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Navy asks industry for safety upgrades to F/A-18C/D flight-control computer. **PAGE 4**

Test and measurement

Today's test and measurement gear keeps on-board systems ready to go at a moment's notice. **PAGE 24**

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SATELLITE COMMUNICATIONS

*SATCOM satellites host surveillance sensors, networking crosslinks, and similar technologies for global situational awareness. **PAGE 14***



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The official Sensor Open Systems Architecture (SOSA) standard is out; so now what?

One of the most influential open-systems standard for embedded computing designs in years has been released in its first official version, so now we're about to find out how important the Sensor Open Systems Architecture (SOSA) standard will be in the long term.

We've been hearing about SOSA at least for the past seven years. The standard seeks to help create a level playing field for embedded computing suppliers and systems integrators who serve the aerospace and defense market. At the very least, SOSA promises to tame the beast of thinly cloaked proprietary architectures that collectively have become known as OpenVPX. At best, SOSA may help military systems designers achieve their dream of high-performance embedded computing at affordable prices.

So SOSA is seven years in, and there's still quite a ways to go before this standard becomes a familiar part of the landscape. SOSA seeks to benefit embedded systems suppliers by incorporating existing standards like OpenVPX as much as possible. The idea is to avoid re-inventing what's already known, and to a great degree SOSA appears to be heading in that direction.

At the same time, however, SOSA is generating no lack of confusion and controversy. The framers of SOSA have been prickly about terminology. Is it compliant? Is it conformant? No, it's aligned; many of us have run afoul of the required terms.

Until the end of last September, there was no official SOSA standard; all of its evolving iterations were called snapshots. Those who tried to meet SOSA guidelines had to do their best to meet the spirit of these snapshots, yet the standard had no binding authority. Since there was no official standard, no products could be called SOSA-compliant or SOSA-conformant. Instead, industry adopted the term "SOSA-aligned."

Now that there's an official standard, however, industry still can't claim to be compliant or conformant to SOSA. Today's there's no way to prove compliance, and it will be about eight months to a year before compliance testing will

be in place to ensure that products meet the SOSA specifications. Only then — sometime in 2022 if we're lucky — will companies be able to put a SOSA-conformant or SOSA-compliant sticker on their products.

Adding to this uncertainty, the SOSA market has yet to define itself clearly, which leaves some embedded computing suppliers wondering if the standard applies to them. The way it's shaking out, SOSA will apply directly to bus-and-board designs, as it goes into detail on standardizing backplanes, connectors, power, I/O interfaces, and form factors.

But what about embedded computing suppliers who specialize in rugged servers built largely on proprietary technology, and who make no claim about industry-standard designs inside the enclosures? Can they play in the SOSA market? As of right now it's not clear. The answer probably is not now, but perhaps in the future. It's likely that the SOSA committees who work under aegis of The Open Group in San Francisco eventually will define standard box-to-box interfaces as part of the SOSA standard. That's in the future, though.

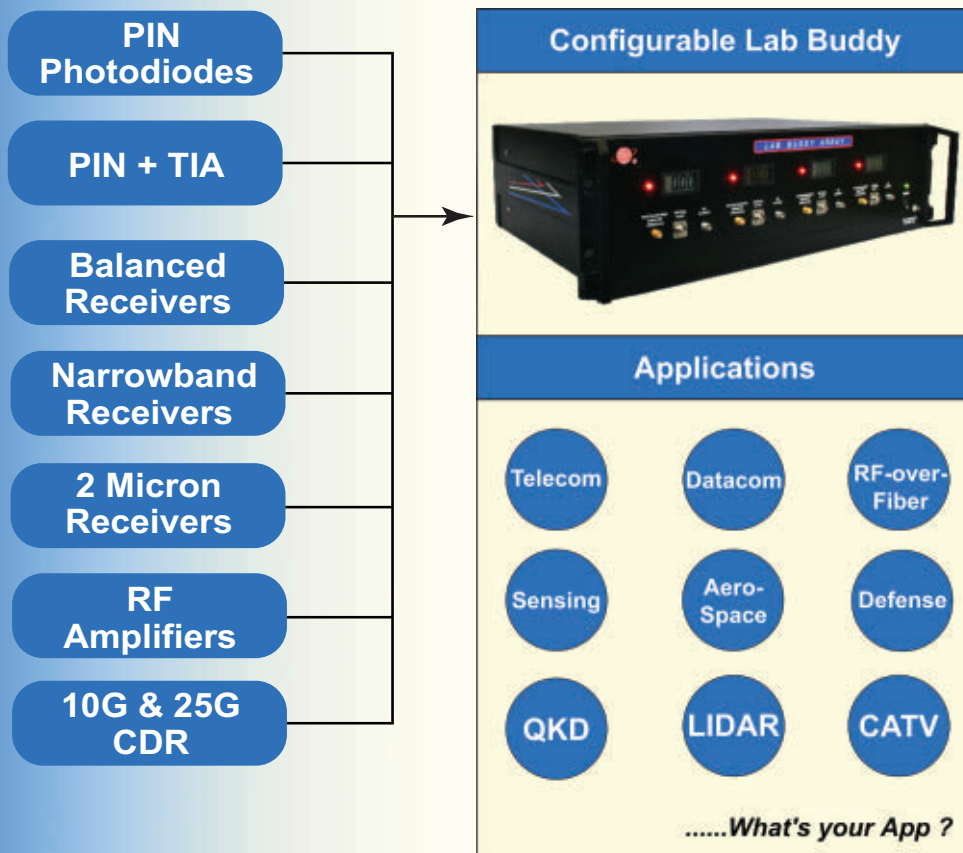
Moreover, what about high-performance embedded computing suppliers who specialize in the latest technologies and who don't particularly care about meeting industry standards? Some of these would argue that SOSA is trying to solve design problems that persisted 10 or 15 years ago in bus-and-board designs that had to consider future upgrades and technology insertion.

Today that may no longer be the case, they argue. Today designers typically upgrade systems by pulling out old boxes and replacing them with new ones. If that's the case, then who cares what's inside the box, as long as it can interoperate efficiently with other components in the system?

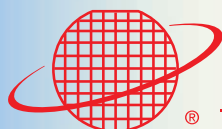
These are some of the issues that SOSA will have to confront as the new standard evolves to meet aerospace and defense needs of the future. If it doesn't, then SOSA could be the latest design approach to be tossed on the scrap heap of history. ←

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Army orders five rebuilt Boeing CH-47F Chinook heavy-lift helicopters and avionics

BY John Keller

REDSTONE ARSENAL, Ala. — U.S. Army aviation experts are ordering as many as five rebuilt Boeing CH-47F Chinook multi-mission heavy-lift transport helicopters under terms of a \$391.4 million contract.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., are asking the Boeing Co. Defense, Space & Security segment in Ridley Park, Pa., to provide the renew twin-rotor helicopters.

The CH-47F is an advanced multi-mission helicopter for the U.S. Army and international defense forces. It contains an integrated, digital cockpit management avionics, common aviation architecture cockpit, and advanced cargo-handling.

The Chinook's primary mission is to move troops, artillery, ammunition, fuel, water, barrier materials, supplies, and equipment on the battlefield. Its secondary missions include medical evacuation, disaster relief, search and rescue, aircraft recovery, firefighting, parachute drops, heavy construction, and civil development.

Under the U.S. Army Modernization Program, new-build CH-47F began deliveries in 2006. Under the same program, CH-47Ds are being upgraded to remanufactured CH-47F helicopters.

Photo (above): The CH-47F is an advanced multi-mission heavy-lift helicopter for the U.S. Army and international defense forces.

The twin-rotor CH-47F Chinook is 52 feet long, 12.4 feet wide, nearly 19 feet tall. It has two 60-foot-diameter rotors and has two Honeywell T55-GA-714A engines. The rotorcraft can lift 24,000 pounds, fly as fast as 170 knots at ranges to 200 nautical miles, and can fly as high as 20,000 feet.

With a crew of three, the CH-47s can transport 44 seated troops or 24 wounded warfighters on stretchers. The aircraft can carry palletized cargo internally, including the U.S. Army Humvee light vehicle, or sling-loaded external cargo, using its triple cargo hooks for stability.

The CH-47's triple-hook system stabilizes large external loads like the 155-millimeter howitzers, and can fly these loads at as fast as 140 knots. The helicopter can deliver external loads like fuel blivets to three separate destinations in one sortie. ←

On this contract Boeing will do the work at locations to be determined with each order, and should be finished by September 2025. For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa>.



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U.S. military orders 16 F-35 combat aircraft and avionics in \$1.1 billion deal

BY John Keller

PATUXENT RIVER NAS, Md. — Combat aircraft designers at Lockheed Martin Corp. will build 16 new F-35 jet fighter-bombers for the U.S. Air Force and Marine Corps under terms of a \$1.1 billion order.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md. — the organization handling F-35 aviation technology procurement for all military forces — are asking the Lockheed Martin Aeronautics segment in Fort Worth, Texas, to build 16, Lot 15 F-35 Lightning II aircraft — 10 for the Air Force and six for the Marine Corps.

The F-35 with its advanced avionics is a fifth-generation single-seat, single-engine, all-weather stealth multirole jet fighter-bomber is designed to perform ground-attack, aerial-reconnaissance, and air-defense missions. It is one of the most advanced combat jets in the world.

Photo (above): The F-35 fifth-generation multirole jet fighter-bomber is for ground-attack, aerial-reconnaissance, and air-defense missions.

The F-35 is to augment or replace Air Force F-16 and A-10 aircraft, and Marine Corps F/A-18, and AV-8B tactical fighter and attack aircraft. Lockheed Martin has been developing the F-35 since 2001.

The single-seat F-35 military jet is 50.5 feet long, has 35-foot wingspan, and is 14 feet tall. It has one Pratt & Whitney F135 afterburning turbofan engine that can produce as much as 43,100 pounds of thrust.

The F-35 aircraft can fly as fast as Mach 1.6, as high as 50,000 feet, and has a range of 1,200 miles. It has one 25-millimeter Gatling gun and can carry advanced air-to-air

missiles, air-to-ground missiles, smart bombs, and conventional bombs.

The F-35's avionics includes the Northrop Grumman AN/APG-81 AESA radar; Lockheed Martin AAQ-40 electro-optical targeting system (EOTS); Northrop Grumman AN/AAQ-37 distributed aperture system (DAS) missile warning system; BAE Systems AN/ASQ-239 electronic warfare (EW) suite; and Northrop Grumman AN/ASQ-242 communications and navigation system.

The plane's navigation and communications include the Harris Corp. Multifunction Advanced Data Link (MADL); Link 16 data link; single-channel ground and airborne radio system (SINCGARS); IFF interrogator and transponder; HAVE QUICK radio; AM, VHF, UHF AM, and UHF FM radio systems; GUARD survival radio; radar altimeter; tactical air navigation (TACAN); instrument landing system for conventional runways and aircraft carriers; the Joint Precision Approach and Landing System (JPALS); and the TADIL-J tactical digital information link with Joint-Variable-Message-Format (JVMF) communications.

F-35 pilots wear a helmet-mounted display that enables them simply to look at a target to shoot weapons, rather than pointing the entire aircraft at the target. The orientation of the pilot's head provides missile seeker heads with targeting information.

The combat aircraft — one of the most expensive military weapon systems in history — is designed for ground attack, aerial reconnaissance, and air-to-air missions. U.S. military leaders say they plan to buy 2,457 aircraft.

The F-35 variants are intended to provide the bulk of the manned tactical air power of the U.S. Air Force, Navy, and Marine Corps. Deliveries of the F-35 for the U.S. military are scheduled to be completed in 2037.

www.militaryaerospace.com

Lockheed Martin and its partners will do the work on this order in Fort Worth, Texas; El Segundo and San Diego, Calif.; Warton, England; Orlando, Fla.; Nashua, N.H.; Cameri, Italy; Baltimore; Nagoya, Japan, and other locations outside the continental U.S., and should be finished by May 2026. ◀

For more information contact Lockheed Martin online at www.f35.com, or Naval Air Systems Command at www.navair.navy.mil.

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Navy asks industry for safety upgrades to F/A-18C/D flight-control computer

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy avionics experts are asking industry to upgrade flight-control software in Navy attack jets to reduce the risk of pilots crashing into the ground on difficult missions.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have issued a request for proposal (223201-21) for the Automatic Ground Collision Avoidance System (Auto-GCAS) Flight Control Computer (FCC) Upgrade.

Navy officials want industry to upgrade the avionics of the Navy Boeing F/A-18C/D light-attack bomber to enhance the aircraft's ability to prevent controlled flight into terrain when the pilot is fixated on a target during an attack dive; spatially disoriented; loses consciousness; or suffers degraded abilities due to oxygen deprivation.

The F/A-18C/D light-attack bomber has a quad-redundant digital fly-by-wire flight-control system that converts pilot and aircraft inputs to flight control actuator commands from surface actuators, air data sensors, pilot controls and displays, software, and the quad-channel flight control electronic set (FCES) subsystem.

The flight-control system provides overall control of the F/A-18C/D aircraft and controls flight, redundancy management, autopilot, input/output processing, system monitors, and built-in-test.

The planned upgrade will include the ability to translate the pull vector from the digital map computer into flight

control movements, provide status to the mission computer, and perform system integrity checks.

The automatic ground collision avoidance system project would be a change to the software in the aircraft's digital map computer, and combines with the existing terrain avoidance warning system to create the automatic terrain avoidance and warning system.

Software updates are necessary in the mission computer and digital map computer. The flight control computer program also will need updating. The company that might win a contract for this project will update and test the flight control computer program.

The automatic ground collision avoidance system is to provide a safety backup that automatically recovers the aircraft from an impending crash using digital terrain elevation data as a reference for ground elevation.

The system will compare digital terrain elevation to flight parameters to generate a warning and initiate automatic recovery if the pilot does not take action. The system will generate visual warnings/advisories and aural alerts to alert the aircrew when needed.

The system will enable the pilot manually to initiate a recovery that returns the aircraft to straight and level flight. Navy experts are looking for a company to modify the existing flight control computer program with new functionality to support automatic ground collision avoidance.

