaryaerospace.com

Elbit Systems' Skylens system boasts a helmet-mounted display and COTS technology.

and Draper's technology can help NASA determine how to better use it when designing future spacecraft.”



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The wearable device's optical sensors determine an astronaut's location within the ISS relative to other objects. Inertial measurement units (IMUs) and algorithms also provide continuous information about movement and orientation. Draper engineers will deliver a wearable prototype system for NASA to test.

"Tracking an astronaut in motion, in three-dimensions and in any orientation, is a unique and complex challenge associated with living and working in space," explains Kevin Duda, Draper's principal investigator for the project. "The integration of this technology into a small, wearable form factor also has the potential to quantify biomechanics and movement here on Earth."

Soldier-worn systems

U.S. Department of Defense officials continue to investigate and invest in wearable computing systems for warfighters on the increasingly digital and network-centric battlefield.

Engineers at the U.S. Army Natick Soldier Research, Development, and Engineering Center (NSRDEC) in Natick, Mass., are partnering with industry to advance wearable electronic and electro-optics for the body area network of individual soldiers.

The operational concept involves wearable electronics in a secure, robust sensor network on individual soldiers' bodies. Various physiological sensors acquire data (heart rate, respiration rate, body temperature, blast effects) that is available for real-time transmission via tactical radio, recording on a soldier-borne data retrieval unit, or automatic download



Elbit's ClearVision Enhanced Vision System is designed to increase pilot situational awareness and enhance safety.

when soldiers return to their base of operations.

The goal is to facilitate the removal of cables, improve soldier mobility, increase sensor system effectiveness, and enhance system scalability—all while using COTS technology adapted to meet the requirements of military applications

and environments. The wireless system's ultra wide-band (UWB) technology is inherently difficult to intercept and detect, and is immune to certain types of intentional and unintentional jamming, officials say.

Secure Communication Systems Inc., a Secure Technology Company in Santa Ana, Calif., is developing a low-power wireless communication system that connects several soldier-borne physiological sensors together in a body area network.

"This technology has the potential to benefit those outside the defense industry as well," explains Secure Communication Systems President Robert Korb. "First responders in hazardous situations will be able to better monitor their vitals wirelessly while in action as well as after action.

Wrist revolution

Rufus Labs engineers are working to make the lives of first responders—including EMS, fire, police, security, and other public safety professionals—safer, easier, and more efficient, as well as to aid industrial workers.

The Rufus Cuff is an advanced wearable device with a TI Cortex A9 processor, Bluetooth 4.0, 3.2-inch TFT capacitive touchscreen, GPS, 9-axis accel/gyro/compass, speaker and dual microphones, video camera, data storage, 1175-mAh battery, Wi-Fi 802.11 b/g/n, and spill/splash resistance.

"Wrist computers will replace smartphones as the epicenter of our connected universe," predicts Rufus Labs Co-founder and CEO

Gabe Grifoni, who envisions a future where "other wearables in different places will connect and provide symbiotic functionality.

"A wrist computer or glasses style head-up display will be beneficial to workers in the industrial sector, giving them the hands-free ability to manage difficult tasks and still receive and send information," Grifoni says.

The Rufus Cuff was created with the industrial sector in mind, being fully functional with smartphones or only WiFi, and can be ruggedized with an EXO protective shell. Rufus Labs officials encourage managers to apply for the company's Industrial Beta Program at <http://bit.ly/1P97iK0>. ◀

Given the increased attention to head trauma in extreme sports, athletes in high-impact contact sports could be more closely monitored for concussions and other injuries, whether at a high school or professional level.”

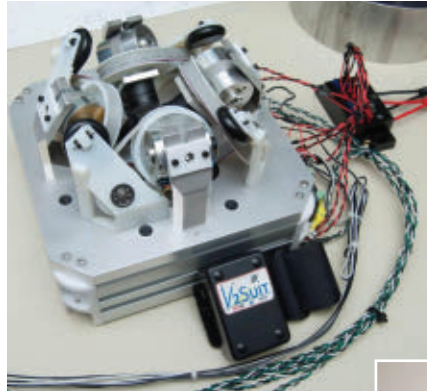
COTS control system

U.S. Air Force Battlefield Airmen Special Projects Office (SPO) officials sought a wearable computing device to be fielded as an Operational Control System (OCS) to all Air Force Battlefield Airmen, including Tactical Air Control Party (TACP), Combat Control Teams (CCT), Para Rescue (PJ), and Combat Weatherman. They found their solution at Black Diamond Advanced Technology (BDATech) in Chandler, Ariz.

