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TOP VISIONARIES of 2022

PGs. 30-35

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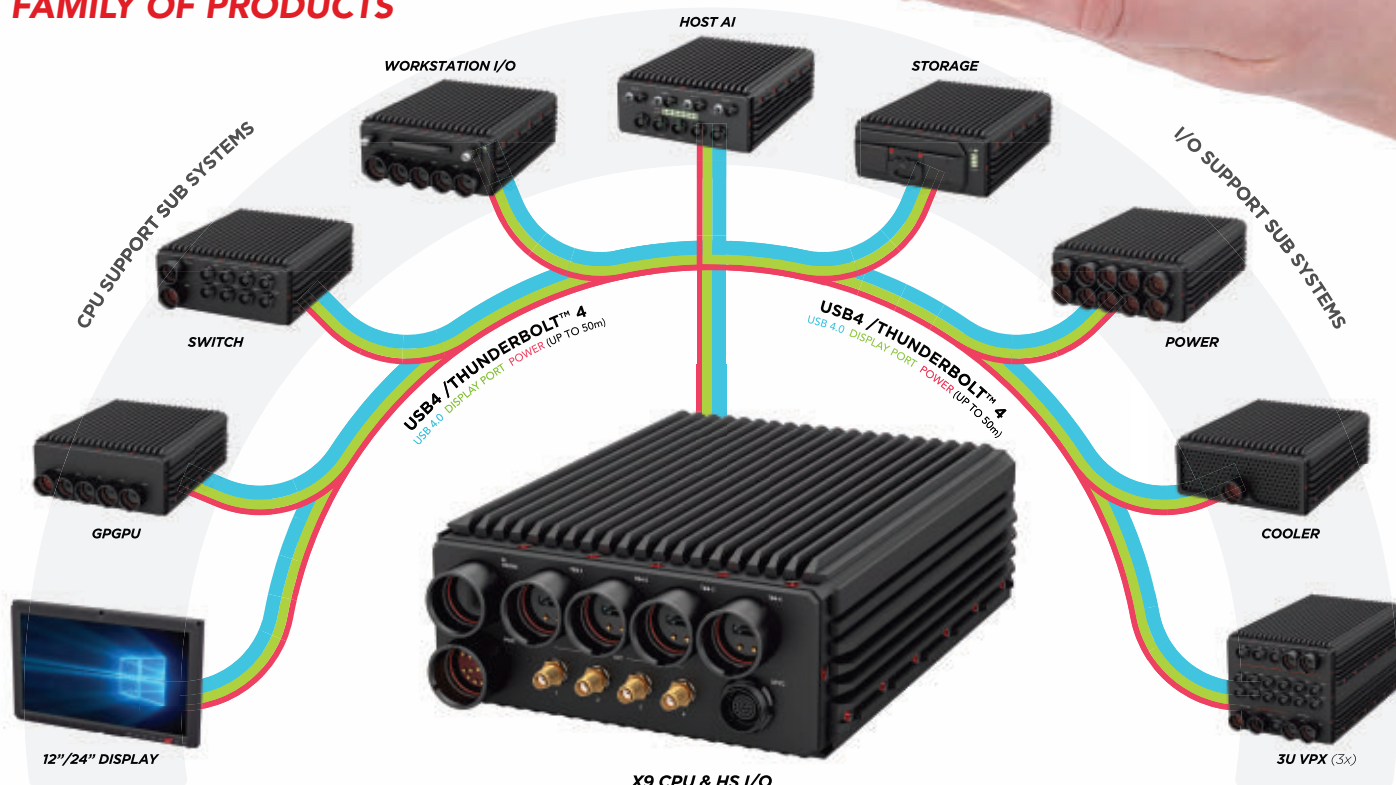
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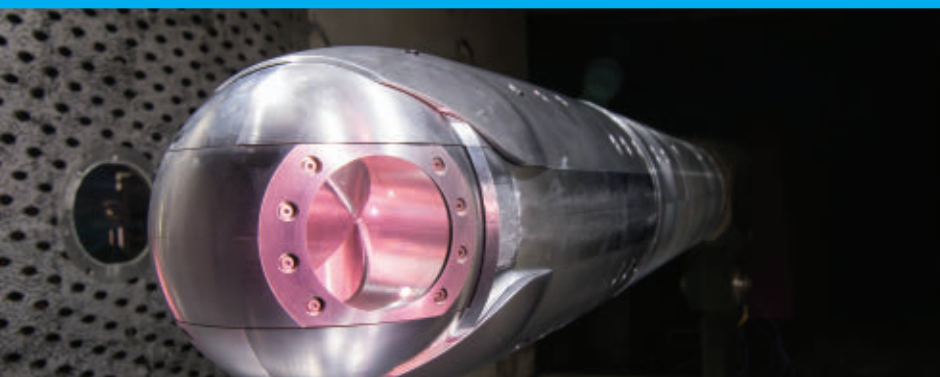
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Systems upgrades and technology insertion projects roll in to keep military systems on the leading edge



BY John Keller
EDITOR IN CHIEF

I can't remember when I've seen so many projects to upgrade U.S. military systems in such a short a time as I did in June. The Pentagon awarded at least 12 contracts in June — probably more — which goes to show how much the U.S. Department of Defense (DOD) relies on systems upgrades and technology insertion to keep military forces on the leading edge.

Avionics computers and networking, cockpit displays, electro-optical sensors, smart munitions, missiles, submarine combat systems, software, and digital signal processing are among the highlights of upgrade projects in June that collectively were worth more than \$700 million.

The orders started rolling in around early June when the U.S. Air Force asked Lockheed Martin Corp. to upgrade the multifunction displays in C-5M Super Galaxy giant four-engine cargo jets in a \$34.7 million order.

Next was a \$23.4 million order for Lockheed Martin to upgrade for technical insertions and support for the AN/BVY-1 Integrated Submarine Imaging System (ISIS). Following that was announcement of an avionics upgrade on a Cessna Citation CJ2+ by Collins Aerospace.

Next was an announcement that Intellisense Systems Inc. in Torrance, Calif. will provide replacement multifunction controls and displays for the U.S. Air Force C-5M cargo jet. Around mid-June was a \$33 million U.S. Army order to Lockheed Martin to refurbish M270 Multiple Launch Rocket System (MLRS) field artillery systems.

The upgrade projects just kept coming. The Navy let a \$39.7 million order to the Boeing Co. for additional Distributed Targeting Processor-Networked

(DTP-N) for U.S. and Australian F/A-18E/F and EA-18G attack jets.

The Navy also asked Boeing to refurbish 25 recertified Harpoon anti-ship missiles in a \$16.9 million order, and then the Navy asked General Dynamics Corp. to maintain and upgrade the AN/BYG-1 submarine combat system in a \$15.9 million order.

The second half of June saw a \$450 million Air Force contract to Lockheed Martin for the Joint Air-to-Surface Standoff Missile (JASSM), followed by a \$22.1 million Army order to Lockheed Martin to upgrade the Target Acquisition Designation Sight/Pilot Night Vision Sensor (M-TADS/PNVS) system, also known as Arrowhead with the Modernized Day Sensor Assembly (M-DSA) kits and spare parts for Army AH-64 Apache attack helicopters.

Months's end saw a \$29.4 million Navy contract to Raytheon Technologies Corp. to upgrade AGM-154C Block III Joint Standoff Weapon (JSOW) hard-target-penetrating and data-linked medium-range precision-guided smart munitions for the governments of Taiwan, Bahrain, and Canada.

The last one I saw — and I certainly missed some — was a \$43.8 million Navy order to Boeing to provide processors for the Distributed Targeting Processor-Network (DTP-N) system on Super Hornet and Growler aircraft.

These transactions are a reminder that the Pentagon doesn't have unlimited access to money, and military leaders must do the best they can with the money they have to keep sophisticated weapons systems functioning and able to meet the best that U.S. adversaries can field. ◀

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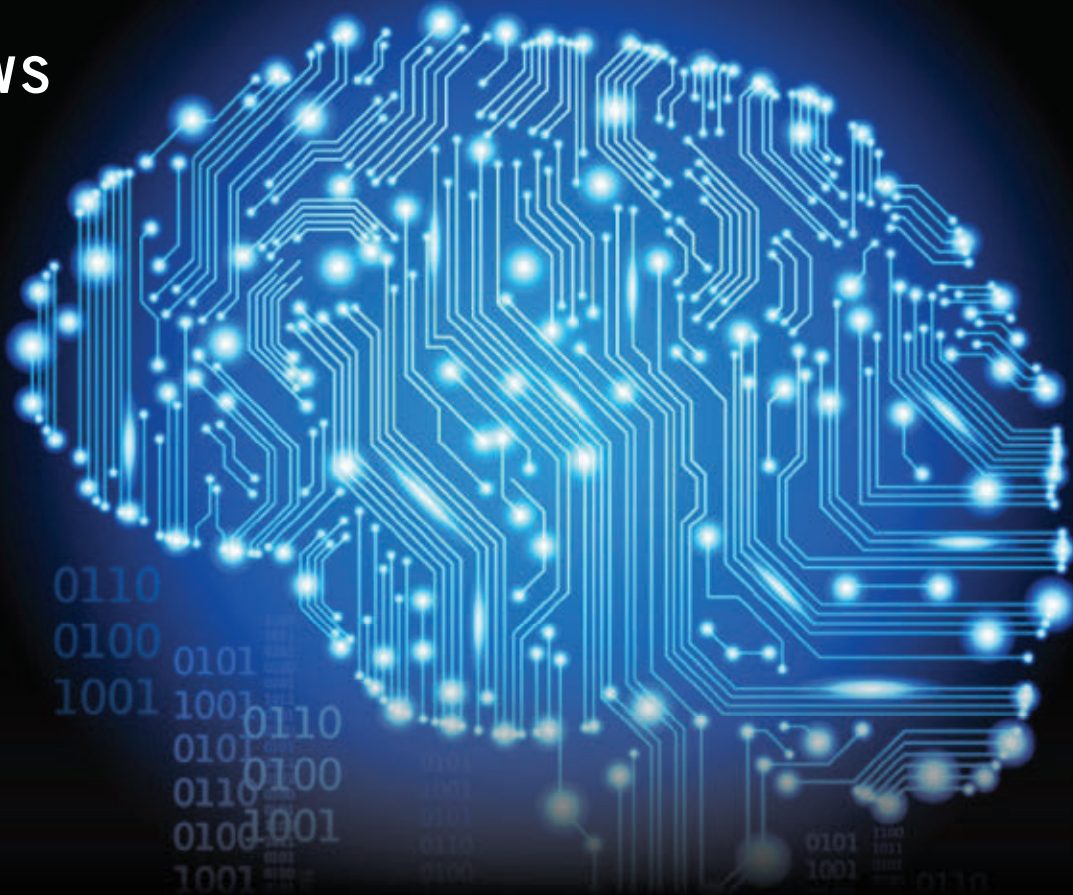
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Researchers eye artificial intelligence (AI) and machine learning for sensor processing

By John Keller

ARLINGTON, Va. – U.S. military researchers are notifying industry of their interest in reconciling and organizing information from separate sensors in an effort to enhance artificial intelligence (AI) and machine learning technologies.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a special notice (DARPA-SN-22-36) for the Enabling Confidence project of the Artificial Intelligence Exploration (AIE) program.

Accurate processing of covariance information related to environmental variations and noise from sensors is paramount

▲ **Military researchers are looking to artificial intelligence and machine learning to help organize and reconcile information from different sensors.**

to how well that statistics-based estimators like Kalman filters perform in sensor processing, and is the key enabler for combining information from several sensors, DARPA researchers explain.

Covariance is a measure of how two random variables differ; if the greater values of one mainly correspond with the greater values of the other — and the lesser variables tend to show similar behavior — the covariance is positive. Conversely, when the greater values of one variable mainly correspond to the lesser values of the other, the covariance is negative.



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The Enabling Confidence project will develop scalable ways to generate covariance information for machine learning systems to enhance performance when combining several subsystems. It encourages using machine learning approaches like deep learning and Bayesian techniques.

Specifically, DARPA researchers want to know if a machine learning system output covariance can reflect sensor and environmental covariance information. Also, can computer scientists develop machine learning subsystems hierarchically to increase inference accuracy?

Researchers also want to know if systems integrators could combine these kinds of machine learning systems with statistics-based estimation, like Kalman filters, to reduce errors.

DARPA researchers seek to overcome two primary challenges in this project. First, simple covariance measures often are insufficient to characterize output uncertainties after sensor and environmental variations propagate through the machine-learning architectures.

Second, nonlinearities in existing machine-learning architectures make direct calculations difficult to control, and approximate methods degrade performance.

The Enabling Confidence project will last for 18 months, with a nine-month first phase, and a nine-month second phase. The first phase will demonstrate the feasibility of generating accurate output covariance for realistic machine learning by experimentally validating the resulting system covariance model using cross-correlation measurements.

The second phase will demonstrate the feasibility of edge deployment of these technologies by demonstrating a 10x speedup in covariance generation over the first phase; and demonstrate lower errors in an estimation task by linking a machine learning subsystem with a conventional statistics-based estimator. ◀

This notice is for information and planning purposes only, and is not yet a formal solicitation. Email questions or concerns to EnablingConfidence@darpa.mil. More information is online at <https://sam.gov/opp/85d024ca121f4211b044642f04e95cc8/view>.



TSA launches \$99 million program for technologies to speed passenger screening

BY John Keller

WASHINGTON – U.S. airport security experts are kicking-off a \$99 million five-year program to more than double the speed of screening passengers and their carry-on baggage over today's screening rates.

Officials of the U.S. Transportation Security Administration (TSA) in Washington released an open broad agency announcement (70RSAT22RB00000001) this week for the Screening at Speed program.

This initiative seeks to develop enabling technologies to increase the speed of passenger and carry-on baggage screening from today's 50 to 150 passengers per lane per hour, to as fast as 300 passengers per hour at each security lane at major U.S. airports.

This initiative will be available for industry bids over the next five years. TSA experts are not taking bids now, but will ask for industry proposals in a series of specific technology calls over the duration of the program.

Evolving airport security threats have created a need for technological improvements to screen the growing

number of people who pass through airport security checkpoints each year, TSA officials explain.

The Screening at Speed program seeks not only to develop and deploy technologies to bolster aviation security while speeding-up the rate of passenger screening, but also to reduce the number of false alarms that today's screening equipment can generate.

The goal of Screening at Speed is to develop and demonstrate faster and

▲ U.S. Transportation Security Administration officials are asking industry for new enabling technologies to speed passenger screening at busy airports.

more robust passenger and carry-on baggage screening technologies by detecting threats at TSA's highest standards; screening more than 300 people per lane per hour; screening people without the need for them to

remove coats, shoes, belts, or hats; screening liquids, aerosols, gels, powders, and electronics without removing them from passenger bags; lifting restrictions on the quantity and size of liquids, aerosols, gels, and powders that passengers can carry on; and significantly reducing false alarms.

In addition, TSA officials want the ability to integrate future third-party technology upgrades into

passenger-screening equipment as these new technologies become available.

TSA officials say they expect technology topics of the Screening at Speed program to include:

- passenger analysis;
- video analytics;
- integrated sensing and data fusion;
- risk-based security;
- identity verification and credential authentication;
- passenger screening;
- millimeter wave (active or passive);
- terahertz wave;
- enhanced metal detection;
- automatic threat recognition;
- radio frequency material characterization;
- property screening;
- computed tomography x-ray;
- phase contrast imaging;
- x-ray diffraction;
- computed tomography reconstruction;
- prohibited items detection algorithms;
- explosive detection algorithms;
- non-X-ray sensors like neutron imaging;
- system architecture and integration;
- open interfaces and algorithms;
- curb-to-gate sensing;
- network interconnects and data topology;
- data storage and curation;
- data fusion algorithms;
- seamless concepts of operations, passenger self-screening;
- image processing and human systems;
- enabling capabilities;
- trace explosives detection (contact or non-contact);
- bulk explosives detection;
- rapid response and emerging threat mitigation;
- user interfaces including augmented/virtual reality; synthetic data generation;
- process optimization and officer evaluation;
- test and evaluation;
- explainable artificial intelligence and machine learning; and
- automated test beds.

Submit questions or concerns by post or courier to John Fortune, manager of the Screening At Speed program, 245 Murray Lane, #0200, Washington, D.C. 20528; Carolyn Lethert, contracting officer, 301 7th Street, SW, RM 3051, Washington, DC 20528-0115; or Jennifer K. Koons, contract specialist, 301 7th Street, SW, RM 3051, Washington, DC 20528-0115. ←

More information is online at <https://sam.gov/opp/70015ebaa5e041f3821c09837649df9f/view>.

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Lockheed Martin to upgrade avionics multifunction displays aboard C-5M cargo jet

BY John Keller

ROBINS AIR FORCE BASE, Ga. – Military avionics experts at Lockheed Martin Corp. will upgrade the multifunction displays in cockpit avionics of the U.S. Air Force fleet of 52 C-5M Super Galaxy giant four-engine cargo jets under terms of a \$34.7 million order.

Officials of the Air Force Life Cycle Management Center at Robins Air Force Base, Ga., are asking the Lockheed Martin Aeronautics segment in Fort Worth, Texas, to build a hardware and software prototype architecture for replacing the C-5M's current multifunction display unit.

This order is part of an overall Air Force effort called the Replacement Multifunctional Controls and Displays (RMCD) program to adapt existing interfaces with the C-5M avionics backplane to avoid any development that would drive a redesign of the entire avionics suite, Air Force officials say.

▲ **Lockheed Martin is upgrading the multifunction displays in the cockpits of the 52 U.S. Air Force C-5M Super Galaxy four-engine cargo jets.**

This design approach seeks to reduce the risk of grounding any of the Air Force's C-5M fleet while they are waiting delivery of mission-critical avionics components, and to improve overall aircraft availability.

Lockheed Martin will provide engineering and technical services to produce a hardware and software prototype architecture that will move the display

upgrade project into engineering and manufacturing development.

The C-5 is larger than a Boeing 747 and is one of the largest military transport aircraft in the world. The aircraft, which has been in the Air Force transport fleet since 1970. Lockheed Martin predecessor Lockheed Corp. is the original designer of the C-5 airlifter. Lockheed and Martin Marietta merged in 1995 to form Lockheed Martin.

