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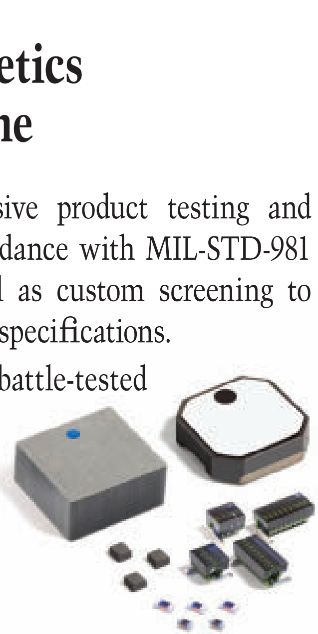

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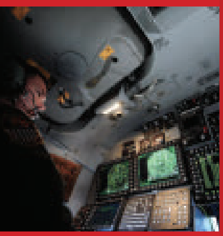

COVER STORY

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BY **JOHN KELLER**, EDITOR IN CHIEF

The critical value of human intelligence in the cockpit

Modern avionics represents amazing technology. Sensors are growing in sophistication, digital satellite communications are helping guide aircraft to destinations more efficiently, and small, powerful computers are blending sensor inputs to produce real-time situational awareness.

Such a wealth of aerospace technological capability is unmatched in history, yet there's one problem that technology itself cannot solve: trained human pilots for manned and unmanned aircraft. The growing sophistication of machine autonomy promises to replace the human pilot in cockpits. Still, even for unmanned aerial vehicles (UAVs), trained pilots must be part of the process.

It's true that automation technology enables one human UAV pilot to fly several unmanned aircraft at the same time, yet without a pilot in the loop somewhere, all those high-tech UAVs stay on the runway. It's much the same with commercial aircraft. The day may be coming when the flying public would board automated passenger jets that don't have human pilots in the cockpits, but let's be honest, that day hasn't arrived yet, and may not for quite a while.

Against this backdrop we have reports of pilot shortages, which demonstrate the crucial importance of trained and experienced humans in flying aircraft. In January, the *Daily Beast* reported that the U.S. military's UAV fleet is at the breaking point because of too few qualified MQ-1 Predator and MQ-9 Reaper pilots to meet demand from military commanders in the field for UAV reconnaissance and attack missions.

On the civil aviation side, representatives from the White House, Federal Aviation Administration (FAA), major U.S. airlines, and regional carriers met at Embry-Riddle Aeronautical University in Daytona Beach, Fla., for a pilot supply and demand summit. The Boeing Company has forecast a need in North America over the next two decades for 88,000 new commercial pilots. This forecast of a pilot shortage is controversial in itself. While Boeing and major airlines say the nation needs more trained pilots, the Airline Pilots Association (ALPA) contends the problem isn't too few pilots, but low pay and working conditions for pilots. ALPA and other commercial aviation experts say plenty of qualified pilots would step up if pay and working conditions were to improve.

Some technology experts claim that the day is upon us when the capabilities of robots and artificial intelligence will surpass humans in complex tasks like flying airplanes. Forgive me if I sound like a backward Luddite, but I'm not seeing it, and I've been paying attention to artificial intelligence and automation technology now for more than three decades.

Maybe the automatic pilot of a disabled jetliner could make the quick decisions necessary to save everyone on board like U.S. Airways Pilot Chesley B. "Sully" Sullenberger did six years ago. Sully's Airbus A320-200 hit a flock of geese on climb-out from New York LaGuardia Airport and lost all engine power. He could try gliding back to LaGuardia, try to make nearby Teterboro Airport in New Jersey, or ditch the plane in the Hudson River. Sully chose the third option. Nobody was seriously hurt as the jetliner skimmed onto the Hudson River's surface; just wet and scared. Could a sophisticated auto pilot do that?

Maybe... but maybe not. A computer's wrong calculation could turn a situation like that into 155 deaths aboard the aircraft and an untold number of dead and injured on the approaches to LaGuardia or Teterboro if that plane landed short.

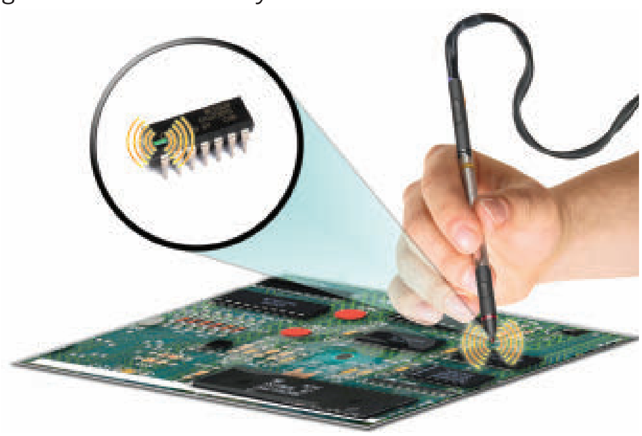
I'm a big fan of advanced technologies like machine automation and artificial intelligence. Still, technology isn't a cure-all for what ails the aviation industry, and we can't lose sight of the value of human intelligence, trained pilots, and the gut instincts gained from years in the cockpit.

news

SRI, Northrop, and Draper to safeguard military from counterfeit electronics

BY JOHN KELLER

ARLINGTON, Va.—Three U.S. research companies have been selected for a U.S. military research program to develop new technologies to safeguard the U.S. military electronics supply chain from substandard used and counterfeit electronics.



Officials of the U.S. Defense Advanced Research projects Agency (DARPA) in Arlington, Va., have chosen SRI International in Menlo Park, Calif.; the Northrop Grumman Corp. Electronic Systems segment in Linthicum, Md.; and the Charles Stark Draper Laboratory in Cambridge, Mass., for the agency's Supply Chain Hardware Integrity for Electronics Defense (SHIELD) program.

SRI International won a $6.8 million contract, Northrop Grumman won a $12.3 million contract, and Draper Lab won a $4.1 million contract. The DARPA SHIELD program aims to develop an advanced supply chain hardware authentication system and a capability that can detect counterfeit electronic components anywhere in the supply chain.

The three companies will develop a tool to verify the trustworthiness of protected electronic components without disrupting or harming the system into which they have been designed.

Used and counterfeit electronic components are widespread throughout the defense supply chain, DARPA officials say. Suspect electronic components present a critical risk in military systems where a malfunction of a single part could lead to system failures that can put warfighter lives and missions at risk.

DARPA researchers are asking the three companies to develop a 100-by-100-micron component, or dielet, that authenticates electronics components. The Draper-designed dielets will have encryption engines, sensors to detect tampering, and that affix to today's electronic components such as microchips.

CONTINUED ON PAGE 7 ➔

IN BRIEF

Lockheed Martin to upgrade Army's early model tactical missiles

Lockheed Martin Corp. is upgrading U.S. Army long-range tactical missiles to reduce the weapon's costs and threats of unexploded ordnance. The Army awarded a $78.2 million contract to the Lockheed Martin Missiles & Fire Control segment in Grand Prairie, Texas, to upgrade Army Tactical Missile System (ATACMS) to modern frontline versions. Lockheed Martin will take hardware from ATACMS Block 1 missiles and develop an enhanced and affordable weapon system capable of eliminating targets without the risk of unexploded ordnance.

Argon ST to provide Navy with torpedo-spoofing decoys

Torpedo-defense experts at Argon ST in Fairfax, Va., are building five shipboard electronics systems for the U.S. Navy that use torpedo-spoofing decoys to lure enemy torpedoes away from U.S. and allied surface ships. Officials of the Naval Sea Systems Command in Washington announced a $6.5 million contract modification to Argon ST, a wholly owned subsidiary of the Boeing Co., to provide five AN/SLQ-25A/C countermeasure decoy systems.

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Agilent's Electronic Measurement Group has become **Keysight Technologies.**

A Navy program to install new communications and networking equipment aboard surface warships is resuming after a contractor protest has been resolved.

Navy settles CANES shipboard networking protest; chooses two more vendors

BY JOHN KELLER

SAN DIEGO—U.S. Navy communications experts are expanding their stable of communications and computing contractors from five to seven for the Consolidated Afloat Networks and Enterprise Services (CANES) program after a contractor protest last September brought the multi-billion-dollar program to a temporary halt.

Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego, announced two additional CANES contractors last month: CGI Federal Inc. in Fairfax, Va., and DRS Laurel Technologies in Johnstown, Pa., to manufacture advanced command, control, communications, computers, and intelligence (C4I) shipboard networking equipment for the Navy's surface warship fleet.

CGI Federal and DRS Laurel will share as much as $2.53 billion over the next eight years with the original five CANES shipboard networking contractors that were announced last August before CGI Federal and DRS Laurel filed protests with the U.S. Government Accountability Office (GAO) in Washington last fall, which triggered a 100-day stop-work order for the CANES equipment contract. The GAO is the investigative arm of Congress.

The original five CANES contractors are: BAE Systems Technology Solutions & Services in Rockville, Md.; General Dynamics C4 Systems in Taunton Mass.; Global Technical Systems in Virginia Beach, Va.; Northrop Grumman in Herndon, Va.; and Serco Inc. in Reston, Va.

With the addition of CGI Federal and DRS Laurel, the CANES program resumes production. The seven contractors will manufacture CANES equipment for shipboard networking based on individual Navy orders.

The Northrop Grumman Corp. Information Systems segment in San Diego, chosen in early 2012 to be the overall CANES shipboard electronics systems architect as part of a $37 million contract, will install CANES equipment aboard surface warships. With options, the CANES contract to Northrop Grumman could be worth as much as $638 million.

CANES serves as the bridge to the future of Navy afloat networks, consolidating existing legacy and stand-alone networks, providing infrastructure for Tactical applications, systems, and services, Navy officials say. CANES will consolidate and modernize shipboard network systems to improve operational effectiveness and affordability across the fleet.

CANES delivers its capabilities within one system, bringing infrastructure that will enable timely and interoperable information exchange among tactical, support, and administrative users, applications, and computer systems.

SPAWAR awarded contracts to the seven CANES equipment manufacturers on behalf of the Navy's Program Executive Office for Command, Control, Communications, Computers, and Intelligence (PEO C4I). Competition will be continuous among the seven CANES equipment manufacturing contractors for the procurement of production and training units.

Lessons learned from the first CANES hardware and software installations will help Navy experts upgrade later CANES equipment.

CANES operational testing began last August aboard the guided missile destroyer USS Higgins (DDG 76). Full CANES deployment and operational capability is expected as early as mid-2015.

Thus far CANES has been installed on nine destroyers, and is in progress on three aircraft carriers, one amphibious assault ship, eight destroyers, one landing dock ship, and one cruiser, Navy officials say. An additional 28 installations are planned over the next two years.

CANES ultimately will be deployed on 180 ships, submarines, and land sites by 2022. The seven CANES equipment manufacturing contractors will do their work in Johnstown, Pa.; Charleston, S.C.; North Charleston, S.C.; Taunton, Mass.; Virginia Beach, Va.; Madison, Ala.; and San Diego as delivery orders determine, and should be finished by January 2023. ←

FOR MORE INFORMATION visit **SPAWAR** online at *www.spawar.navy.mil*, and the **Navy's PEO C4I** at *www.public.navy.mil/spawar/PEOC4I*.

SRI CONTINUED FROM PAGE 4

The SHIELD program's goal is to provide 100 percent assurance against recycled components that are sold as new; unlicensed over-production of authorized components; test rejects and sub-standard components sold as high-quality; parts marked with falsely elevated reliability or newer date of manufacture; low-quality clones and copies that may include hidden functionality; and components that are covertly re-packaged for unauthorized applications, DARPA officials say.

"SHIELD demands a tool that costs less than a penny per unit, yet makes counterfeiting too expensive and technically difficult to do," says Kerry Bernstein, the SHIELD program manager at DARPA.

"The dielet will be designed to be robust in operation, yet fragile in the face of tampering," Bernstein says. "What SHIELD is seeking is a very advanced piece of hardware that will offer an on-demand authentication method never before available to the supply chain."

The three companies will develop a dielet that can be inserted into the electronic component's package at the manufacturing site or affixed to existing trusted components, without any alteration of the host component's design or reliability.

The three companies will design dielets with no electrical connections to the host component, such that authenticity testing can be done anywhere with a handheld or automated probes. After a scan, an inexpensive appliance like a smart phone will upload a serial number to a central, industry-owned server. The server sends an unencrypted challenge to the dielet, which sends back an encrypted answer and data from passive sensors—like light exposure—that could indicate tampering.

FOR MORE INFORMATION visit **SRI International** online at *www.sri.com*, **Northrop Grumman Electronic Systems** online at *www.northropgrumman.com*, the **Charles Stark Draper Laboratory** online at *www.draper.com*, and **DARPA** online at *www.darpa.mil*.

Avionics upgrades keep military planes flying

Some aircraft in the U.S. inventory are 60-year-old designs, yet systems upgrades and technology insertion are keeping these legacy planes on the cutting edge of technology as decades-old airframes receive 21st-century avionics.

BY **J.R. Wilson**

From the 60-year-old B-52 bomber to the F-35B Lightning II joint strike fighter, scheduled to enter service with the U.S. Marine Corps in December 2015, many U.S. aircraft of various ages not only are still in service but many are scheduled to remain in the fleet for another 10 to 30 years.

To meet the increasingly complex combat environments in which they must fly, nearly all are scheduled to receive upgrades and technology refresh, at the heart of which are combat avionics.

Those efforts include:

- B-1 Integrated Battle Station (IBS);
- C-5 Avionics Modification Program (AMP — completed in 2012);
- EA-18G advanced Airborne Electronic Attack (AEA) suite;
- F-15E Strike Eagle's continuous avionics

The B-1's vertical situation display upgrade switches the B-1's forward cockpit by replacing two unsupportable, monochrome pilot and co-pilot displays with four multifunctional color displays.


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upgrades — including a proposed "Silent Eagle" variant with a digital fly-by-wire flight control system (DFCS), digital electronic warfare suite, advanced electronic scanning array (AESA) radar and other advanced avionics;

- F/A-18E/F Super Hornet's advanced sensors, such as the APG-79 AESA radar;
- AWACS block 40/45 major mission system upgrade;
- AH-64E joint digital operability, improved survivability and cognitive decision aiding upgrades;
- CH-47F advanced avionics for improved situational awareness and digital automatic flight control (with automatic altitude and position capture/hold modes for stability in brownout conditions and reduced pilot/crew workload) and Common Missile Warning system.

The Advanced Crew Station on the F/A-18 Super Hornet will contain a high-definition, touch-screen display that enables aircrew to view and manipulate information.

The U.S. Air Force Boeing B-1 strategic jet bomber is one focal point for major avionics upgrades. "The IBS really combines three development programs: Vertical Situational Display Upgrade (VSDU), Fully Integrated Datalink (FIDL) and Central Integrated Test System (CITS). We went through parallel development on those and what they do is modernize the front and back cockpit of the B-1," says Rick Greenwell, B-1 program director at Boeing Global Services & Support (GSS). "VSDU replaces two unsupportable pilot and copilot displays with four 8-by-6-inch multifunction displays [MFDs], two on each side for each pilot.

"FIDL is a back cockpit mod where we have the defensive and offensive systems operator," Greenwell continues. "It adds five new multifunctional displays, cursor control devices, and integrated keyboards and provides improved connectivity and situational awareness.

"We added a new moving digital map, simulated voice and data comms, improved weapons release. Before we had to fat-finger in a hundred steps to release a weapon and now that can be done automatically," Greenwell says. "The CITS is the diagnostic system for the aircraft. The old system had a line display and now you can record more than 20,000 parameters, data and enhanced diagnostics for troubleshooting the aircraft."

Development on all three has been completed and the IBS modifications are now being made on the aircraft.

B-1 bomber upgrades

Boeing is under contract for IBIS lots 1, 2, 3, and 4 — a total of 33 kits. Lots 5, 6 and 7 are expected to come under contract this year, adding another 27 kits. Boeing provides the kits to the Air Force and Air Force installers do the kit installations at Tinker Air Force Base, Okla.

As of January 2015, two development aircraft had been completed and six production aircraft delivered to Dyess Air Force Base, Texas, for aircrew training; those eventually will be deployed to the active fleet when initial operational capability (IOC) is achieved in early 2016.