Air Force officials selected the COTS APEx Predator System from BDATech, awarding a five-year, \$48.1 million contract and an initial order of 22 APEx Predator System kits for operational testing.

“BDATech is putting the most technologically advanced tactical computing and power management system ever developed into the hands of the most lethal force multipliers in the world,” says a company representative.

The modular, wearable APEx Predator System (APS) consists of the Agile Port Expander (APEx) Controller for POWER + DATA distribution, a COTS tablet computer, and system cabling optimized for tactical plate carrier use in dismounted operations. The ruggedized APS provides tactical communications to enable command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); digitally aided close air support (DACAS) operations; small



Draper Labs is developing small, wearable electronics modules to help keep astronauts healthy in space.

unmanned aircraft system (sUAS) control; and more for the dismounted operator.

APEx provides connections for multiple peripheral cables, a system power cable, and a tactical computer or end user device (EUD). The APEx Controller distributes power to connected devices and enables data communication of tactical data radios, video downlink, targeting, and many other devices to the computer.

The APEx Controller employs 5 gigabit-per-second SuperSpeed USB 3.0 on four sealed, circular military-grade universal peripheral ports enabling the user to connect multiple tactical peripherals.

Increased uptime

New wearable technology remotely connects aircraft technicians with aviation experts around the world to reduce down-time and maintenance costs associated with defense, commercial, and regional aircraft. An aircraft out of service can cost considerable money or even lives, depending on the mission.

“In the aerospace industry, costs associated with aircraft downtime are a critical issue,” says Andrew

Sanderson, managing director of TAE in Queensland, Australia. “If a plane’s not operational, it can cost a company up to \$12,000 per hour. Therefore, any technology that makes maintenance easier, and helps bring down repair times is a valuable investment.”

Australian aerospace company

TAE will commercialize the Guardian Mentor Remote (GMR) wearable technology system from Australian firm CSIRO, making it available to the global aerospace industry. GMR hands-free technology uses a headset and glasses to connect

experts with onsite operators for real-time assistance with aircraft and engine maintenance and repairs without the need to fly in specialist engineers or mechanics.

The technology can potentially reduce maintenance costs for aircraft operators, especially those in remote locations, Sanderson adds. “Using the GMR system, it is just like the expert is in the room with you, even if they’re in another state or another country. No more waiting days to get aircraft back up and running.”

The GMR system includes a helper station and an operator station, both of which use a wearable computer with a helmet-mounted camera and a near-eye display. The display provides a shared visual space, enabling the off-site expert to demonstrate using a pair of virtual hands.

Boeing and Aviation Australia professionals conducted trials of the system. TAE’s commercialization of the technology will make the system available to aerospace companies around the world. ◀



► General Dynamics to provide Navy radios

U.S. Navy shipboard communications experts are placing a \$29 million order with General Dynamics to provide AN/USC-61(C) shipboard radios for surface warships and submarines. Space and Naval Warfare Systems Command (SPAWAR) officials in San Diego, announced a contract modification to General Dynamics Mission Systems in Scottsdale, Ariz., for continued production of the digital modular radios (DMRs), which enable high frequency (HF), ultra-high frequency (UHF) line of sight, UHF satellite, and very high frequency (VHF) communications.

► Navy lets \$880 million contracts for MIDS LVTs

U.S. Navy experts are earmarking more than three-quarters of a billion dollars for new situational awareness communications terminals that enable U.S. and allied aircraft, ships, and ground forces to exchange tactical pictures in near-real time. SPAWAR in San Diego announced a potential \$514.3 million contract to ViaSat in Carlsbad, Calif., and a potential \$366.5 million contract to Data Link Solutions, a Rockwell Collins and BAE Systems joint venture in Cedar Rapids, Iowa, to build and maintain the Multifunctional Information Distribution System (MIDS) Low Volume Terminal (LVT). ◀

Defense companies repackaging Joint STARS radar for smaller aircraft

BY John Keller

HANSCOM AIR FORCE BASE, Mass.—Three U.S. defense prime contractors are moving forward with a cost-cutting program to redesign the sophisticated ground-monitoring radar system of the U.S. Air Force Joint Surveillance and Attack Radar System (Joint STARS) for a business jet or other relatively small aircraft.

