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U.S. Navy eyes unmanned vehicles, sensors, and digital signal processing alongside traditional surface ships and subs. PAGE 16

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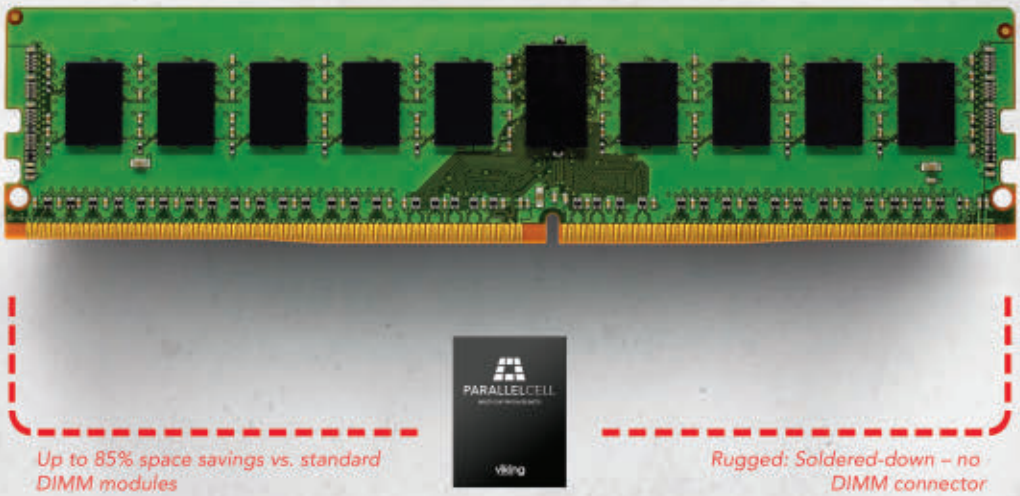

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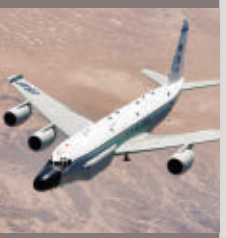

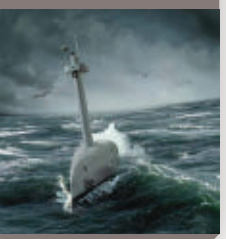

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BY **JOHN KELLER**, EDITOR IN CHIEF

House cleaning at the Pentagon: out with the old and in with the new

The 2021 U.S. Department of Defense (DOD) budget proposal is out, and it looks like several years of consistent growth driven by the Trump Administration may be leveling off. A closer look, however, may indicate a pivot to leading-edge new technologies and away from legacy systems.

DOD leaders in their fiscal 2021 budget request to Congress, which was released last month, are asking for $705.4 billion, which is down about 1 percent from this year's level of $712.6 billion. Before you conclude that the Pentagon budget has turned flat, however, take a look at where the money's going.

First, the bad news: procurement. This is where big-ticket items like aircraft, combat vehicles, and ships get funding. The DOD's procurement budget request for 2021 is $136.9 billion, down nearly 7 percent from this year's level of $147.1 billion.

Contained in the procurement budget, moreover, are aggressive cuts to legacy weapons systems. The U.S. Air Force, for example, will retire 24 RQ-4 Block 20 and Block 30 Global Hawk Battlefield Airborne Communications Node (BACN) unmanned aerial vehicles (UAVs) and Block 30 multi-intelligence aircraft UAVs next year.

The U.S. Navy, meanwhile, will retire four Ticonderoga-class missile cruisers. The U.S. Army plans to eliminate 13 programs involving munitions, fires, protection, sustainment, mobility, mission command, and cyber programs that no longer are priorities. Additional cuts are expected.

Next year the Navy plans no additional purchases of P-8A Poseidon maritime patrol aircraft; the MQ-4 Triton long-range maritime patrol UAV; or the MQ-25 Stingray UAV.

The counterweight to these procurement cuts, however, is in the DOD's budget for research, development, test, and evaluation (RDT&E). As procurement spending is going down, the research budget is headed in the other direction. The Pentagon is asking for $106.6 billion, which is up about 1 percent from this year's research budget of $106.6 billion. Revealing is where money is going.

The DOD next year plans to spend $9.8 billion for cyber security and cyber warfare — up 81 percent from $5.4 billion this year; $3.2 billion for hypersonics; $1.5 billion for military microelectronics and 5G networking; and $800 million for artificial intelligence (AI) research.

The Pentagon hypersonics budget will pay for research and development initiatives to develop the Army Long-Range Hypersonic Weapon; Navy Conventional Prompt Strike (CPS); and Air Force Advanced Rapid Response Weapon (ARRW).

Research money also would include $1.1 billion for the Navy's next-generation frigate; $4.4 billion for the future Columbia-class ballistic missile submarine; and $464 million for two Large Unmanned Surface Vessels.

The U.S. Defense Advanced Research Projects Agency (DARPA) is asking for $3.6 billion in 2021, a 3 percent increase from the $3.5 billion the agency received this year. DARPA has asked for $322.7 million for electronics research in 2021 — a 1.7 increase from the 317.2 million the agency received this year. For sensors research, DARPA is asking for $200.2 million in 2021 — a 26 percent increase over the $158.9 million the agency received this year.

So, in short, it sounds like out with the old, and in with the new at the Pentagon. Four Navy cruisers that are at least 30 years ago are heading for retirement. Large, slow, and vulnerable Global Hawk UAVs are to be taken out of service, and Army programs are no longer relevant amid today's global threats will be taken off the board.

At the same time, enabling technologies considered crucial for today's military needs are on the upswing: hypersonic munitions and aircraft, cyber security and cyber warfare, 5G networking, and artificial intelligence.

Perhaps the DOD has been due for a house cleaning like this for a while. Getting rid of obsolescent weapons systems makes sense because they're past the point of diminishing returns. Pumping more money into technologies for tomorrow's battlefield makes sense, too. These kinds of realignments are painful, yet essential.

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The U.S. Air Force will retire 24 RQ-4 Block 20 and Block 30 Global Hawk long-range surveillance unmanned aircraft next year, according to budget documents.

2021 DOD budget would cut procurement, boost research, retire 24 Global Hawk UAVs and four Navy cruisers

BY **John Keller**

WASHINGTON — The U.S. Department of Defense (DOD) in 2021 plans to reduce procurement, increase research and development, and retire ageing manned aircraft, unmanned aerial vehicles (UAVs), and surface warships.

DOD leaders in their fiscal 2021 budget request to Congress, which was released last month, are asking for $705.4 billion, which is down about 1 percent from this year's level of $712.6 billion.

The DOD's procurement budget request for 2021 is $136.9 billion, down nearly 7 percent from this year's level of $147.1 billion. The Pentagon's procurement budget is where many of the big-ticket military programs are, and accounts for new ships, planes, combat vehicles, and the like.

The DOD's 2021 budget request for research, development, test, and evaluation is $106.6 billion, which is up about 1 percent from this year's research budget of $106.6 billion. Military research develops new enabling technologies for the weapons systems of tomorrow.

One big issue in the 2021 DOD budget is the planned aggressive retirement of relatively old military aircraft, surface warships, and land systems that do no align with the so-called 2018 National Defense Strategy, which seeks to revitalize U.S. military capability against near-peer foes like China and Russia.

Instead, military leaders will use the money they save from retiring these systems to help pay for new weapons and enabling technologies. All of these so-called divestitures should save the DOD about $1 billion, officials say.

The U.S. Air Force will retire 24 RQ-4 Block 20 and Block 30 Global Hawk Battlefield Airborne Communications Node (BACN) unmanned aerial vehicles (UAVs) and Block 30 multi-intelligence

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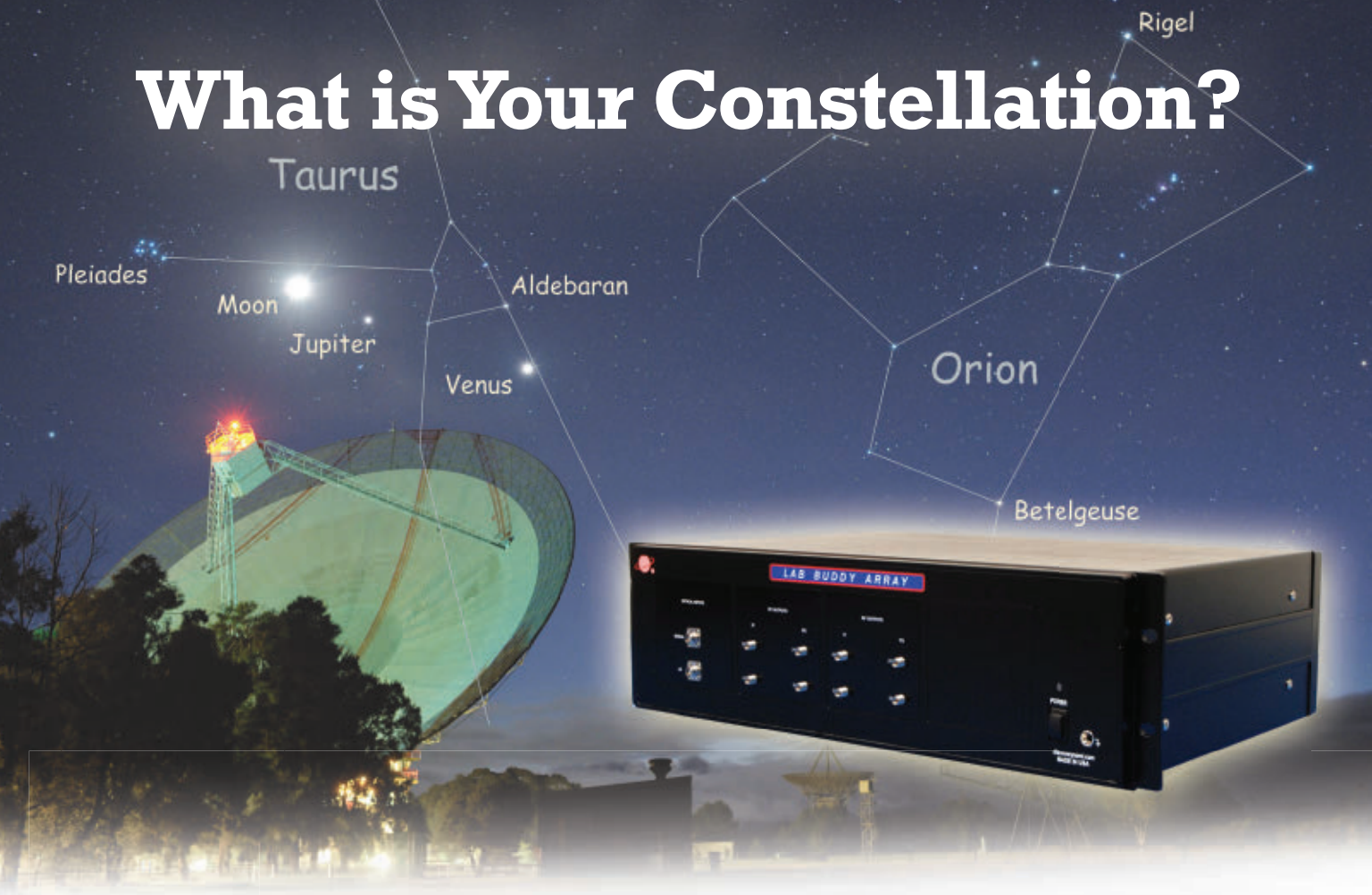

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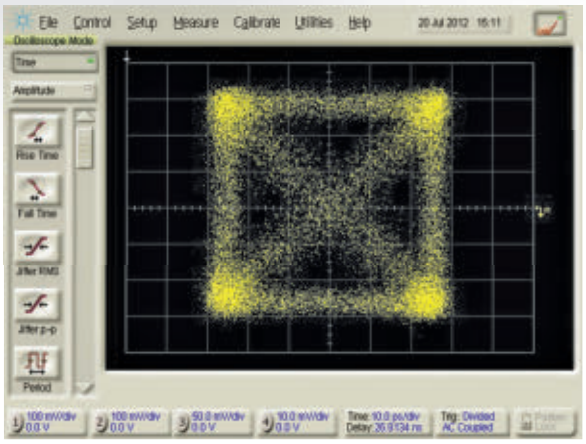

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aircraft UAVs next year. Instead, officials will rely on the Air Force fleet of manned E-11s — militarized versions of the Bombardier BD-700 Global Express business jet — for the BACN role.

The U.S. Navy, meanwhile, will retire four Ticonderoga-class missile cruisers next year — the USS Monterey (CG 61), USS Shiloh (CG-67, USS Vella Gulf (CG 72), and USS Port Royal (CG 73). These ships, DOD officials say, are the Navy's least capable missile-defense ships, and will be decommissioned.

U.S. Army leaders plan to eliminate 13 programs involving munitions, fires, protection, sustainment, mobility, mission command, and cyber programs that no longer are priorities.

For high-priority programs, the DOD next year plans to spend $18 billion for space initiatives, including $15.4 billion for operations, procurement, and research for the new U.S. Space Force; $9.8 billion for cyber security and cyber warfare — up 81 percent from $5.4 billion this year; $4.2 billion for nuclear command, control, and communications research; $3.2 billion for hypersonics; $1.5 billion for military microelectronics and 5G networking; and $800 million for artificial intelligence (AI) research.

The Pentagon hypersonics budget will pay for research and development initiatives to develop the Army Long-Range Hypersonic Weapon; Navy Conventional Prompt Strike (CPS); and Air Force Advanced Rapid Response Weapon (ARRW).

For weapons and military systems, the Pentagon plans next year to spend

- $3 billion to buy 15 KC-46 aerial tankers;
- $1.2 billion for 52 AH-64E Guardian attack helicopters;
- $876 million for 639 advanced medium-range air-to-air missiles (AMRAAM);
- $577 million for 400 Joint Air Surface Standoff Missiles - Extended Range (JASSM-ER);
- $4.7 billion for one Virginia-class fast-attack submarine;
- $3.5 billion for two Arleigh Burke-class destroyers;
- $1.1 billion for the Navy's next-generation frigate;
- $4.4 billion for the future Columbia-class ballistic missile submarine;
- $464 million for two Large Unmanned Surface Vessels;
- $224 million for 53 long-range anti-ship missiles (LRASM);
- $603 million for 203 Tactical Tomahawk missiles —including some with maritime strike capability;
- $6.9 billion for armored combat vehicles — including 4,247 joint light tactical vehicles (JLTVs), and 72 Amphibious combat vehicles;
- $1.5 billion for the Ground Based Strategic Deterrent next-generation nuclear ballistic missile;
- $2.8 billion for the future B-21 bomber;
- $474 million for the future Long-Range Stand-Off Weapon air-launched nuclear cruise missile;
- $11.4 billion for 79 F-35 joint strike fighters;
- $1.6 million for 12 F-15EX jet fighters;
- $2.1 billion for 24 F/A-18E/F Super Hornet jet fighter-bombers;
- $1.5 billion for seven CH-53K King Stallion heavy-lift helicopters; and
- $1.1 billion for four E-2D Advanced Hawkeye radar surveillance aircraft.

Next year the Navy plans no purchases of additional P-8A Poseidon maritime patrol aircraft; MQ-4 Triton long-range maritime patrol UAV; or the MQ-25 Stingray UAV.