For the F-16, Core Mission Computer upgrades, cockpit display improvements, and AESA radars are planned for the future. The current

Block 50/52 upgrade includes color cockpit displays, a new electronic warfare suite, and advanced sensors, while Block 60 will include all-new avionics to provide more sensor data and improved situational awareness to pilots, as well as new, more advanced flight controls and radar detection capabilities.

Lockheed Martin Corp., the F-16 designer, is promoting the F-16V — with an AESA radar, advanced architecture, and new center display for improved pilot situational awareness — as an option for new production jets and current fleet upgrades. It has been selected by Taiwan for their 145 Block 20 F-16s.

The Boeing F/A-18E/F Block 2 Super Hornet went operational in 2007, making it the youngest tactical aircraft in the U.S. fleet, with a new mission suite, displays, and avionics. The EA-18G Growler, built on the same platform, became operational in 2009 with then state-of-the-art avionics.

"Both platforms will be flying as the backbone of carrier aviation through 2040, according to the Navy," says Dan Gillian, vice president for F/A-18E/F & EA-18G programs at Boeing GSS. "There is a fairly well-defined roadmap of capability insertion, although not out for the full 25 years of service.

"That roadmap has been working for the F/A-18 for the past decade-plus as a low-risk, latest technology insertion that continues to grow with both technology and the threat environment," Gillian says. "That is evolutionary and allows the two platforms to be and stay relevant into the future. The cornerstone of the Block 2 Super Hornet is the APG-79 AESA radar, but additional capability is planned for the future, beginning with the recent Milestone 3 approval for a pod-mounted infrared search & track (IRST) sensor. While the IRST has been around for a while, it is just coming to the Super Hornet, along with an electronic warfare (EW) suite to meet day one threat requirements.

"We have an upgrade each year on the Hornet, using only even numbers, every other year. We're already working on H12 and H14, even some initial stuff on H16. Also coming to the Super Hornet is data fusion, which really is managing all data information flow in the battlespace. UAI (Universal Armament Interface) is the software and code that will allow it to bring new weapons to the platform," Gillian says.

"Data fusion requires more computing and better displays. Some of the display logic is borrowed from the F-22's mission systems, along with the pilot interface, which helps ease the workload in an increasingly complicated environment," Gillian adds. "Tactical network technology will make it easier to interface across multiple platforms using a common interface network in the future."

Growler avionics

Boeing is following a similar evolutionary flight plan for the Growler, beginning with fielding of the Next-Generation Jammer to replace the ALQ-99 Tactical Jamming System.

"The Next-Gen is a leap forward in technology in terms of power, capacity and the ability to deal with threats going forward for the EA-18G. It requires additional computing throughput, so for the Block 39 airplanes the ACMC — Advanced Capability Mission Computer — will come forward, offering about a 50 percent increase over the current system," Gillian says. "Those will be delivered in 2017. The current mission computer is very capable, but the ACMC is really coupled to the increased load of the Next-Gen Jammer. It will then be backfitted to the existing fleet.

"Also in work is the advanced crew station, with an 11-by-19-inch display that could go front or backseat, but the nearest need is in the backseat. It also is part of some of our international offerings for the Super Hornet. It is not yet a defined

Half a century old and still on the cutting edge of technology

The Boeing B-52 long-range strategic jet bomber went into service 60 years ago this month — February 1955. Even though the aircraft is more than half a century old, its avionics still are on the cutting edge of technology.

Many other aircraft in the U.S. military inventory are as old as a half century, yet all these platforms are staying up to date with modern capabilities through series of avionics upgrades and technology insertion.

Here is a list of active-duty U.S. aircraft and their dates of service. All have gone through upgrades to improve their capabilities.

- The B-52 Stratofortress went into service in February 1955;
- the C-130 Hercules in December 1956;
- the P-3 Orion in August 1962;
- the CH-47 Chinook in 1962;
- the C-5 Galaxy in June 1970;
- the AH-1 SuperCobra/SeaCobra in 1971, the F-15 Eagle in January 1976;
- the A-10 Thunderbolt II (aka Warthog) in March 1977;
- the E-3 Sentry (airborne warning and control system, AWACS) in March 1977;
- the F-16 Fighting Falcon in August 1978;
- the UH-60 Black Hawk in 1979;
- the KC-10 Extender in March 1981;
- the CH-53 Sea Stallion/MH-53 Sea Dragon in 1981;
- the F/A-18 Hornet in January 1983;
- the AV-8B Harrier II in January 1985;
- the AH-64 Apache in April 1886;
- the B-1 Lancer in October 1986;
- the E-8 Joint STARS in 1991;
- the KC-10 Globemaster III in January 1995;
- the MQ-1 Predator in July 1995;
- the B-2 Spirit in April 1997;
- the RQ-4 Global Hawk in 1998;
- the F-22 Raptor in December 2005;
- the V-22 Osprey in June 2007;
- the UH-72 Lakota in 2007;
- the EA-18G Growler in September 2009; and
- the P-8 Poseidon in November 2013. ←

program, so there is no cut-in timeline. We will continue to see radar developments over time, aligning with the H12, H14, etc., upgrades through the 2040s."

Next-generation avionics systems center on integrated communications, navigation, and identification (CNI) functions, such as software-defined radios (SDRs) developed by Northrop Grumman as part of a modular avionics design, using a wideband set of general-purpose electronics to meet multiple processing and radio requirements.

The company's advanced avionics efforts are being employed in a number of legacy aircraft upgrades, including the Northrop Grumman B-2 stealth bomber, E-8C Joint Surveillance Target Attack Radar System (Joint STARS) and, with funding now restored by Congress, the A-10 Thunderbolt II close-air-support jet.

"The robustness of aircraft today permits them to stay around for a long time," Jeffrey Q. Palombo, vice president of Northrop Grumman's Land and Self-Protection Systems Division, told reporters at a 28 Oct. 2014 briefing. "Not only is there tremendous added value when you can deliver platform-agnostic avionics across multiple platforms, but when you incorporate open architecture into the design, you can insert those capabilities much quicker than in the past."

An example is the platform-agnostic, capability-based integrated avionics systems procured for the Army's UH-60V Black Hawk digital cockpit, which features an integrated architecture with a partitioned, modular operational flight program through which future enhancements can be accomplished using software upgrades rather than new hardware. That same architecture is being applied to multiple other platforms, including the AH-64D/E Apache and CH-47D/F Chinook helicopters.

Integrated avionics

At the heart of its Integrated Avionics System, which is aligned with the Future Airborne Capability Environment (FACE), are next-generation, dual-mission FlightPro Gen III mission computers, featuring multiple partitioned 8-core PowerPC-based processors, which have been installed on the Marine Corps' upgraded UH-1Y Venom and AH-1Z Viper helicopters.

"What will change over the next 40 years? The world has gone digital and, because of that, the services need to be able to make changes; they need more autonomy," Palombo says. "An aircraft may be updated once or twice over its lifespan, but the avionics may need to be upgraded 10 times in that same time frame.

"Flexibility is important; autonomy for our customer is very important," Palombo adds. "Think about how rapidly things can be accomplished using an open architecture approach and how quickly new capabilities and threats can be addressed. That is our future."

While among the newer platforms in the U.S. military fleet of combat aircraft, the Bell Boeing V-22 Osprey represents some of the most recent advances in avionics as well as potential future evolutions. Its four multifunction displays (compatible with night-vision goggles) and shared Central Display Unit enable the glass cockpit to give the crew various operational displays, including digimaps, imagery from the Turreted Forward-Looking Infrared System and primary flight instruments, navigation and system status.

Although it is scheduled to be replaced in the Marine Corps inventory by the F-35B, the AV-8B Harrier jump jet is to receive updated datalink capability and targeting sensors to keep it relevant until its final retirement, now scheduled for 2025.

The Sikorsky CH-53K King Stallion helicopter, planned to enter service in 2019 as the Marine Corps' new heavy-lift helicopter, will feature a new Rockwell Collins digital glass cockpit with fly-by-wire controls and Avionics Management Systems incorporating integrated flight and navigation displays. The AMS comprises five integrated active matrix liquid crystal MFDs, dual integrated processing cabinets (IPCs), dual control display units (CDUs), and dual data transfer units (DTUs).