There are several key challenges that the contractor must face. While Navy experts will provide source code for the flight control computer program, they cannot provide the build tools that actually generate the executable program.

The F/A-18C/D aircraft uses the General Electric MCP 701E processor for flight control, which has no significant commercial use outside the F-18C/D application, and has proprietary build tools. ←



Navy experts want industry to upgrade the F/A-18C/D jet fighter-bomber with a new flight-control computer that will help disoriented pilots avoid crashing into the ground.

Companies interested in this avionics software project should upload proposals no later than 20 Dec. 2021 to the PEE Solicitation Module online at <https://piee.eb.mil/sol/xhtml/unauth/search/oppMgmtLink.xhtml?solNo=N0001921R0045>. More information is online at <https://sam.gov/opp/2296ebe662f64e2cae32727c5e6f03be/view>.

Navy eyes 5G and multi-access edge computing for unmanned underwater vehicles (UUVs)

Experts from wireless communications expert AT&T will install 5G and multi-access edge computing (MEC) equipment at the U.S. Naval Postgraduate School in Monterey, Calif., to help the military explore ways to use the technologies to enhance national security. Chris Smith, vice president of civilian and shared services at AT&T Public Sector and FirstNet, told Mobile World Live that Naval Postgraduate School officials want to use 5G and MEC to connect unmanned vehicles in the air, on the ground, and under the sea. AT&T is deploying millimeter wave spectrum, citing research this can detect underwater sonar signals as they reach the surface. Smith explains that 5G could provide good connectivity to enable submarines to transmit information without surfacing. AT&T also will also install a 4G- and 5G-compatible mobile tower at the Naval Postgraduate School to co-locate edge compute resources to help Navy researchers process information on-site not only for advanced communications, but also for virtual- and augmented reality services.

BAE Systems uses Hydra APKWS rockets with new proximity fuze to shoot down small UAVs

Small unmanned aerial vehicles (UAVs) increasingly employ common warfare and surveillance technologies, and military forces are funding projects to knock drones out of the sky. The latest company taking this approach is BAE Systems, which has tested a modified rocket and laser guidance system to shoot down drones for less cost than existing missile options. Recent tests at Yuma Proving Ground, Ariz., involved Advanced Precision Kill Weapon System (APKWS) laser-guided rockets used to take down UAVs, which can be tricky to target because they move so quickly. BAE Systems officials say the APKWS rockets paired with the Mk66 motors and M151 warheads, a new proximity fuze, and the APKWS guidance kits. BAE systems officials say the proximity fuze is key to this new capability, because it gives the rockets point detonation and proximity detection; the rockets don't need to hit the target to take out the drones.

Continued on page 13

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Wanted: trusted computing hardware and software for military command and control

BY John Keller

ROME, N.Y. — U.S. Air Force researchers are asking industry for trusted computing technologies that enable secure, resilient, affordable command, control, communications, computer, intelligence, and cyber information processing.

Officials of the Air Force Research Laboratory Information Directorate in Rome, N.Y., re-issued a broad agency announcement (FA8750-20-S-7012) for the Foundations of Trusted Systems project for military command and control applications.

Researchers are focusing on technologies that support hardware and software for high-assurance, trusted, and secure computer architectures.

This project has two technical areas: trusted, secure, and resilient computational systems; and trusted and assured software.

Trusted, secure, and resilient computational systems seeks to develop elements, tools, and methodologies for trusted, secure and resilient computing, which includes hardware, software, power, cost, performance, and reliability.

Photo (above): the Foundations of Trusted Systems project for military command and control applications is asking industry for new enabling technologies.

Topics of interest include:

- processor trustworthiness;
- computer architecture trustworthiness;
- tools for ensuring trustworthiness of integrated circuits (ICs), as well as defenses against malicious inclusions, side-channel attacks, and probing attacks;
- data integrity, code protection, and verification;
- software operating systems to help enable trustworthy computer hardware;
- tools for ensuring the security of software development, including compilers, assemblers, linkers, binary checks, and source code analysis;
- software-based assurance designs for implementation in hardware, rather than in software; and

- Integrated circuit inspection, characterization, and testing for automated post fabrication verification, counterfeit identification, device identification, tampering evidence identification, wear-out characterization, and adaptive system degradation.

Trusted and assured software, meanwhile, seeks to lay a foundation of trust across all layers of software development; maintain that trust as the system adapts during its deployment; improve the scalability of interoperable software tools; and to craft a holistic design approach to scale-up the application for formal verification.

Topics of interest include:

- software assurance to addresses all layers of the supply chain and enterprise including governance, partnerships, process, standards, and education;
- trusted and resilient software-intensive systems engineering to create self-healing and repair techniques that can fight through cyber attacks, including zero-day attacks;
- cyber physical systems to develop the tools that help provide scalability and interoperability necessary to

integrate and analyze computational and physical components and the networks connecting them; and

- artificial intelligence in trusted systems using human-machine teaming to improve automation, raise human understanding, and mitigate the potential risks of bad information or bad decisions from designers.

This project is closed to foreign participation, including foreign ownership and foreign nationals as employees or subcontractors.

Companies interested were asked to email two-to-five-page white papers no later than 3 Dec 2021 for 2022 projects; by 2 Dec 2022 for 2023 projects; and by 1 Dec. 2023 for 2024 projects to the Air Force's Jillian Stublely at Jillian.stublely@us.af.mil. Those submitting promising white papers will be invited to submit full proposals. ←

Email technical questions to Jillian Stublely at Jillian.stublely@us.af.mil. Email contracting questions to Amber Buckley at Amber.Buckley@us.af.mil. More information is online at <https://sam.gov/opp/7855dd8226c44bb9a2f0d8d68329ac6d/view>.

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SOSA open-systems standard officially released; now comes compliance testing

BY John Keller

SAN FRANCISCO — U.S. electronics open-systems standards experts have published the first official version of the Sensor Open System Architecture (SOSA) technical standard, which is intended to reduce development and integration costs for military capabilities and reduce time to field.

The Open Group in San Francisco published the Technical Standard for SOSA Reference Architecture, Edition 1.0 in late September. Prior to that date, all SOSA-aligned embedded computing components followed guidelines of preliminary SOSA standards, rather than an official version.

SOSA 1.0 is to streamline U.S. military capabilities by enabling rapid, affordable, cross-platform capabilities based on best practices of system, software, hardware, and electrical and mechanical engineering.

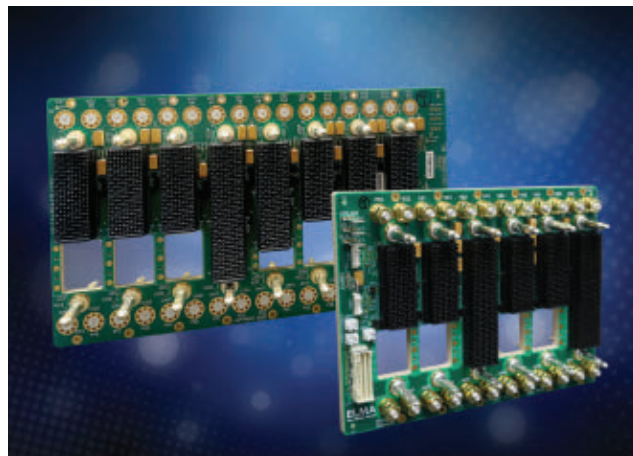
The new standard encapsulates fundamentals of the Modular Open Systems Approach (MOSA) design approach to develop embedded computing solutions for military applications that involve a unified set of sensor capabilities.

The SOSA Consortium aims to create a common framework for moving electronics and sensor systems to an open-systems architecture based on key interfaces and open standards established by industry and government consensus.

The open architecture supports aerospace and defense applications for manned and unmanned surface vessels, submarines, aircraft, land vehicles, and spacecraft. The goal is to reduce development and integration costs and reduce time to field new sensor capabilities.

With the new SOSA 1.0 standard in place, The Open Group is formalizing compliance testing to enable embedded computing manufacturers to meet guidelines of the SOSA standard. Those introducing products intended to meet the standard but that have not gone through compliance testing will be considered SOSA-aligned. ←

Some of the first SOSA-compliant embedded computing components are expected to hit the market within the next nine months. For more information contact The Open Group online at www.opengroup.org.



The Sensor Open Systems Architecture embedded computing standard 1.0 has been released, and now authorities will define procedures for official standards compliance.



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Continued from page 9

Cyber security problems leave U.S. complex weapons open to hackers

Computer hackers could gain access to the U.S. military's most complex weapons systems. That's a warning straight from the U.S. National Security Agency (NSA) in Fort Meade, Md. As the military begins to confront high-tech adversaries like China and Russia, weapons that run on computers are at risk of being compromised, NSA officials say. It's hard to get around that cyber security reality at present; in a world where the Pentagon wants advanced weapons that can transfer data to one another wirelessly, nearly all of them rely on computers, networks, and data links that computer hackers could exploit. Most Americans know the NSA as the country's leading intelligence agency, responsible for collecting foreign intelligence via computer, cell phone, and other electronic means. Yet the NSA also is responsible for cyber security and playing defense against other countries that seek to penetrate American computers and computer networks.

Air Force shows newest bunker-busting bomb to attack deeply buried targets

The U.S. Air Force has demonstrated the GBU-72/B 5,000-pound-class bunker-busting bomb, dropped from an F-15E Strike Eagle jet fighter-bomber over a test range near Eglin Air Force Base, Fla. The GBU-72 was developed to overcome hardened deeply buried targets and is designed for fighter and bomber aircraft. It uses GPS/INS guidance

to enable its use in any weather, and enable the launch aircraft to stay relatively far away from the target. The bunker-busting bomb also could be used against tunnel networks and above-ground buildings, and offer a way limit collateral damage to adjacent structures and their occupants. Testing this weapon was done under the Advanced 5,000 Pound Warhead program (A5K). Air Force officials say they will perform more test flights into 2022. The announcement last week shows that the service has already taken important steps forward toward fielding its newest bunker-buster bomb.

Army future light tank for infantry units offers updated vetronics

The U.S. Army's Mobile Protected Firepower (MPF) program seeks to provide a light armored combat vehicle to Army infantry brigade combat teams for use against hardened positions, enemy infantry, and light armored vehicles. The MPF vehicle — essentially a light tank — will equip Army light infantry and airborne units that do not have a tracked armored combat vehicle. Competing vehicles are from BAE Systems Platforms & Services segment in Falls Church, Va., and General Dynamics Land Systems in Sterling Heights, Mich. The General Dynamics entry will have electronics and fire control systems similar to the company's larger M1 Abrams main battle tank to simplify training, and will have a 105-millimeter main gun. The BAE Systems version is considerably smaller and lighter, and an easily removable engine for in-field repairs and maintenance. It's based on the M8 Armored Gun System, has underbelly blast protection, updated vetronics, and modest engine output. ←




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Eyes in



the sky

Today's military SATCOM

It's not only about communications; SATCOM satellites also are hosting surveillance sensors, networking crosslinks, and similar technologies to produce better global situational awareness than ever before.

BY Megan Crouse

Satellite communications (SATCOM) literally expanded humanity's horizons, enabling ships, aircraft, and land vehicles to communicate over the curve of the Earth. With thousands of communications satellites in the sky today a lot has changed since their advent, as the technology is continuing to move forward. Meanwhile, U.S. military and government decisions makers are trying to increase on-orbit interoperability.

Brief history of SATCOM

Satellite communications enable an aircraft to communicate via satellite with air traffic control and other ground-based facilities while in the air. It can include voice and ground service, and unlike very high frequency (VHF) terrestrial radio stations or conventional ground radar, can operate beyond line of sight.

In the commercial world, people are looking to SATCOM for improved air traffic control, which could enable more planes to fly safely in the same airspace at the same time; more efficient routing; and tailored arrivals to negate the need for inefficient step descents, which has been trialed at airports in Los Angeles and San Francisco.

Photo: An Inmarsat GX1-4 satellite in space. All GX1-4 satellites were manufactured by Boeing.



Inmarsat's fourth Global Xpress satellite, GX4, launched on 15 May 2017 at 00:12 BST with SpaceX from NASA's Kennedy Space Center, Fla.

"With the arrival of internet protocol (IP)-based applications and new data-hungry cockpits, SATCOM will deliver critical safety data as well as improve operational performance for today's commercial and military aircraft fleets. The potential to enhance the safety and efficiency of air travel is almost unlimited," stated Mary McMillan, vice president of safety and operational services at Inmarsat Aviation in London, in a 2017 Inmarsat report.

While this is still relevant background information, military applications in 2021 are part of a slightly different conversation. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are looking at new ways to connect satellites. In September 2021, they issued a solicitation for a reconfigurable multi-protocol intersatellite optical communications terminal. Specifically, they're looking for two technical areas of the Space-Based Adaptive Communications Node (Space-BACN) project, one of the two major DARPA projects in this area today.

"There's a long history of reliance on commercial capabilities in the satellite communication realm by the Department of Defense, the intelligence communities and the whole national security apparatus," says Rebecca Cowen-Hirsch, senior vice president of government strategy

& policy at Inmarsat Government in an interview with Military & Aerospace Electronics in October 2021.

"Going back nearly a generation now, where the defense satellite communication program operations at that point in time during Desert Storm and in that epoch, there were gaps in programs, there were technological challenges and the satellite communication capabilities on the commercial side were really coming into their own. And at that stage once deployments began, the dependence on commercial satellite communications became integral to successful operations for deployments overseas. And as time has progressed forward, the commercial industry has advanced technologically significantly faster not only in capability but in deployment capacity and coverage, as well as advancements in the type of mobility operations that are employed broadly across the commercial arena."

When it comes to SATCOM, size, weight, and power consumption (SWaP) matters, Inmarsat's Cowen-Hirsch says, but so do "reliable components that will maintain our regulatory compliance, so that we actually control our off-axis EIRP to ensure that we're not causing unintentional interference to any other adjacent satellite. So we respect those regulatory restrictions and also want to be

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A Falcon 9 rocket launches in January 2020, carrying an installment of Starlink satellites, was the first official launch of the U.S. Space Force.

able to get the greatest throughput that we can with this smallest size terminal. This is a demand signal that we've read and indicated very clearly from our user community."