The plane is large enough to fit six Greyhound buses, lined up two abreast. The aircraft is designed to perform strategic airlift, emergency aeromedical evacuation, transport of brigade-size forces and equipment, and delivery of oversize cargo.

The aircraft can transport 12.5 tons of cargo, and can carry two M1 Abrams main battle tanks, an Abrams tank plus two M2 Bradley Fighting Vehicles, 10 Light Armored Vehicles, six AH-64 Apache attack helicopters, or 36 standard cargo pallets. The aircraft's lower deck also can accommodate 270 troops.

Since 2002 the C-5M has undergone a major series of upgrades, including the Avionics Modernization Program to install a mission computer, a glass cockpit with digital avionics including autopilot and automatic throttles, and communications, navigation, and surveillance components for air traffic management. The aircraft also has received new engines.

The new C-5M display and graphics processors will replace legacy multifunction display through legacy interfaces to the existing mission processing system, while also being prepared for future interface technology updates.

Lockheed Martin also will update the C-5M's operational flight programs, update the plane's diagnostic system by using an Ethernet interface, and update the C-5M's aircraft wiring. ◀

On this order Lockheed Martin will do the work in Fort Worth, Texas, and should be finished by May 2025. For more information contact Lockheed Martin Aeronautics online at www.lockheedmartin.com/en-us/who-we-are/business-areas/aeronautics.html, or the Air Force Life Cycle Management Center at www.afllcm.af.mil.

Raytheon picks ANRA to help integrate uncrewed aircraft in national airspace

BY Jamie Whitney

WASHINGTON - Raytheon Intelligence & Space sought support simulation and live drone flight operations technology. They found their solution from ANRA Technologies in Tartu, Estonia.



▲ **Raytheon Intelligence & Space sought support simulation and live drone flight operations technology. They found their solution from ANRA Technologies in Tartu, Estonia.**

ANRA's SmartSkies suite of technology solutions will be put in use at the Mid-Atlantic Aviation Partnership UAS test site at Virginia Tech. The testing is part of a larger project to safely integrate uncrewed aircraft systems (UAS) into the National Airspace System and advance beyond visual line of sight (BVLOS) operations.

Under the contract, Raytheon will establish a ground-based surveillance supplemental data service provider (SDSP) test program consisting of local radar services using the company's Skyler active

electronically scanned array, AESA, UAS weather product services and UAS service suppliers.

ANRA Technologies will partner with Raytheon and other program participants, including Virginia Tech, SkyGrid and Tomorrow.io, to test technologies that will support scalable, safe and compliant BVLOS drone operations at low altitudes.

ANRA will implement its SmartSkies airspace management and data services platform to gather detailed and comprehensive SDSP data to provide a holistic operating approach as the nation moves forward to create a safe and reliable environment for UAS and Urban Air Mobility.

For this project, ANRA SmartSkies FUSION will consume data feeds from the Skyler AESA and data transmitted from cooperative aircraft flying within the USS network to develop a well-defined and known airspace environment. ◀

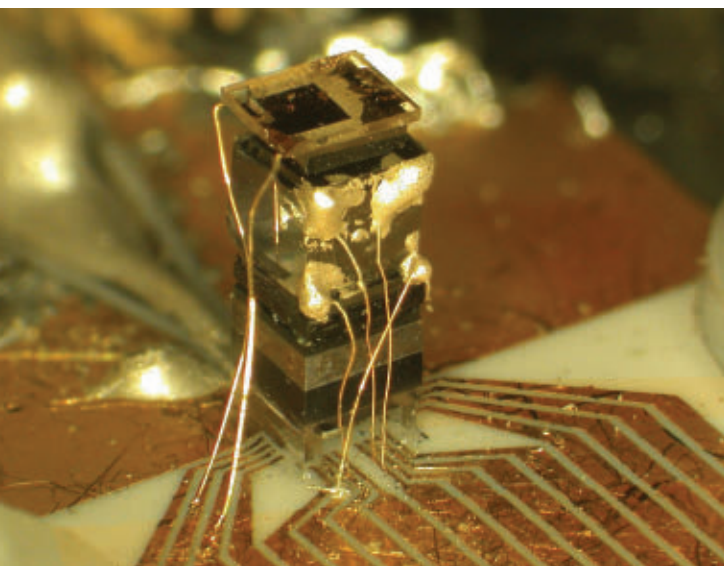
SmartSkies FUSION leverages artificial intelligence and machine learning to generate a path-prediction capability to forecast into the future where aircraft will be positioned. SmartSkies CTR, in turn, enables the ability to aggregate and integrate networked and non-networked surveillance data with UTM, creating a complete airspace picture that can be distributed to authorized users. SmartSkies AWARE will integrate the Tomorrow.io weather intelligence platform into the system for flight planning and route optimization and other supplementary datasets already available in the system.

DARPA needs rugged ultra-small clocks to maintain navigation and guidance without GPS

BY John Keller

ARLINGTON, Va. – U.S. military researchers are asking industry to develop ultra-small low-power clocks to help military forces maintain precise positioning, navigation, and timing (PNT) in case that GPS navigation satellites are damaged, destroyed, or jammed.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has issued a broad agency announcement (HR001122S0038) for the H6 program, which seeks to develop ultra-small, low-power clocks that can maintain microsecond precision for at least one week in temperatures from -40 to 85 degrees Celsius.



Military researchers are asking industry to develop ultra-small low-power clocks to help military forces maintain precise positioning, navigation, and timing (PNT) in the absence of GPS.

H6 refers to an 18th Century British ocean-navigation project that in five increments developed precise chronometers that helped British ocean navigators determine their vessels' positions in longitude to prevent catastrophes like the 1707 Scilly Naval Disaster that wrecked four British warships and killed between 1,400 and 2,000 sailors due to navigational errors.

British inventor John Harrison developed five generations of clocks, which he called H1 through H5; the last one was the first marine chronometer with the accuracy necessary to determine longitude accurately. Navigators can determine latitude with sextants using the sun and stars; determining longitude, however, requires precise clocks.

H6 is the spiritual successor to Harrison's maritime chronometers. While the longitude problem was the preeminent PNT challenge of the last millennium, GPS denial is the greatest problem today, DARPA researchers point out.

Ubiquitous compact timing today remains critical not only for navigation, but also for communications, electronic warfare (EW), and intelligence, surveillance, and reconnaissance (ISR).

A tactical-grade clock that maintains weeklong microsecond timing would remove PNT timing from dependence on navigational satellites for the majority of U.S. military missions, and enable signal assurance, pervasive communications security, and high-bandwidth communications.

Today, no such fieldable tactical-grade clock exists; while there are clocks which can achieve the necessary performance, their size, weight, and power consumption (SWaP) limitations preclude their use in a tactical setting.

DARPA researchers are interested in SWaP-constrained clocks that rely on compound mechanical clock technologies; sub-terahertz molecular clock technologies; or something completely different.

H6 will be a five-year, three-phase program. The first phase will focus on clock dependence on temperature and SWaP reduction, while the second phase will focus on clock aging throughout the tactical temperature environment. The third phase will demonstrate an integrated tactical-grade clock and build five clocks. ←

Companies interested were asked to upload abstracts by 16 June 2022, and full proposals by 8 Aug. 2022 to the DARPA BAA website at <https://baa.darpa.mil>. Email questions to HR001122S0038@darpa.mil. More information is online at <https://sam.gov/opp/fba0b64702914a0ab95f26681362cf79/view>.

FAA begins investing \$1 billion into air traffic control system

The U.S. Federal Aviation Administration (FAA) has started investing \$1 billion into the country's air traffic control (ATC) system. The funding will sustain, repair, or replace hundreds of buildings and pieces of equipment that make for safe flying in the U.S. The FAA will invest in communications, surveillance, weather, and navigation systems; replace underground power cables, transformers, switches, engine generators, and fuel storage tanks; update and repair air route traffic control centers; renovate or replace long-range radar sites; prepare for building air traffic control towers; improve towers and approach & departure facilities; remove and restore outdated facilities or personnel safety infrastructure; recruit and hire installation technicians and engineers; and upgrade integrated security systems at all FAA-staffed facilities.

Honeywell's Anthem is moving avionics into the future

Honeywell Anthem is designed to solve two problems: creating ways for aircraft to function with more autonomy; and enabling the aircraft-support systems to work together. Historically, mechanics and pilots had to be on board aircraft with wired connections to transfer critical data like maintenance status and flight plans. Honeywell Anthem allows for this data transfer without needing to be physically near the aircraft. Additionally, individual support systems (fuel, maintenance, catering, etc.) have also been disjointed, forcing pilots to interface with multiple third-party apps, websites and businesses both pre-flight and post-flight.

United Airlines picks Honeywell 131-9A auxiliary power unit for new Airbus fleet

United Airlines has selected Honeywell's 131-9A auxiliary power units (APUs) to equip 120 of its scheduled deliveries of Airbus NEO and XLR aircraft. These

APUs are designed to provide operational performance, low maintenance cost and fuel savings. The Honeywell 131-9A APU provides the air source to start an aircraft's main engines as well as electrical power and air conditioning while the plane is on the ground, ensuring maximum passenger comfort. The 131-9A is known for its reliability and low maintenance costs over the course of its entire life cycle, resulting in significant fuel savings each year. ◀

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Upgrades set to enable Army MLRS artillery to fire ATACMS and PrSM missiles

By John Keller

REDSTONE ARSENAL, Ala. – Fire support experts at Lockheed Martin Corp. will refurbish M270 Multiple Launch Rocket System (MLRS) field artillery systems for the U.S. Army under terms of a \$223 million order announced in late April.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., are asking the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, to upgrade existing M270A1 and decommissioned M270A0 MLRS artillery pieces to the new M270A2 configuration.

MLRS is a heavy tracked mobile launcher, transportable via C-17 and C-5 aircraft, that fires guided MLRS rockets and Army Tactical Missile System (ATACMS) missiles.

MLRS also will be able to fire the Army's future Precision Strike Missile (PrSM) and Extended-Range GMLRS rockets, which are in development.


The M270A2 is an upgraded variant of the Lockheed Martin M270 MLRS. The A2 version features the Common Fire Control System (CFCS), as well as new engine, transmission, launcher-loader modules, and improved armored cabs.

The CFCS will be common to the Army MLRS and to the High-Mobility Artillery Rocket System (HIMARS). The CFCS

will help enable the MLRS to fire the extended-range Guided Multiple Launch Rocket System (GMLRS) munition, which has a range of nearly 94 miles, and is expected to see future upgrades.

The Army ordered the first batch of 50 M270A2 upgrade kits through a \$362 million contract in April 2019. Army leaders say they plan to upgrade 225 existing M270A1 and 160 decommissioned M270A0 rocket launchers this decade, which should extend the life of the MLRS through at least 2050. ◀

On this order Lockheed Martin will do the work in Camden, Ark.; Grand Prairie, and New Boston Texas, and should be finished by April 2026. For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa/>.



◀ Lockheed Martin engineers are making upgrades to enable the Multiple Launch Rocket System to fire the Army's future Precision Strike Missile (PrSM) and Extended-Range GMLRS rocket.

Raytheon to stave-off component obsolescence in StormBreaker air-to-ground missiles

BY John Keller

EGLIN AIR FORCE BASE, Fla. – Smart munitions designers at Raytheon Technologies Corp. will produce, upgrade, and maintain U.S. Air Force radar- and infrared-guided air-to-ground missiles under terms of a potential \$75 million order.

Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., are asking the Raytheon Missiles & Defense segment in Tucson, Ariz., for Small Diameter Bomb II Life Cycle Support Contract III for all versions of the GBU-53 StormBreaker Small-Diameter Bomb.

Support includes engineering and manufacturing development integration, production, sustainment, testing, obsolescence analysis and management, logistics support, testing, training, upgrades, and software updates.

Raytheon also will provide upgrade studies and analysis, simulations, modeling, test hardware, aircraft integration, procurement of test hardware, engineering, management fielding, and logistics for future growth requirements.

Like the GPS-guided GBU-39 SDB I already integrated on the F-35 joint strike fighter, the 208-pound StormBreaker is six to seven inches in diameter. This size can fit eight StormBreaker munitions in the F-35's confined internal weapon bays.

If stealth is not a factor, about 16 more can fit on the F-35's wings. The munition also is approved for use on the Navy the F/A-18E/F Super Hornet carrier-based jet fighter-bomber and Air Force F-15E jet fighter-bomber.

The StormBreaker air-to-ground smart weapon with multi-mode seeker can hit moving targets in bad weather. The winged munition autonomously detects and classifies moving targets in darkness, rain, fog, smoke or dust.

The tri-mode seekers share targeting information among all three modes to engage fixed or moving targets any time, and



Raytheon is finding ways to avoid potentially time-consuming and expensive component obsolescence issues in the U.S. military's StormBreaker Small-Diameter Bomb.

in any weather. The weapon can also fly more than 45 miles to strike mobile targets. The total cumulative face value of the Small Diameter Bomb II Life Cycle Support Contract III contract is \$275 million.

The smart munition for guidance uses millimeter wave active radar homing, semi-active laser guidance, infrared homing with an uncooled imaging infrared camera, GPS-coupled inertial guidance, and radio data-links back to the aircraft.

Its millimeter wave radar detects and tracks targets through weather; imaging infrared provides enhanced target discrimination; and its semi-active laser enables the weapon to track a laser designator on the aircraft, or on the ground. ◀

On this order Raytheon will do the work in Tucson, Ariz., and should be finished by September 2024. For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

High-energy

W La Weapon





Laser weapons

ready for the front lines

The U.S. military services are working with the defense industry to develop new-generation laser weapons for deployment on land, on aircraft, and on Navy surface warships.

BY Megan Crouse

High-energy and laser weapons seem to be perpetually on the metaphorical horizon. Over the decades, the U.S. military has tested them for a variety of applications, from blinding sensors to disabling enemy vehicles.

Field tests in the last few years prove the interest of government and industry in demonstrating lasers with increasing wattage. There also is the matter of practicality: mounting a largely experimental weapon on a vehicle that may jostle on wheels over rough ground or reach high speeds in flight is an added challenge. Still, the industry is showing interest in making it a reality.

Types of lasers

Practical laser beams for defense can fall into one of two categories: distributed gain — a series of slabs through which energy is beamed serially; and spectrum beam — a combination of fiber lasers similarly to what one might see in fiber communications. Fiber lasers were developed originally for industrial cutting and welding. While there are a variety of other ways to classify the components, these are two major distinctions.

“High-energy weapons” or “directed energy” is the larger category that can include lasers. It might also refer to RF and



microwave sources used as weapons, which some refer to as electromagnetic weapons. These have been demonstrated for non-lethal use against people

Other examples of high-energy weapons can include sound-based weapons, as well as a theoretical “particle beam.” While there is an element of speculation to this field overall, some signs do point to laser weapons becoming more practical.

Uses of laser weapons

In the past, defense experts theorized that lasers might be best for blinding enemy sensors or obscuring the vision of pilots of aircraft or helicopters. Today, the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., seeks them for destroying or disabling enemy unmanned aerial vehicles (UAVs). Lasers often are considered part of a missile-defense screen — in particular, burning through the side of a cruise missile potentially could incapacitate it.

On the Defense Matters podcast in March 2022, retired U.S. Air Force Col. Mark Gunzinger, former director at the Mitchell Institute for Aerospace Studies and former deputy assistant secretary of Defense, pointed out that the Defense Department is seriously investing in lasers.

▲ **The Army evaluated a Directed Energy-Maneuver Short-Range Air Defense system, or DE M-SHORAD, aboard a Stryker combat vehicle in July 2021 at Fort Sill, Okla.**

“Over the years I’ve seen a constant level of funding somewhere between \$500 million and \$600 million per year going into research and development for all kinds of directed energy capabilities,” Gunzinger told Defense Matters. “That has been almost doubled in

the last budget, but still, if you think about hypersonic weapons, that last budget was about \$3.8 billion for hypersonic weapons. So directed energy research development and some acquisitions is still about a third of that.”

Electromagnetic weapons that use high-power microwave energy have several advantages over conventional weaponry, Gunzinger said. As long as the weapon has electric power, it does not need to carry ammunition or to reload. That also means there essentially is no supply chain necessary for operation. This means the weapon can move around frequently. Moreover, it’s a good fit for distributed operations that reduce their vulnerability to attack.

However, Gunzinger notes, the efficacy of laser weapons may be reduced by certain weather conditions. Therefore, he said, the military needs kinetic and non-kinetic weapons to be able to work together in the same place. Likewise, fire control systems need to be able to integrate both.

A war game in January at Kirtland Air Force Base, N.M.,

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demonstrated one of these joint fire applications. As its name suggests, the Directed Energy and Kinetic Energy Directed Energy Utility Concept Experiment provided an early look at using directed energy and conventional weapons under the management umbrella of an artificial intelligence (AI)-enabled battle management system. They included a laser pod mounted on an aircraft and two “future kinetic concepts” as part of the virtual test.

Gunzinger notes that practical lasers for missile defense or other applications seem perpetually to be 10 years out. However, he also pointed out that recent developments indicate we may at least be in a period of rapid iteration and activity in this area. Over the last six years, U.S. tests have gone from 60-kilowatt lasers to 300-kilowatt lasers. In another two years, Gunzinger predicts, the U.S. will be fielding 300-kilowatt and possibly even 500-kilowatt systems. He predicts megawatt-class lasers will enter the conversation in the next five years.

Experiments with ground vehicles

One way to solve a laser weapon’s need for power is to build it onto its own vehicle. Adding the additional variables that come with a mobile platform also adds challenges.

Integration needs to include factors like available volume, weight, how much power and cooling it needs, and placement, says Dr. Robert Afzal, Lockheed Martin Aculight senior fellow in laser and sensor, in Bothell, Wash.

▲ **The U.S. Army is moving one step closer to fielding a platoon of four laser-equipped Stryker prototypes next year after a combat shoot-off last year.**

“What are the vibration and shock environments?” says Afzal. “What temperatures will the system be exposed to? What other considerations like air pressure, salt spray, waves, dust or other conditions. Design choices are made to balance survivability with performance.”