Military launches Gremlins drone for first time; valuable data gathered before crash

The U.S. Department of Defense (DOD) is one step closer to building swarming drones that it can launch from military planes and recover in mid-air, after conducting the first flight of the Gremlins aircraft in November. The test at Dugway Proving Ground, Utah, proved that a C-130A utility turboprop aircraft could launch an X-61A Gremlins drone, said Tim Keeter, who manages the program for Dynetics. The company won the Gremlins contract from the U.S. Defense Advanced Research Projects Agency (DARPA) in 2018. The X-61A Gremlins drone flew with no anomalies during its test flight, and validates the Gremlins' data links and the ability to hand off control of the drone between air and ground control stations. The recovery process was a different story however, as the drone was destroyed in a crash to the ground, when its main parachute did not deploy correctly due to a mechanical issue.

Army asks Lockheed Martin to build Patriot PAC-3 missiles for 12 U.S. allies

Air- and missile-defense experts at Lockheed Martin Corp. will provide MIM-104 Patriot Advanced Capability-3 (PAC-3) missiles to 12 U.S. allied countries under terms of a $77.1 million foreign military sales contract. Officials of the U.S. Army Contracting Com-

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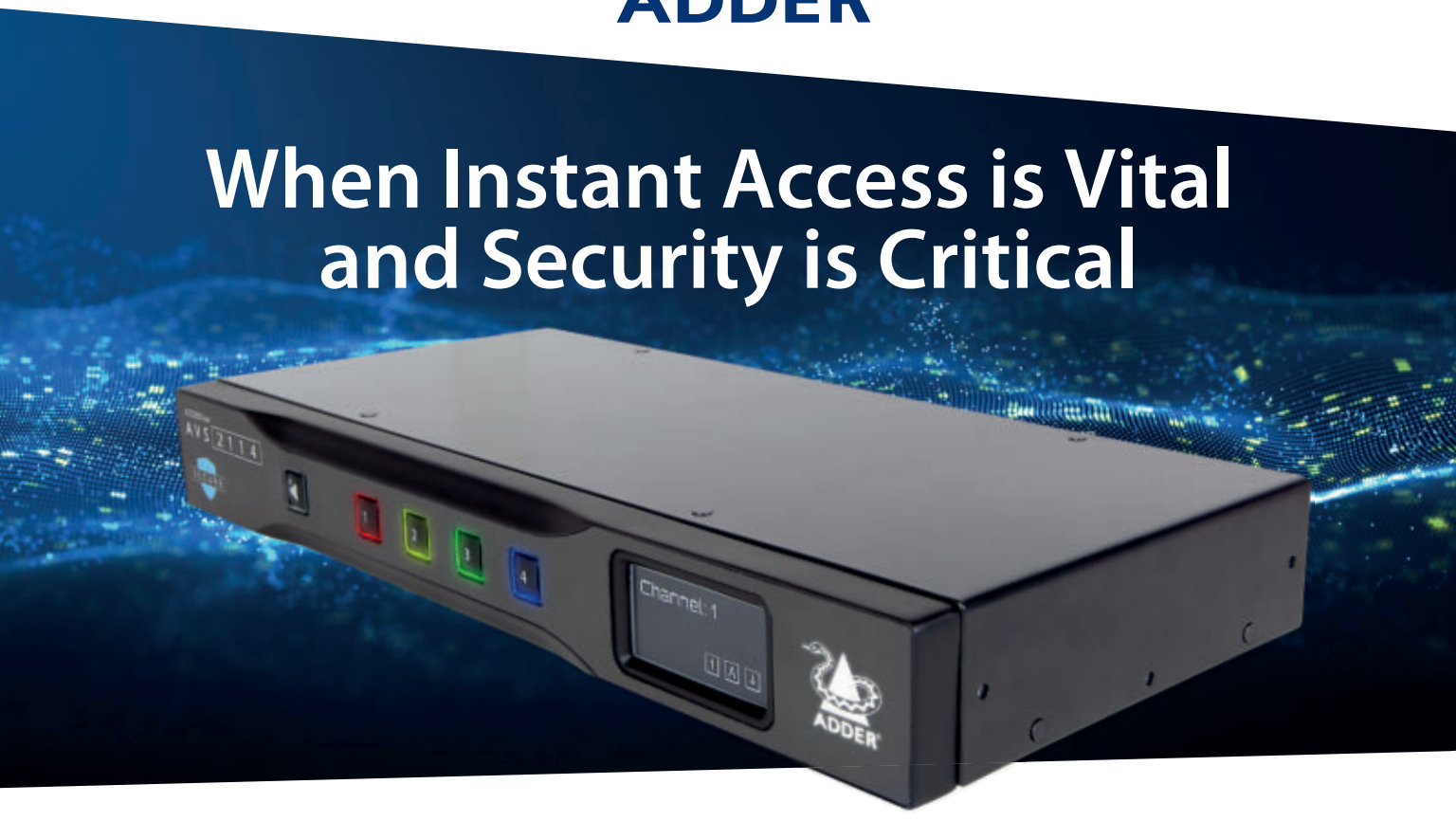

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Air Force to recompete 3DELRR air-defense radar project

BY **John Keller**

HANSCOM AIR FORCE BASE, Mass. — U.S. Air Force tactical radar experts are moving forward with a quick-turnaround plan to recompete an air-defense radar system intended to detect, identify and track enemy missiles as well as manned and unmanned aircraft.

Officials of the Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., issued a draft solicitation in February (3DELRR_02) for the Three-Dimensional Expeditionary Long-Range Radar (3DELRR) project, won in 2014 by Raytheon Co.

Even before its award to Raytheon, the 3DELRR program was in hot contention among three of the nation's most prominent radar houses: Raytheon, Northrop Grumman Corp., and Lockheed Martin Corp.

The 3DELRR radar is to replace the Air Force's Northrop Grumman AN/TPS-75 transportable 3-D passive electronically scanned array air search radar for enabling U.S. and allied invasion forces to protect themselves from airborne threats after establishing beachheads.

Raytheon won a potential $71.8 million contract in October 2014 to begin 3DELRR engineering and manufacturing development (EMD). A 2017 $52.7 million contract to the Raytheon Integrated Defense Systems segment in Woburn, Mass., confirmed Raytheon as the 3DELRR prime contractor, and resolved the protests from Raytheon and Lockheed Martin.

The Air Force will recompete the 3DELRR air-defense radar system to detect, identify and track enemy missiles as well as manned and unmanned aircraft.

Now the Air Force wants to recompete the 3DELRR project because of numerous technical and supplier challenges. Friday's so-called "SpeedDealer" solicitation gives the radar industry another chance to demonstrate a production-ready radar system that can meet or exceed the original 3DELRR requirements.

The Air Force may award as many as three contracts for companies to provide prototype 3DELRR systems. The company with the most promising prototype may receive a contract for as many as 35 3DELRR systems.

Raytheon had proposed a C-band gallium nitride (GaN)-based radar for the original 3DELRR competition. GaN technology helps increase the radar's range, sensitivity, and search capabilities, while operating in C-band offers

mand at Redstone Arsenal, Ala., are asking the Lockheed Martin Missiles and Fire Control segment in Dallas to provide PAC-3 missiles for the governments of Bahrain, Kuwait, Qatar, Saudi Arabia, United Arab Emirates, Japan, South Korea, Germany, The Netherlands, Poland, Romania, and Sweden. Patriot PAC-3 is a hit-to-kill missile designed to defeat tactical ballistic missiles, cruise missiles, and aircraft. It is a high- to medium-altitude long-range air defense missile that defends ground combat forces and high-value military equipment. The PAC-3 missile is a high velocity interceptor that defeats incoming targets by body-to-body direct impact. PAC-3 missiles, when deployed in a Patriot battery, provide 16 PAC-3s on a Patriot launcher. Lockheed Martin also handles the PAC-3 missile segment upgrade, which consists of the PAC-3 missile, PAC-3 missile canisters in four packs, a fire solution computer, and an Enhanced Launcher Electronics System.

U.S. military faces challenges of encryption of mobile computers

Early this year, a brigade of U.S. soldiers deployed to the Middle East received instructions from their superiors to use two commercial encrypted messaging applications, Signal and Wickr, on their military-issued cell phones. These leadership cues trickled down from the Department of Defense's (DoD) position that strong encryption is critical to national security. While U.S.

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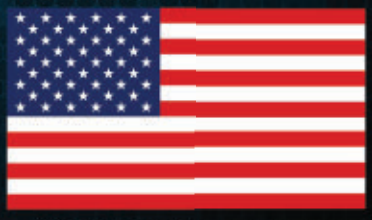

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increased flexibility because that portion of the spectrum is relatively uncongested, Raytheon officials say.

3DELRR is to be the principal Air Force long-range, ground-based sensor for detecting, identifying, tracking, and reporting aerial targets for the Joint Force Air Component Commander through the Theater Air Control System, Air Force officials say.

The 3DELRR system is designed to deal with regional and near-peer conflicts of the future that could involve large numbers of enemy advanced unmanned aerial vehicles (UAVs), fixed-wing aircraft, helicopters, and ballistic and cruise missiles, Raytheon officials say.

3DELRR is designed to detect, identify and track a wide variety of objects accurately at great distances, Raytheon officials say. C-band, moreover, is a relatively uncongested portion of the electromagnetic spectrum. The radar is interoperable with coalition systems and meet the requirements of many foreign militaries, company officials say.

The 3DELRR system is similar to the Ground/Air Task-Oriented Radar (G/ATOR) that Northrop Grumman is building the for U.S. Marine Corps. G/ATOR is being developed to protect Marine Corps expeditionary forces from rockets, artillery, mortars, cruise missiles, UAVs, and other low observables. It is a deployable short-to-medium-range multi-role radar system. 3DELRR, on the other hand, is designed to detect and track threats at longer ranges.

Like 3DELRR, the G/ATOR is based on GaN technology, yet the G/ATOR system is designed to handle air surveillance, weapon cueing, counter-fire target acquisition, and air traffic control for Marine Corps warfighters operating in invasion beaches.

The 3DELRR will provide the Air Force control and reporting center with real-time data to display air activity, and will provide warning and target information.

The system also will provide operators with a precise, real-time air picture to provide air traffic control services to individual aircraft across a wide range of environmental and operational conditions.

The Air Force asked for industry comments on the 3DELRR draft solicitation by email by 25 Feb. 2020 to the Air Force's Kevin Kelleher and Robert Hylton at AFLCMC.3DELRR.org@us.af.mil. More information is online at https://beta.sam.gov/opp/49d0291bfb6d4e3a9cb6e43cfc063e85/view.

IARPA asks for image processing technology and sensor fusion for space remote sensing

BY **John Keller**

WASHINGTON — U.S. intelligence experts approaching industry for an image-processing project to blend data from satellite- and aircraft-based multispectral imaging sensors and visible-light sensors to detect activities like heavy building projects and highway construction.

Officials of the U.S. Intelligence Advanced Projects Agency (IARPA) in Washington issued a broad agency announcement last month (IARPA-BAA-19-04) for the Space-based Machine Automated Recognition Technique (SMART) project.

SMART seeks to use sensor fusion to enable automated broad-area search, monitoring, and characterization of the progression of natural or man-made activities using time-series spectral imagery from several different satellite- or aircraft-based electro-optical sensors.

Examples include heavy construction, real estate or urban development, crop disease propagation, forest fire, flooding and mudslides, insect or battle damage, human migration, mining, logging, farming, earthquakes.

The IARPA SMART project will use sensor fusion for automated broad-area search, monitoring, and characterization of the progression of natural or man-made activities.

SMART applications potentially could include geospatial intelligence, disaster recovery, humanitarian aid, and automated assessment of land-use trending.

Today there is no single remote-sensing system with spatial, spectral, and temporal resolution necessary to detect changes over time, IARPA officials point out. SMART aims to use several images from different sensors to provide for persistent monitoring.

The program will focus on two pri-

mary technical areas: data fusion; and algorithms to detect and characterize events. Offerors may address one or both of these areas in their proposals.

Data fusion seeks to quantify data quality and cross-sensor inconsistencies in time-series satellite images and develop automated data calibration techniques by blending geometric and radiometric correction, cloud masking, pixel quality, gridding, and collection management.

Algorithms to detect and characterize events or activities over areas larger than 8,000 square meters using space-based time-series imagery. IARPA would like proposers to identify standards like software libraries, data type definitions, architecture guidelines, and software processes that are easy to follow and efficient to carry out.

SMART essentially will rely on geographical information from satellite and aircraft cameras, and develop multi—spectral and multi—temporal sensor processing to overlay data from infrared and multispectral sensors to make the intelligence analyst's job easier.

The program will focus on two primary technical areas: data fusion; and algorithms to detect and characterize events. Offerors may address one or both technical areas in their proposals. SMART will be a four-year project that will extend from August 2020 to July 2024.

Data fusion seeks to quantify data quality and cross-sensor inconsistencies in time-series satellite images and develop automated data calibration techniques by blending geometric and radiometric correction, cloud masking, pixel quality, gridding, and collection management. Algorithms seeks to detect and characterize events or activities over areas larger than 8,000 square meters using space-based time-series imagery.

IARPA officials say they expect to create an infrastructure that will enable analysts to access, calibrate, and process data streams from several satellites simultaneously for time-series analysis.

Companies interested were asked to upload proposals no later than 7 April 2020 to the IARPA Distribution and Evaluation System (IDEAS) Website at https://iarpa-ideas.gov.

Email questions or concerns to IARPA at dni-IARPA-BAA-19-04@iarpa.gov. More information is online at https://beta.sam.gov/opp/65774ed561254fd58d18a48a50bf3170/view.

L3Harris to provide SIRFC EW systems for Special Operations aircraft

BY **John Keller**

MacDILL AIR FORCE BASE, Fla. — Airborne electronic warfare (EW) experts at L3Harris Technologies Inc. will provide AN/ALQ-211 Suite Of Integrated Radio Frequency Countermeasures (SIRFC) equipment for U.S. Special Operations Command aircraft under terms of a $48.7 million order.

Officials of the U.S. Special Operations Command at MacDill Air Force Base, Fla., are asking the L3Harris segment in Clifton, N.J., to provide SIRFC components and services for Special Operations Command.

The ALQ-211, a family of electronic self-protection systems, includes the SIRFC, which protects U.S. Special Forces helicopter and tiltrotor aircraft from sophisticated enemy radio frequency (RF) threats. Tiltrotor aircraft take off and land like helicopters, and fly like fixed-wing turboprop aircraft.

The ALQ-211 detects, denies, disrupts, degrades, and evades lethal threats and provides situational awareness for enemy threats involved with RF, infrared, and laser weapons and sensors.

When the aircrew encounters a threat emission, the ALQ-211 determines how far away it is from the mission aircraft. If the aircraft is in lethal range of a radar-, infrared-, or laser-guided missile, the ALQ-211 can break missile lock through RF and electro-optical countermeasures by cueing chaff and flares.

The SIRFC electronic warfare system helps protect special operations aircraft like the CV-22 Osprey, shown above, from radar-guided anti-aircraft missiles.

As the aircraft's survivability suite controller, the ALQ-211 coordinates the response for laser and infrared threats. The system is integrated into the CV-22 Osprey Special Operations aircraft. It also is fitted to the Norwegian NH 90 multi-mission helicopter, as well as F-16 fighters for Chile, Poland, Pakistan, Turkey, and Oman.

The ALQ-211 works in densely populated hostile environments with mobile air defenses in all weather conditions, during the day, and at night. It is effective against threats hiding in terrain, and that employ adaptive tactics, L3Harris officials say.

Monday's order increases the maximum of Special Operations Command's original ALQ-211 order from $190 million to $290 million. L3Harris will do the work in Clifton, N.J., and should be finished by July 2019.