The idea is to package the Joint STARS synthetic aperture radar (SAR) ground moving target indicator (GMTI) onto an aircraft smaller than the Boeing 707 jetliner aircraft on which the system is housed today.

Officials of the Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., placed orders with three major defense primes for pre-engineering and manufacturing development (pre-EMD) as part of the Joint STARS recapitalization program. Joint STARS recapitalization contracts have gone to Lockheed Martin Corp. of King of Prussia, Pa.; the Northrop Grumman Corp. Aerospace Systems segment in Melbourne, Fla.; and Boeing Service Co. in Richardson, Texas.

The current Joint STARS system is designed onto the Boeing 707 four-engine jet originally developed in the late 1950s as a passenger jet. The plane has not been manufactured in more than 30 years, and is expensive to operate and maintain. Joint STARS recapitalization is intended to take Joint STARS



Three defense contractors are working to repackage the Joint STARS surveillance radar to fit in a business jet.

ground-surveillance capability off of the 707 jetliner platform and onto a smaller airframe like a business jet or on a Boeing 737 small passenger airliner that is less expensive to maintain and operate.

The three companies will perform pre-EMD work on the Joint STARS recapitalization program, which consists of assessing the maturity of subsystem technology, reducing weapon system integration risks, and reducing life cycle cost by virtue of design. These efforts will help the Air Force refine Joint STARS recapitalization requirements, identify costs, and reduce design risks.

For the aircraft's surveillance sensors and other electronics, the Air Force wants to use an open-systems architecture that enables technicians to integrate new capabilities onto the aircraft quickly and more efficiently than is possible today on the 707 platform.

The Joint STARS SAR and GMTI systems represent an airborne

battle management command and control capability that detects, tracks, and identifies moving military vehicles or foot soldiers, slow-moving fixed-wing aircraft and helicopters, as well as surface ships at sea.

Lockheed Martin, Northrop Grumman, and Boeing are defining the future Joint STARS aircraft, as well as its sensors, battle management, and communications. The government eventually will acquire the system using a multiple

contracts strategy, officials say.

Air Force leaders ultimately want to develop a redesigned Joint STARS aircraft and on-board electronics in time to deploy by 2022.

The new system will have the same or better capabilities than today's Joint STARS aircraft, yet with reduced systems-integration, operating, and sustainment costs.

Air Force officials also want to design a new Joint STARS system that can promote increased competition among defense contractors

for systems upgrades and technology insertion.

Lockheed Martin is working with partners Raytheon and Bombardier are working on a design to be based on a Bombardier business jet.

Northrop Grumman is working with partners the Gulfstream subsidiary of General Dynamics and L-3 Communications on a system based on a Gulfstream business jet.

Boeing, meanwhile, is proposing a solution based on the company's 737 single-aisle jetliner aircraft. ←

Marines switching G/ATOR radar electronics from gallium arsenide to gallium nitride

BY John Keller

QUANTICO, Va.—Systems designers at Northrop Grumman Corp. are inserting new electronic technology into a new U.S. Marine Corps air-defense radar to make the system more effective in detecting rockets, artillery, mortars, cruise missiles, unmanned aerial vehicles (UAVs), and other low observables.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced a \$9.2 million contract modification to the Northrop Grumman Electronic Systems segment in Linthicum Heights, Md., to insert gallium nitride components into the Ground/Air Task-Oriented Radar (G/ATOR).

The contract modification calls for Northrop Grumman experts to switch from gallium arsenide to gallium nitride-based electronics to help reduce costs of the expensive G/ATOR system, as well as to enhance its performance and reduce its weight and power consumption.



Northrop Grumman is shrinking the size and weight of the G/ATOR radar system with gallium nitride electronic components.

The contract modification incorporates phase II of the gallium nitride transition of the G/ATOR low-rate initial production (LRIP) systems, Marine Corps officials say.