Current DARPA projects

DARPA is working on several new SATCOM efforts today. One seeks to resolve the issue that there is no standardization today for inter-satellite links in low-Earth orbit (LEO). Space-BACN seeks to change that, providing standards and hardware for space-based communications, optical inter-satellite links, reconfigurable modems, modular components, and space command and control.

Today's new satellite constellations often communicate using single-waveform crosslinks. These almost always consist of custom-made components, making interoperability difficult. After all, each waveform has different wavelengths, polarization, clock rate, spatial acquisition sequence, modulation format, framing and error correction coding. Even though they operate within the same band, another step is necessary to get them to talk to each other.

The second major project is the Blackjack program. Started in 2017, it calls for a constellation of surveillance satellites with a high-speed network to replace existing,

larger systems, including the classified Misty project. In part by incorporating commercial components, they plan to be able to swap out systems easily if they are damaged or destroyed. The first wave will see DARPA launch 12 satellites on board a SpaceX Falcon 9 rideshare in 2022, although this may face delays. In the end, DARPA plans for the constellation to have as many as 20 satellites.

It was founded before the departmental restructuring that led to the creation of the U.S. Space Force and Space Command. Starting out as a broad request for possible technologies and uses, it has narrowed its focus as companies sign on, but also is pursuing the ability to pivot as necessary.

Some of the latest news on this is a DARPA award to Lockheed Martin, the prime contractor, of \$25.3 million in early September. On top of existing \$13.1 million and \$27.3 million contracts, that brings the contract total to \$65.8 million. In addition, DARPA has ordered 10 buses from Blue Canyon Technologies LLC in Boulder, Colo; two from Telesat in Ottawa; and additional payloads from the Raytheon Technologies Corp. Intelligence & Space segment in El Segundo, Calif.; SEAKR Engineering Inc. in Centennial, Colo.; and SEAKR Photonics Inc. in Los Gatos, Calif. SEAKR will provide the so-called Pit Boss artificial intelligence coordinator for Blackjack.

DARPA also awarded an undisclosed amount in a Small Business Innovation Research contract to Augustus Aerospace Co. in Colorado Springs, Colo., for an Army Space and Missile Defense Command payload. Several other companies also are involved in DARPA Blackjack, including L3Harris Technologies in Melbourne, Fla.; and Danbury Mission Technologies in Danbury, Conn.

In May 2021, Blackjack program manager Stephen Forbes said only two of the current “handful” payloads in consideration are likely to be chosen in the end. Those will probably include a radio frequency system for communications and geolocation and an overhead persistent infrared (OPIR) missile warning payload. Each of these would require a different bus design to incorporate the necessary components such as antennae. The program is working on putting two payloads on one bus, depending on cost.

“We’re still not focused on a specific mission,” Forbes says. “We’re not trying to solve specific capability gaps or technical gaps, related to a specific sensor payload, which is why you continue to see a broad swath of contracts and other activities ongoing with the program because of that architecture.”

Blue Canyon officials put it this way: “By incorporating commercial sector advances in low-Earth orbit, including designs used for LEO broadband internet service, the goal of the Blackjack program is to demonstrate that a constellation of LEO satellites meets U.S. Department of Defense performance and payload requirements, at a significantly lower cost, with shorter design cycles and with easier and more frequent technology upgrades. The Blackjack program aims to establish an economy of scale not previously available with current National Security Space (NSS) assets, which are large, costly and would take years to replace if degraded or destroyed.”

Forbes says the primary Blackjack customer is the U.S. Army, which could use the satellites for tactical utility. That’s an “underserved market,” he says. However, that could change if higher-ups decide they want to ask something different of the satellite makers.

The need for optical inter-satellite links (OSILs) in particular has gone through some changes. The commercial world simply isn’t as far along with these as military researchers would require, Forbes says.

Commercial LEO

The Mandrake 2 experimental satellites under a Blackjack contract are headed for the U.S. Space Development Agency

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Photo: The Air Force launches the ninth Boeing-built Wideband Global SATCOM satellite at Cape Canaveral Air Force Station, Fla. Such satellites play an integral part in the strategic and tactical coordination of military operations.

(SDA) National Space Defense Architecture, established in March 2019. This new effort to “disrupt military satellite acquisition” will work toward an eventual ecosystem of hundreds of LEO satellites. They include data communications, hypersonic and cruise missile tracking and enhanced battle management, for a total of seven capability layers. The SDA procured the first satellites for the architecture next year and sought industry feedback for the procurement of the next batch throughout 2021.

A commercial and government partnership in LEO satellites is still evolving. One major problem is that military satellites are very expensive, and industry could contribute with a lower-cost option. These could also contribute to Joint All Domain Command and Control efforts.

LEO in particular is getting more attention. Some within the Pentagon saw it as too expensive and resource-intensive to be worth the effort. However, the SVA says new developments are changing that. Those include Moore’s Law’s effect on computing, the commoditization of satellite parts, artificial intelligence, optical crosslinks and better onboard processors.

Inmarsat’s Cowen-Hirsch says Inmarsat Government’s customers “continually ask for enhanced security, greater

mobility, coverage on a worldwide basis. ... In defense operations there’s this constant desire to be able to operate through a wide array of environments, whether it is — certainly over broad ocean areas where there is, generally speaking, very little commercial capability outside of maritime and aviation, which is core to our business because we have operational systems that support these highly mobile users. The government users want to have that resiliency, to be able to have interoperability where it makes sense with military capabilities which we provide in our commercial Ka and military Ka capabilities in Global Xpress, as well as with our L-band constellations, to be able to support and augment the government’s narrowband operations.”

This October, the Space Development Agency posted a solicitation to “help build the Tranche 1 Transport Layer (T1TL). T1TL is a mesh network of over one hundred optically interconnected satellites that provide a resilient, low-latency, high-volume data transport communication system,” the backbone of CJADC2. It’s one of many modern efforts to add to LEO constellations.

After all, for an adversary looking to damage a large network of satellites, “the bullet now costs more than the

satellite,” says Bill Gattle, president of space and intelligence systems at L3Harris Technologies.

Optical crosslink in particular is in focus for Mynaric in Gilching, Germany, maker of the CONDOR optical crosslink terminals requested by DARPA for the Blackjack program.

“In the quest to support the SDA and other governmental customers in our core markets, it is important that we help bridge the differences between the commercial and governmental markets, and reduce the risks of technology adoption,” CEO Bulent Altan says in a press release. “Standardization is crucial in facilitating both objectives and we are excited to be leading the field with our CONDOR line of terminals.”

Missile tracking

LEO also is in the sights for future ballistic and hypersonic missile tracking satellites. The U.S. Missile Defense Agency (MDA) at Fort Belvoir, Va., launched two cubesats, the CubeSat Networked Communications Experiment (CNCE) Block 1, in June 2021 to help develop a new system for doing so. MDA officials want the ability to track missiles globally from launch to impact, meanwhile feeding data to command centers running efforts to destroy them. Each satellite flies to the tune of about \$1.3 million.

Overall, the Pentagon is signaling a desire to shift to a lot of small satellites instead of larger and more expensive ones. The SDA, part of the Pentagon’s Office of the Secretary of Defense, is working with L3Harris and Space Exploration Technologies Corp. (SpaceX) in Hawthorne, Calif., on this. The latter of which will use their Starlink design, created to provide better broadband internet access for commercial and military customers, as a jumping-off point.

Standards

Mynaric is among the crosslink providers working on standards for laser crosslinks on satellites. Company experts plan to ensure the eventual National Defense Space Architecture can talk to Amazon’s Project Kuiper, Telesat’s Lightspeed, or other future commercial constellations. The Naval Research Laboratory (NRL) in Washington and Mynaric demonstrated standard-compliant modems via optical fiber for the first time at an SDA/NRL-hosted testbed in April.

Specifically, this ensured that Mynaric’s CONDOR optical inter-satellite link product is compatible with the Optical Inter-Satellite Link (OISL) Standard from the SDA.

“The challenges, of course, are in ensuring there [are] common standards to be able to enable for interoperability

at the lowest level,” says Inmarsat’s Cowen-Hirsch. “The natural tendency in the past for government has been to dictate a specific direction, which inhibits the technological advances that the commercial industry can bring to bear. So, finding that balance between adaptability and having sufficient, reliable standards and maintaining security structure in supply chains as well as in the ability to respond to potential threat vectors are critically important. So you’ve got technological advancements but also you’ve got very complicated balance structures to ensure you can meet those requirements and do it in an affordable fashion.”

More on modems

Modern modems must interchange information from the ground and the sky, and from commercial to military. This is a key component for today’s SATCOM, says Inmarsat’s Cowen-Hirsch.

“With those modems that are adaptive to be able to transition from the commercial Global Xpress to the military Ka capability and then can traverse over onto WGS wideband global SATCOM.”

“On the modem architecture, we need to be able to have that adaptability so that you have a modem manager that can leverage the highly mobile commercial capabilities of Global Xpress as an example but can also be able to use a preferred modem of a military user to be able to leverage the military Ka. To have that modem manager, to be able to flex between those two air interfaces so that we’ve



The first of Inmarsat’s I-6 satellites, I-6F1, which carries L-band and Ka-band payloads, so also is known as GX6A, enters thermal vacuum testing in Toulouse, France. Manufactured in the UK and assembled in France, I-6F1 undergoes this test to simulate the harsh space environment prior to launch in H2 2021.



Inmarsat's first I-6 series satellite, F1, is undergoing testing in Toulouse, France ahead of a 2021 launch. This will be the first of seven Inmarsat launches by 2024 of new, world-leading satellites to further enhance the London-based company's global networks on which shipping, airlines, other businesses and governments depend.

got reduced power and reduced size but has the flexibility in the modem itself to be able to leverage the commercial capabilities that enable high mobility, but also to be able to use a legacy air interface that may be beneficial or required for a specific network that a government user may require," she says.

SATCOM-as-a-service

SATCOM companies are also experimenting with offering their products and capabilities "as a service."

The Army seeks to buy a pilot program for satellite communications from a commercial firm like a cell phone plan, Brig Gen. Rob Collins, head of the Army Program Executive Office (PEO) Command, Control, & Communications – Tactical (C3T) and therefore the SATCOM as a Managed Service (SaaS) program, told Breaking Defense at the SATELLITE 2021 conference in September.

The Army program leaders might like to buy "everything from a piece of hardware to the operations center to the bandwidth" as a service, Collins says.

Commercial SATCOM companies generally encourage this, including Inmarsat. Cowen-Hirsch pointed out that this includes ground terminals as well as the satellites themselves, and is part of the 'system of systems' structure in which they're packaging their products and services.

Space Force involvement

Another recent structural shift in the U.S. government is the inclusion of the U.S. Space Force. In September 2021, Army and Navy satellite communications billets, funding, and mission responsibility were moved to the Space Force effective Oct. 1, pending budget approvals. (At the time of writing, Congress has until Dec. 3, 2021 to pass a full budget plan for the military.) That transfer will include 15 global units with 319 military and 259 civilian billets from the Army and Navy.

"Now all of that— training, operations, acquisition and sustainment and follow-on activities, user allocations—all of that, will be consolidated under the Space Force to create that unity of effort, and hopefully gain the ability to be more resilient, more dynamic, and ultimately more efficient with that

mission set," says Space Force Lt. Gen. B. Chance Saltzman, deputy chief of space operations for operations, cyber, and nuclear.

2021 supply chain problems

A wide range of industries are facing supply chain problems this year, and SATCOM is no different. While port delays mean everyday deliveries are piling up, space travel faces a different complication. Airgas, the supplier of liquid nitrogen for United Launch Alliance (ULA) rocket launches, couldn't deliver for a September 2021 launch until 11 days after the expected launch because they were handling medical liquid oxygen for COVID-19 patients. That delayed the launch of Landsat 9, a NASA and the U.S. Geological Survey observation satellite.

The computer chip shortage affecting consumer graphics cards also had an impact for SpaceX. Shortages delayed the development of a new user terminal for the Starlink satellite broadband system. Even Blackjack is feeling the strain. The expected 2022 launch may be delayed depending on the changing manufacturing delays in the microchip industry and other electronics.

"We're ... trying to make sure that we can find the parts that we need, especially when we're buying one-sies and twosies," Forbes told Space News in August.

The Department of Defense is working on securing related supply chain channels within the United States. In an August contract they partnered with Intel on a project to improve commercial chip manufacturing in the United States as part of the Rapid Assured Microelectronics Prototypes - Commercial (RAMP-C) program.

COMPANY GUIDE

Airgas, Inc.

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Colorado Springs, Colo.

<https://www.augustusaero.com>**Blue Canyon Technologies**

Boulder, Colo.

<https://www.bluecanyontech.com>**Cubic Corp.**

San Diego

<https://www.cubic.com>**Inmarsat Government**

Reston, Va.

<https://www.inmarsatgov.com>**L3Harris**

Melbourne, Fla.

<https://www.l3harris.com>**Lockheed Martin Corp**

Bethesda, Md.

<https://www.lockheedmartin.com/>**Mynaric USA**

Hawthorne, Calif.

<https://mynaric.com>**Raytheon Intelligence & Space**

El Segundo, Calif.

<https://www.raytheonintelligenceandspace.com>**SA Photonics Inc.**

Los Gatos, Calif.

<https://www.saphotonics.com>**SEAKR Engineering Inc.**

Centennial, Colo.

<https://www.seakr.com>**SpaceX**

Hawthorne, Calif.

<https://www.spacex.com>**Telesat**

Ottawa

<https://www.telesat.com>**Tyvak**

Irvine, Calif.

<https://www.tyvak.com>**York Space Systems**

Denver

<https://www.yorkspacesystems.com>**Lack of user equipment**

Another challenge to adoption is lack of user equipment. Federal watchdog organization Government Accountability Office issued a report in September saying the Navy's Mobile User Objective System, or MUOS, a narrowband SATCOM program, has faced some problems on the ground despite successful deployment of its constituent five satellites.