For more information contact L3Harris Electronic Systems online at www.l3harris.com, or U.S. Special Operations Command at www.socom.mil.

Researchers seek to encapsulate human experience into computational models

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry for ways to encapsulate local and collective human experience into computational models to give intelligence analysts and military commanders an "insider" view to enhance decision-making.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a solicitation on in February (HR001120S0035) for the Habitus project to create

self-sustaining, adaptive, generalizable, and scalable ways to generate causal system models based on local knowledge to aid operational decision-making.

Understanding how to work with and influence local systems to support military operations is critical for decision-making, and is most challenging in undergoverned regions in which the systems themselves often change rapidly and are inaccessible to the U.S. military, DARPA researchers explain.

Humans develop cognitive models of systems of which they are a part, which include local customs, relations, and understanding. Unfortunately, these cognitive models often are largely inaccessible to outsiders.

This leads to problems like the failure to recognize how local burial practices may have influenced the spread of the Ebola virus in West Africa, and led to substantial errors in predicting of the disease's spread in 2014.

U.S. early information operations in Iraq, moreover was ineffective because Iraqis distrusted radio and television broadcasts after years of Ba'athist propaganda. Efforts to secure a small town from ISIS created local turmoil when U.S. forces set up a perimeter that excluded the local glass factory and disrupted locals' ability to get to work.

The primary challenge of the Habitus program focuses on creating of localized and collective human experience to give intelligence analysts and military commanders an "insider" view to enhance decision-making.

Big data methods often lack the ability to interpret data through a local lens. Exceptions tuned to one city often do not translate to other areas or populations. Instead, Habitus seeks a capability that is adaptive, scalable, self-sustaining, and detailed.

Projections must update to maintain accuracy, for example. Methodologies must be able to transfer to new regions, populations, and topics. This capability also must require few resources to maintain over time.

Habitus will capitalize on engagement with locals to build of collective local political, economic, and social experience to help decision makers understand not only what factors are important but also why and how these systems work from an insider's view. In this way, military experts might be

The DARPA Habitus project could make it easier for intelligence analysts and military commanders who must operate in remote regions like Afghanistan.

able to anticipate changes as events unfold, and help the military achieve its local goals.

The Habitus program will find ways to capture local knowledge, and make it available to intelligence analysts and military commanders. The program has two technical areas: model development, and engagement.

The program also will have three phases and last for 42 months. The first phase will build initial capabilities; the second phase will demonstrate scalability for in new regions; and the third phase perform an expended demonstration in a DARPA-specified region.

Companies interested were asked to upload abstracts by 28 Feb. 2020, and full proposals no later than 23 April 2020 to the DARPA BAA Website at https://baa.darpa.mil/.

Email questions or concerns to Bart Russell, the DARPA Habitus program manager, at Habitus@darpa.mil. More information is online at https://beta.sam.gov/opp/2bfdcf9c688646ec8d01e1058f491dc4/view.

Attorney General William Barr continues to push for a broad mandate for backdoors for law enforcement, those on the front lines of protecting America have notably decided on a different approach. Simply put, weakening encryption means putting our military service members at risk. In a recent letter to U.S. Rep. Ro Khanna, D-Calif., the Pentagon's Chief Information Officer Dana Deasy made clear that the use of encryption to protect the mobile computers of U.S. service members and their stored data is an "imperative." Deasy makes clear that the use of commercial encryption and virtual private networks (VPNs) are key to DoD's cybersecurity strategy. Therefore, "maintaining a domestic climate for state-of-the-art security and encryption is critical to the protection of our national security."

Fire Weaver may be Israel's high-tech secret weapon to win the next big war

The infantry soldier with an M-16 entering a congested urban area won't have to call in for support and wait precious minutes for it to arrive in the future battlefield. Israeli battle management technology that links fighters on the ground with their battalion commanders will give a full picture to all the boots on the ground, the UAV assets, and shooters in the vicinity to find the best angle to take out adversaries who hide among civilians. It will also protect against friendly fire because all the soldiers are on the same network and can see each other through the new technology. Called Fire Weaver by its developers at Rafael Advanced Defense Systems, the Israeli Ministry of Defense is now betting big on its technology as Israel's army seeks to digitize the modern warrior on the frontline.

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SHIPBOARD ELECTRONICS

STEAMS INTO THE 21ST CENTURY

U.S. Navy is on track for increases in surface ship and submarine building, unmanned vehicles development, shipboard weapons, sensors, and digital signal processing.

BY **Edward J. Walsh**

The U.S. Navy surface warship fleet in 2019 achieved important strides in shipbuilding and fielding new weapons. In late June, the Naval Sea Systems Command's (NAVSEA) Electric Ships program office released a Naval Power and Energy Systems Technology Development Roadmap, or NPES-TDR — a path to new enabling technologies for exotic new shipboard weapons and sensors.

In releasing the TDR, NAVSEA Commander Vice Adm. Thomas Moore said, "Ensuring maritime superiority requires a ready and capable fleet, and fundamental to fleet capability is the electric power behind the fleet. This roadmap aligns electric power and energy system development with increasing warfighter power needs."

Photo (above): The Navy plans to upgrade all Arleigh Burke-class (DDG-51) destroyers, shown above, with new Aegis combat system, with Flight IIA ships getting a variant of the SPY-6(v) air and missile defense radar.

Shipbuilding

The Navy continues to peg the 12-vessel Columbia-class ballistic missile submarines (SSBN-826) as its top priority. The Navy plans to fund the first ship next year.

For 2020 the Navy asked to build 12 new ships: one Ford-class aircraft carrier; three Virginia-class attack submarines, three Arleigh Burke-class destroyers, an FFG(X) new frigate, two Lewis-class fleet replenishment oilers, and two salvage and rescue ships.

The five-year shipbuilding plan for 2020 through 2024 calls for 55 new ships, or 11 per year. The Congressional Research Service (CRS) reports that the 30-year shipbuilding plan, if carried out, would build 304 ships, achieving in 2034 the Navy's 355-ship goal set by a 2016 force structure assessment (FSA). This would happen partly by extending the services lives of Burke-class destroyers to 45 years.

Congressional researchers note that a new "integrated" shipbuilding assessment that will reflect closer integration of Navy and Marine Corps requirements dramatically may change the mix of ships in the fleet. Shipbuilding plans will include fewer and larger ships, like cruisers and destroyers, and add smaller ones like the littoral combat ship (LCS) and FFG(X) and more unmanned vehicles.

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The Navy is working on requirements for a large unmanned surface ship (LUSV) that could be fitted with the sensors and weapons now on manned ships, including a vertical launch missile system.

In the name of cost-cutting the new shipbuilding assessment also reduces the requirement for amphibious ships from 38 to 32 with concurrence of Marine Commandant General David Berger, a step that has angered some Marines.

Both CRS and the Congressional Budget Office expressed skepticism that the Navy would get the money needed. Navy leaders acknowledge they're in a hard place.

In a January speech, Chief of Naval Operations Adm. Michael Gilday said bluntly that "we need more money. More topline. We'll get to 355, plus 10, if we get the dough."

Yet he added that he's "committed to increasing fleet lethality. That comes at a high price, that could be a reduction in growth. We have to sustain the Navy we have today."

Acting Navy Secretary Thomas Modly in an interview in January said that 355 ships is a 30 percent increase over the 275-ship fleet at the time of President Trump's inauguration. "But we're not going to get a 30 percent larger budget."

Littoral combat ship

Shipbuilders Fincantieri Marinette Marine and Austal USA continued to build littoral combat ships. Fincantieri is teamed with Lockheed Martin for the Freedom LCS variant (odd hull numbers). Austal, teamed with General Dynamics, builds the even-hull-numbered Independence variant to a trimaran design. Freedom ships are 388 feet long and displace 3,450 tons fully loaded. The Independence variants are 421 feet long and displace 3,200 tons.

In October the Navy commissioned the USS Indianapolis (LCS-17), the ninth Freedom variant. In December the USS St. Louis (LCS-19) finished an acceptance trial, anticipating delivery this spring. Seven Freedom-class ships are under construction at Fincantieri's Marinette, Wis., shipyard.

Austal's Mobile, Ala., yard is building four Independence-class ships. Kansas City (LCS-22) completed acceptance trials in October.

The shipyards delivered three LCSs to the Navy in 2019, and five more will be delivered this year. At year end 2019 the Navy had bought 35 LCSs, and 19 have been delivered.

The companies also expect to market LCS designs internationally. In late October the Navy and Fincantieri held a "cut steel" event marking the start of construction of the first of four multi-mission surface combatants, based on the Freedom-class design, for Saudi Arabia.

Responding to criticism that the LCSs are too lightly armed, the Navy established the FFG(X future frigate program, intended as a more lethal open-ocean type of warship. The Navy wants to build 20 new frigates, with a contract to build the first 10 sometime this summer, and a second contract in 2025 for 10 more.

Four companies are developing FFG(X) designs: Fincantieri, General Dynamics Bath Iron Works/Navantia, Huntington Ingalls Industries), and Austal USA.

The ships will be armed with the Mk 41 vertical launch system (VLS) capable of launching the evolved Seasparrow (ESSM) and SM-2 block 3C air-defense missiles. They also will get the SQQ-89(v) sonar and SQS-62 variable depth sonar for anti-submarine warfare (ASW) and the enterprise air-surveillance radar or EASR, a smaller version of Raytheon's SPY-6(v)1 air and missile defense radar (AMDR).

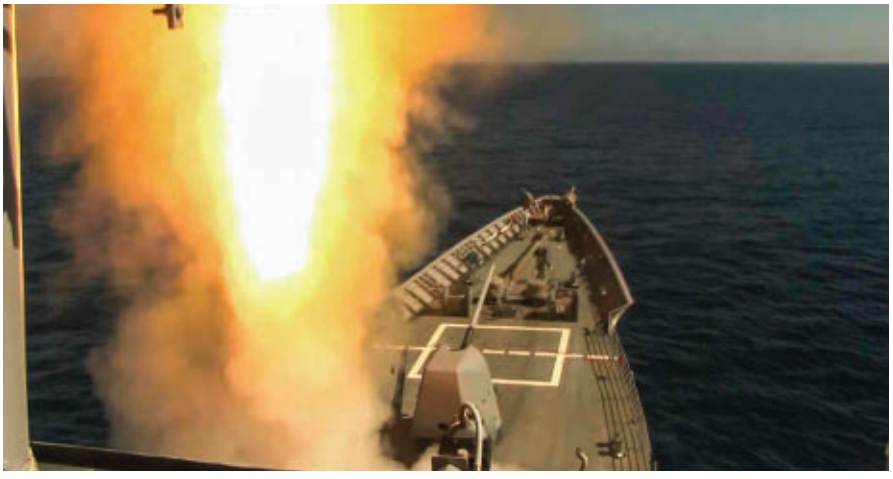
Burke-class destroyers

The bedrock Navy shipbuilding program remains the completion of Flight IIA of Burke destroyers and the start of the much-publicized Flight III, with its transformational advances for combat and ship-management architectures. A total of 13 Flight III ships are under contract through 2022, six at Huntington Ingalls and five with one option at Bath. In November the Navy and Huntington authenticated the keel of the first Flight III ship, Jack H. Lucas (DDG 125).

The centerpiece of Flight III is the SPY-6(v)1, a high-powered electronically scanning air-search radar managed by Baseline 10 of the Aegis combat system for integrated air-missile defense, ballistic missile defense (BMD), surface warfare (SUW), and ASW. The system succeeds Lockheed Martin's SPY-1(v), fielded in several versions on all the Burkes and the Ticonderoga (CG-47)-class cruisers.

Huntington also is building Flight IIA ships Delbert D. Black (DDG 119), Frank E. Petersen Jr. (DDG 121), and Lenah H. Sutcliffe Higbee (DDG 123). In August, Paul Ignatius (DDG 117), an Huntington Ingalls ship, was commissioned at Port Everglades, Fla.

The first Flight III ship built at Bath will be Louis H. Wilson (DDG 126). Bath is building Flight IIA ships Daniel Inouye (DDG 118), Carl M. Levin (DDG 120), John Basilone (DDG 122), Harvey C. Barnum (DDG 124), and Pat-



Selected Ticonderoga-class (CG-47) guided missile cruisers will get full-up ballistic missile defense capability in their modernization programs.

rick Gallagher (DDG 127). Bath christened the third and final Zumwalt-class (DDG 1000) destroyer, Lyndon B. Johnson (DDG 1002) in April. Zumwalt and Michael Monsoor (DDG 1001) already are in fleet testing.

Huntington also is building the 12th and 13th San Antonio-class (LPD-17) amphibious assault ships Fort Lauderdale and Richard M. McCool Jr. (LPDs-28 and -29). McCool will be the last ship of the Flight 1 San Antonio design. The ships carry 720 Marines and amphibious assault craft or landing craft air-cushion for amphibious operations. San Antonio Flight II will start with LPD-30 to replace the LSD-41 and -49 amphib classes.

Amphibious assault ships

Huntington Ingalls also is building Bougainville (LHA-8) the third ship of the America (LHA-6) class. Tripoli (LHA-7) completed builder's trials last summer. The 45,000-ton America-class ships are built with a large hangar deck, aviation support facility, and increased aviation fuel storage. Bougainville will be the first Flight I ship of the class, adding expeditionary warfare capability.

America-class (LHA-6) amphibious ships are powered by a new hybrid propulsion plant.

The LHAs are powered by a hybrid propulsion system that combines a gas turbine propulsion plant and auxiliary electric motors — a system introduced with Makin Island (LHD-8), the last ship of the Wasp big-deck amphib class; the first seven Wasp ships use diesels.

In another Marine Corps-oriented program, expeditionary sea base Miguel Keith (ESB-5) completed trials last fall. The ESBs will provide sustainment for ashore tactical operations, humanitarian missions, and MCM operations.

The first two ships, USNS Montford Point (ESD-1) and USNS John Glenn (ESD-2), are Military Sealift Command ships, called expeditionary transfer docks. The third ship, Lewis B. Puller (ESB-3) and following ships are commissioned Navy (USS) ships. The 784-foot-long ships are built with a 52,000-square-foot flight deck to support V-22 Osprey tiltrotor aircraft and helicopters.

General Dynamics NASSCO is under contract for design and construction of ESBs -6 and -7, with an option for ESB-8.

Submarines

In a huge move, the Navy awarded a $22.2 billion multiyear (2019-2023) contract, called Block V, to General Dynamics Electric Boat for eight Virginia-class (SSN-774) attack submarines, with an option for a ninth. Huntington Ingalls Newport News Shipbuilding acts as major subcontractor. The subs will be outfitted with the new Virginia payload module or VPM, which adds four missile tubes, each capable of launching seven Tomahawk cruise missiles, increasing the strike capacity from 12 to 40 missiles.

The Navy has fielded 18 Virginia-class boats. The first Block V sub is scheduled for delivery in 2025.

In October the Navy took delivery of Delaware (SSN-791), the eighth

and final Block III submarine. Block III boats have a redesigned bow that replaces 12 individual vertical-launch tubes with two larger diameter Virginia payload tubes, each capable of firing six Tomahawks.

Shipboard weapons

The surface fleet achieved critical technology advances for the Aegis combat system, both for the Flight IIA Burkes and Aegis Ashore sites in Romania, Poland, and Japan. In November the Navy changed the nomenclature for the Aegis radar from SPY-1(v) to SPY-7(v). The Romania and Poland sites now are operational. Japan will have two Aegis Ashore sites.