A major driver in avionics development through mid-century is the

The B-1B Lancer was recently upgraded with a new Integrated Battle Station — a combination of three different upgrades.

growing commitment to anti-access/area denial (A2/AD) capabilities by the world's militaries, especially in the enhanced U.S. focus area of the Asia/Pacific region. The goal is to keep U.S. capabilities away from potential foreign targets, thus diluting American leadership in stealth and other deep penetration technologies.

"A lot of nations today are invested in A2/AD, pushing U.S. interests farther from their countries. So we're looking at global strike capability for the B-1 to work against A2/AD systems," Gillian says. "New tactics have to be developed to deal with evolving threats. We think bombers are a perfect fit for that environment, with long legs and large payload capacities, plus the standoff weapons required to go against A2/AD systems, which, again, is why global communications is important.

"Missions can be generated from CONUS and engage at long range. The B-52 program is in a similar upgrade of displays and datalinks and there is some commonality between the two programs," Gillian explains.

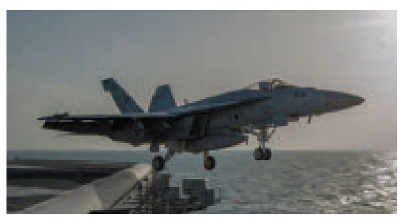
Before the IBS modifications take place, two other parallel developments must be completed.

Flight navigation

"One of those is the inertial navigation system upgrade, on which 33 aircraft have been completed and we should have all the rest done by the end of 2015," says Boeing's Greenwell. "The other is our radar modification improvement program, in which Boeing and Northrop Grumman did the development and the Air Force is contracting directly with Northrop Grumman for the production piece.

"That had two LRUs [line replaceable units] that were upgraded as part of improving the B-1 radar system — one called CORP (common radar processor), the other MORE (modular receiver exciter)," Greenwell continues. "There was a reliability/maintainability issue with the old systems and those upgrades provide a better framework to grow the radar system in the future."

Not all improvement programs are strictly designed to enhance an aircraft's capability, however — some are more focused on reducing acquisition, maintenance and future upgrade costs, as well as size, weight, and power.



An F/A-18E Super Hornet launches from the flight deck of the Nimitz-class aircraft carrier USS Carl Vinson (CVN 70).

A NATO Airborne Warning and Control System aircraft flies with three F-16 Fighting Falcons during a recent test mission.

"There are two initiatives focused on lowering operating costs more than new capability. The first is called Magic Carpet, which basically is software algorithms to make it easier for pilots to land on carriers, which means less money and time spent on training," Gillian says. "The other is Integrated Live, Virtual & Constructive (I-LVC). I-LVC will allow a synthetic environment in flight to make the pilot think he is fighting red air without actually putting those aircraft and pilots in the air. His radar tells him there are bad guys out there and he fights them. It will reduce operating costs.

"Magic Carpet will be on both the F-35 and F/A-18E/F. The F-35 role in the Navy is to replace the classic Hornets, so it will be on the carrier deck with the Super Hornets, two squadrons of each platform. Going forward, I'm sure there will be opportunities for things to move back and forth between the platforms. The F-15 is in our tacair portfolio and some of those capabilities also are going into the F-15E and derivatives."

Unmanned aircraft

The military also is looking at ways to integrate its manned combat aircraft with future generations of unmanned aerial vehicles, including unmanned combat aerial vehicles (UCAVs), which will require even more sophisticated and real-time avionics, communications, and datalinks. That roadmap is being heavily influenced by the Pacific pivot, which will rely on carrier- and long-range, land-based aircraft, across the spectrum.

"We're looking at UAVs from a couple of perspectives, more at a trade study level, but there have been no firm decisions. However, the Super Hornet and Growler have the growth capacity in their architecture to do that," says Kevin Fogarty, the F/A-18 chief engineer at Boeing. "We're also actively engaged with the customer community looking at how they can integrate into a battlespace that includes UAVs. As we go forward and the Growler gets greater use, we see it as the quarterback of the forward mission. In that role, interfacing, pulling data, doing targeting is an environment that includes UAVs in the future.

"We believe both aircraft have lots of growth capacity left. The UAV piece is not a high priority for the Growler and more focused on a comms piece rather than a specific UAV mission," Fogarty says. "But from Boeing's perspective, looking at the capabilities and current roadmap — including data fusion, Next-Gen Jammer, computing throughput, etc. — those are all capabilities that will serve carrier aviation very well for the time the Growler will be in service, so upgrades will continue well into the future." ←

Hybrid processor architectures meet demands for SWaP

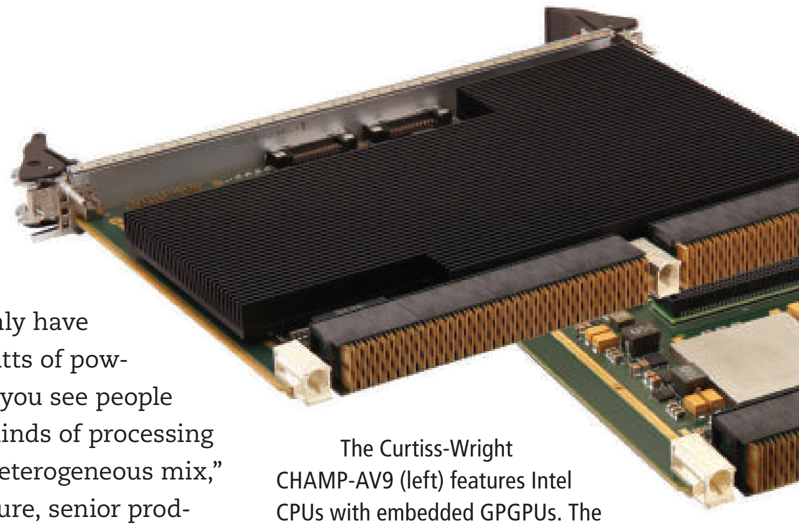
Embedded computing designers are blending FPGAs, CPUs, GPGPUs, and server-class processors for optimal performance, size, and weight, yet this approach is not for everyone because of system complexity and high software costs.

BY **John Keller**

Aerospace and defense electronics designers are being pulled in many different directions by their customers who at the same time are demanding increases in embedded computing performance, as well as reductions in computing size, weight, and power (SWaP) consumption. More power and smaller size seems like a contradiction at first glance, but designers are finding a clear path to meeting both demands.

The solution to this puzzle lies in a new discipline of high-performance embedded computing (HPEC) that involves hybrid architectures that blend several different kinds of processors in the same box. Here's the idea: If designers exploit the strengths of each different processor, they can build an advanced HPEC system that marries high performance as well as advantages in SWaP.

"The reality is you really want to be able to do all these capabilities like electro-optics/infrared (EO/IR), signals intelligence (SIGINT), and radar processing—and want to fit into a 2-by-3-foot box, and you only have so many kilowatts of power—this is why you see people with different kinds of processing solutions in a heterogeneous mix," says Marc Couture, senior product manager for digital signal processing products at Curtiss-Wright Controls Defense Solutions in Ashburn, Va.



The Curtiss-Wright CHAMP-AV9 (left) features Intel CPUs with embedded GPGPUs. The CHAMP-FX4 (right) has Xilinx FPGAs.

Today's most demanding and SWaP-constrained embedded computing systems often use a mix of different processors that include field-programmable gate arrays (FPGAs), traditional central processing units (CPUs), general-purpose graphics processing units (GPGPUs), and in some cases advanced server-class processors like the Intel Xeon.

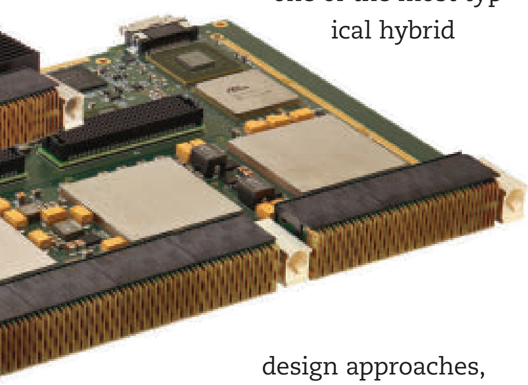
"There is a lot of mixing of technologies these days," says Shaun McQuaid, senior manager of product management at Mercury Systems in Chelmsford, Mass.