Mobile lasers today may also include portable generators. As we reported last year, one of the projects the U.S. government has its eyes on in a very public way is the army’s test of 50-kilowatt lasers on Stryker combat vehicles. Since last year, this has undergone more testing. The Army tested M-SHORAD (Maneuver-Short Range Air Defense, built by Raytheon) in May, a vehicle-mounted laser which runs power from a gasoline-fueled generator.

They worked with Kord Technologies in Huntsville, Ala. (a subsidiary of KBR), to integrate the 50-kilowatt weapon onto an eight-wheeled Stryker combat vehicle from General Dynamics Land Systems in Sterling Heights, Mich. The laser was able to track, target and defeat 60-millimeter mortar rounds and drones in three different sizes during a test at White Sands Missile Range in New Mexico. This is part of a legacy of fitting more powerful lasers on smaller and more mobile footprints.

The M-SHORAD system also demonstrates the way a laser can integrate into wider command and control nets. While it includes a radar system, it can also connect to air picture from the Terminal High Altitude Area Defense command and control (THAAD C2). Rapid deployment is currently planned for 2022.

Craig Robin, deputy director of the RCCTO DE Project Office, told the AFCEA's Signal Magazine in August 2021 that the Army has three directed-energy projects in the works. M-SHORAD is one of them, as well as another high-energy laser project and a high-power microwave weapon project made to defend against close-range swarms of drones.

"With an effectively infinite magazine and near-zero cost per shot, [High Energy Laser] is now the proven answer to asymmetric threats like drones and mortars," Byron Bright, president of KBR Government Solutions, said in a news announcement.

The Army has been seeking solicitations for a 300-kilowatt laser weapon in 2021 and 2022, as well as awarding some projects for practical testing.

Afzal noted that some major changes have come about as these lasers have been practically demonstrated. The U.S. military and Lockheed Martin has learned from laser engineering and field tests in the last year.

"Systems are demonstrating they can be effective against a variety of threats. There is still much learning to be had as the systems move from demonstrations to field deployment," said Afzal.

In particular, Lockheed Martin and the U.S. Office of Naval Research (ONR) in Arlington, Va., demonstrated the Layered Laser Defense (LLD) laser weapon system could defeat a surrogate cruise missile at tactically relevant ranges in April.

Designed and built by Lockheed Martin, the LLD is a multi-domain, multi-platform demonstration system. Its 100-kilowatt-class spectrally beam combined high energy laser was chosen because it "exhibits excellent beam quality and aim point precision throughout engagement of increasingly challenging targets and a growing range of threats," Afzal said.

Like other laser tests we've mentioned recently, targets for the LLDs included unmanned aerial systems, rockets, artillery and mortars and fast-attack boats.

There also have been some efforts to use laser weapon systems on even smaller vehicles. Forbes reports a 10-kilowatt laser weapon from Raytheon for the Air Force was developed to ride along on a Joint Light Tactical Vehicle (JLTV), and a custom military vehicle the size of a dune buggy. Its four main subsystems — the laser unit itself, the energy magazine or battery, the power system and the thermal management — all fit on the back of the vehicle, plus a basketball-sized beam director for targeting moving drones.

This system uses fiber laser amplifiers to combine multiple—kilowatt beams from relatively small amplifiers, decreasing the footprint. Commercial technological improvements in terms of fiber lasers and electricity storage enabled this downsizing.

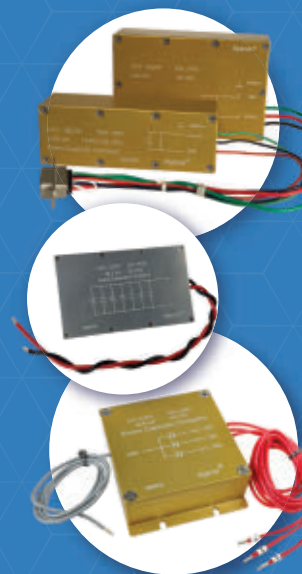
"Another example is the energy storage capability that we get from advanced lithium-ion batteries out of the hybrid vehicle industry. These allow us to store hundreds of seconds of clean, on-demand, and rechargeable HEL power in a compact package," Evan Hunt, high energy laser business development lead at Raytheon, told Forbes in September 2021.

Afzal notes that every development builds on the next, particularly when it comes to making these systems hit those magic words: smaller and more affordable.

"Our past R&D successes include a prototype 30-kilowatt laser in 2013 (ALADIN) and a complete end-to-end laser weapon system in 2014 (ATHENA)," he said. "Looking ahead, Lockheed Martin is scaling from this proven foundation to develop subsystems that enable higher-power mission capability within incrementally smaller volumes. These current and future advancements will provide tactical and strategic advantages that shift the cost calculus for customers."

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An artist's rendering of Lockheed Martin's HELIOS system for defending U.S. Navy surface warships from airborne attack.

Ship-mounted lasers continue tests

Working off of a ship's onboard electricity eliminates a laser weapon's need for kinetic ammunition. The Navy has taken delivery of the 60-kilowatt High-Energy Laser with Integrated Optical Dazzler and Surveillance, or HELIOS, from Lockheed Mission Systems and Sensors. This is one of several projects in this area being worked on by the Navy.

Jon Rambeau, Lockheed Martin's vice president and general manager for integration for systems and sensors, told Seapower Magazine he sees HELIOS opening a new era for high-power weapons.

"The question is going to turn more to funding priorities, price points, the capacity of our industry primes, and the supply chain that could build these things in full quantities and at

scale and then, ultimately, conversations around doctrine and how they would actually be employed in combat," Rambeau said.

In December 2021 the Navy tested another system, the Solid State Laser - Technology Maturation Laser Weapons System Demonstrator (LWSD) Mark 2 MOD 0, on drone targets or small boats. This builds on what the Navy learned from three years of testing their 30-kilowatt laser system aboard the amphibious transport dock USS Ponce.

Directed energy for fighter jets faces delays

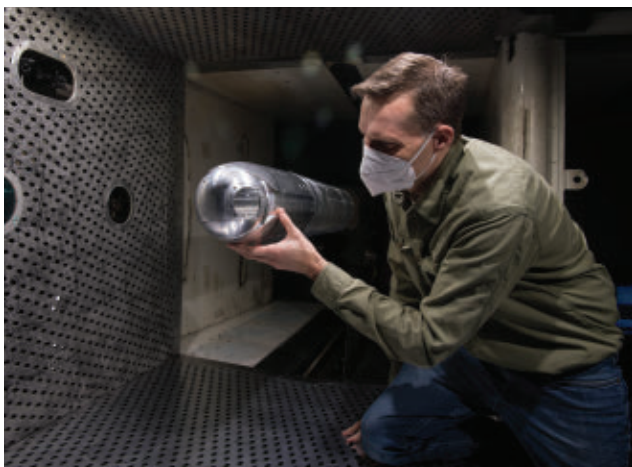
Making laser systems small enough to sit in back of a dune buggy also helps make it possible to install them aboard fighter jets, although this is the ultimate test of limitations in size, weight, and power consumption (SWaP). With every inch and pound of space on an aircraft accounted for, adding one system threatens to require the removal of another. However, there have been some developments in this area.

Lockheed Martin is working with the Air Force Research Laboratory (AFRL) on the Self-Protect High Energy Laser Demonstrator (SHIELD), a directed energy system meant to be mounted on an F-15 to defend against incoming missiles. However, this program and others like it have faced some notable delays.

Lockheed Martin, Boeing, and Northrop Grumman have worked together on the SHIELD program. Originally planned for 2021 and now slated for possible demonstration in 2024,



A directed energy (DE) system turret is positioned on a sting in the 4-foot transonic wind tunnel at Arnold Air Force Base for testing.



Researchers look at a directed-energy (DE) system turret in the four-foot transonic wind tunnel at Arnold Air Force Base, Tenn., last March.

SHIELD has been delayed by COVID-19 and technical limitations. The technology is still catching up to the required power levels, beam stability, ability to defend against ballistic missiles at very short range, and the ability to operate under heavy atmospheric turbulence.

Skeptics like former U.S. Department of Defense (DOD) head of Research & Engineering Mike Griffin also have cited support requirements as hurdles that will provide a lot of challenges before high-powered directed energy systems can go airborne. At high-speed, the pods must be able to stand up against constant high wind and high G forces.

The Air Force "already has systems that use lower powered lasers to blind the infrared sensors on missiles, so the ability to steer the beam and keep it on a target exists in the types of engagements we're talking about here," Todd Harrison, head of the Aerospace Security Project at the Center for Strategic and International Studies (CSIS) told Breaking Defense in 2021. "The difficulty is doing that at a higher power level and maintaining focus and beam coherence."

However, Harrison added, "Directed energy systems like this are likely the future of air and missile defense for airborne platforms because they can provide a much larger magazine of shots than kinetic interceptors. This is the most viable way to shift the cost exchange ratio in favor of the defender."

Other decision-makers involved in this area, such as former Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics Will Roper, have discussed focusing on using directed energy against drone swarms instead of trying to intercept missiles in flight from the air. Still others have proposed a ground-based laser could do the job of defending against

missiles better than a system onboard an aircraft could. It's uncertain whether getting a directed energy weapon to work in such extreme conditions as on board an aircraft will be plausible without prohibitive amounts of time and money.

The Drive pointed out in August 2021 that wind tunnel tests highlight the complications and how the possibility of an aircraft-mounted laser is getting some serious consideration. In the Aerodynamics Branch of Arnold Engineering Development Complex (AEDC) at Arnold Air Force Base, Tennessee, engineers tested what happens to a directed energy weapon when the aircraft it's mounted on travels at Mach 2.0. It's an effort almost eight years in the running.

One major concern is flow mitigation, which required an "aerodynamic fence" to be built around the turret containing the directed energy weapon in order to maintain acceptable beam quality. This project also assumes the directed energy weapon system's pod will be equipped on a F-15 fighter.

The Army also flight-tested a solid-state laser pod on an AH-64 Apache attack helicopter back in 2017. In 2014, Lockheed Martin experimented with a directed energy turret on a Dassault Falcon 10 business jet.

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What's next for industry?

Afzal says that, in general, customers are starting to ask more specific and pointed questions about the entire laser weapon life cycle.

"For example, we are seeing an increased emphasis on training and warfighter touch points, as well as conversations around how to optimally establish global sustainment and support infrastructure," he said. This may be a sign that more stake holders are seeing production as a practical consideration.

"Customers are also interested in laser weapons scaling to address additional mission areas, and inquiries along those lines entail how systems can grow in capability to take on a greater diversity of threats," he said.

Dr. Rich Roberts, chief of the Aerodynamics Branch Store Separation Section of Arnold Engineering Development Complex, also says the tests will have results that will be able to feed information back into industry even if the laser pods don't end up being deployed.

"As more directed-energy systems are developed and integrated onto aircraft, we'll be able to help with design decisions, creating employment envelopes, defining adjacent weapons load-outs and other things routinely needed by program offices and manufacturers," he told The Drive.

China and Russia

While it can be difficult to pin down adversary capabilities, the war in Ukraine has brought laser weapons back into the headlines. For a few years now, the Pentagon has been taking seriously possible threats to U.S. satellites from Russia or China-based lasers pointed toward space. In May 2022, Reuters reported Russia claimed the use of lasers to burn through drones in Ukraine.

Conversely, Ukrainian President Volodymyr Zelenskiy compared this to "propaganda ... about an amazing weapon" released by the Nazis in an attempt to prevent their defeat in World War II.

While whether Russia might be focusing on burning drones or dazzling satellites may be unclear, 2022 Defense Intelligence

Agency report also focuses on the potential for lasers that can "dazzle" or damage satellites from China and Russia.

Electronics considerations

With high-energy comes the need for technological leaps and other input from microelectronics organizations. Last April a division of DARPA asked for enabling technologies in four areas, which have applications in areas including high-energy laser weapons:

- embedded microsystem intelligence and localized processing
- next-generation front-end component technologies for electromagnetic spectrum dominance
- microsystem integration for increased functional density and security
- disruptive defense microsystem applications in general.

Officials of the DARPA Microsystems Technology Office (MTO) highlighted these as topics not fully addressed by other MTO solicitations. Abstracts are due Jan. 6, 2024. Their inclusion on this list shows the commitment DARPA is making to exploring directed energy component technologies.

DARPA also noted other areas that prove challenges for development of high-energy laser weapons. In February, DARPA issued a broad agency announcement seeking technologies for better beam quality, SwaP considerations, and other improvements. The multi beam-combined high-power amplifiers and large, complex optical subsystems needed for high-energy weapons do not scale well, the agency reported.

On the other hand, today's coherent beam combined-tiled array high-energy laser sources are more scalable. The desired tiles contain laser emitters whose phase can be sensed and controlled continuously to achieve coherent beam combination. Arranging several to several hundred of these tiles allows for scalable output power for a panelized, gimbal-mounted laser weapon source.

Coherently beam-combined tiled arrays can generate and project the laser beam directly without bulk optics, DARPA said. A tiled array is intrinsically scalable, as it has no inherent limits. It can also perform non-mechanical beam steering for beam jitter corrections and apply complex phase corrections to compensate for atmospheric disturbances.

This project is looking to capitalize on the military-commercial symbiosis between the development of technologies such as semiconductor fabrication techniques, coherent beam combining, photonic integration, and 3D integration and packaging.

Making directed energy weapons that can burn through drones or missiles from the back of a relatively small vehicle are still a technical challenge. However, it's one on which progress has been made in the last five years. ◀

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<https://kordtechnologies.com>

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<https://www.lockheedmartin.com>

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Power electronics keeps today's high-performance systems running

BY Jamie Whitney

Power electronics technologies enable military systems designers to take precise control over the amount of electrical power that flows to ever-smaller and ever-more-sensitive electronic components such as next-generation microprocessors, solid-state memory, and networking equipment.

Still, standard products and new integrated power electronics architectures can make the integration job easier and more efficient in terms of system size, weight, and power consumption (SWaP).

Gone are the days of esoteric design approaches as the U.S. Department of Defense (DOD) demands easily integratable

components that can keep enabling technologies at the cutting edge. Likewise, commercial aerospace interests are embracing electronics solutions that can make autonomous passenger flight a reality.

At the crux of the military and commercial aerospace power design is how to balance what is possible with what is realistic and meet power demands and cooling requirements below the sea, on the ground, and in the air.

Power conditioning and control

Power electronics — the control and conditioning of electrical power is following technology trends in power density and SWaP. This results in innovative cooling and thermal management; adherence to open-architecture industry standards; high levels of systems integration; obsolescence management; and a reliance of commercial off-the-shelf (COTS) designs.

Andreas Heldwein, the director of defense products for IR HiRel Products — an Infineon Technologies company based in San Jose, Calif., notes that power electronics can play a key role in mission readiness and success in the mil-aero sector.

“High reliability, lightweight and compact electronics; simpler systems with greater logic and programmability; greater power efficiency and increased payload capacity — these benefits all contribute to mission readiness for space applications and operational readiness of military equipment, personal gear and weapons,” Heldwein explains.

Using technology in military applications to gain an edge is nothing new,



Aviation Electronics Technician 2nd Class Erica Evans, from Stafford, Va., conducts maintenance on an MH-60R Sea Hawk helicopter on the USS Chancellorsville in the Philippine Sea. Navy photo.



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◀ A Marine artillery gun crew fires an M777 howitzer during a training exercise at Quana Range on Fort Sill, Okla. The Precision Guidance Kit (PGK) “smart” fuzes were installed on 155-millimeter shells fired from the howitzers.

U.S. Army photo.

nor is it solely the modus operandi of the United States and its allies. This spring, Heidi Shyu, the Under Secretary of Defense for Research and Engineering told attendees at the McAleese defense conference in Washington D.C. in March that commercial partners will be crucial in helping the United States and allies maintain technological superiority, particularly with China and Russia investing heavily in electronics themselves.

“[This] has amplified the criticality of strengthening our technological superiority and maintaining our military advantage, to include teamwork with our allies and partners,” Under Secretary Shyu said, noting that the COTS revolution is playing out in near-peer nations just as it is in the U.S. “We cannot afford a leveling of technology advantage. It is imperative for the department to nurture early research in emerging technologies to prevent technological surprise. We must leverage critical state-of-the-art commercial technology where rapid advancements are trying to accelerate our military capabilities.”

Efficiency in action

Increased power efficiency with newer shipboard electronics, avionics, and vetronics is being driven by a quartet of trends according to Daniel West, a field application engineer with Kyocera AVX in Fountain Inn, S.C.

“Efficiency in power conversion is one of the biggest trends we’re supporting, West says. “In terms of passive electronic components in a given power converter design, capacitors play a huge role in overall efficiency, and there are four main ways we are responding to this trend:

- “Higher Voltage Ratings. III-V semi-conductors are very efficient now in a higher range of voltages and capacitor technology is keeping up to meet these requirements.
- “Higher Capacitance Ratings. Bulk capacitors with higher values accommodate size/weight constrained designs. Tantalum and Tantalum Polymer capacitor technologies specifically are the most volumetrically efficient, and the latest advancements of reducing ESR (equivalent series resistance) allows higher current flow.
- “Higher Reliability. Film capacitor technology have a self-healing property to them for applications requiring an open circuit failure mode and enables efficiency further by the innovations of increased operating temperature range. In addition, there is new development for the polymer and hybrid cathode systems for those applications using aluminum electrolytic devices in their circuits that effectively improve the lifetime of this technology.
- “Low Parasitic Loss. There is constant material and process improvements across all capacitor technologies to reduce losses due to temperature, frequency, and voltage, but for power conversion there is a concentrated focus on stacked ceramic, power film, and electrolytic capacitor technologies,” West concludes. Heldwein explains how SWaP demands in power electronics are met for the military market.

“In military applications, power efficiency is key to improving size, weight and power of vehicles and equipment,” Heldwein says. “Improved SWaP could manifest as smaller batteries and/or longer battery life, reduced logistical burden of soldier-carried equipment, and greater payload capacity for vehicles and/or equipment. This leads to tactical and operational advantages in combat situations.”

Kyocera AVX’s West notes that “Efficiency in power conversion is one of the biggest trends we’re supporting. In terms of passive electronic components in a given power converter design, capacitors play a huge role in overall efficiency.”