The Aegis baseline programs used by the U.S., Australian, South Korean, Norwegian, and Spanish navies and the Japanese Maritime Self-Defense Force are maintained in a common source library (CSL) owned by the Navy and maintained by Lockheed Martin. The CSL is a repository for fielded Aegis programs, including baseline 9, the newest BMD program. Ships now using older baselines could be upgraded through the CSL. The combat systems used by the LCSs and Coast Guard's National Security Cutter also use programs maintained in the CSL.

Late last year, the Navy selected Lockheed Martin as the combat systems engineering agent (CSEA) for the ship self-defense system (SDDS) aboard aircraft carriers and large-deck amphibious ships. Jim Sheridan, Lockheed Martin's vice president for naval combat and missile defense systems, says the company will deliver the first major program, called ACB 20, in July (advanced capability build—the number refers to the year of development).

The ship self-defense system combat system will integrate variants of the SPY-6(v), which in its (v)1 baseline version will go aboard the Flight III Burkes. The San Antonio-class LPDs will get (v)2. Carriers will get (v)3. SPY-6(v)4 will be backfit to the Flight IIA Burkes, and (v)5 will go aboard the new FFG(X) frigates.

In late December NAVSEA awarded Lockheed Martin a $138 million contract modification for continued systems engineering for the latest ACB for the Aegis system (called ACB 20 but distinct from the SSDS ACB). The Aegis ACB 20/Baseline 10 software will incorporate the SPY-6(v)1, the ESSM anti-air

The Navy's three Zumwalt-class (DDG-1000) will serve as long-range land and surface-attack strike platforms.

missile, and SM-6 anti-air and anti-surface missile. The SM-6 also will be able to destroy ballistic missiles in the terminal phase.

The fielding of ACB 20/Baseline 10 is the starting point in the Navy's plan to shift to a Surface Combatant Combat Systems Engineering Agent (SCCSEA) for all surface combatants, carriers, and amphibs. In mid-2019, following its win on the SSDS combat system, Lockheed Martin won a one-year $7 million award, with nine option years, to act as CSEA for the FFG(X), giving it the CSEA role for all major surface combatants. The Navy plans to award a series of contracts for the SCCSEA role.

The full Aegis modernization program, commenced in 2010, continues with delivery of ACB-12 to Flight IIA Burkes, providing Aegis Baseline 9.C1 for enhanced BMD. Eventually all Burkes up through Flight IIA will be fitted out with a multi-mission signal processor, Naval Integrated Fire Control-Counter Air or NIFC-CA, Cooperative Engagement Capability (CEC), ESSM, and other upgrades.

Aegis modernization

Aegis modernization (AMOD) extends to 11 Ticonderoga cruisers. In October Hue City (CG-66) became the seventh cruiser inducted into the modernization program of 11 ships. BAE Systems has won several of the modernization contracts. The program adds new BMD capability and hull, mechanical, and electrical systems. The Navy's 2020 budget proposes decommissioning six older cruisers by 2022.

In December Raytheon Missile Systems won a $1 million multiyear contract (2019-2023) for full-rate production of the SM-6, including all-up rounds, flight-test rounds, and spares.

Raytheon's Integrated Defense Systems is working on a $123.5 million award for 2020 production of Aegis fire-control system components for the Burke Flight III design and the Spanish navy's F-110 Aegis ships. The award includes several upgrades for AAW and BMD capabilities. Raytheon units are supporting the AMOD with continuing work on the SPY-6(v), SM-6, SM-2, ESSM, and Tomahawk, the Navy's principal long-range land-attack cruise missile.

CEC blends the sensor tracks of several ships, aircraft, and the Marine Corps' composite tracking network to produce a consolidated track picture for highly integrated fire control. CEC goes aboard Aegis ships, San Antonio- and Wasp-class amphibs, and carriers. DRS Laurel Technologies, a unit of Leonardo DRS in Johnstown, Pa., is performing engineering modifications for CEC.

Ultra Electronics Ocean Systems, Braintree, Mass., won a NAVSEA contract for production of spares and engineering services for the Mk 54 mod 0 lightweight torpedo, which is launched from surface ships, fixed-wing aircraft, and helicopters to target submarines. The award also is for torpedoes for the Canadian, Norwegian, and Netherlands navies.

To beef up LCS surface warfare capability, the Navy in June 2018 awarded Raytheon and Norway's Kongsberg a $14.8 million contract for the Mk 87 Mod 0 over-the-horizon naval strike missile (NSM) for both LCS variants. As systems integrator for the Independence ships, General Dynamics Mission Systems test-launched the missile off Gabrielle Giffords (LCS-10) last summer. The FFG(X) also will get the Mod 87 missile.

Both variants accommodate mission packages configured for SUW, ASW, and mine countermeasures (MCM) that could be on- and offloaded based on assigned missions. Northrop Grumman is managing development of the mission packages.

Among the key SUW package systems are a Mk 50 30-millimeter gun, Hellfire missile, and two 11-meter RIB boats. In August 2019 NAVSEA award Northrop Grumman a $9.4 million contract for production of the LCS Surface-to-Surface Missile Module

Littoral combat ships (LCSs) and will increasingly employ unmanned vehicles for surveillance and reconnaissance.

The MCM package includes an airborne laser mine detection system (ALMDS) built by Northrop Grumman and the Raytheon AQS-20 sonar. Both systems are operated from MH-60S helicopters, and both have achieved initial operating capability.

Northrop Grumman has offered its own candidate, the AQS-24C sonar fitted with a laser and volume search sonar, that rides in an unmanned vehicle built by Textron. The company delivered two '24C kits in 2016, and will deliver ten more this year.

The MCM package also includes an underwater influence sweep system and a surface mine countermeasure unmanned undersea vehicle called Knifefish, which searches for bottom and buried mines in high-clutter waters. For the ASW package the Navy will field a dipping sonar and sonobuoys, which will be deployed from the MH-60 helicopter.

The SUW package is in service and has deployed on three ships for Western Pacific operations. the MCM module will reach initial operational capability in 2021. The ASW package is still in development. The Navy plans to buy 44 mission packages: 10 SUW and 10 ASW packages and 24 MCM packages.

Unmanned Systems

The LCS program is a primary Navy target for new unmanned systems for all three mission packages. In October the Program Executive Office for Unmanned and Small Combatants and the Mission Modules program office demonstrated a prototype system called GARC/TALONS (Greenough Advanced Rescue Craft and Towed Airborne Lift of Naval Systems), an advanced communications system. The program office said the system, which could reduce the time needed to clear minefields, went from concept to at-sea test in ten months.

The Navy awarded several key contracts in August for unmanned systems work. For the MCM package, General Dynamics Missions Systems won a $44.5 million NAVSEA award for low-

The Navy's largest acquisition program is the Columbia ballistic missile sub, with first ship to be ordered in 2022.

rate initial production of test systems for the Knifefish UUV.

Raytheon won an $8 million sole-source award for engineering for towed systems for the LCS escort mission module and associated shipboard components to support the LCS ASW package. The company also received an $11.7 million delivery order for "deploy and retrieve" systems for the AQS-20 sonar.

The Navy last year released a request for proposals for a medium unmanned surface vehicle (MUSV) and for the LUSV. The MUSV will be a pier-launched, self-deploying and self-navigation. A contract award is planned early this year.

The Navy says the LUSV will be a "high-endurance, reconfigurable ship able to accommodate various payloads for unmanned missions," either independent of or with manned ships and potentially be fitted out with advanced sensors and missile launch tubes. Two developmental LUSVs built for the program would be 200 or 300 feet long, the Navy says, and displace 2,000 tons.

The Navy also pushed forward on its major unmanned airborne systems, with Naval Air Systems Command awards to Northrop Grumman for the MQ-8C Fire Scout and MQ-4C Triton UAVs. The Fire Scout will operate from the LCSs. The company won a $9.1 million delivery order for production and delivery of eight kits for modifying the Fire Scout radar. The Navy in mid-2019 declared Fire Scout ready for operational service aboard the LCSs as long-range sensor platforms. The Navy plans to buy 38 of the helicopter-look-alike Fire Scouts for use for intelligence-gathering, surveillance, reconnaissance, and targeting.

The company also received an $18.2 million contract modification for the Triton long-range, long-endurance UAV. The Triton will conduct reconnaissance, collecting high-resolution imagery and video, from altitudes to 55,000 feet and stay aloft up to 24 hours. The Navy expects to buy 68 aircraft.

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Austal USA
Mobile, Ala.
https://usa.austal.com

BAE Systems
Arlington, Va.
https://www.baesystems.com/en/home

DRS Laurel Technologies
Johnstown, Penn.
https://www.leonardodrs.com/locations/naval-electronics-laurel-technologies-johnstown-pa

Fincantieri Marinette Marine
Marinette, Wis.
http://fincantierimarinettemarine.com

General Dynamics Corp.
Reston, Va.
https://www.gd.com

General Electric Co.
Boston
https://www.ge.com

Huntington Ingalls Industries
Newport News, Va.
https://www.huntingtoningalls.com

Kongsberg Gruppen
Kongsberg, Norway
https://www.kongsberg.com

L3Harris Technologies
New York
https://www.l3t.com

Lockheed Martin Corp.
Bethesda, Md.
https://www.lockheedmartin.com/en-us/index.html

Navantia
Madrid, Spain
https://www.navantia.es/en/

Northrop Grumman Corp.
Falls Church, Va.
https://www.northropgrumman.com

Raytheon Co.
Waltham, Mass.
https://www.raytheon.com

Ultra Electronics Ocean Systems
Braintree, Mass.
https://www.ultra-electronics.com/os

Power technologies

The mid-2019 release of the Naval Power and Energy Systems Technology Development Roadmap is a culmination of years of Navy efforts to move toward more efficient and affordable power generation, now made more urgent by new power-intensive systems.

Stephen P. Markle, director and program manager of the Electric Ships office, says the roadmap "conveys the guide for an evolutionary strategy to meet the challenges of revolutionary

weapon and sensor systems."

The Navy surface community has worked for years to develop an integrated electric drive architecture that would blend the generation and distribution of propulsion and "ship-service" power. General Electric, Leonardo DRS, and L3 now are in the forefront of these efforts, mostly managed by the Naval Surface Warfare Center's Philadelphia Division.

In a key advance, the America (LHA-6) class ships are powered by a hybrid propulsion system combining gas turbine engines and auxiliary electric propulsion motors, the system introduced aboard Makin Island (LHD-8).

The three Zumwalt destroyers are fitted out with an "integrated fight-through power system," using four Rolls Royce gas turbines to provide power to a General Electric Converteam advanced induction motor.

The Navy says the TDR responds to the critical need for order-of-magnitude increase in shipboard power for new sensor and weapons, among them the SPY-6(v) and lasers and electronic rail guns now being tested.

The Electric Ships program office says its roadmap defines power and energy (P&E) as the "foundation of the kill chain." It identifies power systems and technologies to support the future sensor and weapons. The roadmap then maps a strategy for modernizing P&E systems to "improve faster" and increase force projection affordably.

The document says "Ships perform a range of functions from basic mobility to putting kinetic or electromagnetic energy on a target. … An integrated energy system involves converting energy to the electric weapon or sensor's needs. The vision of integrated P&E systems carries this further, with the end-goal of linking all energy consumers with all energy sources in a single electrical network."

The TDR lays out requirements for advanced sensors and weapons; advanced electric propulsion; survivability; unmanned systems; communications and information security and cyber security; flexible ship modularity; and standard modular interfaces. The roadmap then describes critical technologies needed for energy storage, power conversion, prime movers, power distribution controls, and rotating machinery.

The shrinking world of small-form-factor embedded computing

Industry experts say open standards are helping drive development in small-form-factor battlefield and aerospace hardware like system-on-chip and single-board computers.

BY **Jamie Whitney**

Whether on the ground, at sea, or in the air, military systems like monitors, sensors, and radios are filled with small-form-factor embedded computing technologies. Open-systems standards like C4ISR/EW Modular Open Suite of Standards (CMOSS), Sensor Open Systems Architecture (SOSA), and Future Airborne Capability Environment (FACE) help to ensure components share a common platform and can interchange information across military branches.

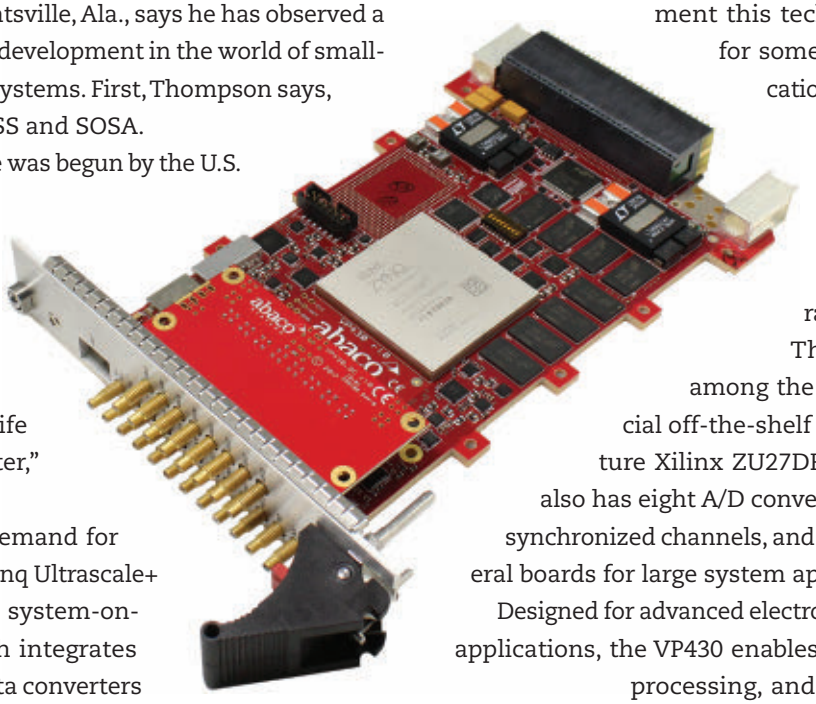
Peter Thompson, vice president of product management at Abaco Systems in Huntsville, Ala., says he has observed a trio of trends advancing development in the world of small-form-factor embedded systems. First, Thompson says, is alignment with CMOSS and SOSA.

"The CMOSS initiative was begun by the U.S. Army's Communications-Electronics Research, Development and Engineering Center (CERDEC) and SOSA was initiated by the U.S. Air Force's Life Cycle Management Center," Thompson says.

"The second is the demand for the Xilinx remarkable Zynq Ultrascale+ RFSoC [radio frequency system-on-chip] technology, which integrates multi-gigasample RF data converters and soft-decision forward error correct (SD-FEC) into a MPSoC architecture. The third is for complete, pre-integrated, pre-qualified subsystems across a broad range of application environments, including mission computers, graphics/video computers and artificial intelligence (AI) platforms."

Regarding the Zynq Ultrascale+ RFSoC, Thompson says it is one of the densest field-programmable gate array (FPGA) digital signal processor (DSP) boards available on the market.

"(It) features the ability to synchronize multiple boards for even larger system applications," Thompson says. "Boards such as Abaco's 3U VPX VP430 that implement this technology are designed for some of the 'hottest' applications across the electronic warfare landscape — MIMO (multiple input/output), beamforming, sensor processing, and radar signal processing."



Abaco's VP430 is a 3U VPX COTS solution that enables beamforming, sensor processing, and radar signal processing.