"The completed constellation of the military's narrowband satellite communications system has been on orbit for more than four years, yet users still cannot access its full range of advanced capabilities and are forced to rely on overtaxed legacy capabilities," wrote Defense News.

Changes

With change the 'new normal' in what defense customers are asking for from satellite makers, a lot of companies are jockeying for position in terms of long-term work. That means increased manufacturing capacity and more modularity to increase interconnectivity. Two major new partnerships — Raytheon acquiring Blue Canyon Technologies and Lockheed Martin adding Tyvak to its SDA contract — illustrate this.

"What becomes really, critically important is with so much emphasis today in the government market but also in the consumer market on one particular orbit, mostly the exuberance on the LEO opportunity, it's very important that not only do we evaluate the efficacy of the technology but also the efficacy of the business model," says Cowan-Hirsch. "The challenge, of course, for any satellite owner/operator is that it is a capital-expensive, high capital-expenditure model with a long-term return. Yet those returns are very significant when you have a stable market and demand signal.

"Now there's an opportunity here to look at and to actually see we leverage these multi-orbit in a more integrated environment? And that's going to be really interesting to see how that evolves over time. It really comes down to whether the business case is there. Whether the demand signal is followed through with the ability to consume the available capacity and whether that capacity is in the right place at the right time and is relevant, so it has the right security structure for the different markets that are being served."

With all this movement in the industry, some concerns (and excitement)

arise around rapidly shifting supply and demand.

"While very capable small satellites have come down in price dramatically just in the last five years, I think that we're going to see them drop even more," Charles Beames, chairman of the Smallsat Alliance and executive chairman of York Space Systems told the SDA.

He compared today's satellite industry with the dot com boom in the 1990s, suggesting more defense primes are likely to start seeing firm-fixed price deals and early capability investment from the government. Inmarsat's Cowen-Hirsch also compared SATCOM in 2021 to the dot com boom, but warned companies to watch out for a bust.

"I think that we'll see some collapsing of the market as mergers take place, different business models either become validated or experimental. And I think that this is back to Blackjack, looking at which of these capabilities are properly designed and deployed and maintained and have a strong business basis to be able to support the national security market is critically important going forward." ←

Test and measurement equipment keeps high-tech systems in working order

No matter how dangerous or complicated military missions become, today's test and measurement gear keeps on-board systems ready to go at a moment's notice.

BY **Jamie Whitney**

Military vehicles — crewed and uncrewed — are packed with an incredible amount of technology necessary to complete dangerous and complicated missions. Soldiers, sailors, Marines, airmen, and space warfighters must have confidence that these machines of war will operate as

intended, and their armaments will work when needed. To meet that goal, the U.S. Department of Defense (DOD) and its private-sector partners rely on accurate test and measurement equipment.

Oscilloscopes, spectrum analyzers, and software-defined test equipment contributes to mission readiness.

"These instruments provide important confirmation of system or bus performance before being placed in real-world environments like flight or defense systems," says Chris Loberg, director of mainstream oscilloscope applications at Tektronix Inc in Beaverton, Ore. "For example, an oscilloscope can confirm the operation of a critical control bus under a variety of simulated conditions."

Angus Robinson, a product manager at Anritsu America in Morgan Hill, Calif., notes that accuracy and traceability in measurements is key to provide confidence.

"For example, all communications networks rely on key metrics such as frequencies, timing, and signal levels. Without the ability to set these parameters precisely, military communication systems would simply fail to work," Robinson says. "Equipment from different manufacturers needs to interface smoothly as systems are always comprised of sub-systems from multiple vendors. Unless each sub-system is confident in the performance of its components with which it connects, they will fail to interoperate. Standards, traceability and measurement accuracy are the cornerstone of this success."

In control

National Instruments Corp. (NI) in Austin, Texas, produces automated test equipment. Its global go-to-market leader of aerospace and defense, Nick Butler, notes that with



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software-defined test and measurement equipment, the user is in control of the equipment's functionality.

"Contrast this to vendor-defined or fixed-function test equipment where you're essentially limited to the functionality and routines prescribed by the vendor," Butler says. "With software-defined test equipment, functionality can be customized and modified over time to meet changing requirements or even to repurpose the equipment across different projects or programs. This is especially important and valuable for mil-aero customers for several reasons. One is the rapid pace of innovation. Requirements are constantly changing to adapt to adversarial threats.

He continues, "Take electronic warfare (EW) systems, for example – EW systems must be able to handle and

respond to new signals and data signatures provided by ELINT teams. And the pace at which new counter measures must be developed leaves no room for changing test hardware. But when you can adapt through software to prototype and deploy new algorithms quickly, using the same commercially available hardware, you can keep pace with threats and maximize mission readiness. And with trends towards cognitive and autonomous radar and EW systems, the role of onboard software – and the ability to rapidly design and test that software – is increasingly important. Another great example is long life cycle programs, which are very common in mil-aero applications – with software-defined test and measurement equipment, companies can ensure that equipment can last the duration of a program's lifetime, adapting over time to comply with new security standards, accommodate technology insertions, evolve test program sets, and keep mission-critical assets operational at all times."

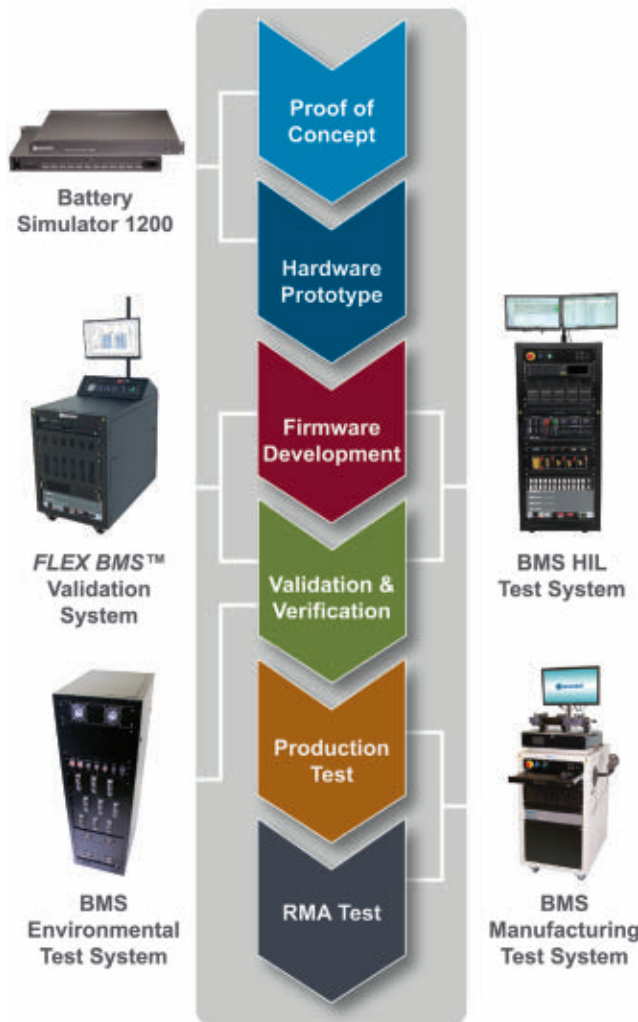
On the line

Retired U.S. Air Force Maj. Gen. Stephen Sargeant, who is the CEO of Marvin Test Solutions in Irvine, Calif. says that his company shines in assuring arms are tested and mission ready.

"The armament consists of bomb racks, launchers, pylons, all their sub components that make weapons work when they're supposed to and not operate when they're not supposed to be operating," Sargeant says. "So, our test equipment ensures that warfighters have the highest level of readiness with the minimal amount of time and effort expended.

He continues, "Once [armaments are] integrated onto an aircraft, the reliability factors of all kinds of equipment that comes together to make an airplane, fighter, bomber, attack helicopter or whatever — do not increase the amount of reliability. When they're all added together, it actually decreases. So, if you have, for instance, a launcher that has a 97 percent reliability factor when you connect it to an aircraft wing and then to the interface of that aircraft, the numbers will actually decrease. So, it's important to have testing continue on the flight line, which we do. And there the testing needs to be rapid, and we provide very rapid, very comprehensive test in a test form factor that is extremely easy for maintainers to use and deploy with. And then when there is a problem found later, you need to take it to one of the shops near the runway."

BMS DEVELOPMENT LIFE-CYCLE



Battery management system (BMS) test equipment from Bloomey Controls has its own life cycle process.

Sargeant explains that with reliable test and measurement equipment and comprehensive testing, non-working line replaceable units (LRUs) can be tracked down and quickly replaced and the affected armaments can be sent to the depot for overhaul or modernization and ensure it will last for the duration of its planned life cycle, often an additional 10 or 15 years from the time it is sent to skilled technicians.

Marvin Test Solutions, Sargeant says, is helping the Air Force achieve their desired goals. According to Sargeant, Gen. Charles Q. Brown, Jr., the Air Force Chief of Staff, operates under the mantra “accelerate, change, or lose.”

“So [Gen. Brown has] got his entire force leaning forward in the innovative space to ensure that they can pick up and deploy rapidly in ways they haven’t necessarily done, in some cases, forever,” Sargeant says. “In some cases, all the way back to World War II before, and it’s called agile combat employment has been the concept of maintenance that has been settled upon as the concept of maintenance, that they’re going to focus their energy on it. So, we have paying attention to that. As it’s been emerging, we looked at our test equipment that we had and said we were kind of thinking about that ahead of time in some ways, because we make our test equipment not only easy to use, easy to maintain, sustainable, we make it very rugged and deployable with a very small footprint. What I mean by that is a lot of the equipment that goes to the flight scientists to maintain tests and sustain armament takes multiple people to carry multiple boxes, large boxes, two main carry types out to the flight line, and then we’ll take hours and hours to run tests.”

Trends in test

Peter Blume, the founder and president of Bloomy Controls, a provider of automated test solutions, noted a quartet of trends in test and measurement in the mil-aero sector. They are digital transformation; autonomy; electrification, and technology migrations.

“Large portions of the industrial sector are only just beginning to recognize the value that digital transformation



The Magnetic Fields Laboratory at Naval Surface Warfare Center Carderock Division in West Bethesda, Md., is for high-precision magnetic measurements that support ship and submarine physical scale-model testing, sensor development, and mission readiness.

can offer development, manufacturing and test,” Blume says. Of these, test seems to be the last to adopt the principles of digital transformation. Bloomy is actively driving these principles into the test equipment sector by providing Thread-Ready test systems to customers who are only beginning to integrate model-based systems engineering (MBSE) tools and techniques into their products’ digital threads.”

Regarding autonomy, Blume says that “Bloomy has noticed an increasing trend away from putting humans in harm’s way or into situations which would otherwise be impossible or impractical to do so, e.g., years-long space research flights or underseas reconnaissance missions. Bloomy augments its offering of system integration laboratory (SIL) hardware in-the-loop (HIL) test systems as the need to test these uninhabited systems emerges.”

Blume notes that because air and ground vehicles are fully embracing electric and hybrid power, including air taxis, vertical take-off and landing (VTOL), that electrification is driving development in test and measurement equipment.

Finally, Blume addressed technology migrations impacting trends in test and measurement in the mil-aero sector.

“Many older military and commercial aircraft programs are supported by antiquated test equipment comprised of instruments and computers that are increasingly difficult to



Sailors conduct tests in the cockpit of an F/A-18E Super Hornet, assigned to the “Stingers” of Strike Fighter Squadron (VFA) 113, on the flight deck of the Nimitz-class aircraft carrier USS Carl Vinson.

support and replace. Add to that the ‘gray wave’ of retiring engineers who designed and maintained the equipment for years, and we find ourselves in a risky situation where we are either holding our collective breath, hoping that the equipment doesn’t fail, or we are making gradual upgrades, while hoping that the necessary downtime doesn’t interfere with any unforeseen test requirements,” Blume says. “In response to these issues, Bloomy has teamed up with partners such as NI and Alta Data Technologies to host the HIL Technology Evolution Center, an industry-first initiative to help aerospace and defense organizations reduce the risk and cost of migrating legacy test assets to updated technologies.”

Anritsu’s Robinson also says that with technology becoming ever more sophisticated and radio frequency (RF) communications using more complex modulations, “the requirements on test equipment could easily become overwhelming. Military and aerospace customers are increasingly in need for test solutions that self-configure to eliminate user error in the field.

Robinson continues, “Advanced signal processing is enabling measurements that used to be confined to the lab to now be made in the field. A good example is the availability of Real Time Spectrum Analyzers (RTSA) in field portable spectrum analyzers, such as the MS2090A. RTSA facilitates the capture and analysis of very short duration signals that are often the cause of interference or illicit communications. Portability and shorter test cycles are driving simplification of testing methods of procedure (MOP). Results need to be uploaded to cloud services in real time so that they can be analyzed by all stakeholders before the engineer moves onto the next job.”

Margaret Grattan, market solutions and business manager at Tektronix, notes that test and measurement technology — like nearly all military tech — is being impacted by open systems mandates.

“In the U.S., our customers are adopting a Modular Open Systems Approach (MOSA) in the development

of new defense systems. This is happening as a result of the still relatively recent major defense acquisition programs (MDAP) mandate,” Grattan says. “Given many of these defense systems must manage and process a great deal of data at high throughputs, our customers are partnering with us to help them on their plans for the testing of high-speed interfaces, including modules and backplanes. Our expertise in physical layer test and measurement, and our decades-long involvement in setting standards for high speed interfaces in particular, has resulted in a great alignment of Tektronix solutions and customer problems.”

In the field

Marvin Test Solutions was recognized by Military & Aerospace Electronics as a platinum-level awardee in its 2020 Innovators Awards for the company’s MTS-3060A SmartCan Gen2 universal O-level aircraft armament test set.