Electronics on orbit

Of course, power efficiency also extends beyond our atmosphere as governments and commercial interests send specialty electronics into space. As NewSpace [private and public-private economic development in space] efforts continue to proliferate and make access less expensive, weight concerns become less of a concern.

“Space applications also benefit from more power efficient electronics,” IR HiRel’s Heldwein says. “However, we’re starting to see less emphasis on weight. With the newer launch vehicles, the payload cost per kilogram is rapidly declining. Higher power density in smaller footprints takes on even more importance, while still enabling additional capacity for mission payload. With 120 volts more the norm, power topologies are changing to improve converter efficiency, leading to different voltage requirements for MOSFETs.”

The metal-oxide-semiconductor field-effect transistors (MOSFETs) offered by IR HiRel include radiation hardened (rad hard) and standard hermetic versions. Standard MOSFETs are available in voltages ranging from 20 to 1000 volts, and in a wide variety of industry-standard packages. The company’s rad hard MOSFET offerings are purpose built to withstand extreme environments and have been utilized in geosynchronous and geostationary orbit, medium Earth orbit (MEO) and low Earth orbit (LEO) applications.

“In space applications, growing satellite payload processing demands drive greater use of high-power FPGAs and ASICs to handle more on-board processing, in-orbit reconfiguration, artificial intelligence on the spacecraft and more,” Heldwein says. “Providing greater flexibility and much higher data processing means that power topologies for generation and distribution must also adapt to these changing requirements.”

Launching technology into space is getting less expensive, but it’s not yet so egalitarian as to not be a concern. Heldwein says that Infineon IR HiRel’s R9 superjunction field-effect transistor technology optimizes efficiency of DC-DC converters in extreme environment applications.

“QPL-qualified, this robust power technology is already used in some of Infineon IR HiRel’s PCB-based DC-DC converters. For military and space applications, the SWaP improvements translate to greater payload capacity,” Heldwein says.

Space components by design are not generally made to be



The MQ-9 Reaper is enabled by electronics that communicate with satellite systems can acquire and pass real-time imagery data to ground users around the clock and beyond line of sight. Air Force photo.

serviceable in orbit, so NewSpace businesses and governmental agencies aim to utilize electronics that are built to last. Of course, that sentiment can be applied to any governmental department/agency, business, or even consumer.

“Component longevity – long term product availability, robustness, and reliability – remain critical,” Heldwein says. “Electronics component longevity continues to be a key factor in the aerospace and military markets where we routinely see program requirements for 15-20 years or more.

For military applications, replenishing munition stock levels can happen over decades. Electronics components that adhere to the stringent certification standards help ensure robustness and long-term reliability in a wide range of operating conditions.

Heldwein concludes, “Classic space applications also demand component longevity for their decades-long programs. For deep space and long-life missions, QPL-qualified electronics remain the gold standard for ensuring robust and reliable system performance.”

Airborne implementations

Kyocera AVX’s West explains that what goes up in the world of power conversion often comes back down for use in ground and sea vehicles.

“Flight electronics are often a leading indicator of what’s to come in the world of terrestrial power conversion, and expansion of commercial-off-the-shelf product offerings in bulk capacitors is very well received,” West says, and explains “ceramic capacitors fill the needs of advanced active devices and demanding

architectures with the MIL-PRF-32535 BME specification. “In addition, we are participating in the development of a MIL-PRF stacked ceramic capacitor based on MIL-PRF-32535 BME parts that builds on their strengths of low parasitic loss and high capacitance capability.

He continues, “Tantalum capacitors with MnO₂ cathode systems have responded with optimized size/weight SMT devices that meet MIL-PRF-55365/12. Slash sheet 12 calls out our CWR15 devices available in 0603, 0805, and 1206 EIA case sizes. Tantalum capacitors with polymer cathode systems have responded with low ESR devices to optimize power capability with MIL-PRF-3700 devices.”

West notes that COTS tantalum polymers, like Kyocera AVX’s TCH Series, is seeing increased agency approval across the Defense Logistics Agency and the National Aeronautics and Space Administration in the U.S. as well as the European Space Agency.

“Proper selection of capacitors will ensure long-term reliable use in end applications,” West explains. Electronics component longevity continues to be a key factor in the aerospace and military markets where we routinely see program requirements for 15-20 years or more. “For military applications, replenishing munition stock levels can happen over decades. Electronics components that adhere to the stringent certification standards help ensure robustness and long-term reliability in a wide range of operating conditions.”

Heldwein agrees, saying, “For LEO space, short-duration and high-redundancy mission applications, we also see use of automotive-qualified electronics. However, we expect that rad hard electronics will continue to play a central role in long mission and deep space applications.

He continues, “Along with our high-reliability and rad hard memory, RF and power solutions, Infineon also has an extensive offering of commercially available, automotive-qualified components. We see

WHO'S WHO IN POWER ELECTRONICS

Absopulse Electronics Ltd.
Ottawa
<https://absopulse.com>

Advanced Energy Industries Inc.
Fort Collins, Colo.
www.advanced-energy.com

Aegis Power Systems Inc.
Murphy, N.C.
www.aegispower.com

AMETEK VTI Instruments
Irvine, Calif.
www.vtiinstruments.com

Analytic Systems Ware Ltd.
Delta, British Columbia
www.analyticsystems.com

Anaren Inc.
Syracuse, N.Y.
www.anaren.com

Astrodyne TDI
Nashua, N.H.
www.astrodynetdi.com

Behlman Electronics Inc.
Hauppauge, N.Y.
www.behlmanpower.com

Calex Mfg. Co. Inc.
Concord, Calif.
www.calex.com

Coilcraft Inc.
Cary, Ill.
www.coilcraft.com

Comdel Inc.
Gloucester, Mass.
www.comdel.com

ConTech
Concord, Calif.
www.contech-us.com

Cornell Dubilier Electronics Inc.
Liberty, S.C.
www.cde.com

Crane Aerospace & Electronics
Redmond, Wash.
www.craneae.com

D6 Industries Inc.
Lawrence, Mass.
<https://d6industries.com>

Data Device Corp. (DDC)
Bohemia, N.Y.
www.ddc-web.com

Energy Technologies Inc.
Mansfield, Ohio
www.ruggedsystems.com

Falcon Electric Inc.
Irwindale, Calif.
www.falconups.com

**General Atomics
Electromagnetic Systems
Group**
San Diego
www.ga.com/ems

International Rectifier HiRel
El Segundo, Calif.
<https://www.infineon.com>

Intellipower Inc.
Orange, Calif.
<https://www.intellipower.com>

Kyocera AVX Corp.
Fountain Inn, S.C.
<https://www.kyocera-avx.com/>

Lind Electronics Inc.
Minnetonka, Minn.
www.lindelectronics.com

Maxim Integrated Products Inc
Chelmsford, Mass.
www.maximintegrated.com

MilPower Source
Belmont, N.H.
www.milpower.com

MilSource
El Segundo, Calif.
<https://militaryethernet.com>

Murata Power Solutions
Mansfield, Mass.
www.murata-ps.com

North Atlantic Industries
Bohemia, N.Y.
www.naii.com

Nova Electric
Bergenfield, N.J.
<https://novaelectric.com>

Nova Power Solutions Inc.
Sterling, Va.
www.novapower.com

Pico Electronics Inc.
Pelham, N.Y.
www.picoelectronics.com

Rantec Power Systems Inc.
Los Osos, Calif.
www.rantec.com

Raycom Electronics Inc.
Dover, Pa.
www.raycomelectronics.com

**Renesas Electronics Corp.
(formerly Intersil)**
Milpitas, Calif.
<https://www.renesas.com/us/en/>

Solitron Devices, Inc.
West Palm Beach, Fla.
www.solitrondevices.com

SynQor
Boxborough, Mass.
www.synqor.com

TDI Power
Hackettstown, N.J.
<http://tdipower.com>

TDK-Lambda Americas Inc.
San Diego
www.us.tdk-lambda.com

Vicor Corp.
Andover, Mass.
www.vicr.com

VPT Inc.
Bothell, Wash.
www.vptpower.com

market interest to consider integration of COTS automotive and MIL-PRF-19500 / MIL-PRF-38534 / MIL-PRF-38535 qualified devices into products for defense applications.”

Taking the heat

Doing power-intensive tasks in hostile and extreme environments can result in an abundance of heat that needs to be dissipated. This can be alleviated by enabling passive or actively cooling the electronics or reducing the amount of heat produced by increasing efficiency.

“We are specifically looking at the DC-DC converters, AC-DC converters, power conversion, batteries, power over RF networking, power generation, and renewable energy,” Kyocera AVX’s West says, and notes that thermal management will be key in the company’s power conversion circuitry. “Our Q-Bridge is a unique device that is an SMD thermal conductor in familiar and small EIA case sizes. It can be terminated directly on active pins because it has extremely low capacitive loading but still routes heat efficiently away from active elements,” West says. “The voltage ratings on these devices are inherently high which falls in line with the upward trend of operating voltages.”

Speed and size

Thanks to electronics, guided munitions are able to enable increased precision over longer ranges, which means a lower risk of collateral damage.

“As governments work to extend artillery projectile range capabilities, guided, smart munition systems will become critical to increase precision over longer distances, IR HiRel’s Heldwein explains. “These long-range precision munitions reduce the time, cost and logistical burden for artillery forces.”

Size still matters in the mil-aero industry though, and according to West, Kyocera AVX’s J-CAP series of conductive



Staff Sgt. Trevor Black, 821st Contingency Response Support Squadron small package initial communications element technician, checks wires on a satellite communication antenna at Roosevelt Roads, Puerto Rico. Air Force photo.

polymer capacitors answers the call for miniature high reliability SWaP performance.

“Smaller low-loss passives easily fit in with next generation power conversion topologies and chipsets,” says West. “Our J-Cap devices have such large capacitance values that it can be thought of in millijoules, hence the moniker ‘J-cap’, and provides large amounts of energy relative to its SMD form factor. The TWM series are wet tantalum technology in a different form factor but store even more energy. Supercapacitors of course, known for storing vast amounts of energy for battery supplement/replacement and energy harvesting applications will see use in this industry as modules with high reliability become prevalent.” ◀



International Rectifier HiRel Products, Inc. are made with SWaP concerns in mind for use in military and space applications.

ARINC 818 as a sensor and display interface enables more capable Enhanced Vision and ISR systems.

Great River Technology (GRT) is the global leader in high-performance ARINC 818 digital video systems and development tools for the mil/aero industry. GRT focuses on products that simplify the design and implementation of mission-critical systems for cockpit displays, graphics generators, infrared sensors and optical cameras, and flight simulators. Our products are found in design and research labs, production, and maintenance facilities, and flight-test and production aircraft.



Tim Keller, Director of Marketing at GRT

1. What do you see as the most important technology trends for your company over the next five years?

We have seen ARINC 818, which originally started as a display interface, propagate throughout the aircraft. It is used for high-speed video interface for all types of displays (HUD, HDD, HMD), mission and video processors, and now high-resolution sensors. We see bandwidths continue to increase and we are updating the ARINC 818 ecosystem to support 32X rates and 100Gbps+.

2. What are the most important aerospace and defense applications that will drive your technology innovation over the next five years?

Developing more capable Enhanced Vision Systems (EVS) (sensors, processing, displays). For example, The RVS 2.0 system on the KC-46A with stereoscopic vision, higher resolutions sensors, enhanced image processing,

and 3D displays provides a leap forward and shows the type of systems where ARINC 818 is deployed due to its high bandwidths, built-in error checking, and low latency.

3. What kinds of disruptive technology innovations do you expect to see in your industry over the next five years?

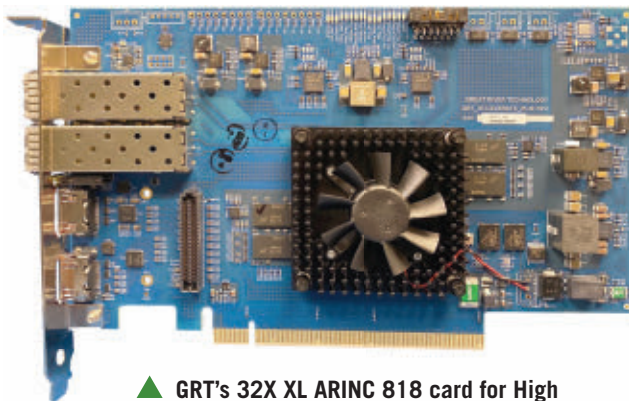
Unmanned aircraft and autonomous vehicles will affect some applications where ARINC 818 is currently used, because there will not be a human in the loop. However, considering systems like the RVS 2.0, removing the human controlling the refueling boom would be a next step in the evolution.

4. What do you see as the noteworthy risks to technology innovation in your industry over the next five years?

Costs are high in the next gen systems. As we move up in bandwidths (i.e., 32X rates), the ecosystem (FPGA, DDRs, optic modules, connectors) to operate at the throughputs required by 4K and 8K sensors and cameras is still quite high. It will take economies of scale to bring the prices down.

5. How do you expect supply chain issues to affect the pace and depth of technology innovation in your industry over the next five years?

I don't foresee a big issue. Component availability is affecting all current electronic production, but not R&D. Our R&D is still very active in both our test equipment and flyable portfolios.



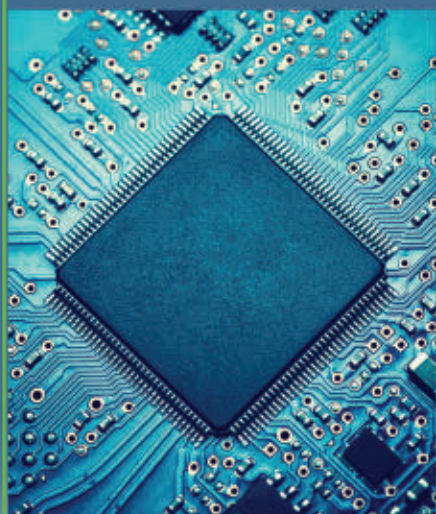
▲ **GRT's 32X XL ARINC 818 card for High Resolution Sensor and Display Development**

ARINC 818

HIGH-SPEED, LOW LATENCY VIDEO
FOR SENSORS, VIDEO PROCESSORS,
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GREAT RIVER TECHNOLOGY ARINC 818 FLYABLE HARDWARE AND IP

ARINC 818 IP



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Elma Electronic is a global leader in modular embedded computing solutions based on open standards (OpenVPX, SOSA, CPCI Serial) for defense and industrial applications. Elma's proven expertise in high performance backplanes, extreme rugged hardware platforms, and extensive partner building blocks result in reliable, interoperable platforms used worldwide.



Boris Micha,
Vice President
Marketing and
Customer Support

1. What do you see as the most important technology trends for your company over the next five years?

We are seeing that open standards are increasingly influencing technology choices. As new platform designs demand more I/O and compute-intensive solutions in smaller footprints, it drives the need for faster speeds, connectivity (PCI Express and Gigabit Ethernet) and higher density signals in SWaP-optimized footprints. As a key driver of solutions to meet those needs and the MOSA directive, we expect the SOSA™ Technical Reference Standard to be adopted in new programs. Customers are also engaging with us earlier in the system-level design process to leverage our expertise and mitigate program risks.

2. What are the most important aerospace and defense applications that will drive your technology innovation over the next five years?

We are seeing new technologies in artificial intelligence and autonomous vehicles enabling advances in solutions that benefit EW, radar, ISR, cyber-security, and any sensor-based applications, driving faster adoption of technology used in the field. The SOSA standard continues to contribute to that effort.

3. What kinds of disruptive technology innovations do you expect to see in your industry over the next five years?

We believe that SOSA, and other open standards under the MOSA directive will enable

innovative solutions in smaller footprint packaging for increased implementations of autonomous and uncrewed vehicles. AI-enabling technologies will push us to develop closer relationships with software partners, and cyber security and trusted computing will increasingly become part of the requirements packages.

4. What do you see as the noteworthy risks to technology innovation in your industry over the next five years?

Lack of available talent and manpower and inherent expertise. Supply chain is currently disrupting and delaying prototyping and new product introductions. Innovation however, is being enabled by open standards which help mitigate risks by not having to start a design from scratch. By providing a baseline design from which a product can be started helps to reduce risk. The standards groups include key suppliers who commit to support solutions based on the standards, so their awareness and participation helps them understand the supply chain requirements.

5. How do you expect supply chain issues to affect the pace and depth of technology innovation in your industry over the next five years?

We expect supply chain issues to continue to be challenging. However, we believe that this environment will contribute to new opportunities to regionalize manufacturing and inventories, mitigating dependence on single-source supplies. It will also encourage an acceleration of innovation and adoption of new technologies, supported by the availability of key components based on modular open standards that can be used across multiple platforms.

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Get ready for next-gen sensor platforms with development and deployable chassis, boards and system management solutions aligned to SOSA™ 1.0, CMOSS and HOST per the modular open systems approach (MOSA).



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Introducing SInergy® — AirBorn's Small, Modular, & Fast Interconnect Solution!



The new Sinergy family of connectors offers OEMs a fast (25Gbps) mini-modular hybrid solution. The die-cast metal connector system has up to 5 interchangeable molded insulator bays. Tested & qualified based on MIL-DTL-83513 requirements, SInergy's rugged 4-points-of-contact design can handle a very rough ride inherent in Mil-Aero, Space, and Industrial applications.



Ryan Strider,
Sr. Mechanical
Design Engineer
William Rhea,
Sr. Product Manager

1. What do you see as the most important technology trends for your company over the next five years?

Automation and vertical integration initiatives will prove critical to our electronics manufacturing business. Signal integrity performance, SWAP C (size, weight, power, & cost) considerations are especially vital in the development of aerospace and deep space system solutions. 3D printing advancements are also an exciting aspect of progressive manufacturing and design technologies.

2. What are the most important aerospace and defense applications that will drive your technology innovation over the next five years?

Data transmission technology – having the ability to process data in real-time through video and information technology. This affects drones, satellite vision systems, ground-based equipment, and piloting systems. Autonomous

vehicles, DC-based all-electric vehicles, vision systems, and hypersonic/supersonic products are also areas of interest.