The Abaco VP430 was among the first 3U VPX commercial off-the-shelf (COTS) solution to feature Xilinx ZU27DR RFSoC technology. It also has eight A/D converter and D/A converter synchronized channels, and it can synchronize several boards for large system applications.

Designed for advanced electronic warfare (EW) MIMO applications, the VP430 enables beamforming, sensor processing, and radar signal processing, and allows the use of fewer boards and much less power while delivering increased processing throughput.

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Eyes on SOSA and CMOSS

Thompson also says that Abaco's SBC3511 rugged 3U VPX single-board computer was developed specifically in response to the requirement for alignment with the SOSA and CMOSS standard.

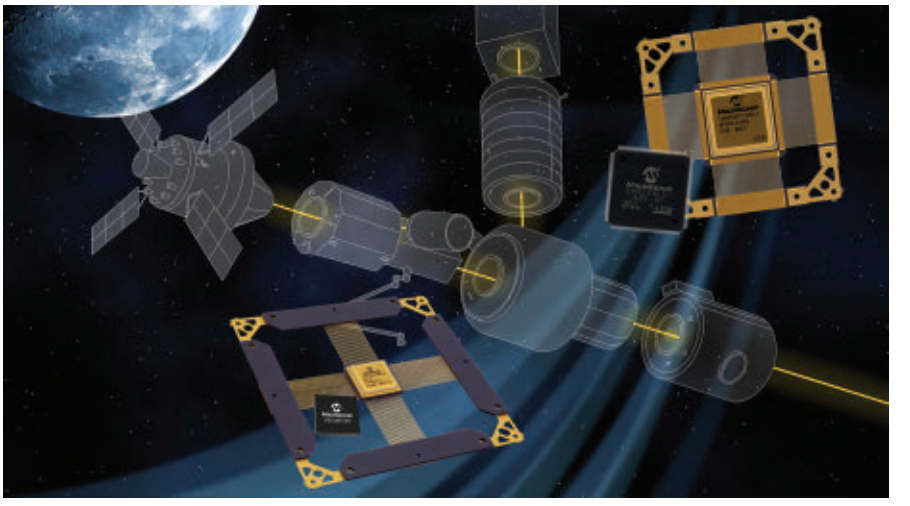
"Recently, at the Georgia Tech Research Institute (GTRI) Tri-Service Open Architecture event in Atlanta, we were able to highlight our experimentation successes with the Army and the EW Planning and Management Tool," says Thompson. "Prolonged efforts with the Army to demonstrate Abaco CMOSS alignment and SBC3511 capabilities culminated in a successful "plug and play" demonstration in a government-designed chassis."

He continues, "What's interesting is that demand for CMOSS- and SOSA-aligned solutions isn't only coming from the U.S. armed forces. As the U.S. represents the majority of the market for military embedded computing, armed forces in other territories can clearly see what the future holds and are asking for similar solutions."

The SBC3511 offers memory resources including 32 gigabytes of high speed DDR4 SDRAM and as much as 256 gigabytes NAND Flash (NVMe solid-state drive), plus a range of I/O including DisplayPort, USB, GPIO and serial comms. An on-board mezzanine expansion site is also provided for enhanced system flexibility.

The SBC3511's Data Plane fabric connectivity is via a 40G-capable Ethernet fat pipe, with a Gen 3 capable PCI Express fat pipe providing the Expansion Plane. Control Plane connectivity on the backplane is via two 10G capable Ethernet ultra-thin pipes with an additional 1000BASE-T thin pipe for external connection.

Available in a range of air- and conduction cooled build levels with extended temperature capability, the SBC3511 is designed to meet the requirements of a wide range of applications from industrial through to fully rugged defense and aerospace programs.



Microchip Technology's SAM3X8ERT is a rad-tolerant microcontroller, and features its latest Arm Cortex-M3 core processor and embedded Ethernet controller.

Trends in embedded tech

At January's Embedded Tech Trends (ETT) conference in Atlanta, Curtiss-Wright Defense Solutions of Ashburn, Va., was one of many companies on hand to "talk shop" about rugged small form factor computing. Curtiss-Wright's Ivan Straznicky, who is the chief technology officer (CTO) for the Virginia-based company's Advanced Packaging division, explained that 5G, Internet of Things (IoT) and artificial intelligence (AI) are three big trends driving development.

"What's next is going to be dependent on how creative we can get," Straznicky told his ETT industry contemporaries and conference attendees. "But that doesn't necessarily mean recreating the wheel from scratch. There is a lot

Abaco's SBC3511 rugged 3U VPX single-board computer was developed specifically in response to the requirement for alignment with the SOSA and CMOSS standard.

of work that has been done with commercial small form factor standards in VITA and other standards bodies. So, we should leverage what we can."

The Curtiss-Wright CTO says that in addition to 5G, AI, and IoT, system-in-package technology is starting to provide additional functional density.

Straznicky explains system-in-package as "potentially a piece of silicon from a processor vendor like AMD or maybe even Intel and combine it with memory chips from Micron and you put that on the same substrate and create a package."

Straznicky says that the Defense Advanced Research Projects Agency's (DARPA) Common Heterogeneous Integration and Intellectual Properties Reuse Strategies (CHIPS) program aims to use system-in-package technology. "They have some long-range strategies and plans to leverage this for defense applications," Straznicky says.

Smaller than small

Curtiss-Wright is taking small form factor even smaller with what it calls "ultra" small form factor. One such example is the Parvus DuraNET 20-11, which is an ultra-small-form-factor rugged COTS 8-port Gigabit Ethernet switch subsystem.

Curtiss-Wright Senior Product Manager Mike Southworth says that "DuraNet 20-11 one of the smallest mini gigabit Ethernet switches; it weighs half-a-pound. U.S. and foreign [militaries] are using it in so many capacities it brings with size and weight reduction. The cards are purpose-built to be extremely small."

The DuraNet 20-11 is made for harsh environments such as high altitude, extreme shock and vibration, extended temperatures, humidity, dust and water exposure, and noisy electromagnetic interference. The switch can help enhance C4ISR capabilities for unmanned air and ground vehicles and other SWaP-constrained platforms deploying network connectivity at the tactical network edge.

Mini and modular

Curtiss-Wright's Southworth selected the company's DuraCOR 312 as another example of how it is tackling small-form-factor computing.

Curtiss-Wright defines the Parvus DuraCOR 312 as an ultra-small-form-factor modular mission computer. The DuraCOR 312 is built around

Mercury Systems has release its the EnsembleSeries HDS6605, a general-purpose 6U OpenVPX embedded computing blade server with hardware-enabled support for AI applications.

the power efficient — but powerful — NVIDIA Jetson TX2i "supercomputer-on-a module" integrated in a miniature rugged chassis with MIL-grade high-density connectors. The DuraCOR 312 combines its NVIDIA Pascal/CUDA-core GPU signal processing with 64-bit Armv8 heterogeneous multi-processing (HMP) for size, weight, power and cost (SWaP-C) sensitive mobile, airborne, ground, manned and unmanned vehicle and sensor platforms.

The mission computer features six Armv8 processor cores and 256 Pascal/CUDA-core GPU along with multiple add-on I/O and storage expansion options to support additional vetronics/avionics interfaces. The unit comes with on-board eMMC Flash and supports an optional internal M.2 solid-state drive (NVMe/SATA), as well as optional removable 2.5" SATA solid-state drive storage for high capacity storage and information assurance requirements.

Pentek's Quartz model 5550 is a SOSA-aligned eight-channel A/D and D/A converter 3U OpenVPX board based on the Xilinx Zynq UltraScale+ RFSoC.

Small footprint

Pentek in Upper Saddle River, N.J. made news at ETT when its experts announced the company's Quartz model 5550, a SOSA-aligned eight-channel A/D and D/A converter, 3U OpenVPX board based on the Xilinx Zynq UltraScale+ RFSoC.

"The model 5550 is leading the industry in the rollout of products developed in alignment with the Technical Standard for the SOSA Reference Architecture," said Bob Sgandurra, director of product management of Pentek. "Pentek continues to be very active in the development of the SOSA technical standard and we are now demonstrating our commitment with supporting products and demonstrations."

A development decision sought to implement connector technology that enables one of the major goals of SOSA reference architecture: backplane-only I/O. The model 5550 incorporates the ANSI/VITA 67.3D VPX backplane interconnect standard for both coaxial RF and optical I/O. In addition, the model 5550 includes a 40-Gigabit-Ethernet interface and a shelf-management subsystem that also are required in the SOSA reference architecture.

The front end accepts analog RF inputs on eight coax connectors located within a VITA 67.3D backplane connector. After balun coupling to the RFSoC, the analog signals are routed to eight 4 GSPS, 12-bit A/D converters. Each converter has built-in digital down-converters with programmable 1x, 2x, 4x and 8x decimation and independent tuning. The A/D digital outputs are delivered into the RFSoC programmable logic and processor system for signal processing, data capture or for routing to other resources. A stage of IP based decimation provides another 16x stage of data reduction, ideal for

applications that need to stream data from all eight A/D's. Eight 4 GSPS, 14-bit D/A converters deliver balun-coupled analog outputs to a second VITA 67.3D coaxial backplane connector. Four additional 67.3D coaxial backplane connections are provided for clocks and timing signals.

Scaling down

Mercury Systems in Andover, Mass., says that technology itself is driving the industry's ability keep things shrinking in the world of small-form-factor embedded systems.

Mercury's Senior Product Manager Shaun McQuaid says, "One of the bigger trends we're seeing is as things get smaller, they're getting closer to the sensor. As they get closer to the sensor, they get smaller, and so what that means for us is that we're actually starting to invest much more significantly in the kind of chips and chiplet areas creating specialized silicon that is really oriented towards that kind of size, weight and power constraints."

McQuaid says what was once at the board or box level has shrunk onto a single chip. "I think what is driving development is really the need to bring that compute power up directly into the platform and closer and closer to the sensor," McQuaid says.

"Think about artificial intelligence and machine learning. The idea that you can leverage the most modern AI technology and put that in service of image recognition or infrared recognition or signal recognition ... that means that the amount of data that these platforms are gathering can be sifted much more effectively and much more quickly when that processing is done right up against the sensor," he says.

These developments can help solve computing bottlenecks, McQuaid continues. "So rather than having this large amount of data either stored and collated for later or beamed to the ground in dribs and drabs for someone else to look at or even dropped on the floor, if you don't have the processing horsepower to deal with it, with those kind of technologies right up against the sensor on the platform at the tactical edge, you have the ability to get actionable information to the warfighter much more quickly, much more efficiently."

Eyes on AI

Mercury has introduced the EnsembleSeries HDS6605 powerful

Curtiss-Wright Defense Solutions has rolled out its DuraCOR 312 for SWaP-C sensitive mobile, airborne, ground, manned and unmanned vehicle and sensor platforms.

general-purpose 6U OpenVPX embedded computing blade server with hardware-enabled support for AI applications.

The HDS6605 is SWaP-optimized and has increased scalability via ultrapath interconnect. Each 6U OpenVPX blade provides as many as 22 cores from one 1.9 GHz processor, delivering 2.6 teraFLOPS of general-purpose processing power. EnsembleSeries HDS6605 server blades offer advanced packaging, cooling, and interconnects to protect the blades from harsh environments.

Earlier this year, Mercury unveiled its EnsembleSeries SFM6126 OpenVPX PCI Express (PCI Express) gen 3 switch, which is also made with space-constrained embedded computing in mind and is suitable for AI, EW, and autonomous platforms.

The rugged 6U modules can switch the control and expansion planes to support the inter-module data distribution architecture required by high-performance OpenVPX high-performance embedded edge computing (HPEEC) subsystems.

"One of the latest trends in commercial data centers is to use a composable infrastructure," says Joe Plunkett, Mercury's vice president and general manager for sensor processing solutions. "This allows the computing, storage, and switch fabric resources to be individually aggregated, disaggregated, and composed based on an application's precise needs, giving system architects much greater flexibility in deploying and reconfiguring resources as needed."

Mercury officials say their company's SFM612 delivers more processing power by pre-integrating other EnsembleSeries HPEEC building blocks including server-class processing blades, FPGA and NVIDIA GPU co-processing engines with a wideband, low-latency and universal PCI Express HPEEC architecture.

Small-form-factor in space

Microchip Technology in Chandler, Ariz., has launched what company officials claim is the industry's first space-qualified Ethernet transceiver.

Microchip's VSC8541RT radiation-tolerant Ethernet transceiver is a radiation-tolerant device based on a COTS solution widely deployed in other industries now offering reliable performance for applications ranging from launch vehicles to satellite constellations and space stations.

The VSC854RT has a total ionizing dose of 100 krad(Si), and a no single event latch-up below an LET threshold of 78 MeV.cm2 /mg at 125 degrees Celsius.

The device supports a wide range of LVCMOS levels for a parallel MAC interface including: 1.5, 1.8, 2.5, and 3.3 volts, as well as 1.2, 1.5, 1.8, 2.5 volts, and 3.3-volt support on the MDIO/MDC interface.

This space-qualified version of the product adds ceramic and hermetic packages, extended temperature range of -40 to 125 C, and extended qualification flow equivalent to QML-V or QML-Q space grade.

Microchip officials also announced that their company has received final qualification for the new SAM3X8ERT rad-tolerant microcontroller, which features its latest Arm Cortex-M3 core processor and embedded Ethernet controller.

The VSC854RT and SAM3X8ERT are COTS-based and share the same pinout distribution, allowing designers to begin implementation with COTS devices before moving to space-grade components.

"Microchip's COTS-based space-grade processing provides the right performance and the right level of qualification to meet evolving requirements from Low-Earth Orbit constellations to deep space missions," says Bob Vampola, associate vice president of Microchip's aerospace and defense group.

The SAM3X8ERT features ARM Cortex-M3 revision 2.0 running at clock speeds as high as 84 MHz, no single event latch-up below an LET Threshold of 62 MeV.cm2 /mg at 105 C, and a total ionizing dose of 30 krad(Si).

WHO'S WHO IN SMALL-FORM-FACTOR EMBEDDED COMPUTING

Abaco Systems
Huntsville, Ala.
https://www.abaco.com/

Aitech
Chatsworth, Calif.
https://aitechsystems.com/

Curtiss-Wright Defense Solutions
Ashburn, Va.
https://www.curtisswrightds.com

Extreme Engineering Solutions (X-ES)
Verona, Wis.
https://www.xes-inc.com/

Elma Electronic
Fremont, Calif.
https://www.elma.com/

Kontron
Fremont, Calif.
https://www.kontron.com/

Mercury Systems
Andover, Mass.
https://www.mrcy.com/

Pentek
Upper Saddle River, N.J.
https://www.pentek.com/

The U.S. Air Force Rivet Joint surveillance aircraft will be one of users of the radiation-hardened AEHF SATCOM terminals.

Raytheon helps with military switch from MILSTAR to AEHF SATCOM

BY **John Keller**

HANSCOM AIR FORCE BASE, Mass. — Military satellite communications (SATCOM) experts at the Raytheon Co. will switch SATCOM terminals aboard the U.S. Air Force B-52 strategic bomber and RC-135 reconnaissance aircraft to the latest Advanced Extremely High Frequency (AEHF) satellite under terms of a contract worth nearly a half-billion dollars.

Officials of the Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., announced a $442.3 million contract to the Raytheon Space And Airborne Systems segment in Marlborough, Mass., for the Force Element Terminal (FET) program.

Raytheon will design radiation-hardened SATCOM terminals to switch the two aircraft from the Military Strategic Tactical Relay (MILSTAR) to the AEHF satellite constellations. Flight testing aboard the two aircraft is part of this contract.