Marvin Test’s Sargeant says that with the SmartCan, “Those units that have it as they migrate from one aircraft to another in the future, they can actually take the

SmartCan with them, and it can be used across all of their fixed or rotary wing armed aircraft, whether they're manned or unmanned. So, it provides a great level of flexibility for them."

Current testers require many personnel to move to the flightline and to operate, and are too slow and cumbersome to validate faults, reducing combat sorties. Warfighters have identified an armament test gap that exists across legacy and 5th generation aircraft equipped with the "Smart" weapon MIL-STD-1760 interface. Legacy handheld O-Level test sets are only capable of performing stray voltage and continuity tests which will not detect digital faults or fully validate the functionality of the interface, requiring the use of additional, multiple large box test sets to more completely test the armament.

The MTS-3060A SmartCan Universal O-Level Armament Test Set was developed to address these needs; the result is an advanced flightline armament test set capable of active testing all fighter aircraft armament and gun systems. The SmartCan incorporates more than 30 measurement channels, electronic loads, communications interfaces such as MIL-STD-1553, MMSI SDB communications, Ethernet, CAN Bus, RS-485), a switch matrix, and video/audio signal generators and cable ID.



NI's USRP X410 features a Xilinx Zynq Ultrascale+ RFSoc with programmable FPGA supporting the Open Source UHD tool flow as well as LabVIEW FPGA.

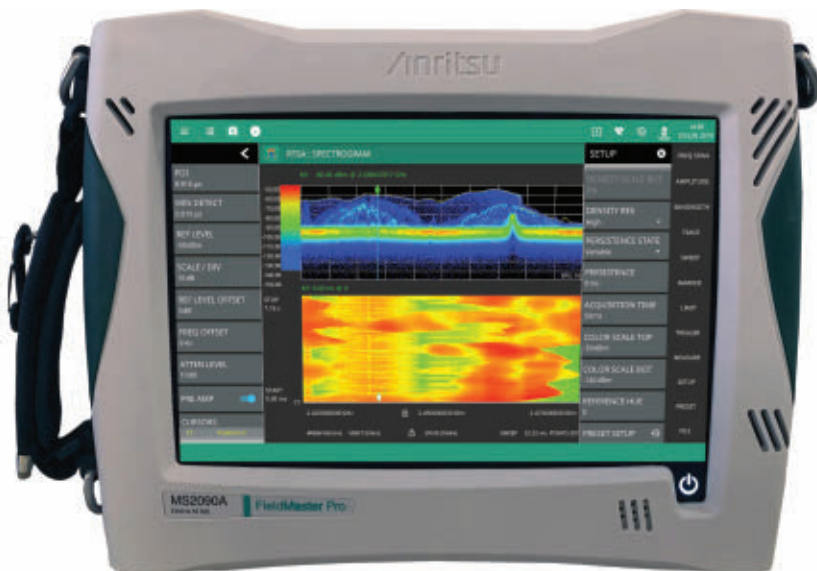
NI's Butler noted the company's USRP X410 software defined radio device shows how the company is responding to trends in mil-aero test and measurement.

The Ettus USRP X410 features a two-stage superheterodyne architecture with four independent transmitter and receiver channels. It also features a Xilinx Zynq Ultrascale+ RFSoc with programmable FPGA supporting the Open Source UHD tool flow as well as LabVIEW FPGA. With these features, the Ettus USRP X410 has the RF and processing performance for applications such as wireless communications prototyping, spectrum monitoring, and signals intelligence.

"With the pace of innovation in communication, radar, and electronic warfare systems, being able to rapidly prototype new protocols and algorithms is critical to mission readiness," Butler says. "The flexibility and performance of the latest USRP from NI ensures design and test engineers can keep pace with the trend of rapid innovation and threat management. It also offers great SWaP-C specifications to address the growing trend of deployed SDR systems for things like Counter-UAS applications."

Tektronix recently released its MSO6B series oscilloscope, which the company says provides mil-aero customers with a more precise, lower-noise measurement instrument.

"The MSO6B enables engineers to see levels of detail in a test system that could not be visualized with prior generations of digital oscilloscopes," says Textronix's Loberg. "In addition



Anritsu's Field Master Pro MS2090A real-time spectrum analyzer (RTSA) measures complex spectrums, like the 2.4 GHz ISM band that splits bandwidth between Wi-Fi and Bluetooth signals.

WHO'S WHO IN TEST AND MEASUREMENT

Abaco Systems
Huntsville, Ala.
www.abaco.com

Anritsu
www.anritsu.com/en-us/
Morgan Hill, Calif.

Astronics Corp.
East Aurora, N.Y.
www.astronics.com

Behlman Electronics
Hauppauge, N.Y.
www.behlman.com

Bloomy Controls
www.bloomy.com
South Windsor, Conn.

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

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

Diversified Technical Systems Inc. (DTS)
Seal Beach, Calif.
www.dtsweb.com

Great River Technologies
Albuquerque, N.M.
www.greatrivertech.com

Kaman Precision Products
Middletown, Conn.
www.kamansensors.com

Keysight Technologies
Santa Rosa, Calif.
www.keysight.com

Marvin Test Solutions
Irvine, Calif.
www.marvintest.com

Meggitt Sensing Systems
Irvine, Calif.
www.meggitt.com

National Instruments Corp. (NI)
Austin, Texas
www.ni.com

North Atlantic Industries
Bohemia, N.Y.
<https://www.naii.com>

Rohde & Schwarz
Columbia, Md.
www.rohde-schwarz.com

Saelig Co. Ltd.
Fairport, N.Y.
www.saelig.com

Tektronix
Beaverton, Ore.
www.tek.com

VIAVI Solutions Inc.
San Jose, Calif.
www.viavisolutions.com

Vishay Precision Group
Malvern, Pa.
<https://vpgsensors.com>

to measurement accuracy; the MS06B contains up to 8 each measurement channels; delivering on a trend to view a greater variety of measurements on a common display/timescale.”

Bloomy's Blume says that his company has a complete offering of battery management system (BMS) test equipment for the BMS product development life cycle.

“The BMS is an embedded system that monitors and balances the cells, optimizes the performance and ensures the safety of the battery. During BMS validation and HIL testing, the battery cells are simulated using either real cells or banks of programmable power supplies and loads,” Blume says. “Because lithium-ion and other advanced chemistry battery cells contain hazardous materials, the use of real cells is dangerous. Consequently, either the test coverage must be limited to regions where the cells are not stressed, or testing is performed in specialized facilities with chemical fire suppression capabilities. In addition, most commercial power supplies and loads don't simulate the current sink and source capabilities of real cells. Bloomy provides a battery cell simulator, the Battery Simulator 1200, that contains 12 simulated battery cells which sink as well as source current for BMS testing. The Battery Simulator 1200 is a commercial, off-the-shelf instrument (COTS) that is widely adopted in the automotive industry and is now also being utilized for aircraft BMS testing. The Battery Simulator 1200 is isolated and modular and is

packaged in a 1U 19-inch rack-mount enclosure, allowing the series connection of many cells from multiple units to simulate a battery pack. The Battery Simulator 1200 is a fundamental building block of all of Bloomy's BMS testing equipment, supporting the full product life cycle from R&D, validation and production. In addition, the Battery Simulator 1200 is also used for testing battery sensitivities of the electronics on an electrified vehicle. ←



The Tektronix MS06B contains up to 8 each measurement channels; delivering on a trend to view a greater variety of measurements on a common display/timescale.



The ARTS-V2 is a ruggedized mobile system designed to emulate radar-guided surface-to-air missiles to help jet aircraft practice to evade enemy attacks.

Lockheed Martin to build training system to help protect combat jet aircrews from enemy missiles

BY John Keller

HILL AIR FORCE BASE, Utah — Radar experts at Lockheed Martin Corp. will build a mobile advanced radar system to help pilots of the F-35 joint strike fighter learn to operate safely in hostile areas guarded by modern radar-guided surface-to-air missiles.

Officials of the Air Force Life Cycle Management Center at Hill Air Force Base, Utah, announced a \$80.7 million order on Friday to the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, to build five Advanced Radar Threat System - Variant 2 (ARTS-V2) systems, and for ARTS-V2 production option two.

The ARTS-V2 is a ruggedized mobile system designed to emulate radar-guided surface-to-air missile threats like the Russian-made SA-10, SA-12, and SA-20, which are built to strike at everything from low-flying drones and stealth cruise missiles to high-altitude reconnaissance airplanes and distant sensor platforms.

The SA-10 is designed to shoot down jet fighter aircraft like the F-35 and earlier-model combat jets. It has a range of nearly 50 miles and top speed approaching Mach 6. The SA-12 is for shooting down tactical ballistic missiles, and similar to the U.S. Patriot missile. The SA-20, meanwhile is an advanced development of the SA-12.

Lockheed Martin will build the ARTS-V2 to provide threat-representative radar tracking and reaction such as acquiring, tracking, and engaging several aircraft

simultaneously with representative receiver, processor, and electronic counter-countermeasures.

The system will emulate advanced anti-aircraft missile radiated power, threat signals, antenna patterns, operational modes, and threat tactics, and can send real-time radar data to the Digital Integrated Air Defense System (DIADS)-controlled threat environment at the Range Control Center (RCC). ARTS-V2 will provide multi-spectral threat representation.

The ARTS-V2 is part of the overall Advanced Radar Threat System (ARTS) project to develop and field high-fidelity threat phased array radar for live, virtual, constructive aircrew training for anti-access and area-denial environments.

ARTS will provide the advanced capabilities necessary to train aircrews in the employment of F-35 aircraft against foreign fielded live double-digit surface-to-air missile threat systems. The program consists of the strategic long-range ARTS-V1 and the tactical short-range ARTS-V2 systems. The solicitation for the ARTS-V1 system was released in January. ←

On this order Lockheed Martin will do the work in Grand Prairie, Texas, and should be finished by October 2023. For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, or the Air Force Life Cycle Management Center-Hill Air Force Base at www.hill.af.mil.



DARPA asks industry to develop G-band RF and microwave enabling technologies

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking industry to develop fabrication and integration technologies to create compact, high-performance RF and microwave electronics to enable communications and sensing systems at G-band frequencies.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has issued a broad agency

announcement (HR001121S0042) for the Electronics For G-Band Arrays (ELGAR) project.

Experts from the DARPA Microsystems Technology Office want industry to develop monolithic microwave integrated circuits (MMICs) and receive array front-end test articles able to operate in the sub-terahertz G-band frequency range between 110 and 300 GHz for applications

Photo (left): DARPA wants industry to develop monolithic microwave integrated circuits (MMICs) and receive array front-end test articles able to operate in the sub-terahertz G-band frequency range.

like radio astronomy, remote security sensing, and telecommunications.

The growing, insatiable thirst for information in military and commercial applications is driving RF and microwave technologies towards increasingly higher data rates and wider bandwidths of operation. This drives systems designs higher operating frequencies to support large channel bandwidths.

Today's 5G cellular networks, for example, operate at 6 GHz and below, and researchers are considering future 5G communications at millimeter wave frequencies from 24.25 GHz to 52.60 GHz. 6G will push frequencies even higher for large-channel bandwidths and high-channel capacities.

The upper millimeter-wave G band of 110 to 300 GHz represents an attractive, underused portion of the electromagnetic spectrum for high-rate data communications — particularly above 200 GHz, where atmospheric absorption is low.

Today, however, RF electronics adequate to support operation in this frequency band does not yet exist — particularly for size, weight, and power (SWaP)-constrained applications. The efficiency of G-band electronics today is poor, and must be addressed to make G-band systems viable.

RF and microwave experts can build G-band communications arrays with silicon-based RF integrated circuits or with III-V compound semiconductor MMICs. Each approach has advantages and limitations.

Through significant investment in programs such as Sub-millimeter Wave Imaging Focal-plane Technology (SWIFT), Terahertz (THz) Electronics, and Nitride Electronic NeXt-Generation Technology (NEXT), DARPA has developed III-V transistor technologies in indium phosphide and gallium nitride that can overcome the gain and breakdown voltage limitations of silicon-based transistors at G-band.

DARPA is interested in heterogeneous integration approaches that result in transmit and receive circuit compactness that enable a revolutionary increase in power density and power efficiency of MMICs and phased arrays at G-band.

The ELGAR program seeks to develop integration technologies to implement demonstration and

validation circuits and test articles including compact, high-efficiency G-band power amplifier MMICs and transmit and receive array front-end test articles that operate at 220 GHz.