3. What kinds of disruptive technology innovations do you expect to see in your industry over the next five years?

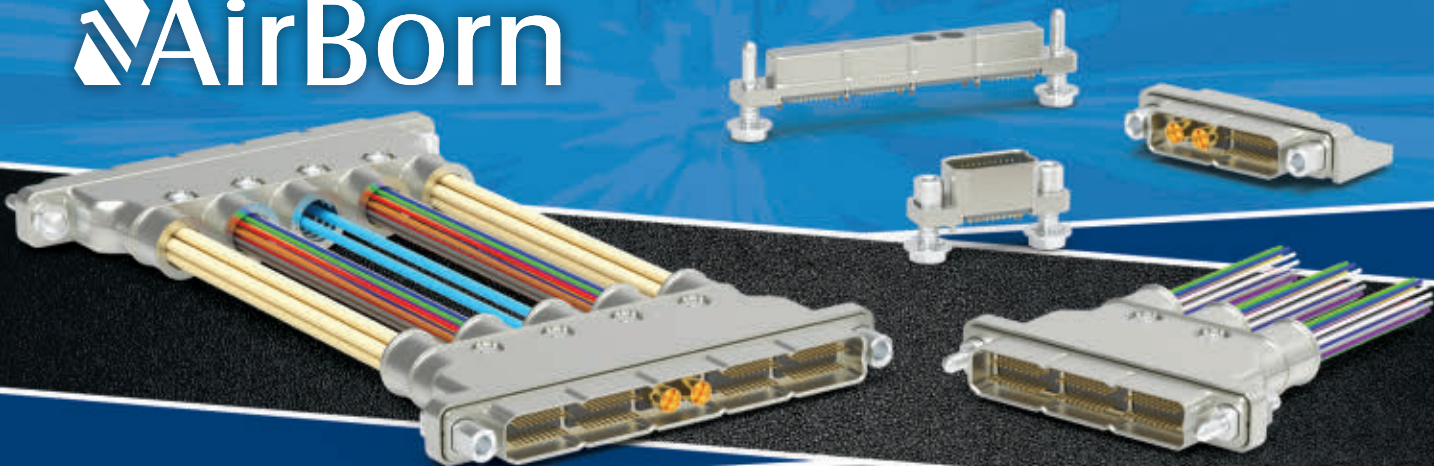
All aspects of artificial intelligence in controls and production. Quality 3D printable PCBs and flexible circuits will also surely advance the state of electronic systems design.

4. What do you see as the noteworthy risks to technology innovation in your industry over the next five years?

Supply chain challenges due to the geopolitical relations, inflation currently endured in the United States, and attracting and retaining engineering and manufacturing talent.

5. How do you expect supply chain issues to affect the pace and depth of technology innovation in your industry over the next five years?

It forces companies to become more vertically integrated. If a company cannot, slow development times may emerge for low-volume, proof-of-concept prototypes. Supply chain challenges also hurt the pace of product development.



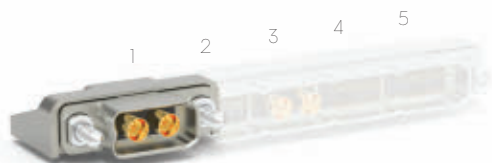
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Ideal for Mil-Aero, Space, & Industrial applications, Sinergy's 4 points-of-contact can handle a very rough ride. Configure Sinergy with interchangeable locking, jacking, or guide hardware and SMT termination. Customers have relied on AirBorn's quality and innovation since our inception in 1958.



Multi-bay, die-cast metal connector system with interchangeable molded insulator bays.



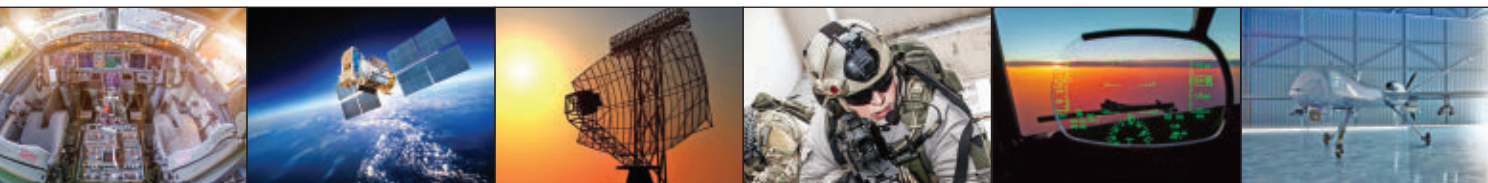
1 and 2 bay Sinergy models are roughly the size of a U.S. quarter — similar to Micro & Nano Ds.



SMPM RF interface (.173"/4.39mm) available in cable & board-mount configurations.



Vertical & right-angle board-mount connectors. Discrete Wire, SMPM RF, & Twinax cable assemblies.





Northrop Grumman to build shipboard electronic warfare (EW) to jam enemy radar

By John Keller

WASHINGTON – U.S. Navy surface warfare experts are ordering advanced electronic warfare (EW) systems for guided missile destroyers, aircraft carriers, and amphibious assault ships under terms of a \$254.4 million order.

Officials of the Naval Sea Systems Command in Washington are asking engineers at the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., to build the Surface Electronic Warfare Improvement Program (SEWIP) Block 3 electronic attack systems and hardware design modifications for destroyers, aircraft carriers, and amphibious assault ships.

SEWIP is an evolutionary acquisition program to upgrade the existing AN/SLQ-32(V) surface warship EW system and provide improved anti-ship missile defense and situational awareness.

Northrop Grumman won \$267 million Navy contract in 2015 to develop and build SEWIP Block 3 to make further upgrades to the AN/SLQ-32 with new technologies for early detection, signal analysis, threat warning, and protection from anti-ship missiles. There are three established SEWIP block upgrades and a fourth is planned.

The SEWIP Block 3 uses active electronically scanned array (AESA) antennas based on gallium nitride (GaN) transmit and receive modules. The system not only jams enemy targeting radars and missile guidance systems, but also has a Soft Kill Coordinator (SKC) to manage electronic-attack engagements.

Soft kill refers to altering the electromagnetic signature of friendly ships and other targets to confuse or interfere with enemy radar targeting systems.

◀ **The SEWIP Block 3 uses AESA antennas based on GaN transmit and receive modules, jams enemy targeting radars and missile guidance, and manages electronic-attack engagements.**

The Lockheed Martin Rotary and Mission Systems segment in Liverpool, N.Y., is building the SEWIP Block 2 surface warfare EW system, which provides improved electronic support receivers and combat system interface and expands the receiver and antenna group to help surface electronic warfare capabilities keep pace with growing threats.

Since the SEWIP program started in 2002, General Dynamics Advanced Information Systems (AIS) in Fairfax, Va., acted as prime contractor for SEWIP blocks 1A, 1B1, 1B2, and 1B3.

Developed by Raytheon in the 1970s, the original AN/SLQ-32 systems employed passive radar technology for early warning, identification and tracking of enemy threats. Subsequent upgrades provided an additional active capability for simultaneous jamming of several different threats.

On this contract Northrop Grumman will do the work in Baltimore and White Marsh, Md.; Tampa, Fla.; Andover and Chelmsford, Mass.; Rochester, N.Y.; San Diego, El Cajon, Los Angeles, and Glendale, Calif.; Winona and Minneapolis, Minn.; Stafford Springs, Conn; Glendale, Chandler, and Tucson, Ariz.; Nashua, N.H.; Elk Grove Village and Woodridge, Ill.; Tucson and Chandler, Ariz.; Washington, N.C.; Richardson, Texas; Hiawatha, Iowa; Littleton, Colo., and other U.S. locations, and should be finished by September 2025. ◀

For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or Naval Sea Systems Command at www.navsea.navy.mil.

EUROMIDS to build secure data communications terminals

U.S. Navy communications experts needed data communications terminal for the U.S. and allied Link 16 that enables military forces to exchange tactical information securely in near-real time. They found their solution from EUROMIDS in Paris — a European consortium of Thales, Leonardo, Indra Sistemas, and Hensoldt. Officials of the Naval Information Warfare Systems Command in San Diego, announced \$322.2 million contract to EUROMIDS to provide Multifunctional Information Distribution System Low Volume Terminals (MIDS-LVTs) for France, Germany, Italy and Spain. The MIDS-LVT is the data communications terminal for the U.S. and allied Link 16 that enables military forces to exchange tactical information securely in near-real time. Link 16 also exchanges text messages, imagery, digital voice. The contract also includes software support to the five MIDS nations' systems engineering and integration of MIDS-LVTs. MIDS offers high-capacity, jam-resistant, digital communication links for tactical information exchange among air, ground, and sea military forces. MIDS-LVT users are the United States, France, Germany, Italy, and Spain. Thousands of EUROMIDS MIDS-LVT terminals are fielded on a broad range of military aircraft, surface warships, and land applications including Rafale, Eurofighter, Mirage 2000, Tornado, NH90, A400M, SAMP-T, NATO ACCS Loc1 and the Horizon frigates. The MIDS-LVT is a software-defined radio (SDR) tactical data link and networking system for aircraft, fixed sites, land vehicles, and surface warships. It is a four-channel communications system that delivers existing Link 16 tactical networking and

situational awareness with concurrent multi-netting-4 and tactical air navigation (TACAN) functionality. For more information contact EUROMIDS online at www.euromids.com, or the Naval Information Warfare Systems Command at www.navwar.navy.mil.

High-reliability GaN amplifier for X-band radar offered by Comtech PST

Comtech PST Corp. in Melville, N.Y., is introducing the model BHCDP928978-4000 gallium nitride (GaN) amplifier for ground or surface X-band radar applications. The AB linear design operates from 9.2 to 9.7 GHz frequency range over an instantaneous bandwidth of 500 MHz. Development of this product is for a traveling wave tube (TWT) replacement. The amplifier design features self-protection for load voltage standing wave ratio (VSWR), duty factor, pulse width, and temperature. It also offers graceful degradation in case of a RF power module failure. A mean time between failures (MTBF) increase of 10 times that of the TWT it replaces is achieved for improved reliability and low maintenance costs, company officials say. Comtech supports custom configurations and features, as well as specific power levels 16 kilowatts. This high-reliability solid state pulse amplifier features class AB GaN technology; high output power dynamic range; efficiency; RF input and output sample detectors; pulse width and duty factor protection; thermal and load VSWR protection; remote status and control Ethernet interface; ruggedization for harsh environmental applications; customization; graceful degradation; and cold start. The amplifier measures 19 by 17 by 7 inches, and weighs 60 pounds. It

Continued on page 39

Raytheon to build AN/SPY-6(V) Air and Missile Defense Radar (AMDR) for Navy destroyers

BY John Keller

WASHINGTON – Shipboard radar experts at Raytheon Technologies Corp. will build hardware for the new AN/SPY-6(V) Air and Missile Defense Radar (AMDR), which will be integrated into late-model Arleigh Burke-class (DDG 51) Aegis destroyers, under terms of a \$650.7 million U.S. Navy order.

Officials of the Naval Sea Systems Command in Washington are asking the Raytheon Missiles & Defense segment in Marlborough, Mass., for AN/SPY-6(V) shipboard radar hardware.

The Raytheon AN/SPY-6(V) AMDR will improve the Burke-class destroyer's ability to detect hostile aircraft, surface ships, and ballistic missiles, Raytheon officials say. The AMDR will supersede the AN/SPY-1 radar, which has been standard equipment on Navy Aegis Burke-class destroyers and Ticonderoga-class cruisers.

The new shipboard radar will go aboard Flight III Burke-class destroyers. Thus far one Flight III Burke-class destroyer has been launched: the USS Jack H. Lucas (DDG 125), which is set for commissioning in 2023.

A construction contract has been awarded for the USS Louis H. Wilson Jr. (DDG 126), which should be commissioned in 2024. The keel has been laid for the USS Ted Stevens (DDG 128), which has no commissioning date set.

Flight III Burke-class destroyers approved for construction are the USS Jeremiah Denton (DDG-129); USS William Charette (DDG-130); USS George M. Neal (DDG-131); USS Quentin Walsh (DDG-132); USS Sam Nunn (DDG-133); USS John E. Kilmer (DDG-134); USS Thad Cochran (DDG-135); the USS Richard G. Lugar (DDG-136) and the USS John F. Lehman (DDG 137). Two Flight III destroyers are approved for construction, but as yet are unnamed.

The new Flight III versions of the Burke-class destroyers



The Raytheon AN/SPY-6(V) radar will improve the Burke-class destroyer's ability to detect hostile aircraft, surface ships, and ballistic missiles.

will be built at Huntington Ingalls Inc. in Pascagoula, Miss., and at the General Dynamics Corp. Bath Iron Works segment in Bath, Me. Flight III is the latest version of the Burke-class guided missile destroyer.

The AN/SPY-6(V) AMDR will provide greater detection ranges, increased discrimination accuracy, higher reliability and sustainability, and lower costs, compared to the AN/SPY-1D(V) radar onboard today's Burke-class destroyers.

The system is built with individual building blocks called radar modular assemblies (RMAs), Raytheon officials say. Each RMA is a self-contained radar in a two-cubic-foot box; RMAs can stack together to form any size array to fit ship mission requirements.

The inherent scalability of the AN/SPY-6(V) AMDR also could enable new instantiations, such as backfits on existing

Burke-class destroyers and installation on aircraft carriers, amphibious warfare ships, frigates, the littoral combat ship, and Zumwalt-class land-attack destroyers without significant new radar development costs, Raytheon officials say.

For the Flight III Burke-class destroyer's SPY-6(V) AMDR will feature 37 RMAs. The new radar will be able to see targets half the size at twice the distance of today's SPY-1 radar. The AMDR will have four array faces to provide full-time, 360-degree situational awareness. Each 14-by-14-foot face is about the same size as today's SPY-1D(V) radar.

The AN/SPY-6(V) AMDR will 30 times more sensitive than the AN/SPY-1D(V) in the Flight III configuration, and is being designed to counter large and complex raids, Raytheon officials say. The new radar will have adaptive digital beamforming and radar signal processing for dealing with high-clutter and jamming environments.

The AN/SPY-6(V) radar also is reprogrammable to adapt to new missions or emerging threats. It uses high-powered gallium nitride (GaN) semiconductors, distributed receiver exciters, adaptive digital beamforming, and Intel processors for digital signal processing.

The new radar will feature S-band radar coupled with X-band horizon-search radar, and a radar suite controller (RSC) to manage radar resources and integrate with the ship's combat management system. ←

On this order Raytheon will do the work in Andover, Mass; Scottsdale, Ariz.; San Diego, Calif; Stafford Springs and Bloomfield, Conn.; Sykesville, Md; Dallas; Bergenfield, N.J.; Portsmouth, R.I.; Chesapeake, Va.; Hanahan, S.C.; Indianapolis; and Huntsville, Ala., and should be finished by November 2025. For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Continued from page 37

also has an instantaneous bandwidth of 500 MHz; output power of 4000 Watts peak; power gain of 66 decibels (nominal); pulse width of 40 microseconds (typical); duty cycle of 10 percent (typical); pulse droop of less than 1.0 decibels (typical); pulse rise and fall time of less than 20 nanoseconds (typical); input VSWR of less than 1.5:1; output load VSWR less than 1.5:1; DC voltage input of 48 volts at 3000 Watts; operating temperature of 0 to 50 degrees Celsius at the baseplate; operating humidity of 0 to 95 percent non-condensing; operating shock and vibration per MIL-STD-810F; operating altitude of 10,000 feet; and mean time between failures of more than 27,500 hours. For more information contact Comtech PST online at <https://comtechpst.com>.

Rugged SiC MOSFETs for use in harsh environments introduced by Infineon

Infineon Technologies AG in Munich is introducing the CoolSiC 650-volt silicon carbide (SiC) metal oxide field-effect transistors (MOSFETs) for high-power applications like energy storage, battery formation, switched-mode power supplies, and motor drives. CoolSiC MOSFETs come in a compact D 2PAK SMD 7-pin package with .XT interconnection technology, and offer switching at high currents and 80 percent lower reverse recovery charge (Q_{rr}) and drain-source charge (Q_{oss}) than the best silicon reference. The reduced switching losses enable high-frequency operations in small system sizes, enabling high efficiency and power density. The trench technology is the basis for gate oxide reliability. Together with an improved avalanche and short-circuit robustness this ensures high system

reliability even in harsh environments. The SiC MOSFETs are suitable for topologies with repetitive hard commutation as well as for high temperature and harsh operations. The devices feature a wide voltage from gate to source range from -5 volts up to 23 volts and supporting 0-volt turn-off V_{GS} and a gate-source threshold voltage greater than 4 volts. For more information contact Infineon online at www.infineon.com/coolsic-mosfet-discretes.

BAE Systems opens production center for aircraft electronic warfare (EW)

BAE Systems has opened a 200,000-square-foot engineering and production facility in Manchester, N.H., to support electronic warfare (EW) systems design for the U.S. military and U.S. allies. The advanced EW systems from BAE Systems combine threat warning and self-protection capabilities to help military pilots conduct their missions and return home safely, company officials say. The growth of the company's EW programs is encouraging the company to hire hundreds of skilled local candidates for critical roles in engineering, finance, and project management. The new facility is the latest step for BAE systems in facility investments that include Austin, Texas; Cedar Rapids, Iowa; and Huntsville, Ala. The Manchester, N.H., engineering and production facility includes engineering design space, modern laboratories, and office space. The BAE Systems Electronic Systems sector develops and maintains commercial, defense, and space electronics, with more than 6,000 employees in New Hampshire. For more information contact BAE Systems Electronic Systems online at www.baesystems.com/en-us/our-company/inc-businesses/electronic-systems. ←

Dzyne Technologies to design swarming unmanned aircraft for precision payload delivery

BY John Keller

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force logistics experts needed to develop enabling technologies for swarms of unmanned gliders for precision payload delivery of air-launched supplies from long ranges. They found their solution from Dzyne Technologies Inc. in Fairfax, Va.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced an \$89.4 million contract to Dzyne Technologies for research into the unmanned Small Payload Precision Air-Launched Inexpensive Delivery System (SPPAIDS).

This low-cost system is designed to improve small-payload precision delivery capability at long standoff ranges. Dzyne Technologies will develop, build, and demonstrate a functional prototype aircraft for this job.

Dzyne Technologies experts will develop, mature, and demonstrate unmanned aerial vehicle (UAV) swarming technologies and related systems for eventual transfer to military users.