"There is no single processor type that is perfect for every application and every stage of the processor chain," says Peter Thompson, senior business development manager for high-performance embedded computing at the GE Intelligent Platforms facility in Billerica, Mass. "We look at a mixture of different types of processors—not just a heterogeneous architecture based on one type of processor."

FPGAs, for example, are particularly good at digesting and reducing massive amounts of data flowing in from radar, electronic warfare (EW), SIGINT, sonar, and other reconnaissance and surveillance technologies.

"If you need to process a lot of input/output (I/O) and data coming in from a radio-frequency (RF) link, that is really where FPGAs do the job as pre-processors," says Daniel March, principal embedded engineer at Extreme Engineering Solutions (X-ES) in Middleton, Wis.

Systems designers consider FPGAs as the front-end processor in hybrid HPEC systems so as not to overwhelm CPUs in the processing chain. Blending FPGAs and CPUs is one of the most typical hybrid



design approaches, but some of these complex systems draw on other kinds of processors for even better performance.

Curtiss-Wright's Couture refers to what he calls the "Periodic Table of Compute Elements." This table includes FPGAs to ingest the output of a digital converter; Intel multicore CPUs like the Core i7 for cognitive processing; GPGPUs like those from NVIDIA for parallel processing, accelerating floating-point math, and graphics rendering; and server-class processors like the Intel Xeon for many X86 processing cores for numbers crunching.

Hybrid HPEC architectures don't have to be limited to these processors, however. GE's Thompson points to high-end processors from Adapteva in Lexington, Mass., and those from Tilera Corp. in San Jose, Calif., as candidates for high-end hybrid HPEC architectures.

Processors like the Tilera TILE-Gx and the Adapteva Epiphany-IV and Eppiphany Multicore IP processors can pack from 64 to 128 processor cores on one chip for extreme CPU performance. Such a large number of processing cores on a chip lends itself to massively parallel processing tasks in an embedded system. This quality places the Adapteva and Tilera processors in competition with the NVIDIA GP-GPUs, which can complicate the system designer's choices.

"In some ways the Adapteva and the GPGPU tend to be similar, but the way you program these devices is different," GE's Thompson says. "The difference is floating point capability; Tilera multicore devices were really designed for fixed-point processing and were not very floating-point capable. If you're looking for floating point you are better off with the GP-GPU," Thompson says, adding that Adapteva and Tilera have improved their floating-point capabilities since their introductions.

Something else to consider when comparing Adapteva and Tilera processors with GPGPUs is the size of the companies and their prospects for long-term survival in the competitive processor market.

"With GPGPUs you are talking about NVIDIA, AMD, or Intel; all are large well-established companies," Thompson says. "The others are from smaller and more boutique companies."

The key consideration is choice. "The point there is you wouldn't build something as complex as a car out of all iron," Couture says. "In aerospace and defense applications, ideally it would be nice to attack a problem like Doppler radar

The Ensemble HDS6603 high-density server from Mercury Systems has the Intel Xeon E5-2600 v3 processors to deliver as much as 1.38 teraFLOPS of embedded general-purpose symmetric multi-processing power.

with just one kind of processor. But the big problem is SWaP: the more pounds your payload weighs, the less time you can stay out on your mission."

Benefits of the hybrid architecture

Like virtually any advanced embedded computing technology, the hybrid HPEC architecture has its advantages and drawbacks. On the plus side, a hybrid architecture is relatively small, power-efficient, and provides powerful signal processing.

For applications that demand these qualities, such as unmanned vehicles, piloted tactical aircraft, and perhaps high-end wearable electronics, there may be few alternatives to the hybrid HPEC architecture—especially where requirements are most stringent.

Hybrid architectures can be optimized and fine-tuned to get the most performance, smallest possible size, adequate electronics cooling, and most optimized application software. It all boils down to a clever design that makes the most of each kind of processor's strengths, minimizes each processor's weaknesses.

The goal is to make the whole greater than the sum of its parts. "It makes sense if your HPEC computing system has a lot of specific tasks and high demand for low latency," says Vincent Chuffart, head of products for the avionics, transportation, and defense group, at Kontron in Poway, Calif.

FPGAs

Take FPGAs. They can be more difficult to program than CPUs, yet they are particularly useful for processing large data streams quickly, pulling out data of interest, and throwing away everything else. They can streamline the process of boiling down data and only passing on relevant information to CPUs or other processing nodes.

"You can do some processing on the FPGA and only notify the CPU when there is something of interest," says March of X-ES. "It could be to determine to eliminate the threat, or hand off to some other data service for future analysis, or for alerting some sort of other system—you name it. If you are gathering a lot of data, and have to handle it efficiently and try to discern some sort of pattern, that is where FPGAs are very efficient."

Electronic warfare, which has high demands for speed, always comes up in conversations about hybrid HPEC architectures. "In electronic warfare, for example, you have a small period of time to listen, digitize the signal, and react to that data with a specific algorithm, and respond to countermeasures," says Kontron's Chuffart. There is not a lot of data exchange between the FPGAs and the CPUs until the FPGA's identify signals of interest.

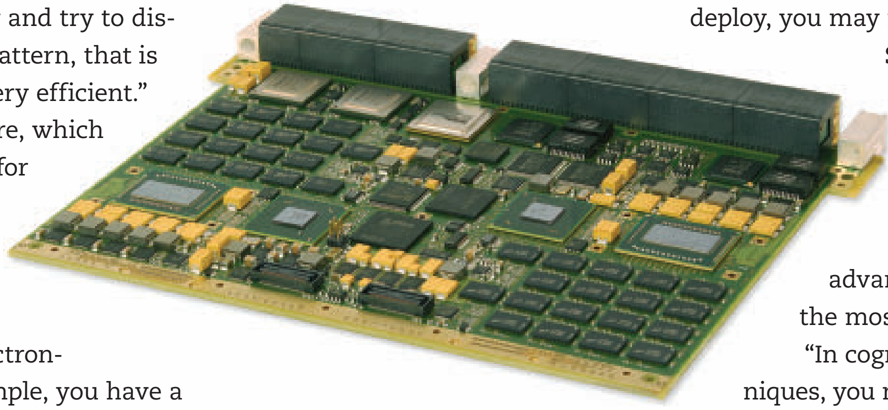
"If you need low latency to know what the signals of interest are and respond to them quickly, that is where the FPGA approach has its strengths," says Mercury's McQuaid. "It can turn around a response with extreme low latency."

Blending FPGAs with CPUs and other kinds of processors also can enhance data security if cyber warfare or anti-tamper are concerns, says Kontron's Chuffart. "It's difficult to reverse-engineer an FPGA so it is more secure."

GPGPUs

GPGPUs also have notable strengths in hybrid HPEC architectures. While designed originally for rendering graphics quickly on computer screens, embedded computing designers also have discovered that GPGPUs also are efficient parallel-processing engines.

"We see both cases of systems where you go straight from the FPGAs at the front end to an array of CPUs at the back end, as well as systems where it goes from FPGAs to an array of GPGPUs for beam forming, and then it's not uncommon to go from GPGPUs to CPUs to do things like target extraction and target tracking," says GE's Thompson. "One reason we see people considering GPGPUs in radar systems is because they can get more processing power in the same power budget and in a smaller space budget by putting GPGPUs into the mix."



The GE Intelligent Platforms DSP281 is a rugged, dual-node, quad core 6U OpenVPX high-performance embedded computing (HPEC) deployed server platform featuring 4th generation Intel Core i7 chip sets.

Using GPGPUs also can enable systems to designers to shrink the sizes of their systems. "You could use 10 different central processors, or one GPGPU, says Couture of Curtiss-Wright. "If it's worth it for the thing you are going to deploy, you may need the GPGPU."