The FET program will build test prototypes for qualification, software development, and integration aboard the F-52 bomber and RC-135 Rivet Joint aircraft.

The FET project has two thrusts: building five baseline SATCOM systems from the existing AEHF product line, and installing these systems aboard B-52 and RC-135 aircraft for qualification testing; and building 12 test FET systems for certification to nuclear-hardened survivability requirements. The project also includes dual concurrent amplifier development.

The B-52 and RC-135 are strategic aircraft that must have the capability to receive orders from national command authorities even through nuclear explosions.

The AEHF satellite constellation relays relay secure communications

for U.S., British, Canadian, Royal Netherlands, and Australian armed forces. AEHF is backward compatible with, and will replace, the older MILSTAR system and will operate at 44 GHz uplink in the EHF band, and 20 GHz downlink in the SHF band.

AEHF satellites use many narrow spot beams directed towards the Earth to relay communications to and from users. Crosslinks between the satellites enable them to relay communications directly rather than via a ground station.

AEHF uses the existing MILSTAR low- and medium-rate data signals that move information at 75 to 2,400 bits per second, and at 4.8 kilobits per second to 1.54 megabits per second. AEHF satellites, unlike MILSTAR, also can move data at rates as fast as 8.2 megabits per second.

On this contract Raytheon will do the work in Marlborough, Mass.; and Largo, Fla., and should be finished by August 2023. For more information contact Raytheon Space and Airborne Systems online at www.raytheon.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Air Force chooses Honeywell to build integrated aircraft GPS and INS avionics

BY **John Keller**

ROBINS AIR FORCE BASE, Ga. — U.S. Air Force guidance experts needed system that blends the Global Position System (GPS) satellite navigation and guidance system with inertial navigation system (INS) technology. They found their solution from the Honeywell Inc. Aerospace segment in Clearwater, Fla.

Officials of the Air Force Life Cycle Management Center at Robins Air Force Base, Ga., announced a potential $3.5 billion 15-year contract to Honeywell to build and sustain the airborne Embedded Global Positioning System (GPS)/Inertial Navigation System (INS)-Modernization, or EGI-M system.

Based on a modular open-systems architecture, the EGI-M system supports the rapid insertion of new capabilities into military aircraft like the F-22 jet fighter and E-2D carrier-based radar aircraft to operate in GPS-denied environments.

EGI-M technology is designed for compatibility with legacy aircraft, and adds Automatic Dependent Surveillance-Broadcast (ADS-B) Out to comply with the Federal Aviation Administration's NextGen air traffic control requirements.

ADS-B Out transmits information about an aircraft's altitude, speed, and location to ground stations and to other equipped aircraft in the vicinity.

The EGI-M is an upgraded version of the Embedded Global Positioning System Inertial Navigation System (EGI) from Honeywell and the Northrop Grumman Corp. Mission Systems segment in Woodland Hills, Calif., which combines GPS and inertial technologies for use in GPS-denied environments.

The EGI, manufactured by Honeywell and Northrop Grumman, is a navigation system that combines a GPS receiver card with an INS in one 20-pound unit that measures 7 by 11 by 12 inches.

Honeywell will build a GPS satellite navigation and guidance system with inertial navigation system (INS) technology for U.S. military aircraft.

The navigation systems are for helicopters and fixed-wing aircraft as upgrades to existing systems or as replacements for older and less capable systems.

The EGI is an Army/Navy/Air Force program that developed a small, reliable, lightweight navigation and guidance unit that contains precise position service GPS on one standard electronic module, plus a ring laser gyro inertial navigation system.

EGI provides three navigation solutions: GPS only, inertial navigation only, or a blended GPS/INS navigation solution. The EGI system has been in production since the late 1990s.

On this contract Honeywell will do the work in Clearwater, Fla., and should be finished by December 2035. For more information contact Honeywell Aerospace online at https://aerospace.honeywell.com, Northrop Grumman Mission Systems at www.northropgrumman.com, or the Air Force Life Cycle Management Center-Robins at www.robins.af.mil/Units/AFLCMC.

DARPA asks for unmanned surface warships with no accommodation for humans

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to design and test a 100-ton unmanned surface vessel (USV) of about 65 feet in length with no accommodations for human presence, access, operation, or habitation.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a broad agency announcement last month (HR0011120S0017) for the No Manning Required Ship (NOMARS) program.

This project seeks a demonstrate vessel and maintenance and logistic plan for a 100-ton class unmanned vessel with no provision or allowance for humans on or inside the ship to demonstrate capabilities unconstrained by a human presence.

This project is to help the U.S. Navy develop a fleet of many relatively small surface warships to replace or augment the capability of a few high-value ships, DARPA officials explain.

Many of today's USVs are limited because of the frequency of maintenance that requires human intervention either at-sea or in port. Researchers point out that a human presence comes with a cost.

Current and planned unmanned vessels typically must include physical access to subsystems, ad-hoc maintenance crew quarters, environmental controls, lighting, displays, and safety equipment. This can prevent design exploration into new technologies and new approaches to ship architectures to optimize for survivability and performance.

Instead, NOMARS seeks to enable the unmanned vessel to demonstrate significant performance improvements and enhanced capabilities without the constraints imposed by a human presence.

NOMARS has two parallel thrusts: make the most of seaframe performance when human constraints are removed; and achieving sufficient vessel maintenance and logistics for long-endurance unmanned operations.

The first objective will focus on unusual hull forms, low freeboard, minimizing air-filled volumes, innovative materials, and repurposing or eliminating space for humans.

The second objective focuses on isolating delicate equipment from seawater, ruggedizing hardware, exploring distributed system designs, and developing architectures optimized for depot-maintenance.

The idea is to design more capable and affordable small warships that can be procured and maintained in large numbers. The typical NOMARS unmanned vessel must be able operate over entire battle theaters in one-year deployments.

These vessels must be able to transit at cruise speed for at least 2,000 nautical miles to a deployment station, where they would maintain position for days and weeks at a time, with occasional repositioning at cruise speeds.

This vessel should be able to sprint to reposition or evade the enemy. When finished, NOMARS vessels would conduct a return trip of more than 2,000 nautical miles back to their home ports.

This solicitation concerns only the NOMARS program's first two-track first phase, and will spend about $31 million. Several contracts are anticipated. The program's first phase concerns seaframe design and integration, conceptual design, preliminary design, and risk reduction. The eventual second phase will involve detailed design, fabrication, assembly, and demonstration.

Companies interested are asked to submit proposals no later than 2 April 2020 to the DARPA BAA Website at https://baa.darpa.mil. Email questions or concerns to DARPA at HR00112S0017@darpa.mil. More information is online at https://beta.sam.gov/opp/dc4233cf116e4852ba4c7b436db95ae2/view.

Navy picks 40 to develop unmanned surface vessels (USVs), sensor-processing, and autonomy

BY **John Keller**

WASHINGTON — U.S. Navy unmanned vehicles experts are assembling a 40-member industry team, which is a veritable who's who of prime systems integrators and subsystems designers, to participate in a major effort to design next-generation unmanned surface vessels (USVs).

Officials of the Naval Sea Systems Command in Washington announced that these 40 companies will share contracts with a potential cumulative value of $982.1 million to support the Unmanned Surface Vehicle Family of Systems. These contracts are for five years, and includes three one-year options.

These companies each will receive $1,000 up-front, and over the next five to eight years will compete for individual delivery orders for integrated unmanned surface vessels, USV propulsion systems, sensor and sensor-processing payloads, and other aspects of advanced USV design.

The project's contractors will provide products and services within six areas: payloads; non-payload sensors; mission-support systems; vehicle autonomy and vehicle-control systems; ashore and host platform elements; and logistics and sustainment.

The 40 companies selected to participate in the Unmanned Surface Vehicle Family of Systems project are:

- Advanced Acoustic Concepts LLC in Hauppauge, N.Y.;
- Raven Aerostar Technical Solutions Inc. in Arlington, Va.
- Arete Associates in Tucson, Ariz.;
- Austal USA LLC in Mobile, Ala.;
- Azimuth Inc. in Morgantown, W.Va.;
- BAE Systems Electronic Systems in Nashua, N.H.;
- BMT Designers & Planners Inc. in Alexandria, Va.;
- Continental Tide Defense Systems Inc. in Reading, Pa.;
- The Charles Stark Draper Laboratory Inc. in Cambridge, Mass.;
- General Dynamics Mission Systems Inc. in Fairfax, Va.;
- Gibbs & Cox, Inc. in Arlington, Va.;
- Gravois Aluminum Boats LLC, doing business as Metal Shark, in Jeanerette, La.;
- Huntington Ingalls Industries Fleet Support Group LLC in Virginia Beach, Va.;
- Hydroid Inc. in Pocasset, Mass.;
- ICI Services Corp. in Virginia Beach, Va.;
- L3Harris Unidyne Inc. in Norfolk, Va.;
- Leidos Inc. in Reston, Va.;
- Lockheed Martin Rotary and Mission Systems in Moorestown, N.J.;
- Maritime Applied Physics Corp. in Baltimore;
- Micro Systems Inc. subsidiary Kratos-MSI in Fort Walton Beach, Fla.;
- Northrop Grumman Corp. Autonomous Systems in Bethpage, N.Y.;
- Oasis Systems LLC in Rockville, Md.;
- Oceaneering International Inc. in Hanover, Md.;
- Peraton Inc. in Herndon, Va.;
- Q.E.D. Systems Inc. in Virginia Beach, Va.;
- Raytheon Integrated Defense Systems in Portsmouth, R.I.;
- Reliable Systems Services Corp. in Melbourne, Fla.;
- Rolls-Royce Marine North America Inc. in Walpole, Mass.;
- Science Applications International Corp. (SAIC) in Reston, Va.;
- System Engineering Associates (SEA) Corp. in Middletown, R.I.;
- Sedna Digital Solutions LLC in Manassas, Va.;
- Serco Inc. in New London, Conn.;
- Spatial Integrated Systems Inc. in Virginia Beach, Va.;
- Teledyne Brown Engineering Inc. in Huntsville, Ala.;
- Textron Systems in Hunt Valley, Md.;
- The Boeing Co. Defense, Space & Security segment in St. Louis;
- The Columbia Group Inc. in Washington;
- Tridentis LLC in Alexandria, Va.;
- Ultra Electronics Ocean Systems (UEOS) in Braintree, Mass.; and
- W R Systems Ltd. in Norfolk, Va.

Unmanned Surface Vehicle Family of Systems payloads include components that the USV will carry in addition to what is necessary to operate and navigate the vessel. Payloads will interface with the USV and help carry out lethal or non-lethal missions.

Example payloads are towed sonars, data recorders, payload controllers, and signal processors, and may include optical, acoustic, infrared, radar, radio, underwater electromagnetic, deployed systems, towed systems, and homing & docking interfaces.

Towed sonars will have an actively controlled towed body with automatic depth or altitude control based on the

mission and will detect, classify, and locate bottom, close-tethered, and volume mines in one pass.

Acoustic sensors will include side-looking sonars with synthetic aperture sonar (SAS), volume search sonar, and an optical identification sensor to identify bottom mines.

Contractors will conduct payload research, handle cyber security and trusted computing, and provide build-to-print technical data packages for follow-on competition, production, modification, integration, and test.

Unmanned Surface Warship

Mission-support systems will provide physical, electrical, and data interfaces to payload systems. Examples are payload launch and recovery, mine countermeasures unmanned surface vehicle minesweeping payload delivery system, minehunting, and mine neutralization.

Autonomy and vehicle control systems enable the USV to develop and select among different courses of action based on the USV's knowledge and understanding of the situation.

Ashore and host platform elements are the systems and subsystems that enable a USV to interface, launch, and recover from an ashore and or host platform, and may include launch and recovery hardware, data interface systems, hardware interface systems, electrical interface systems, local command and control, energy system charging and refueling equipment, onboard storage equipment, maintenance equipment, and tendering for a USV.

Elements include USV communications between the USV and its ashore host, USV to USV, and USV to its payloads, such as radios, cross-domain solutions, enclosures, power supplies, and communications software.

Logistics and sustainment activities are services necessary to maintain optimal performance of the USVs, and payloads.

On these contracts the Unmanned Surface Vehicle Family of Systems companies will do the work in various locations of the contiguous U.S., and should be finished by February 2025. With options, work could continue until February 2030.

For more information contact Naval Sea Systems Command online at www.navsea.navy.mil.

Aerojet Rocketdyne to develop technologies to counter enemy hypersonic threats

Photo (above): DARPA researchers are looking to Aerojet Rocketdyne for enabling technologies to help destroy or disable enemy hypersonic weapons in the upper atmosphere before they can do damage.

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers needed a company to develop enabling technologies to counter the growing threat of enemy hypersonic missiles and aircraft. They found their solution from Aerojet Rocketdyne in Huntsville, Ala.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $12.1 million contract to Aerojet Rocketdyne last month for the base period of the Glide Breaker program.

Glide Breaker seeks to develop enabling technologies to counter enemy hypersonic vehicles — or those that can fly faster than five times the speed of sound.

Top U.S. military leaders over the past few years have voiced their alarm about Chinese and Russian projects to develop hypersonic missiles and aircraft. Hypersonic missiles particularly would be useful to attack large U.S. surface warships like aircraft carriers.

The DARPA Glide Breaker project asks Aerojet Rocketdyne to develop an enabling technology critical for an advanced interceptor capable of defeating hypersonic vehicles, DARPA officials say. Key aspects of the project are classified.

This missile defense effort asks Aerojet Rocketdyne for innovative approaches in counter-hypersonics to advance U.S. means to counter hypersonic vehicles. Aerojet Rocketdyne will develop and demonstrate an advanced interceptor able to engage enemy maneuvering hypersonic threats in the upper atmosphere.

The company also will develop requirements, define a design, manage risk, mature enabling technologies, develop requirements, develop a conceptual design, develop software, conduct trade studies, and analyze costs.

If the Glide Breaker program makes sufficient progress to warrant prototyping and other advanced development, DARPA may release additional solicitations as early as this year.

On this contract Aerojet Rocketdyne will do the work in Huntsville, Ala.; Sacramento, Healdsburg, and Sunnyvale, Calif.; and Orange, Va., and should be finished by February 2021.

For more information contact Aerojet Rocketdyne online at www.rocket.com, or DARPA at www.darpa.mil.

Navy orders more electro-optics-packed MQ-4C Triton surveillance unmanned aircraft

BY **John Keller**

PATUXENT RIVER NAS, Md. — Maritime aviation surveillance experts at Northrop Grumman Corp. will build two more MQ-4C Triton long-range patrol unmanned aerial vehicles (UAVs) under terms of a $172.4 million order announced in February.

Official of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Northrop Grumman Aerospace Systems sector in San Diego to build three low-rate initial production lot 4 MQ-4C Triton UAVs.

This is the second Triton order within three months. In December, the Navy awarded a $251.6 million order to Northrop Grumman for three MQ-4C Triton UAVs. February's order includes one Navy main operating base, trade studies, and technical data.

Northrop Grumman is building the MQ-4C Triton, also called the Broad Area Maritime Surveillance (BAMS) UAV, to fly maritime surveillance missions as long as 24 hours at altitudes of more than 10 miles to enable coverage out to 2,000 nautical miles. The UAV's suite of sensors can detect and classify different types of ships automatically.