▲ **Dzyne Technologies will develop swarming lightweight unmanned aircraft to deliver military cargo loads quickly and precisely on the forward edge of the battlefield.**

The company will develop the aero design and prototyping of the glider vehicle, mechanical design and testing of the shock attenuation method, software development to demonstrate precision landing, and material and manufacturing development to support rapid destructibility.

Military demand for a system able to deliver small payloads precisely has been largely unmet in military and commercial applications, Air Force researchers say.

The SPPAIDS system will meet this commercial and military demand with a system that precisely delivers as much as 25 pounds of payload, with minimal cost and labor necessary from the end user. ◀

On this contract Dzyne Technologies will do the work in Irvine, Calif., and should be finished by June 2027. For more information contact Dzyne Technologies online at www.dzynetech.com, or the Air Force Research Laboratory at www.afrl.af.mil.

Red Cat Holdings rolls out multi-drone system for government and military

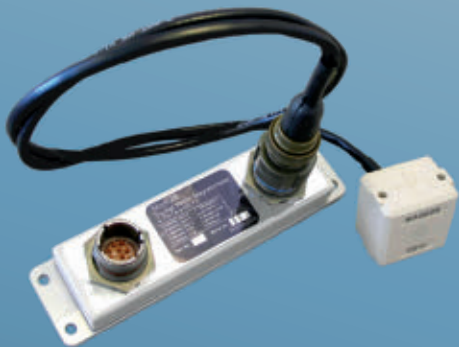
Red Cat Holdings, Inc., a hardware-enabled software provider to the drone industry based in Puerto Rico, has completed a four-drone, multi-vehicle system for defense, government, and public safety applications. Developed by its subsidiary Teal Drones, and in cooperation with strategic partner Autonodyne LLC, the multi-vehicle package will come in two configurations: 4-ship and 4-ship+. Both configurations will enable one pilot to control as many as four of Teal's Golden Eagle units simultaneously. The 4-Ship+ will include two extra Golden Eagle units and an additional linked controller to facilitate handoff of control from one pilot to another. The 4-Ship+ configuration allows a back-up pilot to take over at any time. The additional two drones also help pilots bring in units with fresh batteries, while units with drained batteries drop off to be charged – all without breaking up the four-drone flight pattern. This allows for continuous 360-degree surveillance of any target and overcomes the biggest weakness of any drone: limited battery life. The 4-Ship is a complete solution that provides operators with actionable information from multiple vehicles at the same time

- including the display of four simultaneous video feeds - resulting in faster situational awareness and decision-making in today's complex environments. To see a video of the system in action, please visit <https://www.youtube.com/watch?v=UacRe6Mh4ac>.

Safran and ATR develop machine learning 'Smart Lander' to analyze hard landings

Safran Landing Systems, a provider of aircraft landing and braking systems based in France, and ATR, a French regional aircraft manufacturer have developed Smart Lander -- a landing gear diagnostics service that uses knowledge in data analysis to optimize the manufacturer's response times in the event of hard landings, and enable aircraft to be returned to service quickly. This service is based on machine learning technology. Based on hundreds of thousands of hard landing simulations, Smart Lander issues recommendations to operators on the maintenance actions to be taken according to the hardness of the landing and to the load level sustained by the landing gear. Aircraft can subsequently be permitted to continue their commercial operations or alternatively, be sent to a maintenance base. This process takes less than an hour, *continued on page 43*

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 **Bartington**
Instruments

ESA contracts Inmarsat to help with airspace congestion and uncrewed integration

BY Jamie Whitney

PARIS - The congestion of airspace around the world is increasing rapidly, and pressure is mounting on the aviation industry to seek more sustainable practices.

In Europe alone, skies are expected to see a 50 percent increase in flights in the next 20 years, while recent estimates anticipate 40 times more commercial unmanned aerial vehicles (UAVs) than commercial aircraft will be flying beyond visual line-of-sight by 2030.

Inmarsat in London and the European Space Agency (ESA) in Paris have signed a new contract focusing on the globalization of their Iris air traffic modernization program.



Inmarsat and the European Space Agency (ESA) plan to globalize the Iris air traffic modernization program to help deal with anticipated future air traffic congestion among crewed and uncrewed aircraft.

This new phase, Iris Global, will focus on the technologies and certification required to share the fuel, carbon dioxide, and congestion-saving benefits of Iris with regions far beyond Europe.

To further accelerate air traffic management (ATM) modernization, it also will adopt System Wide Information Management (SWIM) applications to facilitate sharing of information such as airport operational status, weather information, flight data, and status of any airspace restrictions.

In addition, research on future capabilities for the integration of uncrewed aviation into European airspace will be supported.

Iris, developed in a public-private partnership and launched by ESA, is a service operating on Inmarsat's SB-S satellite-based aviation data communications system. It was created to deliver powerful benefits to airlines and air navigation service providers (ANSPs) by enabling high-bandwidth and cost-effective satellite-based datalink communications between air traffic controllers and pilots.

Entering commercial and operational service in Europe in 2023, the Iris communication service will benefit from a Pan-European certification from EASA, the European aviation safety agency.

It enables aircraft to send and receive live data with ground systems during flight, enabling increased predictability of operations and the ability to adapt to evolving conditions on the air traffic network, thus making ATM more effective and safe.

Iris will be an enabler for trajectory-based operations through the sharing of four-dimensional (4D) trajectory data between the aircraft and the ground.

Initial 4D trajectories will enable not only optimized climb and descent pathways, but also allow for en-route optimization of the trajectory, creating fuel and carbon dioxide emissions savings.

Iris makes use of the International Civil Aviation Organization's (ICAO) Aeronautical Telecommunication Network (ATN) standards, including those suitable for future ATM and ATN Open Systems Interconnect (ATN OSI) protocols, enabling ground-breaking new ATM functionalities such as 4D trajectory management to be deployed.

For the fully global Iris solution, Inmarsat will work with industry partners and standards organizations to implement next-generation Aeronautical Telecommunication Network using Internet Protocol Suite (ATN/IPS) satellite communications, which are being finalized as the global standard for air traffic control communications to and from the aircraft.

Iris Global will build a seamless ATN/OSI to ATN/IPS gateway, allowing all aircraft, no matter which of the two standards they operate on, to fly seamlessly across the globe. ◀

For more information contact Inmarsat online at www.inmarsat.com/en/index.html, or the ESA at www.esa.int.

continued from page 43 compared to more than a week previously. By reducing the response times required for returning the aircraft to service after a hard landing, Smart Lander will offer advantages to ATR and its customers in terms of man-hours, aircraft availability and customer satisfaction.

Israeli startup AIR unveils its full-scale eVTOL prototype

AIR, a commercial-focused electric vertical takeoff and landing (eVTOL) aircraft company has unveiled the full-scale prototype of its inaugural vehicle, AIR ONE. The all-electric aircraft offers a range of 110 miles on a charge at speeds to 155 miles per hour. With collapsible wings, AIR ONE can be stored in most garages, driveways, and is suitable for trailer hauls. AIR says the AIR ONE produces 771 horsepower with a maximum payload of 441 pounds, and can charge from 0 to 100 percent in one hour, and can “top off” from 20 percent to 100 percent in 30 minutes. AIR simultaneously announced a partnership with Aeroauto to establish a specialized Urban Air Mobility (UAM) vehicle showroom. AIR has completed a successful drop test and has finalized the first stage of the power and communication

system integration. The company is also currently preparing to begin hover testing shortly and continues to work closely with the FAA to finalize its formal application. For more information contact AIR online at www.airev.aero.

TruWeather teams with Iris for ground-based weather surveillance for uncrewed aircraft

TruWeather Solutions in Reston, Va., and Iris Automation in Reno, Nev., will combine technologies in Iris Automation's Casia G ground-based surveillance system (GBSS). TruWeather is a data and analytics firm, while Iris Automation is an avionics safety technology company. This meshed network will provide real-time integrated communications, collision avoidance and micro-weather data to operators. Micro weather or low-altitude local atmospheric conditions can often substantially differ from that in higher altitudes, injecting uncertainty into the safety equation. This can significantly impact uncrewed aircraft systems (UAS) and advanced air mobility (AAM) operations and revenue. According to an FAA-funded MIT Lincoln Lab study, currently only 3% of the U.S. has accurate surface weather and cloud ceiling report measurements. ←

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Northrop Grumman picks SemiConductor Devices for infrared targeting sensors

BY John Keller

APOPKA, Fla. – Electro-optical sensors experts at the Northrop Grumman Corp. Mission Systems segment in Apopka, Fla. needed infrared sensors for the Next Generation Handheld Targeting System (NGHTS) that Northrop Grumman is building for the U.S. Marine Corps. They found their solution from SemiConductor Devices (SCD) in Colorado Springs, Colo.

Northrop Grumman has chosen SCD to provide the high performance and small size, weight and power consumption (SWAP) infrared (IR) solution to support the Marine Corps NGHTS system.

NGHTS is a lightweight portable system that enables Marines to acquire targets quickly in day and night conditions; perform guidance against targets; and generate target location data during combat operations. NGHTS will combine target location, laser spot imaging, and laser target designation.

The SCD infrared imaging solution is part of company's Sparrow product family, which is based on SCD's 640-by-512-pixel 10-micron infrared focal plane array with mature XBn high-operating-temperature (HOT) technology.

The Sparrow enables new capabilities for a wide range of applications that otherwise would have to rely on larger, heavier, and more expensive sensors that consume a lot of power, SCD officials say.

Sparrow is appropriate for hand-held sensors, tactical mini-unmanned aerial vehicle (UAV) sensor payloads, armored vehicle sights, sniper thermal weapon sights, and perimeter security sensors.

The Sparrow has a digital readout integrated circuit (ROIC), a linear cooler with high-reliability and performance,



integrated smart electronics to support the cooler, focal plane array control, and built-in image processing.

The Marine Corps Systems Command at Quantico Marine Base, Va., announced a \$252 million eight-year contract to Northrop Grumman in February to design and build NGHTS.

The NGHTS handheld targeting system will combine all of the legacy capabilities into one system that is compatible with current and future fire-support systems and will support the Marine Corps for the next 15 to 20 years. NGHTS will reduce the weight of Marine Corps laser designation and laser spot imaging capability by 60 percent, experts say.

▲ **SemiConductor Devices (SCD) will provide infrared sensors for the Northrop Grumman Next Generation Handheld Targeting System (NGHTS) for the U.S. Marine Corps.**

The Marines today use four legacy systems: the Portable Lightweight Designator Rangefinder, Joint Terminal Attack Controller, Laser Target Designator and Thermal Laser Spot Imager. The intent is for NGHTS to replace all four systems.

“Our engineering and production teams ensured the rapid and seamless integration of our SWAP cooled IR solution into the Northrop Grumman solution,” says Mark Fydenkevez, CEO of SCD. ◀

For more information contact SCD online at <https://scdusa-ir.com> or Northrop Grumman Mission Systems at www.northropgrumman.com/who-we-are/business-sectors/mission-systems.



Lockheed Martin to redesign F-35 panoramic cockpit display electronics

BY John Keller

PATUXENT RIVER NAS, Md. – Combat avionics experts at Lockheed Martin Corp. will supervise redesign of the panoramic display in the U.S. F-35 joint strike fighter to stave-off the effects of electronics component obsolescence under terms of a \$43.6 million order.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Lockheed Martin Aeronautics segment in Fort Worth, Texas, to supervise redesign of the F-35 panoramic cockpit display to help maintain and upgrade the large cockpit display.

The Navy is asking Lockheed Martin for diminishing manufacturing sources non-recurring engineering in support of a redesigned panoramic cockpit display electronic unit video mixer for F-35 Lightning II production aircraft.

The aircraft that this order affects are those of the U.S. Air Force, Navy, Marine Corps, foreign military sales (FMS) customers, and non-U.S. Department of Defense (DOD) participants.

The F-35 jet fighter-bomber has set new standards for combat aircraft cockpit avionics with its 8-by-20-inch panoramic cockpit display, which the company showed in 2010 at the Farnborough International Airshow in Farnborough, England.

This large active-matrix liquid crystal display (AMLCD) is from L3Harris Technologies in Alpharetta, Ga., and from Elbit

▲ **Lockheed Martin will redesign the panoramic display in the U.S. F-35 joint strike fighter to stave-off the effects of electronics component obsolescence.**

Systems of America LLC in Fort Worth, Texas. It is an intuitive touch-screen, and can present the F-35 Lightning II pilot with all the information he needs, quickly, and without overwhelming him with too

much information.

The panoramic display for the F-35 is divided in two electronically. This design offers full redundancy and enables the display to continue functioning in case of component failure or battle damage.

The panoramic display smart-stitches separate images into one continuous image. It shows a variety of sensor information, attack information, and aircraft status data.

The display reportedly can withstand a puncture or a crack, and still offer all its features on only one side. In a pinch, the F-35 pilot still can rely on his helmet-mounted display in case of catastrophic avionics failure. ←

On this order Lockheed Martin will do the work in Fort Worth, Texas, and should be finished by January 2029. For more information contact Lockheed Martin Aeronautics online at www.lockheedmartin.com/en-us/who-we-are/business-areas/aeronautics.html, L3Harris Technologies at <https://engage.l3harris.com/f35-lightning-mission-critical-technology/p/1>, or Naval Air Systems Command at www.navair.navy.mil.

Raytheon to upgrade multispectral sensors for Navy anti-submarine and counter-mine helicopters

BY John Keller

PHILADELPHIA – U.S. Navy maritime surveillance experts are asking Raytheon Technologies Corp. to upgrade and maintain multispectral targeting sensors for the Navy MH-60R and MH-60S anti-submarine and counter-mine helicopters under terms of a potential \$376.4 million contract.

Officials of the Naval Supply Systems Command Weapon System Support activity in Philadelphia are asking the Raytheon Intelligence & Space segment in McKinney, Texas, for logistics, repair, and upgrade support for 15 Multi-Spectral Targeting System Forward-Looking Infrared components in support of MH-60R and MH-60S helicopters.

The AN/DAS-3 Multispectral Targeting System (MTS) 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, Raytheon officials say. The contract award is for \$272.7 million, and has options that could increase its value to \$376.4 million.

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

MTS sensors provide detailed intelligence data from the visual and infrared spectra. The new AN/DAS-4 MTS variant 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 DAS-4 includes four high-definition cameras covering five spectral bands; a three-color diode pump laser designator and rangefinder; laser spot search and track capability; automated sensor and laser bore sight alignment; three-mode target tracker; and built-in provisions for future growth.

This advanced electro-optical and infrared (EO/IR) system provides tracking and laser designation for the Griffin and

Paveway missiles, as well as all tri-service and NATO laser-guided munitions. MTS sensors offer several fields of view, electronic zoom, and multimode video tracking.

Multispectral sensors divide images and video into several light wavelengths — typically three to 15 spectral bands — across



Raytheon technicians will handle upgrading the AN/DAS-3 Multispectral Targeting System electro-optical sensors with greater fire control and target location accuracy for precise targeting coordinates.

the electromagnetic spectrum, including light from frequencies beyond the visible light range such as infrared and ultra-violet.

Dividing images into several different wavelengths enables the sensor to extract additional information the human eye fails to capture with its receptors for red, green and blue.

The L3Harris Technologies Advanced Laser Systems Technology segment in Orlando, Fla., is providing the eye-safe laser rangefinders for the Raytheon MTS. ←

On this order Raytheon will do the work in Jacksonville, Fla., and in McKinney, Texas, and should be finished by March 2027. With options the contract could extend to May 2029. For more information contact Raytheon Intelligence & Space online at www.rtx.com/our-company/our-businesses#ris, or the Naval Supply Systems Command Weapon Systems Support activity in Philadelphia at www.navsup.navy.mil/NAVSUP-Enterprise/NAVSUP-Weapon-Systems-Support.

Raytheon to launch and recover counter-mine system that has electro-optical sensors

BY John Keller

WASHINGTON – Counter-mine experts at Raytheon Technologies Corp. will provide deploy and retrieve systems for the U.S. Navy AN/AQS-20 mine-hunting sonar system under terms of a \$10.8 million contract.

Officials of the Naval Sea Systems Command in Washington are asking the Raytheon Missiles & Defense segment in Portsmouth, R.I., to facilitate deployment and retrieval of AN/AQS-20 mine-hunting sonars.

The AN/AQS-20 is a mine-hunting and -identification system aboard the Navy's Littoral Combat Ship and Arleigh Burke-class destroyer. It has acoustic and identification sensors housed in an underwater towed body. The acoustic sensors detect, classify, and pinpoint bottom, close-tethered, and volume enemy mines in one pass.

The AN/AQS-20 uses imaging sonar, signal processing, electro-optical sensors, and computer algorithms to provide real-time, computer-aided detection and classification of threat mines. It automatically localizes mine-like objects and provides the operator with a visual image and a contact data list. All mission data is recorded for post-mission analysis.

In 2016, the Navy canceled the program after purchasing 10 systems, which are to be competed against the Textron Systems Fleet-class unmanned surface vessel system and the Knifefish unmanned underwater vehicle from the Bluefin Robotics segment of General Dynamics.

The AN/AQS-20A's combination of sidescan, forward-looking, and gapfiller sonars enables the system to detect and classify mine-like objects from the seafloor to the near surface in one pass.

Last year Raytheon won a \$66.5 million contract to enhance the system's imaging sonar resolution by upgrading the 10 legacy AN/AQS-20A mine-hunting sonars to the AN/AQS-20C configuration.

While the legacy AN/AQS-20A has four separate sonars in a compact, lightweight and hydro-dynamically stable towed body, the AN/AQS-20C adds a fifth sensor — a synthetic aperture



Raytheon is helping the U.S. Navy deploy underwater electro-optical sensors for counter-mine and anti-submarine warfare.

sonar that provides the highest possible resolution for acoustic identification of underwater threats like submerged mines.

The AN/AQS-20 also has an electro-optical identification capability that delivers high-definition images of bottom mines using Streak Tube Imaging Laser technology. This provides the operator with range and contrast data for post-mission analysis to aid in mine identification. The system can find and neutralize sea mines placed as deeply as 450 feet deep.

It is a key element in single-sortie detect-to-engage capability, which combines the search, detect, identify, and neutralize elements of the Littoral Combat Ship's mine-countermeasures package.