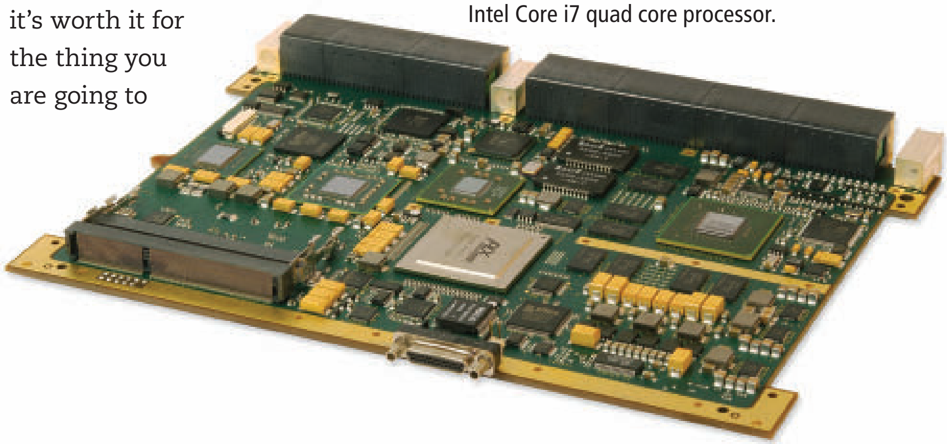
Systems designers may find that for specific complex HPEC applications, the GPGPU may have advantages over even the most advanced CPUs.

"In cognitive EW techniques, you may want to parse out what you are trying to do in order to get through the noise and countermeasures to find out what you are dealing with," says Mercury's McQuaid. "That is where GPGPUs are strong in cycling the same algorithm through over and over."

Central processing units

Central processors have primary roles in HPEC architectures—especially since there is such a wide variety of CPUs, ranging from powerful mobile processors like the Intel Core i7, to the more powerful server-class processors like the Intel Xeon, and even to the highly parallel multicore processors like the Adapteva and Tilera chips.

The CPUs often represent the



The GE Intelligent Platforms rugged IPN251 6U OpenVPX GPGPU Multiprocessor combines the latest 384-core NVIDIA Kepler GPGPU technology with a third-generation Intel Core i7 quad core processor.

heart of a hybrid HPEC architecture because this link in the processing chain involves the decision making and courses of action based on distilled sensor data. While FPGAs and GPGPUs can help detect potential targets, sources of electronic warfare jamming, threats from improvised explosive devices (IEDs), and the like, CPUs help enable the system to take action like shoot or don't shoot, the kinds of EW countermeasures to deploy, and whether or not to bring in specialized IED-hunting equipment.

"The general-purpose processor, like an Intel device with x86 cores, are vector engines and are very good at math," says Curtiss-Wright's Couture. "They can distill the data and start to crunch on the data and come up with actionable information like this is a threat and this is not."

Choosing among the different CPUs takes some effort, and is based on the specific applications involved. Server-class processors like the Xeon have advantages in raw computing power and memory management. The Xeon, for example, can move data in and out of memory more efficiently than a Core i7. Yet the Core i7, on the other hand, is adept at driving displays and rendering graphics than the Xeon. "The Core i7 and Xeon are very different," says Mercury's McQuaid.

The two processors also may have very different futures, he says. "Look at where the Intel roadmap is going: the Core i7 is maintaining the same level of performance with better power efficiency, whereas the server-class chip is trying to increase its capacity and performance without changing the power requirements."

While it might seem like an attractive option to include server-class processors like the Xeon in hybrid embedded computing, systems designers must give close consideration to their intended operating requirements. Server-class chips tend to be physically large, and at least for today would not be appropriate for a 3U VPX or other small-form-factor system. Their large size makes it difficult to included mezzanine sites or low-level, low-speed I/O for MIL-STD-1553 and older technologies on the same board.

Xeon chips, moreover, have issues when it comes to ruggedized systems designed to withstand the effects of shock and vibration. “The downside of server chipsets is they are available only as socketed devices,” points out GE’s Thompson. This kind of packaging does not have the mechanical rigidity for shock and vibration environments as does a ball grid array (BGA) package.

This is not to say that server-class processors always will have these drawbacks. Industry experts predict the Intel Xeon and processors like it eventually will be available in rugged packaging, and may shrink to fit small-form-factor systems. “As technology continues to develop we will see Xeon moving onto the 3U architecture in one to three years,” says Mercury’s McQuaid.

It is the CPUs, also which are starting to blend several kinds of processors on one chip. The Intel Core i7, for example has GPGPU capability on the same chip. Some FPGAs are blending CPU capability on board by including CPU processor cores.

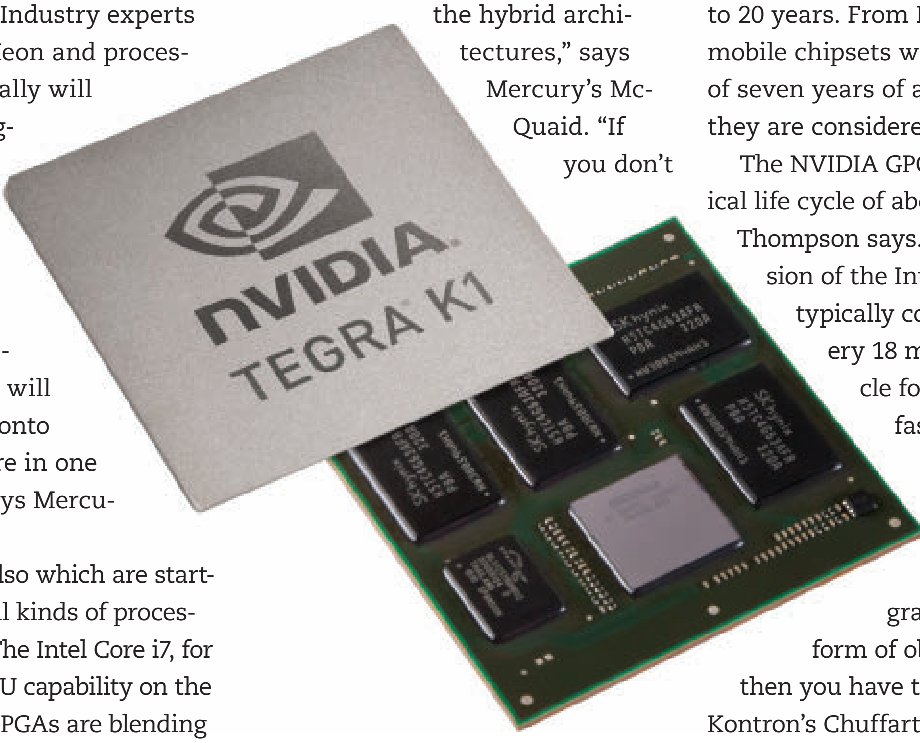
“The lines are starting to blur,” Couture says. “The FPGA vendors have ARM cores in their FPGAs and x86 cores. The GPGPUs are mixing GPUs with ARM and X86 cores. It is getting harder to choose now that there are so many choices.”

Not for everyone

With all their potential benefits, however, hybrid HPEC architectures are not for every design. They have plenty of drawbacks, and this is the reason that only a relative handful of embedded computing companies are heavily involved in hybrid designs.

Systems designers to get these systems designed and fielded must confront relatively high costs, system complexity, difficult logistics, component obsolescence, and economies of scale. “Getting stuff working together there is a price to pay,” says Kontron’s Chuffart.

“Software cost is a big hit with the hybrid architectures,” says Mercury’s McQuaid. “If you don’t need the optimal solution, then a general-purpose processor might make more sense.” Programming a hybrid system requires many levels of expertise, which isn’t available to all companies.



GE Intelligent Platforms signed an agreement with NVIDIA to bring products based on the NVIDIA Tegra K1 mobile processor to the embedded computing market.

“If you start putting all these processors in a single system, our customers don’t have the manpower to be expert in FPGAs, CPUs, and GPGPUs,” says March of X-ES. “It is a tremendous software burden if you do all three.”

Systems designers also must consider the expected life cycles of each kind of processor they plan for hybrid systems; not every roadmap is the same.

“One of the big considerations designers have is the longevity of supply for these systems,” says GE’s Thompson. “These military designs may have to say in the field for 15 to 20 years. From Intel and their mobile chipsets we see a minimum of seven years of availability before they are considered for end of life.”

The NVIDIA GPGPUs have a typical life cycle of about five years, Thompson says. While a new version of the Intel mobile CPUs typically comes out about every 18 months, the cycle for GPGPUs is must faster—sometimes just six to 10 months. “By the time you get it right, your program is hit by some form of obsolescence, and then you have to do it again,” says Kontron’s Chuffart.