G/ATOR is an expeditionary, three-dimensional, short-to-medium-range multi-role radar system designed to detect low-observable targets with low radar cross sections such as rockets, artillery, mortars, cruise missiles, and UAVs.

Substituting gallium nitride

electronic components for older gallium arsenide technology will help Northrop Grumman and the Marine Corps reduce the mass of the G/ATOR system without compromising its performance, officials say.

Reducing size, weight, and power consumption especially is important for the G/ATOR system because Marine Corps leaders plan to use the system on attack beaches to help defend Marine expeditionary forces from low-observable threats. The system must be sufficiently small and lightweight to accompany Marines in their initial land attacks.

On this contract Northrop Grumman will do the work in Linthicum Heights, Md., and should be finished by the end of 2016. ←

FOR MORE INFORMATION visit **Northrop Grumman Electronic Systems** online at www.northropgrumman.com, and **Marine Corps Systems Command** at www.marcorsyscom.marines.mil.



UNMANNED vehicles

Researchers gather contractors for fast, energy-efficient undersea vehicles

U.S. government researchers are gathering contractors for a program to develop revolutionary underwater propulsion and drag-reduction technologies to enable manned and unmanned undersea vehicles to move through the water faster and more energy-efficiently than ever before. Officials of the Naval Undersea Warfare Center (NUWC) in Keyport, Wash., have awarded three contracts on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., for the Blue Wolf program, which focuses on at-sea testing of undersea energy, hydrodynamic lift, and drag-reduction technologies for manned and unmanned underwater vehicles (UUVs). Blue Wolf will develop underwater vehicle prototypes able to operate at speed and range combinations previously unachievable in fixed-size platforms. Blue Wolf contracts have gone out to the Charles Stark Draper Laboratory in Cambridge, Mass., for \$3.7 million; Applied Physical Sciences (APS) Corp. in Groton, Conn., for \$3.1 million; and The Boeing Co. Defense, Space & Security segment in Huntington Beach, Calif., for \$126,845. ◀

Worldwide UAV spending to more than triple over next decade, say Teal analysts

BY John Keller

FAIRFAX, Va.—Worldwide spending on unmanned aerial vehicles (UAVs) will more than triple over the next decade, growing from \$4 billion this year to \$14 billion by 2024, predict analysts at Teal Group in Fairfax, Va.

Military UAV research spending is likely to add another \$30 billion in spending over the next 10 years, Teal analysts report in “World Unmanned Aerial Vehicle Systems, Market Profile and Forecast 2015.” The study provides 10-year forecasts for a range of aerial drone payloads, including electro-optic/infrared sensors (EO/IR), synthetic aperture radars, signals intelligence, electronic warfare, and command, control, communications, and intelligence (C4I) systems.

Spending for UAV payloads for C4I missions should double over the next decade, increasing from \$3.1 billion this year to \$6.4 billion in 2024. New UAV sensor markets will see increases as radio-frequency systems supplant EO/IR capabilities, and next-generation UAVs require more sophisticated sensors, analysts say.

“Rapidly increasing capabilities for RF sensors will be funded, as potential conflicts shift from clear-skies Central Asia to the more restrictive geographies of Eastern Europe and the Pacific,” says David Rockwell, author of the electronics portion of the study. Military UAV spending will make up 72 percent of the market over the next decade, followed by 23 percent consumer, and 5 percent civ-



Worldwide demand for unmanned aerial vehicles (UAVs) is expected to more than triple over the next decade.

il. Of the three areas, civil UAVs grow most rapidly over the forecast period as airspace around the world is opened, but it grows from a very low base. This year’s study includes consumer UAVs for the first time because of their rapid growth and the blurring of the commercial and consumer markets, analysts say.

“The market for UAVs looks very strong, increasingly driven by new technologies such as the next generation of unmanned combat systems, and the development of new markets such as civil and consumer drones,” says Philip Finnegan, Teal Group’s director of corporate analysis and an author of the study.

The U.S. will represent the world’s largest UAV market over the next decade, with 64 percent of total military worldwide research spending and about 38 percent of military UAV procurement, analysts say. ◀

FOR MORE INFORMATION visit Teal Group online at www.tealgroup.com.