The AN/AQS-20 completed developmental testing in February 2019, has been integrated aboard the Littoral Combat Ship. It is 10.5 feet long, 15.5 inches in diameter, and weighs 975 pounds.

In January 2020 Raytheon delivered its 10th and final AN/AQS-20 minehunting sonar system to the U.S. Navy. The sonar-towed body was transferred officially to the Naval Surface Warfare Center Panama City Division in Panama City, Fla. ◀

For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or Naval Sea Systems Command at <https://www.navsea.navy.mil>.

Army orders Switchblade UAV loitering munition for use in Ukraine

Unmanned aerial vehicle (UAV) designers at AeroVironment Inc. in Arlington, Va., are building additional manpackable killer drones that have become notable for their use in Ukraine against invading Russian military forces. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., have announced an \$18 million order to AeroVironment to build the Switchblade loitering munition that launches from a small tube that can be carried in a warfighter's backpack. The Switchblade attack drone system, which essentially functions as a smart mortar round, transmits live color and infrared video wirelessly after launch for display on a small ground-control unit. The operator confirms the target using the live video feed, commands the air vehicle to arm its payload and lock its trajectory onto the target. The Switchblade UAV weapon reportedly has been successful in Ukraine against invading Russian light combat vehicles and other valuable targets of opportunity. Ukraine officially uses the Switchblade 300 attack drone. Controllers can manipulate the Switchblade loitering munition from as far away as 6.2 miles, and the missile can operate for as long as 10 minutes. It can engage long-range targets and help to relieve warfighters who are pinned down by enemy fire. The Switchblade 300 uses compressed air to shoot out of its launch tube, and has an electric engine for propulsion. The loitering munition uses a fly-by-radio frequency signal, and daylight and infrared cameras to lock on to stationary and moving targets. The warhead has a forward-firing shotgun-blast effect that throws pellets forward of the missile. The missile weighs six pounds, and is for use against beyond-line-of-site targets. It can provide real-time GPS coordinates and video for information gathering, targeting, or target recognition.

Medium-wave infrared sensor for reconnaissance introduced by Teledyne FLIR

The Teledyne FLIR segment of Teledyne Technologies Inc. in Wilsonville, Ore., is introducing the Neutrino SX12 ISR1200 high-performance medium-wave infrared (MWIR) camera modules with integrated CZ optics for intelligence, surveillance, and reconnaissance (ISR) applications. The HD MWIR system combines a Teledyne FLIR MWIR camera module and 120-to-1,200-millimeter CZ optics with imaging electronics from InVeo Designs LLC in Louisville, Ky., to provide ISR with low-switching-cost for defense and industrial integrators. Based on Teledyne FLIR focal plane array (FPA) technology,

near diffraction-limited optics, and a long-life linear Stirling cooler with 25,000-hour mean time between failures, the Neutrino SX12 ISR1200 offers 1280-by-1024-pixel resolution with 12-micron pixel size. It also features dual-parallel outputs using a 60 Hz Camera Link base with 1080P30 HD-SDI or 720P60 HD-SDI for tracking, turbulence mitigation, and artificial intelligence (AI). The SX12 ISR1200 is a turnkey system for integration with ground-based, long-range ISR, perimeter surveillance, border surveillance, and counter-unmanned aircraft systems (C-UAS). The long-focal-length CZ lens is from the former New England Optical Systems (NEOS), which joined FLIR in 2019. The system provides autofocus, focus, and boresight retention through zoom, and it is factory optimized for each integrated system. The lens, the MWIR camera module, and imaging electronics are designed and manufactured in the U.S. For more information contact Teledyne FLIR online at www.teledyneflir.com/neutrino.

Army orders Javelin anti-armor missiles for Ukrainian military

Missiles experts at Lockheed Martin Corp. and Raytheon Technologies Corp. will build additional Javelin anti-tank missiles, which have achieved fame in the Russia-Ukraine war as one of the most lethal weapons used against invading Russian armored combat vehicles. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., have announced a nearly quarter-billion order to the Raytheon/Lockheed Martin Javelin Joint Venture based in Tucson, Ariz., to build Javelin weapon systems. The order is worth \$237.9 million over three years. The electro-optically guided Javelin anti-armor weapon is an infantry fire-and-forget missile with lock-on before launch and automatic self-guidance designed to destroy main battle tanks, armored personnel carriers, and other armored combat vehicles. The missile also is effective against buildings and enemy helicopters. Javelin has an imaging infrared-guided seeker to guide the warhead to its target. The tandem warhead has two shaped charges: a precursor warhead to detonate any explosive reactive armor, and a primary warhead to penetrate base armor. On this order the Raytheon/Lockheed Martin Javelin Joint Venture will do the work in Tucson, Ariz., and should be finished by November 2025. For more information contact Raytheon at www.raytheonmissilesanddefense.com/what-we-do/land-warfare/precision-weapons/javelin-missile, or Lockheed Martin at www.lockheedmartin.com/en-us/products/javelin.html. ←

PRODUCT APPLICATIONS

RADAR

► Lockheed Martin to build Aegis air defense and radar for Navy cruisers and destroyers

Shipboard electronics experts at Lockheed Martin Corp. will build and deliver Aegis combat systems for U.S. Navy cruisers and destroyers under terms of a \$92.5 million order.

Officials of the Naval Sea Systems Command in Washington are asking the Lockheed Martin Rotary and Mission Systems segment in Moorestown, N.J., for the design, development, integration, test, and delivery of Aegis Advanced Capability Build (ACB) 20.

The Aegis combat system uses powerful computers and radar to track and guide weapons to destroy enemy targets. More than 100 Aegis-equipped ships have been deployed in five navies worldwide. Aegis, not an acronym, refers to the shield of the mythical Greek God Zeus.

Aegis, developed in the 1980s, integrates the AN/SPY-1 radar, MK 99 fire control system, weapons control, the command and decision suite, and SM-2 Standard missile family, which includes the basic RIM-66 Standard, the RIM-67 extended-range missile, and the newer RIM-161 designed to counter ballistic missiles.

The Aegis air defense system was developed by the Missile and Surface Radar Division of RCA, which after a series of acquisitions became part of Lockheed Martin in 1995.

Lockheed Martin engineers are installing additional capabilities into the Aegis weapon system, such as ballistic missile defense (BMD) 5.1, which integrates a 21-inch-diameter variant of the SM-3 missile called the SM-3 Block IIA. BMD 5.1 also will improve Aegis data links to enable engage on remote track data.

Lockheed Martin's work also integrates the SPQ-9B surface search & fire control radar into the Aegis weapon system. The SPQ-9B detects and tracks incoming targets at



sea level, on the surface of the water for either gun fire engagement or navigation.

Work also integrates the Lockheed Martin MH-60R Seahawk anti-submarine warfare (ASW) helicopter into the Aegis system, as well as improves the system's electronic warfare (EW) capabilities via the Surface Electronic Warfare Improvement Program (SEWIP).

Lockheed Martin experts also will expand the Tactical Data Link (TDL) capability with Link 22 on the Aegis system for improved interoperability, and improve shipboard training capability through Total Ship Training Capability (TSTC).

Previous Aegis upgrades installed commercial off-the-shelf (COTS) computers to enhance warfighting capabilities such as simultaneous anti-air warfare and ballistic missile defense.

On this contract modification Lockheed Martin will do the work in Moorestown, N.J., and should be finished by December 2022. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Sea Systems Command at www.navsea.navy.mil.



RADIO COMMUNICATIONS

◀ General Dynamics to build shipboard software-defined radio with NSA Type 1 encryption

U.S. Navy shipboard communications experts are asking General Dynamics Corp. to provide AN/USC-61(C) maritime radios to enable Navy surface warships and submarines to communicate over high frequency (HF), ultra-high frequency (UHF) line of sight, UHF satellite communications (SATCOM), and very high frequency (VHF) radio bands.

Officials of the Naval Information Warfare Systems Command (NAVWAR) in San Diego announced a \$49.9 million order to the General Dynamics Mission Systems

segment in Scottsdale, Ariz., to build AN/USC-61(C) digital modular radio (DMR) systems.

The contract includes high-frequency distribution amplifier group components and engineering services for continued fielding and maintenance of the maritime radio communications system.

DMR is a modular, software reprogrammable shipboard radio system with embedded cryptography that provides all radio frequency (RF) to-baseband and baseband-to-RF conversion functions required for U.S. naval line-of-sight, beyond line-of-sight and satellite communications systems.

This contract modification asks General Dynamics engineers to carry out new radio communications requirements that were not anticipated in the original contract award. NAVWAR awarded the order on behalf of the Navy's Program Executive Office for Command, Control, Communication, Computers, and Intelligence (PEO C4I) in San Diego.

The AN/USC-61(C) is a maritime software-defined radio (SDR) that has become standard for the U.S. military. The compact, multi-channel DMR provides several different waveforms and multi-level information security for voice and data communications.

The radio includes NSA Type 1 encryption; embedded red/black baseband switching and routing; co-site performance; reduced manpower requirements; single point of control for HF/VHF/UHF/SATCOM radio communications; and built-in test (BIT).

Software-defined radio waveforms are computer programs that enable SDR-enable radios to operate on different frequency bands with different encryption and cyber security functions. The AN/USC-61(C) operates on Navy surface ships, submarines, and other military platforms using frequencies from 2 MHz to 2 GHz.

General Dynamics has certified the DMR to pass secure voice and data at multiple independent levels of security (MILS) over HF, VHF, UHF, and SATCOM channels, and to withstand the effects of electromagnetic interference and other harsh operating conditions.

The DMR also is certified by the Joint Interoperability Test Command (JITC) to be compliant with the U.S. government's MIL-STD-188-181B/182A/183A requirements for UHF SATCOM. General Dynamics builds the AN/USC-61(C) using open-architecture standards.

On this order, General Dynamics will do the work in Scottsdale, Ariz., and should be finished by December 2022. For more information contact General Dynamics Mission Systems online at <https://gdmissionsystems.com>, or NAVWAR at www.navwar.navy.mil.



ANTI-SUBMARINE WARFARE

▲ Navy orders 18,000 multistatic sonobuoys from ERAPSCO and Lockheed Martin

U.S. Navy anti-submarine warfare (ASW) experts are replenishing their supplies of advanced multistatic air-launched sub-hunting sonobuoys that work together with other sonobuoys to detect, pinpoint, and track enemy submarines.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced that ERAPSCO in Columbia City, Ind., and the Lockheed Martin Rotary and Mission Systems segment in Manassas, Va., will share as much as \$222 million to build as many as 18,000 AN/SSQ-125A multistatic sonobuoys for Navy airborne ASW operations.

Sonobuoys are air launched expendable, electro-mechanical ASW acoustic sensors designed to relay underwater sounds of ships and submarines. Sonobuoys enable Navy ASW forces to track potentially hostile submarines operating in the open ocean and in coastal areas that could be threats to Navy carrier battle groups or other forces. Information from these systems can help enable precision attacks with air-launched torpedoes.

Navy fixed-wing aircraft and helicopters can drop a pattern of sonobuoys, which relay information back to the aircraft by radio link, to determine the exact locations of enemy submarines. ERAPSCO and Lockheed Martin will compete for AN/SSQ-125 sonobuoy orders over the next two years.

The AN/SSQ-125 sonobuoys work together with the Navy's AN/SSQ series of sonobuoys, which consist of the SSQ-36 bathythermograph (BT); SSQ-53 passive directional low frequency analyze and record (DIFAR); SSQ-62 directional command active sonobuoy system (DICASS); SSQ-101 air deployed active receiver (ADAR); SSQ-110 multi-static non-coherent source; and SSQ-125 multi-static coherent source.

The AN/SSQ-125 sonobuoy is a source in a multistatic field, and can generate a variety of waveforms, and is designed to work with the AN/SSQ-53F, AN/SSQ-77C, and AN/SSQ-101 (ADAR) sonobuoys.

A multistatic sonar system contains several spatially diverse monostatic or bistatic sonar components with a shared area of coverage, and enable Navy ASW operators to use sensor fusion to combine the power of the separate sonobuoys.

The AN/SSQ-125's RF channel can be programmed to any of the standard sonobuoy operating channels. At any time after deployment, the AN/SSQ-125 can be commanded to change its operating parameters or depth (deeper only), generate a ping, or scuttle.

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The AN/SSQ-36B provides vertical temperature profiles of the ocean layer for ASW and research, and used widely in ASW operations to evaluate local effects of seawater temperature on sonar propagation and acoustic range prediction.

The AN/SSQ-53F uses four hydrophones -- each one a multichannel directional piezoelectric ceramic transducer -- that operate at depths of 90, 200, 400, and 1,000 feet to listen for potentially hostile submerged enemy submarines. Aircraft can drop a pattern of sonobuoys, which relay information back to the aircraft by radio link, to determine the exact locations of enemy submarines.

The SSQ-53F has three sensors: a constant shallow omni (CSO), an advanced DIFAR sensor, and a calibrated wide-band omni. The buoy digitally conditions and amplifies the acoustics and provides directional data that helps establish azimuthal bearing to the submarines being tracked.

The AN/SSQ-62E DICASS sonobuoy is for detecting and localizing submarines in preparation for attack. It can provide range and bearing to the target to fix position, and can

support any of the four acoustic frequencies as selected via the Electronic Function Select.

The AN/SSQ-101 ADAR sonobuoy provides a commandable passive search capability, and functions as the receiver in a multistatic active receiver system. The device uses a pentagon-shaped horizontally oriented pattern of hydrophones to detect and beam form underwater sound waves.

ERAPSCO operates as a joint venture between the Sparton Corp. Defense & Security segment in Le Leon Springs, Fla., and Ultra Electronics USSI in Columbia City, Ind. On this contract, ERAPSCO will do the work in De Leon Springs, Fla.; and Columbia City, Ind., while Lockheed Martin will do the work in Manassas, Va., and Clearwater, Fla.

For more information contact ERAPSCO online at <http://erapsco.com>, Lockheed Martin Rotary and Mission Systems at www.lockheedmartin.com, or Naval Air Systems Command at www.navair.navy.mil.

Software

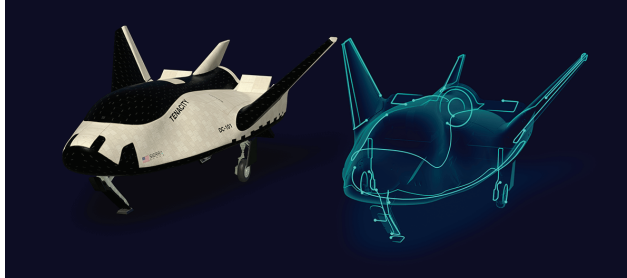
▲ **Sierra Space selects Siemens Xcelerator software and services for commercial space venture**

Siemens Digital Industries Software have announced that Sierra Space, a commercial space company that focuses on creating and building space transportation and infrastructure for Low Earth orbit (LEO) commercialization, has implemented Siemens' Xcelerator portfolio of software and services.

Siemens says its Xcelerator engineering software suite enables product and manufacturing design, while MBSE and digital thread capabilities ensure that data is accessible.

Sierra Space is implementing Xcelerator to establish a fully digital environment from engineering to manufacturing through sustainment as it develops its Dream Chaser "space plane" that is a multi-mission utility vehicle designed to transport crew and cargo to low-Earth orbit (LEO) destinations such as the International Space Station.

Sierra Space will use Siemens' Xcelerator in all phases of next-generation Dream Chaser development, including structural, thermal, mechanical, electrical, and software design, vehicle manufacture, requirements verification and complete life cycle maintenance.



The spaceplane is capable of a smooth 1.5 low-g re-entry for crew and cargo transportation with the ability to land on compatible existing commercial runways worldwide. NASA contracted Dream Chaser to perform cargo supply and return missions to the International Space Station (ISS), where it can deliver up to 12,000 pounds of cargo in a single trip. Sierra Space is expanding on this long-standing collaboration with Siemens as the company fully embraces the transformation to become a digital enterprise.

In addition to Dream Chaser, Sierra Space is also working to design, develop, build, operate, and support a customer-centric destination in Earth orbit. In partnership with Blue Origin, they have developed the Large Integrated Flexible Environment (LIFE) habitat, a component in the Orbital Reef project. .

SPACE POWER

▼ Boeing's Spectrolab selected by NASA to power Roman Space Telescope

Spectrolab Inc. in Sylmar, Calif., a wholly owned subsidiary of Chicago's Boeing Co., will manufacture, integrate, and test approximately 4,000 XTJ Prime solar cells for NASA's Nancy Grace Roman Space Telescope.

"Using Spectrolab's XTJ Prime solar cells, NASA will be able to maximize the Roman Space Telescope's power generation, allowing greater data gathering capability while operating in a unique mission environment at the L2 Lagrange point," said Tony Mueller, president of Spectrolab. "These cells leverage both heritage and high efficiency for the agency's newest universe studying telescope."

Spectrolab's NeXt Triple Junction (XTJ) Prime solar cells will provide power to the telescope, including its two main instruments – the Wide Field Instrument and the Coronagraph Instrument – as well as the primary mirror that is 2.4 meters in diameter (7.9 feet), and is the same size as the Hubble Space Telescope's primary mirror. The solar array consists of six panels, each approximately 3 by



2.5 meters and consists of 4,000 triple-junction solar cells. Triple junction solar cells leverage multiple band gaps tuned to different wavelengths of the solar spectrum, allowing higher efficiencies not possible with commercially available silicon solar cell technology.

CARBON FIBER COMPONENTS

▲ Beyond Gravity selects D-Orbit to provide carbon fiber components for ESA's Space Rider

Beyond Gravity in Toulouse, France needed carbon fiber components for the European Space Agency's Space Rider reusable space vehicle. They found their solution from D-Orbit in Como, Italy.

D-Orbit, a space logistics and orbital transportation company, has signed of a subcontract with space company Beyond Gravity under which D-Orbit will deliver lightweight carbon fiber-reinforced polymer (CFRP) tools and metallic structural components for the European Space Agency's Space Rider reusable space vehicle. The financial terms of the transaction were not disclosed.

D-Orbit will supply the CFRP tooling and metallic structural flight hardware components. D-Orbit will also coordinate and monitor the work of Italian suppliers, to ensure that the production and documentation follows the space industry's best practices.