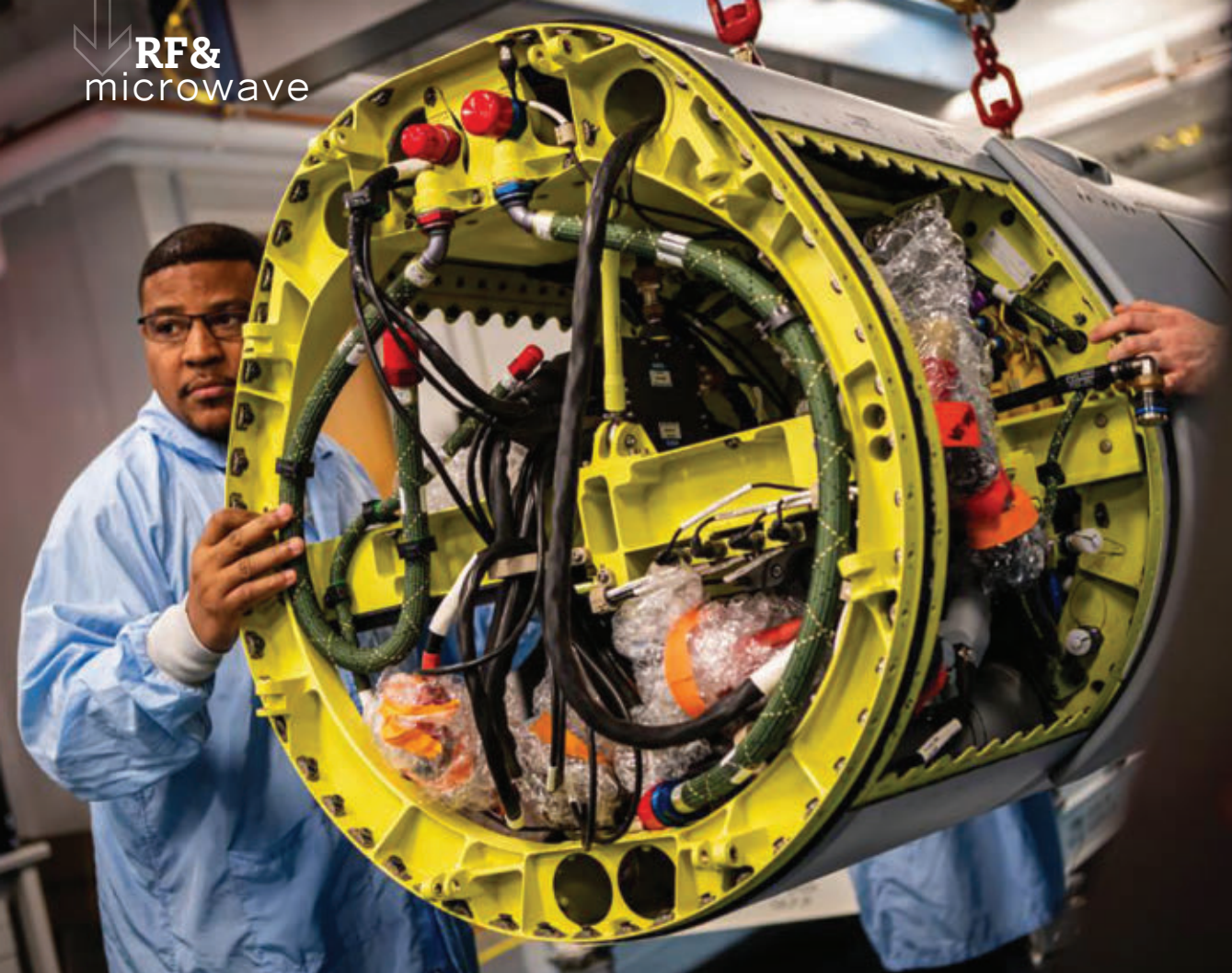
DARPA anticipates that the most challenging performance aspects of these MMICs and array test articles will be achieving 30 percent power amplifier power-added efficiencies, and more than 34 Watts per square centimeter transmit array power density and 24 percent transmit array efficiency at the 220 GHz operating frequency.

DARPA briefed industry on details of the ELGAR program in virtual meetings on Tuesday 12 Oct. 2021. Email questions about the briefings to DARPA-sn-21-47@darpa.mil. More information on the proposers day is online at <https://sam.gov/opp/d5822e3694ff44299174756977e8ea9c/view>. ←

Companies interested should upload abstracts to the DARPA BAA website no later than 29 Oct. 2021 at <https://baa.darpa.mil>. Upload full proposals no later than 13 Dec. 2021 at <https://baa.darpa.mil>. The project should begin by May 2022. More information is online at <https://sam.gov/opp/e4acf53435144c52906d2c19f0210586/view>.

Space company HawkEye 360 eyes global RF and microwave SIGINT from orbiting satellites

The U.S. National Geospatial-Intelligence Agency (NGA) in Washington has issued a \$10 million contract to commercial satellite company HawkEye 360 in Herndon, Va., to use satellites to detect and map radio frequency emissions all over the world. HawkEye 360 officials say they will provide services for NGA analytics to help the agency detect and track military and criminal activities. Combatant commanders will be able to use the data. The intelligence community has been assessing HawkEye 360 since December 2019 for signals intelligence (SIGINT) capabilities, which use satellites to detect and characterize RF emissions when the National Reconnaissance Office issued the company a study contract. NGA was able to leverage that study contract, initiating a RF GEOINT Pilot program with the company in Sept. 2020 to further see how the company's unclassified RF and microwave capabilities could benefit the agency. Following a request for proposals in March 2021, the company was awarded the sole contract in July. ←



Boeing moving closer to deploying next-generation EW airborne jammer

BY John Keller

PATUXENT RIVER NAS, Md. — Airborne electronic warfare (EW) experts at the Boeing Co. are moving closer to deploying advanced electronic jammers for U.S. Navy EA-18G Growler EW jets under terms of a \$14.5 million order announced Friday.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Boeing Defense Space & Security segment in St. Louis for additional test and engineering to integrate the Next Generation Jammer (NGJ) midband (NGJ-MB) aboard the Boeing EA-18G Growler carrier-based electronic warfare (EW) jet.

Boeing will provide engineering to complete the development of the NGJ-MB in support of the phased replacement of the AN/ALQ-99 Tactical Jamming System currently mounted to the EA-18G aircraft. The Raytheon Technologies

Photo (above): The Next Generation Jammer-midband aboard the Boeing EA-18G Growler jet denies, disrupts, and degrades enemy communications and air-defense radar systems.

Corp. Intelligence and Space segment in El Segundo, Calif., designs and builds the NGJ-MB.

The NGJ-MB is an advanced electronic attack jammer that denies, disrupts, and degrades enemy communications and air-defense radar systems. Raytheon builds the EW system with a combination of agile active electronically scanned arrays (AESA) and an all-digital back end.

Related: Navy asks L3Harris for 19 AN/ALQ-214 A(V)4 airborne electronic warfare (EW) jammers for the F/A-18 aircraft

The NGJ-MB helps the Growler aircraft operate at long ranges, attack several different targets simultaneously, use

advanced electronic jamming techniques, and incorporate rapid upgrades through a modular, open systems architecture.

Raytheon delivered the first NGJ-MB pod to the Navy for testing in July 2019. The technology can scale to other missions and aircraft.

The NGJ is a tactical electronic jammer pod that replaces the 40-plus-year ALQ-99 jammer system on the EA-18G — a version of the Navy's carrier-based two-seat F/A-18F Super Hornet jet fighter-bomber that is modified specially for electronic warfare.

Related: Raytheon to build three midband airborne electronic warfare (EW) jammers for Navy EA-18G Growler aircraft

The EA-18G leads an airborne attack by disrupting enemy radar, communications, and computer networks with jamming signals and computer viruses. The aircraft also can destroy enemy radar installations with its AGM-88 High-speed Anti-Radiation Missiles (HARM).

Raytheon's NGJ will integrate the most advanced electronic attack technology into the EA-18G, such as high-powered, agile beam-jamming techniques, and solid-state electronics to deny, degrade and disrupt enemy threats while protecting U.S. and coalition forces.

Raytheon's NGJ will provide airborne electronic attack and jamming capabilities, and will include cyber-attack capabilities that use the aircraft's active electronically scanned array (AESA) radar to insert tailored data streams into enemy radar and communications systems.

Related: Navy picks Mercury Systems to provide airborne electronic warfare (EW) technology to confuse enemy radar

The NGJ also will have an open-systems architecture for future upgrades. Raytheon will use its gallium nitride (GaN)-based AESA technologies for the NGJ design.

Eventually Raytheon engineers may modify the NGJ to install it aboard the F-35 joint strike fighter, unmanned aerial vehicles (UAVs), as well as to other manned aircraft in addition to the EA-18G.

The goal of the NGJ technology-development phase is to develop an electronic attack system that will improve airborne electronic attack capabilities against advanced threats through enhanced agility and precision within jamming assignments, increased interoperability, and expanded broadband capability for greater threat coverage against a wide variety of radio frequency emitters, Navy officials say.

Related: Navy prepares electronic warfare (EW) competition to develop new low-band component of aircraft jammer pod

L3Harris Technologies Inc. in Melbourne, Fla., is developing the Next Generation Jammer Low Band (NGJ-LB) in an urgent effort to develop low-band tactical radar jammers using existing technologies for low size, weight, and power consumption (SWaP) applications on the EA-18G Growler EW jet.

L3Harris Technologies won a contract last December to design and build the NGJ-LB, which experts say will be useful in jamming low-band radar systems design to detect stealth aircraft like the F-35 joint strike fighter. The NGJ-LB transmitter will fit in a pod on Station 6 of the EA-18G.

The system will enhance the performance of frequency coverage, effective isotropic radiated power, spatial coverage, spectral purity, and polarization; obtain existing contractor data related to transmitter group performance; and assess the potential to deploy an open-systems interim pod solution rapidly. ◀

On this order Boeing will do the work at Patuxent River NAS, Md., and in St. Louis, and should be finished by September 2022. For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, Raytheon Intelligence and Space online at www.raytheonintelligenceandspace.com, L3Harris at www.l3harris.com, or Naval Air Systems Command at www.navair.navy.mil.

Army takes another look at networking land mines with remote operation

U.S. Army combat engineers are looking for new ways to deploy land mines by artillery, unmanned aerial vehicle (UAV), or robot ground vehicles on the battlefield. Lt. Gen. Scott A. Spellmon, chief of engineers and commanding general of the U.S. Army Corps of Engineers says the number-one priority for modernizing Army regiments is altering terrain with land mines. Although better aircraft, communications networks, and ground vehicles offer advantages, terrain shaping with networked land mines denies the enemy from using its own systems and enables Army infantry to control the tempo of the battlefield. Next-generation networked land mines are the Standoff Activated Volcano System and the Common Anti-Vehicle Munition, which aim to be portable, be easier to deploy, use a common munition, have self-reporting features, and ways to conduct remote self-deactivation and self-destruct. ◀



Extra-large UUVs typically are autonomous mini-submarines that measure about seven feet in diameter — sometimes larger.

Boeing to support large unmanned submarines with modular payload bays

BY John Keller

WASHINGTON — Undersea warfare experts at the Boeing Co. will continue supporting extra-large unmanned underwater vehicles (UUVs), which will be expected to undertake long-endurance missions to deploy sensors or other UUVs.

Officials of the U.S. Naval Sea Systems Command in Washington announced an \$11.3 million order to the Boeing Defense, Space & Security segment in Huntington Beach, Calif., for engineering support services in support of the Extra Large Unmanned Undersea Vehicle (XLUUV) program.

Extra-large UUVs typically are autonomous mini-submarines that measure about seven feet in diameter — sometimes larger. They are designed for launch from shore or from large military ships with well decks, or from large civil vessels with moon pools.

The modular-construction Boeing Orca XLUUV will be an open-architecture reconfigurable unmanned underwater vehicle (UUV) with the core vehicle providing guidance and control, navigation, autonomy, situational awareness, core communications, power distribution, energy and power,

propulsion and maneuvering, and mission sensors, Navy officials say.

The Orca XLUUV will have well-defined interfaces for cost-effective future upgrades to capitalize on advances in technology and respond to threat changes. The Orca XLUUV will have a modular payload bay, with defined interfaces to support current and future UUV payloads.

XLUUVs, which are among the largest unmanned submersibles ever conceived, will be for long-endurance surveillance missions or undersea cargo vessels to deliver other sensor payloads and other UUVs.

These large unmanned undersea vehicles eventually could be used as motherships to deploy and recover smaller surveillance UUVs on far-flung reconnaissance, surveillance, or special warfare missions in the open ocean or along coastlines and inside harbors.

The Navy and the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have involved Lockheed Martin and Boeing on a variety of large UUV

projects such as the Large-Displacement Unmanned Underwater Vehicle (LDUUV) project.

An LDUUV typically is described as an autonomous submarine no larger than 80 inches in diameter. Future XLUUVs likely will be larger. Experience with the LDUUV will help inform concepts for using XLUUV.

DARPA issued a solicitation two years ago for the Hunter program to develop a payload-delivery system from an extra-large UUV. The Hunter program, however, involves only the payload delivery system and not the extra-large UUV itself.

Hunter payloads could involve persistent-surveillance sensors, weapons, or other unmanned underwater vehicles (UUVs) and unmanned aerial vehicles (UAVs). They could involve persistent-surveillance sensors, weapons, or other UUVs and perhaps even unmanned aerial vehicles (UAVs).

The Navy's XLUUV project is moving enabling technologies forward that were developed originally in other projects such as the DARPA Hydra program to develop an unmanned submersible large enough to transport and deploy UAVs and UUVs stealthily in enemy territory to respond quickly to situations around the world.

Boeing also has developed the Echo Voyager, a 51-foot large UUV that can reach depths of 11,000 feet and can operate independently for months underwater. Boeing unveiled the Echo Voyager in early 2016 and began sea trials of the unmanned undersea craft in summer 2017.

Boeing and Lockheed Martin both were involved in a DARPA project in 2015 ago called Blue Wolf, which focused on revolutionary underwater propulsion and drag-reduction technologies to enable manned and unmanned military undersea vehicles to move through the water faster and more energy-efficiently than ever before.

The Blue Wolf program demonstrated integrated underwater vehicle prototypes able to operate at speed and range combinations previously unachievable in fixed-size platforms, while retaining traditional volume and weight fractions for payloads and electronics.

Blue Wolf involved dynamic lift from winglets, body shaping, coatings, and novel drag reduction technologies applicable over various range and speed combinations to improve system energy efficiency. ◀

On this order Boeing will do the work in Huntington Beach, Calif.; Cockeysville, Md.; and Herndon, Va., and should be finished by September 2022. For more information contact Boeing Defense, Space & Security online at www.boeing.com, or Naval Sea Systems Command at www.navsea.navy.mil.

RE2 Robotics eye autonomous unmanned underwater system to detect sea mines

The U.S. Navy has awarded a \$9.5 million contract to RE2 Robotics Inc. in Pittsburgh to develop autonomous systems to neutralize underwater mines and explosive devices. RE2 experts say they plan to use a robotic system to place and attach neutralization devices to the mines or explosives to keep humans from doing the dangerous work. The company's unmanned underwater system will enable the Navy to find and autonomously neutralize targets in deep ocean waters, while experienced divers supervise from a safe distance. The system also is for complex offshore infrastructure and maintenance applications in the oil and gas and renewable wind industries, company officials say.