Navy asks industry for ideas on how to defend helicopters from RPGs

BY John Keller

ARLINGTON, Va.—U.S. Navy researchers are interested in equipment that can detect, track, and shoot down incoming rocket-propelled grenades (RPGs) that threaten attacks on aircraft operating on or near the ground.

Officials of the Office of Naval Research in Arlington, Va., have issued



Military researchers are trying to find ways to defend vulnerable hovering helicopters from rocket-propelled grenades.

a presolicitation (N00014-15-R-BA14) for the Helicopter Active RPG Protection (HARP) program, which seeks ways to defeat an RPG with an expendable countermeasure launched from a tiltrotor aircraft or helicopter.

Unguided anti-aircraft weapons like RPGs pose a unique problem for aircraft survivability equipment (ASE). Currently fielded ASE typically try to defeat the guidance systems on anti-air weapons, but are ineffective against unguided threats. Instead, tiltrotor aircraft and helicopter aircrews depend on tactics, techniques, and procedures to defend from RPGs and other unguided

threats. Emerging technologies that could defeat RPGs with hard-kill expendables are a focus of the HARP Future Naval Capability project.

HARP technology should be developed with open-systems technologies, and proposed architectures should link into existing aircraft survivability equipment, such as hostile fire indication cueing from the AN/AAQ-24(V) Advanced Threat Warning sensor. Navy researchers want to integrate HARP command and control processing onto an advanced single-board computer located in the Large Aircraft Infrared Countermeasure System Processor Replacement.

Researchers want HARP's expendable countermeasure to be compatible with launch from the AN/ALE-47 Countermeasure Dispense System. On cueing, the HARP system must sense the inbound RPG, reject false alarms, and shoot down the RPG far enough away so that it doesn't damage the aircraft.

Three or more HARP contractors may be chosen for the potential \$14 million program. Companies interested should e-mail white papers no later than 5 Oct. 2015 to roger.sullivan@navy.mil. Mail full proposals no later than 21 Dec. 2015 to Office of Naval Research Document Control Unit, ONR Code 43, 875 North Randolph St., Arlington, VA 22203-1995. ◀

MORE INFORMATION IS online at <http://1.usa.gov/1EmVJxN>.

▶ Lockheed Martin to upgrade attack helicopter laser targeting

Electro-optics experts at Lockheed Martin are upgrading the laser targeting system of the U.S. Army AH-64E Apache attack helicopter under terms of a \$21.7 million contract. The contract calls for Lockheed Martin to build Modernized Laser Rangefinder Designator (M-LRFD) kits, which will improve the principal targeting aid for the Apache that enables pilots to designate targets and establish target range for accurate weapon engagement. The contract is part of a project to upgrade the Modernized Day Sensor Assembly (M-DSA), the Apache helicopter's targeting and pilotage system. Lockheed Martin is to produce and deliver 786 M-LRFD kits for the Army and international customers.

▶ BAE Systems wins rad-hard certification for ICs

BAE Systems next-generation 45-nanometer application specific integrated circuits (ASICs) for space applications achieved U.S. Department of Defense Qualified Manufacturers List (QML) Level V radiation-hardened certification. The small-geometry microchips from BAE Systems completed three years of radiation-hardened testing in which they were evaluated against rad-hard criteria by the U.S. Defense Logistics Agency. QML Level V is part of the MIL-PRF-38535 standard, which establishes performance and verification requirements of single-die integrated circuits used in military and high-reliability applications. ◀

PRODUCT applications

VETRONICS

Raytheon modernizing Marine Corps LAV-AT anti-tank armored vehicle

U.S. Army armored combat vehicle experts are asking engineers at the Raytheon Co. Missile Systems segment in McKinney, Texas, to provide upgraded anti-tank missile systems for the anti-tank version of the General Dynamics Light Armored Vehicle (LAV).



Officials of the Army Contracting Command in Warren, Mich., have announced a \$19.3 million contract modification to Raytheon to upgrade the missile turrets on 13 U.S. Marine Corps LAV systems. The anti-tank LAV fires the Raytheon tube-launched, optically tracked, wireless-guided (TOW) anti-armor missile.

Raytheon will provide the LAV anti-tank version (LAV-AT) with an improved thermal sight and advanced fire-control system to enable the combat vehicle to acquire targets while on the move, fire current and next-generation heavy anti-armor missiles, and provide multi-shot capability.