The Space Rider spacecraft, which will be built by prime contractor Thales Alenia Space, which is based in Cannes, France, is an automatic, uncrewed laboratory designed to perform technology demonstration and pharmaceuticals, biomedicine, biology, and physical science experiments over missions lasting up to two months.

A key feature of Space Rider is the ability to re-enter the atmosphere to return experiment results, land on a runway, and fly multiple times, a mission profile that will validate Europe's know-how in operating missions in low Earth orbit. Space Rider's maiden mission is expected to launch in 2023. ◀

CONNECTORS

► Positronic D-Sub power and signal connectors introduced by Powell Electronics

Electronics distributor Powell Electronics in Swedensboro, N.J., is introducing Mach-D high-performance D-Sub power and signal connectors from Positronic, an Amphenol company in Springfield, Mo. The Mach-D connectors are for high-reliability defense, aerospace, and industrial applications that must operate in harsh environments. The devices are built with precision machined shells that provide superior EMI shielding and robustness. Mach-D connectors are available with standard-density contacts (MCD series), and high-density signal contact arrangements (MCDD series) as well as hybrid versions (MCBX series), which combine power and signal in one connector body. The Mach-D connectors offer integrated hardware to eliminate unintentional disassembly. Benefits include banding options on the rear shell, shell-to-shell grounding strips, shell-to-back-shell grounding strips, IP67 sealing options, rear grommets, and 36-position keyed jackscrews for mechanical keying between otherwise like connectors. MACH-D devices meet or exceed all M24308 Group B testing requirements. For more information contact Powell Electronics online at www.powell.com, or Positronic at www.connectpositronic.com.



security cameras, telescope drive mechanisms, time-lapse photography and winders. The standard 1-, 2-, 3-, and 4-axis

FIGARO motion control Systems are available as compact counter-top enclosures or 19-inch rack mounts for stepper motors, DC servo motors with quadrature incremental encoders,

three-phase brushless DC servo motors with quadrature incremental encoders, hall effect sensors, and voice coil motors with linear encoders. Additionally, the FIGARO series can be configured with a combination of drivers for steppers, DC servos, and brushless DC motors. An external host such as a PC, micro-controller, or programmable logic controller sends commands to the controller via a USB or RS-232 serial port, and the controller processes and executes the commands. For more information contact OES online at www.oesincorp.com.

POWER ELECTRONICS

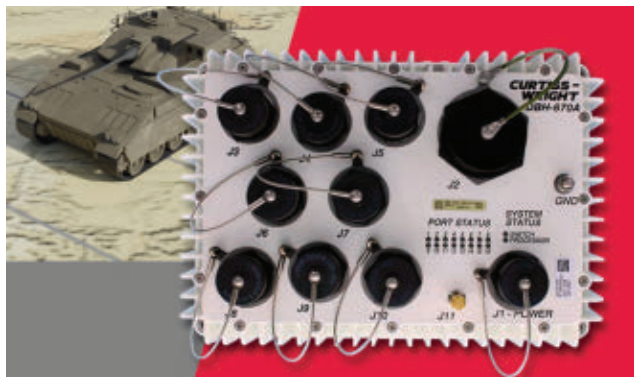
▼ Industrial-grade power capacitors introduced by Cornell Dubilier

Cornell Dubilier Electronics Inc. in Liberty, S.C., is introducing 380LX and 381LX aluminum electrolytic capacitors for rugged and industrial electronics designers who push applications boundaries into high voltages. The 380LX and 381LX power capacitors include voltages to 600 volts DC. The 380LX and 381LX snap-in series have a published load life of 3,000 hours when tested at rated voltage and ripple current at rated temperature. The 380LX series of capacitors is designed to operate in temperatures as hot as 85 degrees Celsius, while the 381LX series meets the same load life at 105 C. These components demonstrate life in real-life applications where conditions typically are lower than the capacitor's maximum specified ratings. Newly added capacitance values in the range of 150 to 330 microfarads are offered at 550 and 600 volts DC in the 380 LX series and 140 microfarads to 340 microfarads at 500, 550, and 600 volts DC in the 381LX series. Developed at Cornell Dubilier's technology center in Liberty, S.C., these ratings come with enhanced ripple current capability to 3.7 amps at full-rated conditions. Company officials say they expect these snap-in capacitors of relatively high voltages are for the latest inverter

MOTION CONTROL

▼ Motion control for machine automation in robotics introduced by OES

Optimal Engineering Systems Inc. (OES) in Van Nuys, Calif., is introducing the FIGARO series motion control system for single and multi-axis positioning stages for use in military, aerospace, astronomy, communications, and motion control. Applications include machine automation, robotics, flight simulation, linear and rotary stages, motion control camera boom systems, pan-tilt gimbals, circuit board assembly and inspection, pick-and-place, positioning stages, scanners,



circuits for renewable energy, UPS systems, battery chargers, motor drives, welders, and other applications that require high-performance components to improve system reliability. For more information Cornell Dubilier online at www.cde.com.

SPACE POWER

► **Radiation-hardened DC-DC converter for spacecraft introduced by VPT**

VPT, Inc., a HEICO company in Blacksburg, Va., is introducing the radiation-hardened SGRB12028S 120 volt DC-DC converter power supply for a variety of high-power space payload or bus applications. Using advanced EPC Space gallium nitride (GaN) technology, the SGRB12028S is capable of 95 percent efficiency, and offers a fixed-frequency reduced-voltage switching topology for low input and output noise. Designed for applications facing the harsh radiation environments of space, the SGRB series space-rated DC-DC converter has been characterized to total ionizing dose (TID) of 100 kilorads of radiation, including low dose rate and single-event effects performance to 85 MeV/mg/cm². The SGRB series features an integrated electromagnetic interference filter, 120-volt input and 28-volt, 400-Watt output, and is rated for full power operation at temperatures from -35 to 85 degrees Celsius. For more information contact VPT online at www.vptpower.com.



AVIONICS

▼ **Lightweight head-up display (HUD) for commercial and military aircraft introduced by BAE Systems**

The BAE Systems Electronic Systems segment in Nashua, N.H., is introducing the LiteWave lightweight head-up display (HUD) that can be integrated into military and commercial aircraft cockpits that have limited cockpit space. LiteWave is a laptop-sized HUD mounted above the pilot's head. It presents critical information such as direction, altitude, and speed, in the pilot's line of sight. The lightweight HUD avionics is 70 percent smaller and lighter than a traditional HUD, is as much as 80 percent faster to install, and its simple design makes maintenance quick and inexpensive, company officials say. Powered by The BAE Systems waveguide technology, LiteWave can

be adjusted to suit any individual flying position and allows the pilot to maintain situational awareness, even during poor weather or at night. LiteWave marks the next stage in bringing state-of-the-art digital technology to the marketplace, and is now available to begin flight trials for future customers on commercial and military aircraft. LiteWave is manufactured at The BAE Systems Electronic Systems site in Rochester, England.

For more information contact BAE Systems online at www.baesystems.com/en-us/productfamily/displays.

RAD-HARD MEMORY

► **Radiation-hardened serial interface F-RAM for space introduced by Infineon**

Infineon Technologies LLC in Munich is introducing a radiation-hardened serial interface ferroelectric RAM (F-RAM) for use in extreme environments in space applications. The devices are more energy efficient than non-volatile EEPROM and serial NOR Flash devices for space applications. It offers support for the industry standard Serial Peripheral Interface (SPI) protocol. The device can replace serial NOR flash and EEPROMs, and is for data logging of mission critical data, telemetry storage, command and control calibration data storage, and boot code storage solutions for microcontrollers, FPGAs, and ASICs. The 2-megabit density F-RAM with SPI offers 10 trillion read/write cycles and 120 years data retention at 85 degrees Celsius, at an operating voltage range of 2 to 3.6 volts. The lowest operating current is 10 milliamps maximum, with an extreme low programming voltage of 2 volts. The radiation-hardened F-RAMs also are suitable for avionics and other applications that require military-standard temperature grades reaching from -55 to 125 C. More information is online at www.infineon.com.



CABLE ASSEMBLIES

► **Brass- and gold-plated micro coax cable assemblies introduced by Amphenol RF**

Amphenol RF in Danbury, Conn., is introducing MMCX cable assemblies to make connections between circuit boards and modules in tight spaces such as IoT infrastructure. These cable assemblies are designed on ultra-flexible 0.81-millimeter micro coax cable. These 50 ohm assemblies are available in a MMCX right-angle plug to AMC4 right-angle plug single



NEW PRODUCTS

configuration. The MMCX to AMC4 assemblies offer reliable electric performance to 6 GHz. MMCX connectors on the cable assemblies are manufactured from brass with gold plating while the ultraminiature AMC4 features a silver-plated phosphor bronze body. The assembly offers secure and reliable mating with the quick connect/disconnect snap-on coupling mechanism. For more information contact Amphenol RF online at www.amphenolrf.com.

DATA STORAGE

► Industrial-grade memory cards with error correction introduced by Swissbit

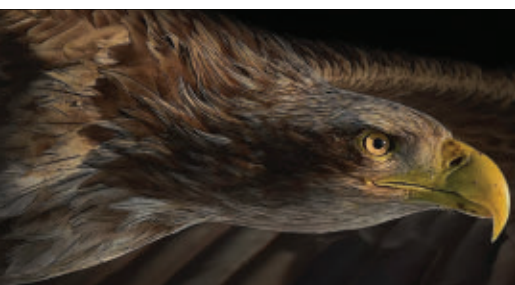
Swissbit NA Inc. in Westford, Mass., is introducing the S-55 and S-58 series industrial-grade SD and microSD memory cards for surveillance and medical applications. The memory cards combine industrial-grade 3D TLC NAND technology with a powerful controller and firmware, and are available in capacities ranging from 16 to 512 gigabytes and support an extended temperature range of -40 to 85 degrees Celsius. The S-55 and S-58



series are based on Micron flash chips, and are optimized to tolerate temperature fluctuations between read and write operations across the specified temperature range. The memory cards feature 120-bit LDPC error correction, page fail protection, read disturb management, background data refresh, data recovery following a sudden power loss, and static and dynamic wear leveling. A

molded SiP package with gold contacts provides optimal protection against high mechanical stress and environmental influences even in harsh environments. The memory cards are SD-6.1 compliant and support the common SPI interface mode and the UHS-I interface mode. They reach UHS speed class U3 or respectively speed class 10, as well as application class A2 and video speed class V30. The S-55 is available in capacities ranging from 64 to 512 gigabytes, with the microSD version S-55u offering between 64 and 256-gigabyte choices. For more information contact Swissbit online at www.swissbit.com. ◀

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NASA to ask industry for advanced fuel-efficient experimental aircraft and avionics

BY John Keller

EDWARDS AIR FORCE BASE, Calif. – Space agency experts are reaching out to industry to find companies able to design and build an experimental aircraft and avionics suite able to make dramatic reductions in fuel consumption and carbon dioxide emissions.

Officials of the U.S. National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center at Edwards Air Force Base, Calif., announced plans in June to issue an Announcement for Partnership Proposals (AFPP) for the upcoming Sustainable Flight Demonstrator project.

This initiative will seek to design, build, test, and fly an advanced airframe configuration and related technologies to reduce aircraft fuel burn and CO2 emissions dramatically as part of the Sustainable Flight Demonstrator project.

NASA say they anticipate entering into one agreement with private industry, with the potential for more, to develop

▲ **NASA is kicking-off a project to develop an experimental aircraft and avionics suite able to make dramatic reductions in fuel consumption and carbon dioxide emissions.**

an advanced airframe and avionics to exploit the potential for commercial use in the 2030s.

This fuel-efficient experimental aircraft project has three goals: develop and flight-test an aircraft and avionics to reduce

aircraft fuel burn and CO2 emissions; obtain ground and flight data to validate the aircraft and flight technologies; and help design next-generation single-aisle passenger aircraft that meet U.S. environmental goals.

This notice is not yet a formal offer; an AFPP will come later. Email questions or concerns to NASA's Bradley Flick, the center ombudsman for this acquisition, at bradley.c.flick@nasa.gov. ◀

An expected time for release of a formal solicitation was not released. More information is online at <https://sam.gov/opp/9c2537a4081441b1a98539c53c377977/view>.



NASA eyes enabling technologies for future near-hypersonic passenger aircraft

By John Keller

CLEVELAND – Space Agency experts announced plans to kick off a new project to develop enabling technologies for future near-hypersonic commercial passenger aircraft that travel at speeds of nearly five times the speed of sound.

Officials of the U.S. National Aeronautics and Space Administration (NASA) Glenn Research Center in Cleveland say they will issue a formal solicitation in August for the NASA High-Speed Endoatmospheric Commercial Vehicle Conceptual Design Study and Technology Roadmaps Development project.

NASA is seeking to develop enabling technologies for high-speed commercial transports able to fly at speeds between Mach 2 and Mach 5 that could enter service as early as the 2030s. Mach 3 to Mach 5 represent speeds between 1,535 and 3,836 miles per hour.

Studies will identify key technology needs and opportunities to enable such passenger aircraft. Specific speed, passenger count, range, and allowable technology readiness level will be negotiated after contract award.

◀ **NASA experts will approach industry next month for enabling technologies for future near-hypersonic commercial passenger aircraft.**

NASA's Hypersonic Technology and Commercial Supersonic Technology projects fall under the NASA Advanced Air Vehicles Program, which will lead efforts to develop an environmentally sustainable civilian high-speed aircraft. These technical criteria are subject to change in the final request for proposals (RFP).

NASA officials say they expected to release a draft RFP for this near-hypersonic passenger jet program on 28 June 2022, and sponsor online industry briefings the week of 18 July 2022. Final proposals will be due around 30 August 2022. ◀

Companies interested should notify NASA of their intent to submit offers by email to NASA's Rita Dickens at rita.k.dickens@nasa.gov. More information is online at <https://sam.gov/opp/60d81f712eab435e91c455cbad77e394/view>.

Volocopter's four-seater aircraft takes first flight

Urban Air Mobility (UAM) company Volocopter in Bruchsal, Germany, has flown its fixed-wing passenger aircraft VoloConnect for the first time. Volocopter's third product, the VoloConnect, offers a range of more than 60 miles and flight speeds faster than 155 miles per hour to bring business travelers and commuters beyond the city center on routes like Burbank to Huntington Beach in California. The prototype completed its first flight in May 2022 after 17 months in the making and performed a few maneuvers for two minutes and 14 seconds during its first flight. The prototype has all the planned aerodynamics and performance features of the planned commercial product. The VoloConnect's six rotors facilitate vertical takeoff, while two electric fans in combination with uplift-creating wings ensure high forward speeds. Its prototype is passing flight tests to verify that the aircraft and its systems are in line with performance limits. This phase encompasses low-speed, transition, high-speed, and engine-failure testing for automated and later autonomous flights – all standard-issue tests for eVTOL passenger aircraft manufacturers. Within the first three test flights of this campaign, the team was able to verify a significant portion of the eVTOL's envelope with forward speeds up to 40 mph and 28 mph side-ward flight speeds during tests. For more information contact Volocopter online at www.volocopter.com.

Embraer installs Ka-Band in Flexjet's Legacy 500 fleet in Europe

Embraer, based in Sao Jose do Campos, Brazil, announced that Flexjet is the first Legacy 500 customer to install Ka-Band, an aftermarket modification on its European fleet of the business jet model. This new capability is available through a service bulletin for the Legacy 450, Legacy 500, Praetor 500 and Praetor 600 business jets. Embraer also offers the Ka-Band from the factory, as an optional item, for the Praetor 600 and the Praetor 500. The Ka-Band provides high-speed internet access for in-flight connectivity, enabling customers to access e-mails, exchange files, stream video content, among other features, allowing several devices connected at the same time.

World's fastest passenger jet goes supersonic in tests

The race to resume supersonic passenger flights nearly two decades after the retirement of Concorde was offered a glimmer of excitement on Monday when plane manufacturer Bombardier revealed high speed achievements while confirming the launch of its new business jet. Bombardier, based in Quebec, has claimed that the Global 8000 – which is still in development – will best any other business jet in range and speed. The Global 8000 is slated to have a range of 8,000 nautical miles and can carry 19 passengers at a speed of Mach 0.94. "The Global 8000 aircraft leverages the outstanding attributes of the Global 7500 aircraft, providing our customers with a flagship aircraft of a new era," Éric Martel, president and CEO for Bombardier, said in a statement. ◀



Elliott Aviation selects Collins Aerospace to upgrade Citation CJ2+ business jet

BY Jamie Whitney

MOLINE, ILL. – Elliott Aviation in Moline, Ill., was looking to upgrade the avionics on a Cessna Citation CJ2+ business jet. They found their solution from Collins Aerospace in Cedar Rapids, Iowa.

A suite from Collins' Pro Line 21 family was selected, which was installed in Moline and took 21 working days. Collins Aerospace is a subsidiary of Raytheon Technologies. Moving forward, Elliott says the installs will be quoted at a four-week downtime thanks to the insight gained during this project.

"The avionics team at Elliott Aviation was able to leverage their Collins experience with Full Pro Line 21 retrofits and being the worldwide leader in Pro Line 21 Modernization upgrades to accomplish the short downtime," notes Elliott's Avionics Sales Manager Bill Forbes.

Elliott says the company performs more than 40 to 50 full-panel retrofits each year. The Pro Line Fusion upgrade

▲ **Collins Aerospace is installing the company's Pro Line 21 avionics suite in the upgrade of a Cessna Citation CJ2+ business jet.**

enables reduced pilot workload, greater situational awareness, and forward touch screens that enhance heads-up flying.

The upgrade is expected to reduce pilot workload by using a new integrated flight management system, which meets the latest equipment mandates.

The avionics enhances situational awareness by enabling pilots to interact with touch-interactive maps – showing high-resolution topography, weather, and obstacles. High-resolution synthetic vision displays Collins Aerospace's patented airport dome feature and extended runway centerlines.

There also is a geo-referenced electronic chart showing own-aircraft position. The Collins patented ChartLink automatically stage charts relevant to the flight plan. ◀

Forward touch-screen displays are 14.1-inch widescreen liquid crystal displays (LCDs) with advanced graphics and configurable windows. The sizing and features of the screens enable pilots to keep their views out of the cockpit for enhanced safety.