Economies of scale also can be a problem for hybrid architectures. With the high costs of development in terms of time and money, it can be difficult to find a business model that makes economic sense.

“It plays well only if you get the volume and the stability in algorithms, and it is difficult to predict where the processor market will go,” Chuffart says. “A company can’t bet its future on a specialized architecture.”

Navy expands Triton facilities at Point Mugu

U.S. Navy leaders are expanding the basing and infrastructure to support the Navy's future fleet of Northrop Grumman MQ-4C Triton Broad Area Maritime Surveillance long-range unmanned aerial vehicles (UAVs) in Southern California, issuing a $16.4 million contract to expand Triton UAV support facilities at Point Mugu Naval Air Station. Triton facilities and aircraft are based domestically at Point Mugu and Jacksonville Naval Air Station, Fla. Tritons will work with P-8A Poseidon long-range manned maritime patrol aircraft to locate and track hostile surface ships and submarines.

Navy orders Blackjack small tactical UAVs

U.S. Navy officials are buying three new RQ-21A Blackjack small tactical UAVs to provide surveillance capability for U.S. Marine Corps and Navy tactical commanders. Boeing Insitu won a $41.1 million contract for low-rate-initial-production Blackjack UAVs, to include air vehicles, ground control stations, launch and recovery equipment, and spare parts. The RQ-21 is a twin-boom, single-engine, monoplane UAV for surveillance and reconnaissance. It an be launched and recovered on land or at sea without runways, using a pneumatic launcher and net-type recovery system.

Army to build special UAV airport at Fort Bliss, Texas

FORT BLISS, Texas—U.S. Army unmanned vehicles experts are building a special airport for Grey Eagle and Shadow unmanned aerial vehicles (UAVs) at the Fort Bliss Army post near El Paso, Texas, to support the Army's 1st Armored Division.

The drone airport to be built at Training Area 4D of the Dona Ana Range on Fort Bliss will have a 5,000-foot paved runway and a smaller, 1,000-foot paved runway, as well as a 50,000 square-foot hangar with office and support buildings, a command and control center, a hot loading facility for munitions, and a hazardous materials building.

Officials of the Fort Worth District of the Army Corps of Engineers in Fort Worth, Texas, announced a $33 million contract to construction specialist SGS LLC in Oklahoma City, Okla., to build the UAV launch and recovery complex at Fort Bliss. The UAV airport and its facilities should be completed by April 2016.

Construction of the UAV airport at Fort Bliss is part of a larger Army plan begun in 2012 to equip each Army combat division with UAVs. The Army Training and Doctrine Command (TRADOC) at Fort Eustis, Va., is overseeing an Army reorganization to put a Grey Eagle company in every Army division.

The Army's 1st Armored Division headquartered at Fort Bliss, which the new UAV airport will support, operates the M1A2SEP Abrams main battle tank; M2A3 and M3A3 Bradley infantry fighting vehicles; M109A6 Paladin self-propelled howitzer; M1151 Humvee and Mine-Resistant Ambush Protected (MRAP) armored vehicles; Stryker wheeled armored vehicle; UH-60 Black Hawk utility helicopter; AH-64 Apache attack helicopter; and other combat equipment.

Army aviation experts are building a special UAV airport at Fort Bliss, Texas, for the Shadow UAV, shown above, and for the armed Grey Eagle UAV.

With the 2012 TRADOC-ordered reorganization and construction of the new UAV airport, the 1st Armored Division is adding the MQ-1C Gray Eagle medium-altitude long-endurance UAV, as well as the RQ-7 Shadow tactical reconnaissance UAV to its arsenal of weapons.

At Fort Bliss, the 5,000-foot paved runway is for the Grey Eagle, and the 1,000-foot paved runway is for the Shadow. The air facilities will include a 1,000-foot cleared and graded dirt safety run-out zone at each end of the Grey Eagle airfield.

The new UAV airfield at Fort Bliss will have security fencing and lighting around the complex's perimeter, and all UAV operations at Fort Bliss will be within military-restricted airspace, officials say.

Custom MMIC offers nonreflective switch

Custom MMIC in Westford, Mass., is introducing the CMD203 DC-20 GHz SP4T nonreflective switch in die form for microwave radio and VSAT, test instrumentation, and military end-use. With insertion loss of 2.4 decibels and isolation of 39 decibels at 10 GHz, the CMD203 offers RF and microwave performance over a broad frequency range, with a switching speed of 66 nanoseconds. The CMD203 includes an on-board binary decoder circuit, reducing the number of required logic control lines from four to two. Each single-ended control line requires logic levels of 0/-5 V. It consumes 4.5 milliamps of DC current.

Gore introduces rugged RF and microwave cable

W.L. Gore & Associates in Landenberg, Pa., is introducing small-diameter RF and microwave cabling for aerospace applications. GORE-FLIGHT cabling delivers low insertion loss for an assembly using Size 8 RF contacts, improves fuel efficiency, and increases payload. The cable measures 0.24 inches in diameter, weighs 0.04 pounds per foot, and offers a minimum bend radius of 1 inch. Applications include airborne electronic surveillance and countermeasures; radar warning systems; missile approach warning systems; radar interconnects; electronic and signal intelligence; and navigation and communication systems. ←

Navy carriers and big-deck amphibs to gain new voice communications

BY **John Keller**

The amphibious assault ship USS America, shown above, will receive new intra-ship communications gear, along with other large Navy warships.

CHARLESTON, S.C.—U.S. Navy shipboard communications experts are revealing plans to install new and upgraded intra-ship communications gear aboard the nation's fleet of aircraft carriers and amphibious assault ships.

Officials of the Space and Naval Warfare Systems Center Atlantic (SPAWARSYSCEN Atlantic) in Charleston, S.C., will issue a formal industry solicitation for the Interior Communication Systems-Integrated Voice Network (IVN) program.

The IVN project will call for a commercial off-the-shelf (COTS)-based modernization of the telephone systems aboard aircraft carriers, amphibious ships, and command ships with the IVN system. The solicitation should be released later this month.

Surface ships involved in the shipboard voice networking project are the Nimitz-class aircraft carriers; Wasp-class amphibious assault ships; America-class amphibious assault ships; and Blue Ridge-class amphibious command ships.

Navy officials plan to replace the integrated voice communication system (IVCS) aboard San Antonio-class amphibious transport dock ships — starting with the USS John P. Murtha (LPD 26) — with IVN. The AN/STC-4(V) voice telephone system (VTS) for the new Ford-class aircraft carriers, furthermore, will be included in the IVN modernization plan.

Scalable versions of the IVN are planned for the USS Whidbey Island and USS Comstock dock landing ships, as well as USS Austin amphibious transport dock ship.

The IVN shall provide user end-to-end communications within the ship, interfaces to other shipboard systems, and to shipboard connection points with the Defense Switching Network (DSN) and the Public Switched Telephone Network (PSTN), Navy officials say.

The project will use existing telephony equipment rooms aboard the warships and where possible will use the existing ship cable plants through a main cross connect field (MCCF) designed for IVN.

The IVN solicitation should be released online at https://e-commerce.sscno.nmci.navy.mil/. For questions or concerns phone the Navy's Ornette Adams at 843-218-6284.

MORE INFORMATION IS online at *http://goo.gl/PLhEFW*.

Keysight N5193A UXG Agile Signal Generator

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Generate wide chirps that are 10% to 25% of carrier frequency

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Lockheed Martin to build electro-optical fire-control for Cobra gunships

Lockheed Martin is building 14 multi-sensor electro-optical/infrared (EO/IR) fire-control systems for U.S. Marine Corps AH-1Z Cobra attack helicopters. Officials of the Naval Surface Warfare Center in Crane, Ind., announced a $43.4 million contract to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., for 14 AN/AAQ-30 target sight systems (TSS). The AN/AAQ-30 TSS provides target identification and tracking, passive targeting for integrated weapons, including Hellfire missiles, and a laser designation capability supporting friendly laser-guided weapons.