Manta ray-shaped UUV undergoes sea test for future Chinese reconnaissance

Chinese researchers from a military-linked university have completed the first open sea test in the Paracel Islands of a bionic robot that looks and swims like a manta ray, Chinese media reported. Countries disputing China's claims in the South China Sea will be watching closely the development of this sophisticated drone. The state-run China Daily quoted developers from the Northwestern Polytechnical University (NWPU) in Xi'an, China, as saying that this bionic unmanned underwater vehicle (UUV) has dived deeper than 3,300 feet, including gliding and flapping wing propulsion.

Navy seeks to expand fleet of large unmanned surface vessels for strike missiles

U.S. Navy leaders want to develop three types of large unmanned marine vehicles: Large Unmanned Surface Vehicles (LUSVs), Medium Unmanned Surface Vehicles (MUSVs), and Extra-Large Unmanned Undersea Vehicles (XLUUVs). The Navy's proposed 2022 budget requests \$434.1 million for research into these large unmanned vessels and their enabling technologies. Navy leaders want these large unmanned vessels to help shift the Navy to a more distributed fleet that consists of relatively few large ships like aircraft carriers, cruisers, and destroyers; many small ships like frigates, corvettes, small amphibious ships; and a third tier of large unmanned surface vessels. ◀



Navy MAGNUSS blends superconductor magnet and high electricity for mine warfare

BY John Keller

ARLINGTON, Va. — U.S. Navy researchers are preparing to approach industry for counter-mine technologies for the future Mine Countermeasures Unmanned Surface Vehicle (MCM-USV) — a long-endurance, semi-autonomous, diesel-powered boat for counter-mine operations.

Officials of the Office of Naval Research (ONR) in Arlington, Va., have issued a special notice (N00014-21-S-SN12) for the Magnetic and Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS) project.

The idea is to develop an advanced minesweeping payload composed of a high-temperature superconducting magnetic source with an advanced acoustic generator for the MCM-USV. The MCM USV program use several payload delivery systems to include the minesweeping payload delivery system, minehunting payload delivery system, and future payload delivery systems for mine neutralization.

The Navy has been moving the mine countermeasures mission to the Littoral Combat Ship (LCS) as a suite of mission modules like the MCM-USV as a deployable system on the LCS to complete the minesweeping mission. The Office of Naval Research, meanwhile, has been developing an advanced closed-loop minesweeping system using an high-temperature superconductor magnet coupled with an acoustic source to generate underwater acoustic energy.

The advantage of using an high-temperature superconductor magnet is the ability to run at very high electrical currents with near-zero resistance, which can sweep magnetic influence mines when coupled to an acoustic generator.

In addition to the recent advancement of high-temperature superconductor magnets to provide

Photo (above): The future Mine Countermeasures Unmanned Surface Vehicle (MCM-USV) will host the Magnetic and Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS).

a non-towed magnetic source, Navy researchers want a non-towed, underwater acoustic source with low-drag as an alternative to a legacy acoustic generator that still enables additional benefits to the non-towed magnetic source.

The modularity of the high-temperature superconductor magnet and acoustic generator potentially could be deployed on any craft of opportunity — not just aboard the MCM-USV.

This electromagnetic warfare project seeks to integrate the high-temperature superconductor magnet, acoustic generator systems, and command and control for deployment onboard a small craft like the MCM-USV.

From industry, Navy researchers want proposals on integrating a high-temperature superconductor magnet with a non-towed low-drag underwater acoustic generator as a single payload deployable aboard the MCM-USV.

The effort will procure a high-temperature superconductor magnet and an acoustic generator; integrate the mechanical, electrical, and command and controls (C2) systems of the two systems with each other; and integrate the complete payload with the MCM-USV and its hull for demonstration. ←

Companies interested should email proposals no later than 17 Dec. 2021 to ONRG.GrantProposals@mail.mil. Email questions or concerns to the Navy's Brian Almquist at brian.almquist@navy.mil. More information is online at <https://sam.gov/opp/3874efee2de042bca3fa067616c83ae7/view>.



Laser JDAM can attack fixed targets using GPS, or can attack moving targets by homing in on the laser beam from a separate laser designator.

Boeing to provide laser-guidance kits to enable JDAM to attack moving targets

BY John Keller

PATUXENT RIVER NAS, Md. — Smart munitions experts at the Boeing Co. are building modification kits to enable the Joint Direct Attack Munition (JDAM) to attack moving targets by homing in on laser beams.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a \$344.6 million order to the Boeing Defense, Space & Security segment in St. Louis for as many as 24,000 DSU-38 A/B Precision Laser Guided Sets (PLGSs).

The PLGS works with the KMU-572 guidance set to create the Laser JDAM smart bomb. The PLGS consists of the DSU-38 A/B laser seeker and a wire harness fixed under the bomb body to connect the laser seeker with the tail kit, which controls the bomb in flight.

Laser JDAM can attack fixed targets using GPS satellite navigation alone if laser guidance is not available, or can attack moving targets by homing in on the laser beam from a separate laser designator aboard aircraft or on the ground. The contract, announced late last month is for the Navy, U.S. Air Force, and foreign military sales customers.

JDAM is a guidance kit that converts unguided bombs to all-weather smart munitions. The precision-guided glide bombs use guidance from an integrated inertial guidance system coupled to a Global Positioning System (GPS) receiver, giving them a range of as far as 15 nautical

miles. JDAM-equipped bombs range from 500 pounds to 2,000 pounds.

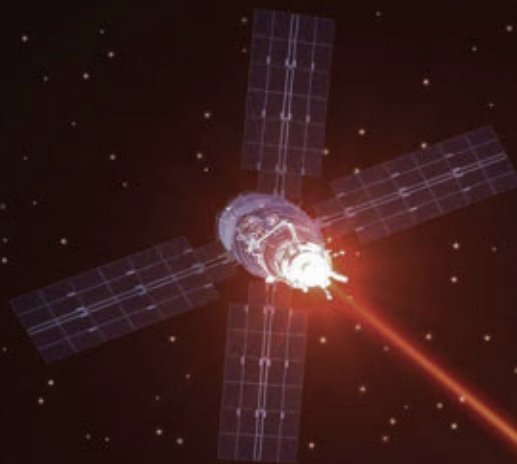
The JDAM guidance systems are bolt-on guidance packages that convert unguided gravity bombs into precision-guided munitions. The key components are tail section with aerodynamic control surfaces, a strake kit, and a combined inertial guidance system and GPS guidance control unit.

The Laser JDAM's PLGS represent a cooperative development between Boeing Defense, Space & Security and Elbit Systems Ltd. in Haifa, Israel.

Aircraft able to carry the JDAM include the F-15E Strike Eagle; F-16C Fighting Falcon; CF-18 Hornet; F/A-18A+/C/D Hornet; F/A-18E/F Super Hornet; F-22 Raptor; F-35 Lightning II; MQ-9 Reaper; Mitsubishi F-2; Panavia Tornado; Mirage F-1; Eurofighter Typhoon; Saab JAS 39 Gripen; and A-29 Super Tucano.

On this contract Boeing will do the work in Fort Worth, Texas; Cincinnati; St. Louis; Odessa, Mo.; Simpsonville, S.C.; Minneapolis, and other Continental U.S. locations, and should be finished by December 2025. ◀

For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, or Naval Air Systems Command at www.navair.navy.mil.



The DARPA the Breakthrough Technologies for Energy Web Dominance project seeks to develop free-space laser power networks able to transmit electrical power over lasers.

Industry eyes wireless networks that use lasers to transmit electrical power

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking industry to develop free-space laser power networks able to transmit electrical power over webs of lasers using aircraft as receivers and relays of optical energy.

Officials of the U.S. Defense Advanced research Projects Agency (DARPA) in Arlington, Va., issued a Small Business Innovation Research (SBIR) opportunity (HR001121S0007-29) for the Breakthrough Technologies for Energy Web Dominance project.

A wireless network energy web that consists of several dynamic nodes will improve military capabilities significantly, DARPA researchers say. To achieve this, researchers are interested in three technology areas: high-energy-flux; high-efficiency optical energy conversion; and relay technologies.

The goal is to develop safe optical power-beaming web networks with links that provide rigorous photon containment and intrusion monitoring to ensure optical energy goes to the intended receiver without harming human bystanders or objects.

Such an energy web network consists of ground laser sources providing power to airborne nodes that use this power for own-ship requirements through conversion, and then relay the remaining power without conversion to other energy web nodes. Designs should support low size, weight, and power (SWAP) for the airborne portions of the power beaming system.

Traditional photovoltaic power beaming loses efficiency at high energy fluxes due to high temperatures, researchers explain. Although conversion methods such as thermoelectrics are one approach to achieving higher energy fluxes, they typically have poor efficiency.

The DARPA Breakthrough Technologies for Energy Web Dominance project seeks to optimize system efficiency by accounting for cooling losses for systems with an energy flux of 1 kilowatt per square meter, and scalable to 100 kilowatts per square meter or more.

Relays are elements of the optical chain that retransmit optical energy without first converting it back to electricity. These optical waveguides could be as simple as a

mirror, but likely will involve several components to redirect power flexibly to intended receivers.

Relays must demonstrate high efficiency and beam quality while accounting for losses such as fiber coupling inefficiencies and wavefront aberrations from turbulence in the propagation path. Proposals should address ways to correct beam aberrations or mitigate losses in optical chain relays.

Safety also is a big concern. Wireless beaming of optical energy will require at least 10 to 100 kilowatts of sustained beamed optical power. These power levels are inherently dangerous and pose substantial systems design challenges, particularly for dynamic platforms operating in real world environments.

Of particular concern is the danger to bystanders who may be subject to “splash” glints or “spillover” reflections that are inadvertently directed toward unintended locations.

DARPA researchers are looking for technologies that substantially address these safety concerns through rigorously assured photon containment. Low-SWAP solutions also must provide continuous path monitoring to detect and react to mobile intruders into the beam.

Any proposed method of assured photon containment may tackle a portion of the overall problem. One solution might involve sensing glints over a nearly spherical field of regard. Another might design surface morphologies that capture reflections, antireflective, or coatings.

Rigorously assured photon containment provides a probability of less than one in one billion likelihood of unintended radiation emission at irradiance levels exceeding 5 milliwatts per square centimeter that are capable of reaching human subjects if below wavelengths of 1.4 microns. If above 1.4 micron irradiance levels should not exceed 100 milliwatts per square centimeter.

Enabling technologies from this project aren't just for military applications. The systems required for efficient power beaming can be applied to many other applications such as free-space laser communications, high-energy laser propagation, LIDAR, or other high-pulse-energy or continuous power laser applications. ←

Companies interested were asked to upload full proposals to the DOD SBIR/STTR Proposal Submission website by 30 Nov. 2021 at www.sbir.gov/content/submission-proposals. Email questions or concerns DARPA at HR001121S0007@darpa.mil, with BAA HR001121S0007-29 in the subject line. More information is online at <https://sam.gov/opp/64463b5ca4464cb291e82f2c928e87e8/view>.

Interface board for electro-optical video camera introduced by dPict Imaging

Electro-optical sensor specialist dPict Imaging Inc. in Indianapolis is introducing the DP-800S camera interface board for surveillance applications aboard unmanned vehicles. The board converts raw video data from Sony block cameras and to produce 4K SDI video output. The board is designed to output 4K SDI video up to 4K 60 (or 12G), however, all video resolutions of the camera are supported. The DP-800S board also provides power to the camera, USB for camera firmware updates, VISCA, and serial support. HDMI and SDI video are implemented in the onboard field-programmable gate array (FPGA). In addition, the FPGA contains a soft processor that enables the board to overlay data from telemetry devices, live text, and bitmap sources onto the output video in real-time. The overlay data comes through the serial port. For more information contact dPict Imaging online at <http://dpictimaging.com>.

Persistent surveillance sensor for unmanned helicopters introduced by Logos

Logos Technologies LLC in Fairfax, Va., is introducing the MicroKestrel sensors for small, tethered, multirotor-type unmanned aerial vehicles (UAVs). When mounted on a tethered UAV and hovering at 200 feet, one MicroKestrel can image three square kilometers, tracking every vehicle and detecting every infantry warfighter within its 180-degree field of view. The wide-area motion imagery (WAMI) persistent surveillance system also can cue high-definition video cameras for close-in inspection should an operator require a positive identification of a target. “At just under five pounds, the new WAMI system is so light that some tethered UAVs can actually accommodate two units, each pointed in a different direction,” says Doug Rombough, vice president of business development for Logos Technologies. The idea of getting WAMI on a small tethered unmanned aircraft once seemed impossible. Now, these sensors will be able to go on tethered UAVs or free-flying UAVs that have been connected to a third-party tethering station. This greatly expands the types of operators who will be able to use WAMI. For more information contact Logos Technologies online at www.logostech.net. ←

PRODUCT applications

AVIONICS

Parts obsolescence forces redesign of data-transfer avionics for B-52 bomber



U.S. Air Force combat avionics experts needed a company to redesign and remanufacture the AN/ASK-7 data-transfer system for the B-52 bomber aircraft. They found their solution from Kihomac Inc. in Reston, Va.

Officials of the U.S. Defense Logistics Agency-Aviation at Robins Air Force Base, Ga., announced a \$9.4 million contract to Kihomac for the design and production of the AN/ASK-7 data-transfer system, generally because of large-scale parts obsolescence.

The AN/ASK-7 also is called the B-52 data-interface unit, and loads and stores B-52 mission software and captures fault data for maintenance purposes aboard the large bomber.

The AN/ASK-7 provides the means of transferring mission data from air force mission support system to the B-52 bomber aircraft and provides information to the B-52 avionics computer units via the 1553A databus.

The AN/ASK-7 is a mission-critical item and an offensive avionics system on the B-52H. It contains hardness-critical items that if damaged or compromised can degrade system survivability in a nuclear, biological, or chemical environment if systems designers do not consider hardness.

Air Force avionics experts say the AN/ASK-7 cannot simply be upgraded or modernized because the system has serious obsolescence issues. The original system has 10 parts that are obsolete with no known replacements across the circuit cards.

Instead, Kihomac avionics engineers will redesign and remanufacture the data-transfer system from scratch, and will consider obsolescence mitigation as part of the job. The B-52 is an old aircraft; it's been in service since 1955, and its latest version, the B-52H, has been flying since 1961.