The Triton will be a crucial component of the Navy's 21st century strategy for conducting surveillance of surface ship and submarine traffic in the vast Pacific and other oceans around the globe. The Triton UAV will work together with the Navy's P-8A Poseidon manned maritime patrol aircraft.

The Triton's maritime search radar is called the Multi-Function Active Sensor (MFAS), and will provide the UAV and its operators with a 360-degree view of a large geographic area while providing all-weather coverage for detecting, classifying, tracking, and identifying points of interest. MFAS is separate from the Triton's air-to-air radar. The MFAS radar first flew on the Triton during testing in April 2015.

Along with the air-to-air and MFAS radar systems, the MQ-4C will carry an electro-optical/infrared (EO/IR) sensor that will provide still imagery and full-motion video of potential threats.

Raytheon also is developing AN/DAS-3 Multispectral Targeting System (MTS) sensors for the Triton. The AN/DAS-4 is the latest variant of the Raytheon MTS family of electro-optical sensors, and incorporates greater fire control and target location accuracy for precise targeting coordinates.

The Raytheon AN/DAS-3 will provide

the MQ-4C carries an electro-optical/infrared (EO/IR) sensor that provides still imagery and full-motion video of potential threats, and a multispectral sensor for target identification in day and nighttime conditions.

Electro-optical system helps armored vehicle crews see outside safely

The electro-optical See-through Armor System (SETAS) from Hensoldt in Taufkirchen, Germany, enables crews of armored vehicles to see in 360 degrees around their vehicles without exposing themselves to danger. The crew of an armored vehicle needs constant awareness of their surroundings, but often cannot do so from inside the vehicle with hatches closed. The SETAS system compensates for this using camera modules that pair cameras with color CMOS sensors with a 95-degree horizontal and 78-degree vertical field of view with longwave infrared thermal cameras with a 58-horizontal and 45-degree vertical field of view. Crew members use the synthetic vision SETAS via a head-mounted display like those used in virtual- and augmented-reality systems. As the crew member pans his head, he can see beyond the walls of the vehicle and into the surrounding environment.

Israeli laser weapons yield technologies to attack long-range targets

Israel's Ministry of Defense have revealed a major achievement in a high energy laser weapons program undergoing with the Directorate of Defense Research and Development (DDR&D). Israeli investments in laser technology have led to the ability to focus laser beams precisely on long-range targets, while overcoming atmospheric disturbances. The

new technology is key for the delivery of laser effects on target within a short time. It will enable the development of laser weapons capable of intercepting a variety of threats. Encouraged with the new technology breakthrough DDR&D embarked on three parallel high-energy laser weapons demonstrator programs with Elbit Systems and Rafael, designed to demonstrate new laser weapons capabilities.

Navy to deploy infrared search and track (IRST) sensor on Super Hornet combat jets

Electro-optics engineers at the Boeing Co. have announced that one of two F/A-18F Super Hornet combat jet test beds they are using to develop the Block III upgrades for the U.S. Navy flew last year with an infrared search and track (IRST) system for the first time. This flight test comes as the company moves closer to delivering the first of these initial jets, which have other Block III updates installed, such as conformal fuel tanks, in the near future. The complete IRST system consists of a FPU-13 drop tank with the IRST21, also known as the AN/ASG-34, installed in the front portion of the combat jet, which the Block III Super Hornets will carry on their centerline station. The FPU-13 with the IRST sensor installed can carry 330 gallons of fuel as compared to a standard 480-gallon centerline tank. Conformal fuel tanks, another part of the Block III upgrade package, will help offset this lower amount of total fuel in the tank.

intelligence, surveillance, and reconnaissance (ISR), detection, identification, and targeting capability in day and nighttime operations on manned and unmanned aircraft.

The system's sensors provide detailed intelligence data from the visual and infrared spectra, and enables mission commanders to use high-definition data from an airborne tactical sensor to identify and engage targets with much greater accuracy, Raytheon officials say.

The Triton also carries an electronic support measures package to identify and geolocate radar threat signals; and an automatic identification system (AIS) that will detect and track vessels equipped with AIS responders.

The MQ-4C Triton is designed to provide combat information to military authorities like the expeditionary strike group, carrier strike group, and the joint forces maritime component commander. The Triton air vehicle is based on the U.S. Air Force RQ-4B Global Hawk, while its sensors are based on components and systems already fielded in the U.S. military.

The large unmanned aircraft provides intelligence for large ocean areas to maintain the common operational and tactical picture of the maritime battle space. The Triton feeds intelligence, surveillance, and reconnaissance (ISR) data to the Global Information Grid (GIG), and can work alone or together with other aircraft and surface ships.

The MQ-4C Triton's ability to perform persistent ISR within a practical range of 2,000 nautical miles enables the P-8A aircraft to focus on anti-surface ship warfare, anti-submarine warfare (ASW), and multi-intelligence. The Triton can fly as far as 8,200 nautical miles without refueling.

Triton aircraft and support facilities are based domestically at Point Mugu Naval Air Station near Ventura, Calif., and at Jacksonville Naval Air Station, Fla. Triton UAVs also will be forward-deployed to Kadena Air Base, Japan; Andersen Air Force Base, Guam; Sigonella Naval Air Station, Italy; as well as at installations on the islands of Hawaii and Diego Garcia.

The Triton UAV has a Rolls-Royce AE3007H jet engine, can remain aloft for as long as 24 hours, can fly as fast as 320 knots, and fly as high as 60,000 feet. The unmanned aircraft is 47.6 feet long, 15.4 feet high, has a wingspan of 130.9 feet, and has a maximum takeoff weight of 32,250 pounds. It can carry as much as 17,300 pounds of fuel, sensors, and other payloads.

The Triton has a ground crew of four — an air vehicle operator, tactical coordinator, and two mission payload operators. Triton development began in early 2008 with a $1.2 billion contract to Northrop Grumman to design and build two Triton UAVs with mission payloads and communications suites; one forward operating base mission control system; one systems integration laboratory; and one main operating base mission control system.

On this order Northrop Grumman will do the work in San Diego, Palmdale, and San Clemente, Calif.; Red Oak and Waco, Texas; Baltimore; Salt Lake City; Bridgeport, W.Va.; Indianapolis; Moss Point, Miss.; Chantilly, Va.; and at various other locations, and should be finished by February 2023.

For more information contact Northrop Grumman Aerospace Systems online at www.northropgrumman.com, or Naval Air Systems Command at www.navair.navy.mil.

UNMANNED SENSOR PAYLOADS

Navy picks General Dynamics for UUVs), upgrades to SATCOM and sensor payloads

U.S. unmanned underwater vehicle (UUV) experts needed a company to upgrade the 21-inch-diameter Black Pearl UUV with new capabilities such as satellite communications (SATCOM) capability. They found their solution from the General Dynamics Corp. Mission Systems segment in Quincy, Mass.

Officials of the Naval Research Laboratory (NRL) in Washington announced a $20.9 million contract to General Dynamics to upgrade the Navy's fleet of UUVs to accommodate new sensor payloads, and build new UUVs to support future research missions.

The contract calls for General Dynamics to provide five new Black Pearl UAVs; two side-scan sonars; upgraded tail and nose sections, and spare parts. The Black Pearl UUV supports Navy research programs in anti-submarine warfare (ASW) and mine countermeasures.

The contract asks General Dynamics to provide two-way Iridium SATCOM to the Black Pearl UUV; alter the unmanned submersible's payloads bay; determine the best way to accommodate side-scan and multi-beam sonar; and manufacture new UUVs and control systems, tail sections, and batteries.

The five new Black Pearl UUVs include tail sections for each of the Black Pearl UUVs; a battery power section for each UUV; and a nose section for each UUV.

General Dynamics is the original manufacturer of the Black Pearl. The company won a $7.1 million contract in April 2014 design and build the Black Pearl underwater drone for research in long range and multi-static mine hunting and ASW programs, as well as in new distributed sensing research. Bluefin experts were to build as many as five next-generation underwater drones based on the company's Bluefin 21 UUV.

General Dynamics also will provide a new software driver for the Black Pearl's Iridium board, develop software to enable basic two-way messaging, software to help upload missions to the UUV via Iridium, and software drivers and mechanical structures to accommodate Navy research payloads in the payload sections.

The company also will provide topside UUV-operator equipment that includes two RF deck boxes with antennas; two Iridium deck box with antennas; one Sonardyne Dunker kit; two RDF receivers and antennas; five battery chargers; two sets of vehicle carts; two vehicle shipping cases; one vehicle tool kit; and two ruggedized operator laptop computers with operator software.

The original Black Pearl design has a 3-to-5-nautical-mile per hour operating speed, a 400 meter depth capability, a minimum of 18 kilowatt-hour energy storage, and a real-time GPS-aided fiber optic gyro (IXSEA PHINS III), inertial navigation system (INS) integrated with Doppler velocity log instrument capable of measuring the vehicle's horizontal position, velocity, and attitude.

For more information contact General Dynamics Mission Systems online at https://gdmissionsystems.com, or the Naval Research Laboratory at www.nrl.navy.mil.

RF AND MICROWAVE

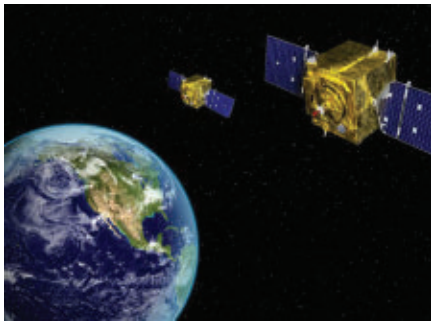
Navy picks Assurance Technology for new ways of sending radio signals from the ground to space

U.S. Navy researchers needed new ways of communicating between the ground and deployed spacecraft and aircraft with radio signals. They found their solution from Assurance Technology Corp. in Carlisle, Mass.

Officials of the Naval Research Laboratory (NRL) in Washington announced $193.7 million five-year contract to Assurance Technology for the Transmitting Energy Radio Frequency (RF) Systems project.

The project focuses on transmitting energy across the RF spectrum from the ground to satellites and aircraft. The targeted spacecraft will process the RF energy, and antennas at locations throughout the world will collect the information for analysis.

Navy researchers chose Assurance Technology because the company has expertise in characterizing large apertures, including photogrammetry and calibration using celestial and mathematical transformations. The company also has experience with high-powered large-aperture antennas from 60 to 150 feet wide; power as strong as 1,000 megawatts; RF ranges of DC to light; RF signal generation with picosecond accuracy; pulse-to-pulse measurement of generated RF signals; and RF mobile communication systems.



Assurance Technology will research proposed RF generation systems and their effects on military satellite and aircraft operations. The company also will develop ways to detect and predict the performance of large apertures, as well as reduce or eliminate the effects of space anomalies on RF signals sent from the ground to space and aircraft.

Mitigation techniques may include advanced signal-compensating algorithms or -avoidance techniques for predicted or detected anomalies.

The company also will develop networks to connect RF systems and devices using uncommon protocols and complex configurations, as well as secure RF mobile communication systems.

The NRL's Space Systems Development Department supports applied research expected to boost enabling technologies for Navy missions.

For more information contact Assurance Technology online at www.assurtech.com, or the Naval Research Laboratory at www.nrl.navy.mil.

TRUSTED COMPUTING

Collins to contribute trusted computing to JTIDS crypto modernization

U.S. Navy airborne communications experts needed cryptography upgrades for the legacy Joint Tactical Information Distribution System (JTIDS). They found their solution from Data Link Solutions LLC in Cedar Rapids, Iowa, a joint venture between Collins Aerospace and BAE Systems.

Officials of the U.S. Naval Information Warfare Systems Command in San Diego announced a $9.1 million order to Data Link Solutions to provide 47 JTIDS cryptographic modernization kits to provide a build-to-print solution to maintain secure operations of Link 16 for all versions of the JTIDS terminal.

JTIDS, developed in the 1970s enables jet fighter and surveillance aircraft to share not only voice and data communications, but also to share graphic representations of targeting and situational awareness data.

JTIDS uses the Link 16 military tactical data link network with information security that enables military aircraft, ships, and ground forces to exchange their tactical picture in near-real time with a variety of information security measures.

Deployment of JTIDS historically was slow and cumbersome because its hardware was large and expensive. Since its first deployments in the early 1980s, JTIDS largely has been superseded by the Link 16-equipped Multifunction Information Distribution System (MIDS).

JTIDS is an L-band distributed time division multiple access (DTDMA) network radio that produces a spread-spectrum signal using frequency- and phase-shift keying to spread the radiated power over a wide spectrum of frequencies.

Its spread-spectrum capability is designed to resist the effects of RF noise, jamming, and interception, military leaders have decided to boost the system's trusted-computing capability by boosting its security through the U.S. military Cryptographic Modernization Program.

In addition to the 47 JTIDS crypto-modernization kits, this order includes program management, testing, and logistics support. United Technologies Corp. acquired Rockwell Collins for $30 billion last year and changed the company's name to Collins Aerospace.

The order has an option that could bring its cumulative value to $12.1 million. Data Link Solutions will do the work in Wayne, N.J., and should be finished by July 2021.

For more information contact Data Link Solutions online at www.datalinksolutions.net, or the Naval Information Warfare Systems Command at www.public.navy.mil/navwar/Pages/default.aspx.

SUPERCOMPUTERS

Cray to upgrade supercomputers to perform calculations in military research

U.S. military researchers needed upgrades to the DOD Supercomputing Resource Center (DSRC) at Stennis Space Center, Miss. They found their solution from Cray Inc. in Seattle.

Officials of the U.S. Army Corps of Engineers support center in Huntsville, Ala., announced a $26.5 million five-year contract to Cray for the U.S. Department of Defense (DOD) High Performance Computing Modernization program.

The high-performance computing (HPC) facility at Stennis Space Center is one of five DSRCs that support U.S. military computationally based science and engineering that help scientists analyze an ever-increasing volume and complexity of data by developing visualization and analysis tools. High-performance computing typically is synonymous with supercomputing.

The DOD's High Performance Computing Modernization program was begun in 1993 to modernize the military's supercomputer infrastructure to explore new theories; use validated applications in design and testing to reduce the time and cost of developing weapon systems; and carry out complex calculations in real-time to produce just-in-time information for decision makers on the battlefield.

The program seeks to develop and field the most advanced supercomputers and storage systems available for routine use by military researchers at the program's five supercomputing centers across the nation. In addition to Stennis Space Center, supercomputing centers are at Wright-Patterson Air Force Base, Ohio; the Army Research Laboratory at Aberdeen Proving Ground, Md.; the Army Engineer Research and Development Center at Vicksburg, Miss.; and

the Maui High Performance Computing Center at Kihei, Hawaii.

Among the most important projects of the High Performance Computing Modernization program is the Defense Research and Engineering Network (DREN) — a component of the Global Information Grid (GIG) that provides high-bandwidth, low-latency computer networking that serves as a proving ground for new networking and cyber security technologies.

Five years ago Cray won a $30.75 million order to provide high-performance computing resources at Stennis Space Center. Cray specializes in supercomputers, open-systems data storage, and analytics for real-time data discovery.

The Cray XC50 supercomputer has a peak system performance of 500 quadrillion floating point operations per second (petaFLOPs), and 1 petaFLOP in one cabinet. It supports Cavium ThunderX2 processors, NVIDIA Tesla P100 PCI Express graphics processing units (GPUs) and Intel Xeon Scalable processors. This supercomputer works with the Aries network and Cray HPC-optimized software stack that includes the Cray Linux Environment and Cray Programing Environment.