These improvements are expected to improve the reliability, availability, maintainability, supportability, and mission effectiveness of the LAV-AT. Raytheon won a similar \$56.4 contract modification last June to provide 34 upgraded LAV-AT missile turrets.

This upgrade program is designed to counter two converging obsolescence issues on the LAV-AT, Army officials say. First, the M901 Emerson turret is no longer in production and has been retired from the U.S. Army inventory. Second, the M220A3 TOW system is being replaced by the M41 SABER system in the infantry and the tank battalions of the Marine Corps.

Ultimately the program seeks to acquire 118 anti-tank weapon systems for the Marine Corps LAV-AT combat vehicles. The Army is handling this procurement for the Marine Corps.

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



SONAR EQUIPMENT

Navy chooses Massa Products for DT-574 hydrophone transducers

U.S. Navy submarine sonar experts needed hydrophones for a variety of submarine sonar systems. They found their solution from Massa Products Corp. in Hingham, Mass.

Officials of the Naval Undersea Warfare Center Division in Newport, R.I., announced a \$10.6 million contract to Massa Products to design, build, and test DT-574 series hydrophones.

The DT-574 hydrophone is an acoustic sensing element with an integrally molded cable used aboard Navy Seawolf- and Virginia-class fast attack submarines, as well as on the Ohio-class ballistic missile submarine.

The DT-574 hydrophone sonar transducer is part of the Seawolf-class submarine's passive spherical array, the Ohio-class submarine's spherical and line arrays, and the Virginia-class large aperture bow (LAB) arrays.

Passive sonar aboard submarines and surface warships does not emit a sonar ping to detect other submarines and ships. Instead, it listens for sounds in the water that might be the tell-tale sound signature of a potentially hostile submarine.

Massa Products specializes in electroacoustic transducers and systems for commercial and military applications. Some of these devices are ultrasonic for use in air, and

others are for underwater sonar and oceanographic applications.

FOR MORE INFORMATION visit **Massa Products** online at www.massa.com.

SIMULATION AND TRAINING

L-3 Link to upgrade F-16 jet fighter flight simulators

Simulation and training experts at L-3 Link Simulation & Training in Arlington, Texas, will upgrade the flight software of advanced U.S. Air Force F-16 Block 40/50 flight simulators.

Officials of the Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, announced a \$12.9 million contract modification to L-3 Link for M7.1 operational flight program for the F-16 Mission Training Center (MTC). The F-16 Block 40/50 MTC is a sophisticated flight simulator that enables as many as four pilots to practice tactics and mission scenarios.


M7.1 MTC software represents the latest programming for the F-16 MTC that will keep the flight simulators up to date with the latest flight programs and controls aboard F-16 jet fighters. The networked high-fidelity F-16 MTC simulators model all the fighter aircraft's weapon systems and ordnance, and support basic and advanced pilot mission training, tactics

validation, and mission rehearsal. The MTCs enable F-16 pilots to train individually or together as a team.

This contract modification is a continuation of a \$68.2 million contract awarded originally in late 2008 for L-3 Link to provide Block 40/50

F-16 MTCs with options to provide as many as 20 of the flight simulation and training centers for F-16 bases throughout the world. ◀

FOR MORE INFORMATION visit **L-3 Link Simulation & Training** online at www.link.com.







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RF AND MICROWAVE

RF amplifiers for EW, communications, and radar introduced by Fairview

Fairview Microwave Inc. in Allen, Texas, is introducing a family of coaxial high-reliability power radio-frequency (RF) amplifiers for applications in electronic warfare (EW), military communications, radar, test and measurement, and satellite communications (SATCOM).



The RF and microwave amplifiers have broadband frequencies ranging from 0.5 MHz to 20 GHz, and can operate in temperatures from -55 to 85 degrees Celsius. The devices are designed to overcome the electrical and mechanical stresses that are seen with exposure to harsh environments.

These RF amplifiers are packaged to withstand vibration and shock exposure during handling and transport. Several models in this offering are designed to meet MIL-STD-202 and MIL-STD-810 environmental test conditions, while some amplifier designs are environmentally screened in production to MIL-STD-202 test conditions.