Synthetic vision to increase snow plow safety

Federal transportation authorities are asking researchers at Carnegie Mellon University in Pittsburgh to borrow from defense and aerospace synthetic vision technology to enable snowplow drivers to see clearly in blizzard conditions. The U.S. Federal Highway Administration awarded a $1.5 million contract to Carnegie Mellon for the Advanced, Low-Cost Snowplow Visual Guidance System, a prototype visual guidance system to help snowplow operators see in blizzards, rural nighttime operations, super-cooled fog, and other low-visibility situations. The Carnegie Mellon solution will gather, synthesize, and display sensor data to help drivers plow efficiently, drive safely, and avoid objects in zero-visibility winter conditions. ←

Northrop Grumman to build helicopter laser mine detection system

BY **John Keller**

WASHINGTON — Ocean mine warfare experts at the Northrop Grumman Aerospace Systems segment in Melbourne, Fla., will provide the U.S. Navy with a helicopter-based system designed to detect floating and submerged ocean mines with laser beams under terms of a potential $163.6 million contract.

Officials of the Naval Sea Systems Command in Washington are asking Northrop Grumman to build and support the AN/AES-1 airborne laser mine detection systems (ALMDS), an electro-optical system that will be mounted on Navy MH-60S helicopters based on the littoral combat ship (LCS). The laser-based mine-detection system uses streak tube imaging light detection and ranging (LIDAR) sensors to detect, classify, and localize surface and near-surface moored sea mines.

The ALMDS, which will be part of the mine countermeasures (MCM) mission package aboard the new LCS, is designed for rapid wide-area reconnaissance and assessment of anti-ship mines in coastal waters, harbors, confined straits, choke points, and amphibious assault areas where aircraft carriers and expeditionary strike groups must operate.

The ALMDS uses pulsed laser light and streak tube receivers in an external equipment pod on the MH-60 helicopter. These lasers are designed to search the water column from the surface to about 40 feet in depth — the area where mines are the biggest threats and coincidentally where mine-hunting sonar is least effective.

The ALMDS projects a pulsed wide 538-nanometer blue-green laser beam into the water and samples at rates greater than 100 per second. ALMDS is capable of day or night operations without stopping to stream out or recover equipment and without towing any equipment in the water. It uses the forward motion of the aircraft to generate image data negating the requirement for complex scanning mechanisms.

The ALMDS was designed with VMETRO central electronics chassis (CEC) — liquid-cooled air transportable rack (ATR) systems with VMETRO CSW1 6U VXS (VITA 41) switch cards and VPF1 quad processor payload cards. Curtiss-Wright Corp. Defense Solutions in Santa Clarita, Calif., acquired VMETRO in 2008. The CSW1 and VPF1 embedded computing boards process image sensor data using real-time multiprocessing over high-speed serial communications. The ALMDS CEC uses a combination of field-programmable gate arrays (FPGAs) and PowerPC processors.

Northrop Grumman and its subcontractors will do the work in Melbourne, Fla.; Tucson, Ariz.; St. Charles, Mo.; Irvine, Calif.; Santa Clarita, Calif.; and Brentwood, N.Y., and should be finished by February 2021. ←

PRODUCT applications

NAVIGATION AND GUIDANCE

Airbus chooses Northrop Grumman navigation units for helicopter guidance

Avionics designers at Airbus Helicopters in Marignane, France, needed an attitude and heading reference system (AHRS) for several different kinds of helicopters. They found their solution from Northrop Grumman Litef GmbH in Freiburg im Breisgau, Germany.

Airbus Helicopters officials have chosen Northrop Grumman Litef to certify and deliver Litef's new LCR-350 AHRS aircraft navigation technology for several helicopter platforms, Northrop Grumman officials say.

Developed by Northrop Grumman's subsidiary in Germany, Northrop Grumman LITEF, the LCR-350 AHRS is for civil and military applications on fixed-wing aircraft and helicopters.

The AHRS provides critical flight control data on an aircraft's heading and attitude. Litef will certify the LCR-350 for various Airbus Helicopters aircraft.

Production of the LCR-350 AHRS is expected to begin in 2016.

The LCR-350 AHRS features a high-performance, microelectromechanical system (MEMS) inertial measurement unit and is based on the standard LCR-300 AHRS. Additionally, the system enables directional gyro mode operation, which minimizes magnetic compass errors, company officials say.

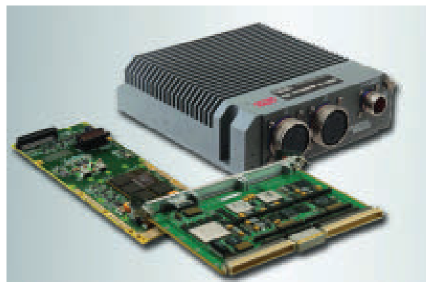
The Northrop Grumman Litef LCR-300, on which the LCR-350 is based, is an evolution from Fiber Optic Gyro (FOG) based systems. It offers MEMS gyro and accelerometer technology. The unit can operate in directional gyro mode, can deliver IRS/GNSS blended hybrid navigation data, and has an optional RVSM air data computer.

FOR MORE INFORMATION visit **Northrop Grumman Litef GmbH** online at *www.northropgrumman.litef.com*, and **Airbus Helicopters** at *www.airbushelicopters.com*.

AIRBORNE COMPUTERS

Curtiss-Wright to provide embedded computing for Army UH-60V

Helicopter avionics experts at Northrop Grumman needed rugged commercial off-the-shelf (COTS) embedded computing components for glass cockpits in Army UH-60 utility helicopters. They found their solution from Curtiss-Wright Defense Solutions in Ashburn, Va. Curtiss-Wright won a contract from the Northrop Grumman Electronic Systems segment in Woodland Hills, Calif., to provide rugged COTS single-board computers, network switches, and graphics display modules for the Army's UH-60V program.



The program seeks to change out the analog cockpit gauges in between 700 and 900 UH-60L Black Hawk helicopters to digital instruments. The program seeks to replicate the same pilot vehicle interface that pilots would experience in the modern UH-60M helicopter conversion. The upgrade replaces the UH-60L cockpit with a scalable, integrated mission equipment package. Curtiss-Wright will provide Northrop Grumman with its DMV-186 computer board, SMS-652 network switch, and XMC-715 graphics and video display products. Shipments are scheduled to begin in 2014.

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

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CONNECTORS

TE Connectivity debuts 10-gigabyte-per-second connectors for aerospace and defense

TE Connectivity in Harrisburg, Pa., is introducing the CeeLok FAS-X connector that meets aerospace and military industry demand for 10-gigabyte-per-second requirements and other high-speed protocols such as IEEE 1394b I/O, Fibre Channel networks, and Modular D38999 for harsh-environment applications. The CeeLok FAS-X connector combines rugged reliability with signal integrity and offers fast field termination and repair, requiring only standard contact insertion/removal and crimping tools. Designed for optimal signal integrity, the patented shielding arrangement virtually eliminates crosstalk and isolates each pair through the connector to provide improved impedance matching, TE officials say. CeeLok FAS-X connectors have an operating range of minus 60 Celsius to 200 Celsius, and are moisture and corrosion resistant for airborne and naval operations. They also are available in a size 25 shell with a variety of standard D38999 modules.

FOR MORE INFORMATION visit **TE Connectivity** online at *www.te.com*.

POWER SUPPLIES

Crane Aerospace & Electronics introduces power electronics products

Crane Aerospace & Electronics in Redmond, Wash., is unveiling four Interpoint power electronics products for aircraft and space platforms: MFK Series 25-watt, MTR 50 Series 30-watt, MFX Series 50-watt, and MWR Series 35-watt DC-DC converters. The new solutions offer conversion from 16 volts to 50 volts to 1, 2, or 3 outputs from 1.8 volts to 28 volts. All have magnetic feedback, an inhibit function, and are packaged in hermetically sealed cases.

FOR MORE INFORMATION visit **Crane Interpoint** online at *www.interpoint.com*.

COMMUNICATIONS SOFTWARE

AIM-USA offers interface software

AIM-USA in Trevose, Pa., is introducing the PBA.pro Engine option for the AIM Ethernet based ANET avionics databus interface family to offer software functionality at the interface level. AIM's avionics databus interface line includes MIL-STD-1553, ARINC 429, and STANAG 3910/EFEX. The ANET embedded Linux operating system runs the PBA.pro application without a graphical user interface, enabling PBA.pro projects, simulation setups, databases for payload decoding, and scripts to execute onboard the ANET interface. Users can control the PBA.pro Engine over an Ethernet TCP/IP connection without using native driver software.

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

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