Cray also offers the Shasta supercomputer, introduced in late 2018 for massive converged modeling, simulation, artificial intelligence (AI), and analytics. Built to be data-centric, it runs fast and diverse workloads all at the same time, and supports multiple processor and accelerator architectures and system interconnect technologies like the Cray Slingshot.

For more information contact Cray online at www.cray.com, the DOD High-Performance Computing Modernization program office at www.hpc.mil, or the Army Engineering and Support Center-Huntsville at www.hnc.usace.army.mil.

REAL-TIME SOFTWARE

Collins picks real-time software from Green Hills for Navy combat jet training

Collins Aerospace, a United Technologies company in West Palm Beach, Fla., needed a secure

real-time software operating system for the Tactical Combat Training System Increment II (TCTS II) system that Collins is designing for the U.S. Navy. They found their solution from Green Hills Software Inc. in Santa Barbara, Calif.

Green Hills officials have announced that Collins has chosen the Green Hills INTEGRITY-178 Time-Variant Unified Multi-Processing (tuMP) real-time operating system (RTOS) for the Xilinx UltraScale+ field-programmable gate array (FPGA) for the TCTS II combat jet training system.

Key factors in the selection of INTEGRITY-178 tuMP were its several independent levels of security (MILS) architecture, its ability to host multi-level security (MLS) applications, its ability to host a guest operating systems and legacy applications in a secure virtualized partition, and its conformance to the Future Airborne Capability Environment (FACE) 3.0 open-systems embedded computing standard, Green Hills officials say.

The Collins Aerospace TCTS II enables rapid adaptation of missions and threats into training as well as joint and coalition interoperability with fourth- and fifth-generation aircraft.

The ability for the Navy and Marine Corps to advance future technology insertions rapidly is due to the Collins Aerospace open architecture design and use of industry standards like FACE.

The INTEGRITY-178 tuMP high-assurance RTOS is certified to the Separation Kernel Protection Profile (SKPP) trusted-computing profile published by the Information Assurance Directorate of the U.S. National Security Agency (NSA).

That certification was done by the National Information Assurance Partnership (NIAP) to Common Criteria EAL 6+. INTEGRITY-178 tuMP also is certified conformant to latest revision of the FACE 3.0 standard, and meets all of the standard's multicore requirements.

For more information contact Green Hills Software online at www.ghs.com, or Collins Aerospace at www.rockwellcollins.com.

RADAR SYSTEMS

Air Force chooses EWR to provide portable Doppler radar for weather forecasting

U.S. Air Force weather experts needed portable Doppler radar systems for relocatable weather forecasting applications. They found their solution from EWR Radar Systems Inc. in St. Louis.

Officials of the Digital Directorate of the Air Force Aerospace Management Systems Division at Hanscom Air Force Base, Mass., announced a $20.7 million sole-source contract to EWR for the Portable Doppler Radar (PDR) program. EWR will provide 22 PDR systems with an option to buy as many as 14 additional portable Doppler radar systems.

Doppler weather radar locates precipitation, calculates its motion and intensity, and estimate its type, such as rain, snow, or hail. It can help weather forecasters determine the structure of storms and their potential to cause severe weather.

EWR provides the E700XD portable Doppler radar, which combines solid state technology, digital signal processing into a compact, portable and advanced Doppler weather radar.

Designed for mounting on a retractable mast, tower, rooftop, trailer, or vehicle, the E700XD is composed of three main components: the radar pedestal unit; radar server and power supply; and commercial off-the-shelf (COTS) PC workstation.

The radar pedestal unit contains the radar's receiver, transmitter, antenna, and signal processor. The radar server and power supply is housed in an environmentally controlled ruggedized case for field deployment. The COTS PC workstation works on a PC or laptop computer that runs the EWR WeatherScout radar control and display software.

The E700XD's pulse compression transmitter transmits long pulses at relatively low power levels to provide the equivalent sensitivity as a short pulse at high power, while compressing the pulse in the signal processor to provide the same short range resolution obtained by transmitting a short pulse.

The system can provide equivalent or better sensitivity and range resolution compared to a 10-12-kilowatt radar while transmitting a fraction of that power, company officials say.

EWR is a supplier of ground based weather radar systems for the U.S. Air Force Special Operations Command, the U.S. Marine Corps Meteorological Mobile Facility (METMF) Next Generation (NEXGEN) systems, and for the Air Force PDR program.

On this contract EWR will do the work in St. Louis, and should be finished by January 2023. For more information contact EWR Radar Systems https://ewradar.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

COMMUNICATIONS

Persistent Systems bases improvements to networked smart radio on Army experience

Unmanned vehicles networking expert Persistent Systems LLC in New York needed help in improving the company's MPU5 networked smart radio and embedded module. They found their solution from the U.S. Army's 101st Airborne Division at Fort Campbell, Ky.

Persistent Systems has released firmware version 19.5.3 for the MPU5 networked smart radio and embedded module, based on feedback from a readiness exercise conducted by the 101st Airborne.

The Persistent Systems firmware version 19.5.3 contains performance improvements based on 101st Airborne experience to benefit infantry warfighters. Improvements include improved battery life and audio quality; rotary knob; LED blackout mode; simplified web management; multicast firmware upgrade; and rapid configuration tool.

The battery life of networking radio for unmanned vehicles has increased by about three hours on a standard 6.8Ah battery pack, which can reduce the number of batteries soldiers must carry. Power consumption improvements also benefit embedded module users.

The MPU5 audio quality implements new Opus audio codec to deliver clear audio and an 8x reduction in network use for voice traffic. This can reduce the cognitive load on the soldier.

The unit's new eight-position rotary knob enables user to modify audio volume or select their intercom talk group. The LED blackout mode enables users to disable the status LED to support stealthy nighttime operations.

The MPU5's new web interface is streamlined based on the cables connected to the radio, and displays only relevant settings to the user. The multicast firmware upgrade enables users to add a large number of nodes to MPU5 networks via multicast. The rapid configuration tool helps automate the mass configuration of MPU5s to enable users to create larger networks.

Firmware version 19.5.3 is immediately available; existing customers will receive an email notification and can download the firmware from the new Persistent Customer Support Portal. All customers are encouraged to upgrade, company officials say.

For more information contact Persistent Systems online at www.persistentsystems.com.

RUGGED COMPUTERS

Rugged computing systems for transportation, disaster recovery, and mining introduced by Elma

Elma Electronic Inc. in Fremont, Calif., is introducing the ComSys-536x family of Cisco-based mission computing systems for rugged applications like transportation, disaster recovery, mining, and drilling operations. Based on modular building blocks, the ComSys-536x family uses Elma packaging to offer many performance and expansion configurations for computing-at-the-edge requirements. The Type 6 COM Express-based systems can be configured using a choice of Intel microprocessors, from Atom to Xeon, as well as expandable and upgradable high-capacity rugged SATA data storage. I/O options include Gigabit Ethernet, CANbus, Wi-Fi, Serial I/O, ARINC-429, and MIL-STD-1553. All Elma ComSys platforms include the Cisco 5921 embedded services router (ESR) with Mobile Ready Net capabilities. For more information contact Elma online at www.elma.com.

RF AND MICROWAVE

RF and microwave amplifiers for radar and communications introduced by Pasternack

Pasternack Enterprises Inc. in Irvine, Calif., is introducing a series of high-power, Class AB broadband amplifiers that incorporate GaN, LDMOS or VDMOS semiconductor technology. The combination of high linearity and efficiency with low distortion over a wide dynamic range for applications like communications systems, military radio, radar, signal jamming, test and measurement, and base stations. Pasternack offers 18 new high power, class AB RF and microwave amplifiers that cover frequency bands from 20 MHz to 18 GHz that feature saturated output power levels ranging from 10 to 200 Watts and power gain to 53 decibels. Designs operate in a 50-Ohm environment and are unconditionally stable. The compact coaxial packages use SMA or N-Type connectors and have integrated D-Sub control connectors for DC bias, enabled with TTL logic control, current sense and temperature sense functions. For more information contact Pasternack online at www.pasternack.com.

WIRING AND CABLE

Low outgassing wire and cable for space avionics introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the SPEC 55 low-fluoride wire and cable insulation system for space and high altitude environments. The SPEC 55 LF insulation system is designed for space avionics systems, C4ISR, guidance and seeker systems, and general wire harnessing systems. The insulation system is made from rugged fluoropolymer, and has a low outgassing rating of less than 10 PPM, which helps reduce the potential for corrosion of other components due to trapped gases escaping in a vacuum or low-pressure environment. The system offers resistance to scrape abrasion, and is available in lightweight single-wall or extra-rugged dual-wall variants, including custom options. The SPEC 55 LF insulation system is qualified to MIL-SPEC SAE-AS22759. The single wall SPEC 55 LF system is qualified to SAE-AS22759/51 and /52 while the dual wall variant is qualified to SAE-AS22759/53 and /54. For more information contact TE Connectivity online at www.te.com.

DATA STORAGE

Rugged solid-state data storage with trusted computing introduced by Crystal

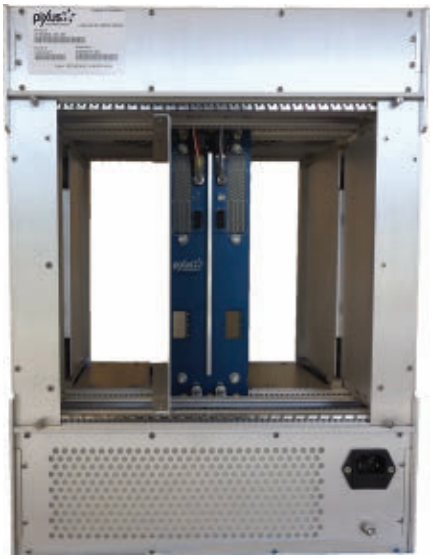
Crystal Group Inc. in Hiawatha, Iowa, is introducing the PASS SAS solid-state drives (SSD), which ruggedized and accredited data-encrypted drives for secure data storage at the tactical edge. Through a partnership with Seagate Government Solutions (SGS) in Herndon, Va., Crystal Group provides this data-at-rest

solution that meets U.S. government computer security standards, including FIPS 140-2 and NIAP accreditation. The unique combination of SGS's commercial, high-capacity 2.5-inch SAS SSDs and Crystal Group's proprietary ruggedization processes is for critical data protection and trusted-computing for military applications in extreme and unpredictable conditions. As the U.S. Department of Defense (DOD) moves closer to a dual-encryption standard for their data strategy requirements, these drives deliver the first layer of accredited, hardware-based data encryption. In turn, it will be easier for the DoD to integrate the next layer of cryptographic key management encryption for CSfC requirements. For more information contact Crystal Group online at www.crystalrugged.com.

CHASSIS AND ENCLOSURES

Embedded computing chassis for RF devices or SOSA introduced by Pixus

Pixus Technologies in Waterloo, Ontario, is introducing a new version of the VPXD1000 series embedded computing enclosures that enables VITA 67 slot configurations for RF interfaces over OpenVPX. Users can partition the chassis for a separate segment for specialty RF devices or Sensor Open Systems Architecture (SOSA) implementation. The new version of the VPXD1000 comes in a 63HP 12.6-inch-wide size to enable designers to use backplanes as large as 10 slots at 1-inch pitch. Alternatively, designers can use one portion of the chassis for a smaller VITA 67 backplane over OpenVPX and a separate segment for RF or other devices. Pixus can optimize the air-



flow/cooling for each segment. The VPXD1000 features removable sidewalls or open-frame access to probe plug-in cards. The chassis

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walls later can plug in for thermal testing or aesthetic purposes for end customers demonstrations. Pixus offers OpenVPX backplane/chassis systems in commercial, development, and MIL rugged formats. The company also provides IEEE and Eurocard components for the embedded computer market. For more information contact Pixus Technologies online at www.pixustechnologies.com.

REAL-TIME SOFTWARE

Wind River to support RISC-V processor with VxWorks real-time software

Wind River Systems in Alameda, Calif., is offering RISC-V open architecture support for the company's VxWorks real-time software operating system (RTOS). VxWorks supports the RISC-V open hardware instruction set architecture (ISA). The company has also joined the RISC-V Foundation consortium that seeks to standardize, protect, and promote RISC-V ISA together with its hardware and software ecosystem for all computing devices. VxWorks delivers performance, determinism, reliability, safety, and security for embedded computing systems of important critical infrastructure. For more information on the VxWorks real-time operating system software contact Wind River Systems online at www.windriver.com.

SPACE ELECTRONICS

Radiation-tolerant Ethernet transceiver for space uses offered by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing the VSC8541RT radiation-tolerant and space-qualified Ethernet transceiver for applications ranging from launch vehicles to satellite constellations and space stations. Microchip also has received final qualification

for the SAM3X8ERT radiation-tolerant microcontroller, an Arm Cortex-M3 core processor and embedded Ethernet controller. Both devices are commercial off-the-shelf (COTS) parts with enhanced characterized levels of radiation performance and high reliability. The VSC8541RT Ethernet transceiver is one-port Gigabit Ethernet copper PHY with GMII, RGMII, MII and RMII interfaces, and is latch-up immune to 78 Mev; TID has been tested to 100 Krad. The SAM3X-8ERT microcontroller embeds as much as 512 kilobytes of dual bank Flash, 100 kilobits SRAM, A/D and D/A conversion, and dual CAN controller on top of Ethernet capability. For more information contact Microchip Technology online at www.microchip.com.

POWER ELECTRONICS

Power control and distribution unit for rugged military applications introduced by DDC

Data Device Corp. in Bohemia, N.Y., is introducing the RP-2A0000000X AC/DC solid-state power distribution unit (PDU) that provides significant size, weight, power and cost (SWaP-C) savings for rugged military applications. The power electronics unit achieves its SWaP by combining 115-volt AC and 28-volt DC functionality, along with high power density, into a ruggedized, military-grade form

factor. The RP-2A0000000X provides a total power capability of 55 115 volts AC and 28 volts DC. The device offers a 70 percent reduction in power dissipation, along with energy savings through intelligent load shedding and prioritization. For more information contact DDC online at www.ddc-web.com.

CLOUD COMPUTING

Hybrid cloud computer with Intel Scalable processors introduced by WIN Enterprises

WIN Enterprises Inc. in North Andover, Mass., is introducing the PL-82010 hybrid cloud computer with dual high-performance Intel Xeon Scalable processors for cloud, Internet of Things (IoT), and call center applications. The server supports Hybrid cloud computers, and can handle private, proprietary data while enabling use of third-party cloud services for less-critical data. Features include 2U/12 bays TPCS system; 12x DDR4 ECC-RDIMM/LRDIMM/3DS LRDIMM 2400, 2666; (4+2) 1G BaseT LAN ports / 4x Gigabit Ethernet SFP+; 80+ Platinum Certified 550 by 850-Watt CRPS; and support for WIN Trusted Platform Control Module. High-speed data analysis comes from 24 processing cores per Intel Xeon CPU. Data originated at edge-deployed IoT devices goes to a PL-82010 central network server for analysis. Critical information is protected during these transactions through support of a TPC module (TPCM). The PL-82010 provides 3TB of DDR4 memory. I/O includes 4x Gigabit Ethernet SFP+, plus PCI Express expansion slots that can provide additional LAN support. In addition, PL-82010s can be deployed in the cloud by service providers to build a high performance computing (HPC) cluster. Storage is provided by 12x 3.5" hot-swap SATA/SAS SSDs; 4x 3.5" hot-swap SATA/SAS SSDs, and 2x M.2 NVMe chips per unit. For more information contact WIN Enterprises online at www.win-ent.com.

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