FOR MORE INFORMATION visit **Fairview Microwave** online at www.fairviewmicrowave.com.

DATA STORAGE

Secure solid-state drive for intelligence and UAVs introduced by Microsemi

Microsemi Corp. in Aliso Viejo, Calif., is introducing the MSD01TAM3R TRRUST-STOR serial advanced technology attachment (SATA) secure solid-state drive for defense, intelligence, unmanned aerial vehicle (UAV), and other defense-related network area storage applications. The 1 terabyte secure data storage device is designed and built for extreme reliability and data security applications. The device has long-life, single-level cell flash and advanced error correction code. The TRRUST-STOR self-encrypting data storage device offers key management methods and advanced security features. For sensitive applications, the encryption key can be erased in less than 30 milliseconds, and a second security layer can be activated to erase the entire storage media in less than 10 seconds, rendering data forensically unrecoverable.



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

TEST AND MEASUREMENT

Signal and spectrum analyzer for aerospace and defense introduced by Rohde & Schwarz

Rohde & Schwarz GmbH & Co in Munich is introducing the R&S FSW85 high-end signal and



spectrum analyzer for demanding research and development applications that involve aerospace and defense, automotive radar, 5G, and other wireless communications. The R&S FSW85 test and measurement instrument covers the frequency range from 2 Hz to 85 GHz in one sweep. This makes it possible for users to test baseband and RF with one analyzer. An internal preselection suppresses the image frequency and other spurious emissions that commonly occur during harmonic mixing. The R&S FSW85 optionally can be equipped with an internal analysis bandwidth of 500 MHz. When combined with the R&S FSW-B2000 option and an R&S RTO oscilloscope, it can achieve an analysis bandwidth of 2 GHz so developers can analyze broadband signals for complex pulse parameters and chirp signals for radar systems.

FOR MORE INFORMATION visit **Rohde & Schwarz** online at www.rohde-schwarz.com.

DATA RECORDERS

Rugged data recorder for military applications introduced by Curtiss-Wright

Curtiss-Wright Defense Solutions in Ashburn, Va., is introducing an enhanced version of its rugged CNS4 Compact Network Storage subsystem for military applications that require high-speed data recording, cryptography, and removable storage. The device supports



Gigabit Ethernet, 10 Gigabit Ethernet, Serial FPD, and other interfaces. This rugged, high-capacity data recorder ensures the integrity of critical data in demanding mili-

tary applications like aircraft transports, helicopters, unmanned aerial vehicles, and mobile radar systems. With its high-density storage capacity, broad support for several network protocols and encryption capabilities, the CNS4 enables system designers to address all their data recording requirements with a single solution, eliminating the need for separate, several data recorders.

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

POWER ELECTRONICS

Power modules for liquid, air, or conduction cooling offered by TDK Lambda

Power electronics specialist TDK Lambda Americas in San Diego is introducing six PH-A280 power modules for liquid-, air-, or conduction-cooled systems in three output power levels: 75, 100, and 150 watts.

The extension to the TDK-Lambda PH-A280 series of DC-DC power modules offers high-voltage DC input, and operates from a DC input of 200 to 425 volts DC, which is widely used in high-voltage



DC current applications. The PH-A280 range now includes 3.3-, 15-, and 28-volt outputs. The six PH-A280 power modules encompass nominal out-

put voltages of 3.3, 5, 12, 15, 24, 28, or 48 volts DC, adjustable by -20 percent to percent (20 percent for 5-volt output models). Efficiencies to 90 percent are achieved, an improvement of 5 percent over the prior PH series. All modules operate at full load over a baseplate temperature range of -40 to 100 degrees Celsius. The dimensions follow the industry-standard quarter brick format of 37.2 by 12.7 by 58.3 millimeters.

FOR MORE INFORMATION contact TDK Lambda online at www.us.tdk-lambda.com.

www.militaryaerospace.com

RUGGED COMPUTERS

Rugged space-saving avionics computer introduced by CES

Creative Electronic Systems (CES) in Geneva is introducing the ROCK-2 rugged, modular, avionics computer with a computing power



scalable from 3,000 to 170,000 DMIPS. The ROCK-2 is open-architecture, pre-qualified, application-ready, safety-certifiable, commercial off-the-shelf (COTS) embedded computing avionics system in which basic functions such as I/O, video, and graphics are designed on carriers while the single-board computer function is designed on XMC.

The XMCs then are installed on the carriers not only to save space, but also for easy, low-cost system upgradeability, company officials say. The switch from air-cooled laboratory to conduction-cooled airborne environment comes from the cross-compatible laboratory and airborne chassis. OpenVPX-compliant and 3U VPX-based, ROCK-2 adopts an integrated modular avionics (IMA) architecture. ←

FOR MORE INFORMATION visit CES online at www.ces-swap.com.

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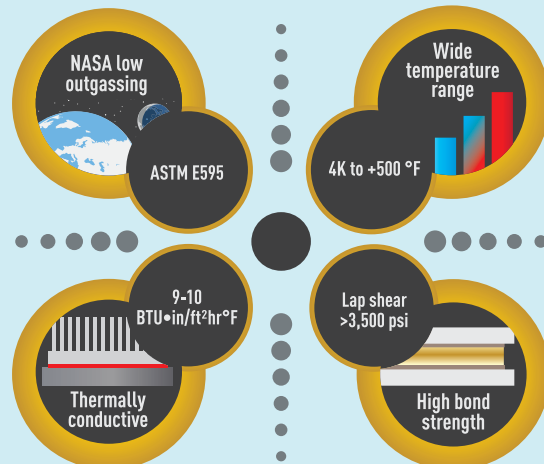
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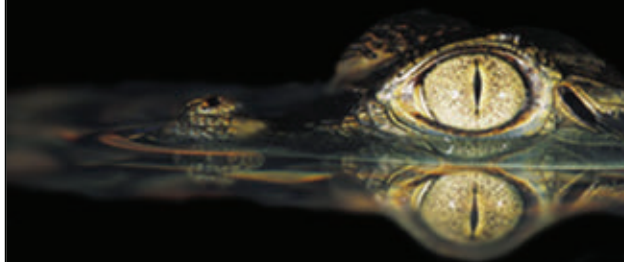


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Military & Aerospace Electronics

GROUP PUBLISHER Alan Bergstein
603 891-9447 / alanb@pennwell.com

EDITOR-IN-CHIEF John Keller
603 891-9117 / jkeller@pennwell.com

EXECUTIVE EDITOR Courtney E. Howard
509 413-1522 / courtney@pennwell.com

CONTRIBUTING EDITOR
WESTERN BUREAU J. R. Wilson
702 434-3903 / jrwilson@pennwell.com

EDITORIAL ART DIRECTOR Cindy Chamberlin

PRODUCTION MANAGER Sheila Ward

SENIOR ILLUSTRATOR Chris Hipp

AUDIENCE DEVELOPMENT MANAGER Debbie Bouley
603 891-9372 / debbieb@pennwell.com

AD SERVICES MANAGER Glenda Van Duyne
918 831-9473 / glendav@pennwell.com

MARKETING MANAGER Gillian Hinkle
603 891-9126 / gillianh@pennwell.com

SUBSCRIPTION INQUIRIES

Phone: 847 763-9541 • **Fax:** 847 763-9607

E-mail: mae@halldata.com

Web: <http://www.militaryaerospace.com/subscribe.html> or

https://www.sub-forms.com/dragon/init.do?site=PNW20_MFcontact



Editorial offices

PennWell Corporation,
Military & Aerospace Electronics
98 Spit Brook Road LL-1, Nashua, NH 03062-5737
603 891-0123 • FAX 603 891-0514 • www.milaero.com

Sales offices

EASTERN US & EASTERN CANADA & UK

Bob Collopy, Sales Manager
603 891-9398 / Cell 603 233-7698
FAX 603 686-7580 / bobc@pennwell.com

WESTERN CANADA & WEST OF MISSISSIPPI

Jay Mendelson, Sales Manager
4957 Chiles Drive, San Jose, CA 95136
408 221-2828 / jaym@pennwell.com

REPRINTS

Jessica Stremmel
717 505-9701 x2205 / Jessica.stremmel@theygsgroup.com

DIRECTOR LIST RENTAL

Kelli Berry
918 831-9782 / kelli@pennwell.com

Corporate Officers

CHAIRMAN Frank T. Lauinger

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