Kihomac designers will build a form, fit, function, and interface drop-in replacement for the legacy AN/ASK-7, and will use current nonproprietary parts and technology with qualified sources defined by drawings and specifications.

On this contract Kihomac will do the work in Virginia and Utah, and should be finished by September 2026. For more information contact Kihomac online at www.kihomac.com, or the Defense Logistics Agency-Aviation at www.dla.mil/Aviation.

SENSORS

Canadian Commercial Corp. to upgrade L3Harris Wescam electro-optical sensor



U.S. Navy electro-optical surveillance and reconnaissance experts needed a company to upgrade the Navy's L3Harris Wescam MX-20D sensor turrets. They found their solution from The Canadian Commercial Corp. (CCC) in Ottawa.

Officials of the Naval Surface Warfare Center Crane Division in Crane, Ind., announced a \$10.7 million order to CCC to upgrade 33 MX-20D turrets and deliver 34 digital master control units.

The WESCAM MX-20D EO/IR targeting and designating system is for high-altitude, long-range persistent surveillance, reconnaissance, and target acquisition from manned and unmanned aircraft.

The CCC is a Canadian corporation mandated to facilitate international trade on behalf of Canadian industry — particularly with governments of foreign countries. CCC helps Canadian exporters gain access to foreign government procurement markets through a government-to-government contracting.

CCC positions qualified Canadian exporters to win international contracts with governments abroad while significantly reducing the risks associated with foreign procurement. The MX-20D sensor turret is from L3Harris Wescam in Burlington, Ontario.

The WESCAM MX-20D is for covert intelligence, surveillance and reconnaissance, armed reconnaissance, and target acquisition and designation from fixed-wing aircraft, helicopters, and aerostats.

The MX20D can support as many as six sensors simultaneously. Among those sensors are HD visible light cameras; HD infrared imaging

sensors; laser rangefinders and designators; high-sensitivity color camera; pseudo color infrared; advanced video tracker, moving target indicators; and laser spot trackers.

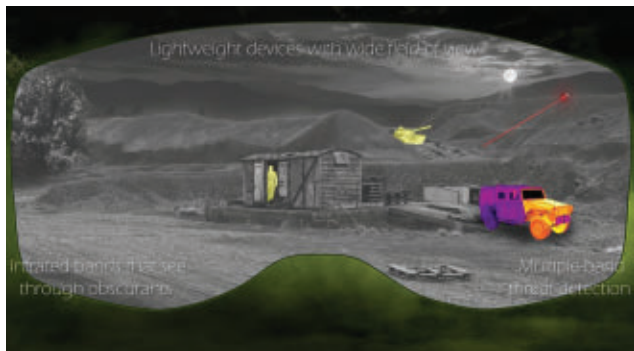
The integrated sensor system is compatible with standard U.S. and NATO designator codes, automatically detects a designator spot of a given code in its field-of-view, and slews the system's line-of-sight to laser energy, and offers dual-channel daylight and electron multiplying CCD charge-coupled device (EMCCD) low-light camera.

The turret has an inertial measurement unit for enhanced location, and a five-axis gimbal with stabilized imagery. On this camera the CCC will do the work Ottawa, and should be finished by September 2022.

For more information contact The Canadian Commercial Corp. online at www.ccc.ca, L3Harris Wescam at www.l3harris.com, or the Naval Surface Weapons Center-Crane at www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Crane.

ELECTRONIC WARFARE

L3Harris to build shipboard EW payloads to protect Navy ships from anti-ship missiles



U.S. Navy shipboard electronic warfare (EW) experts are asking L3Harris Technologies Inc. to build special EW payloads to help protect Navy warships from enemy anti-ship cruise missiles.

Officials of the Naval Sea Systems Command in Washington announced a potential \$124 million sole-source contract on Thursday for the MK 234 10/11/12/13 Nulka Advanced Decoy Architecture Program (ADAP) series payloads.

The ADAP payload provides an advanced EW transmitter and increased signal processing capability to target specific threats that the current payload on the shipboard Nulka decoy does not. The initial value of the contract is \$33.6 million.

ADAP payloads are designed to lure missiles away from their intended targets with advanced electronic techniques. The ADAP payloads are an upgrade to the existing Nulka decoy.

Nulka is a joint program with Australia, and is in service with the Australian, Canadian, and U.S. navies. Nulka consists of the MK 53 decoy-launching system and MK 234 offboard active decoy to defeat hostile anti-ship missiles.

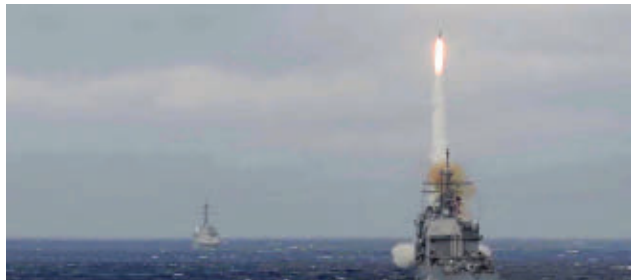
The MK 53 DLS consists of a decoy launch processor, launching power supplies, and from two to six launchers depending on the ship class. Each launcher can store and launch two Nulka decoys. The MK 53 DLS provides the launch authorization and flight demands to the Nulka decoy when a Nulka engagement is initiated.

The MK 53 DLS has been installed on U.S. Ticonderoga-class cruisers, Arleigh Burke-class destroyers, Nimitz-class aircraft carriers, Whidbey Island- and Harpers Ferry-class amphibious assault ships.

On this contract L3Harris will do the work Clifton and Hamilton, N.J.; Rancho Cordova, Calif.; Ronkonkoma, N.Y.; and Andover, Mass., and should be finished by April 2026. For more information contact L3Harris online at www.l3harris.com, or Naval Sea Systems Command at <https://www.navsea.navy.mil>.

NIGHT VISION

DARPA hires two groups to develop lightweight eyeglasses for night vision



Researchers at Raytheon Technologies Corp. and the University of California at San Diego will develop night-vision devices far smaller and lighter in weight than today's night-vision goggles, which would be about the same size and weight as a typical pair of eyeglasses.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., awarded a \$3 million contract to Raytheon BBN Technologies Corp. in Cambridge Mass., and a \$2.3 million contract to UC San Diego for the Enhanced Night Vision in eyeglass form factors (ENVision) project.

Today's night-vision goggles typically are as bulky as 4 inches long and as heavy as 2.2 pounds. This causes a large torque on the wearer's neck, which limits the wearer's agility and often leads to chronic injury over prolonged use of these electro-optical devices.

Today's night-vision goggles also burden the wearer with a narrow field of view and generally have limited spectral access to the near-infrared spectral band, which limits situational awareness.

This drawbacks from refractive optics for imaging, and image-intensifier tubes — two technologies in modern night-vision systems that have remained largely the same since their inception.

Instead, the DARPA ENVision program seeks to overcome these limitations by developing enhanced direct-view night-vision systems that are of a size and weight near those of typical eyeglasses.

Raytheon BBN and UC San Diego researchers will develop small and lightweight night-vision eyeglasses to extend visual access beyond near infrared to include shortwave, midwave, and long-wave infrared spectral bands through a common aperture, giving users access to spectral ranges from 1.5 to 12 microns. These night-vision eyeglasses, furthermore, are to widen the user's field of view to natural eyesight of about 100 degrees.

Optical specialists have attempted to widen the fields of view for today's night-vision goggles, but improvements come at the cost of increased systems size, weight, and wear-and-tear on the user. The ENVision project seeks to explore the next technical leap in night-vision technologies by achieving direct vision of the infrared through photon upconversion.

While current night vision systems use a multi-step process, the physics to upconvert infrared photons directly to visible light in one step has been known since the invention of the laser in 1960. Direct photon upconversion involves the absorption of two or more photons and re-emission of a photon of higher energy.

Currently, these processes are inefficient and are limited in the bandwidth of light that can be upconverted simultaneously. Yet recent advances in material systems such as polaritonic structures and sensitized core-shell nanoparticles have opened up new avenues in exploring photon upconversion.

The process of photon upconversion-based night vision would eliminate the need for several components and could lead to even simpler, all-optical night-vision systems in the future, such as night vision contact lenses, DARPA researchers say.

Planar optics and planar image intensifiers could enable direct vision of several infrared bands through one common aperture. Structured materials such as diffractive optics and metamaterials enable one to embed optical functionalities far beyond those of traditional refractives into one optical element.

While wide field of view, broad bandwidth, and high imaging quality all are achievable individually, combining these traits in practice remains a challenge. In addition to planar optics, image intensification is necessary to convert the often weak infrared light into visible photons detectable by the naked eye.

The ENVision program will last for four-years in two two-year phases, and has two technical areas: prototypes and upconversion. Those participating in the first technical area will develop prototypes of enhanced night vision systems in eyeglass form-factors, while those in the second technical area will investigate broadband direct photon upconversion.

For more information contact Raytheon BBN online at www.raytheonintelligenceandspace.com, the University of California at San Diego at www.sandiego.edu/academics/research, or DARPA at www.darpa.mil/program/envision.

PROJECT MANAGEMENT TOOLS

Pratt & Whitney chooses DecisionEdge and Encore Analytics for project management software



Project management experts at jet engine designer Pratt & Whitney, a Raytheon Technologies company in East Hartford, Conn., needed software to help manage complex projects. They found their solution from DecisionEdge in Austin, Texas, and Encore Analytics LLC in Santa Rosa Beach, Fla.

The two companies are working together to replace Pratt & Whitney's current Earned Value Management Tool Suite. The companies are basing their replacement project-management tool with the DecisionEdge WebEVM and the Encore Analytics Empower software tools.

Pratt & Whitney specializes in the design, manufacture, and service of commercial and military aircraft engine systems, as well as auxiliary power units. Financial details of the deal were not released.

DecisionEdge and Encore Analytics will provide Pratt & Whitney with software tools that provide data and value for portfolio, program, and project management.

The DecisionEdge WebEVM has tight integration with Oracle P6, Microsoft Project, and Empower. The tool's enterprise speed, web-based ease of use, and error checking enables users to operate with lean resources and focus on data analysis instead of data loading and verification, company officials say.

The Encore Analytics Empower browser-based analytical tool integrates earned value, schedule, work authorization, and other key performance data to enable proactive management of complex projects.

Empower is for control account managers, program managers, support staff, and oversight organizations. The tool helps locate problem areas, identify trends, display element-of-cost information, graphically display schedule Gantt chart information, and provide immediate insight into data quality issues.

For more information contact DecisionEdge online at www.decisionedge.com, Encore Analytics at www.encore-analytics.com, or Pratt & Whitney at <https://prattwhitney.com>. ←

CABLING

Low-PIM coaxial cable assemblies for wireless, antennas, and test introduced by Pasternack



Pasternack, an Infinite Electronics brand in Irvine, Calif., is introducing low-PIM coaxial cable assemblies from Times Microwave for use in wireless infrastructure installations, distributed antenna systems, and other low-PIM applications. These low-PIM cables are for indoor wireless systems, wireless infrastructure, multi-carrier communications systems, WISP networks, small cell installations, and PIM testing applications. These cable assemblies offer more than 400 configurations with PIM levels of less than -160 dBc. Cable options include SPP plenum-rated, quarter-inch SuperFlex, SPF fire-rated, SPO outdoor-rated, and flexible TFT-402 and TFT-402-LF options. These are durable cable assemblies are constructed from a solid center conductor and are available in standard diameter options. The assemblies come with 2.2-5, 4.1/9.5, 4.3-10, 7/16 DIN, Type-N, NEX10 and SMA straight and right-angle connector options. These cables deliver low insertion loss and high voltage standing wave ratio (VSWR), are 100 percent RF and PIM tested and ship with the PIM test results marked on each cable. For more information contact Pasternack online at www.pasternack.com.

RF AND MICROWAVE

Voltage-controlled oscillator (VCO) for digital radio offered by Crystek



Crystek Corp. in Fort Myers, Fla., is introducing the CVC055CC-2950-2950 voltage-controlled oscillator for use in applications such as digital radio equipment, fixed wireless access, satellite communications (SATCOM), and base stations. The RF and microwave device operates at 2950 MHz with a control voltage range of 0.5 to 4.5 volts. This VCO features a typical phase noise of -115 dBc/Hz at 10 kHz offset and has excellent linearity. Output power is typically 7.0 dBm. The CVC055CC-2950-2950 voltage-controlled oscillator (VCO) is engineered and manufactured in the U.S., and is packaged in the industry-standard 0.5-by-0.5-inch SMD package. Input voltage is eight volts, with a current consumption of 30 milliamps typical. Pulling and Pushing are minimized to 3.0 MHz peak to peak and 0.1 MHz per volt respectively. Second harmonic suppression is -15 dBc typical. For more information contact Crystek Corp. online at www.crystek.com.

RF AND MICROWAVE

60 dB digital attenuator for the UHF band introduced by Comtech PST

Comtech PST Corp. in Melville, N.Y., is introducing the model LA01-001 digital attenuator for RF and microwave applications in the UHF band. The design operates over the 400



to 500 MHz frequency range for use in military or commercial applications. The attenuator provides 0 to 60 decibels of range. Switching speed is very fast when attenuation needs to be changed. Features of this RF and microwave device include TTL controlled attenuation level; 4 bit attenuation control; 60 dB attenuation range; amplitude/phase matched state to state; excellent attenuation accuracy; fast switching speed; +5 and -15 volts DC input. The digital attenuator has maximum input power of 20 dBm; voltage standing wave ratio (VSWR) of 1.4:1 max, any state; insertion loss of 1.4 dB max; attenuation range of 0 to 60 dB, 6 dB steps; attenuator accuracy (to 36 dB) of plus-or-minus 0.25 dB max; switching speed of 1 microsecond max; and impedance of 50 ohms. The device operates in temperatures of 0 to 50 degrees Celsius at the baseplate; in humidity of 0 to 95 percent non-condensing; operates in shock and vibration conditions per Mil-Std-810F; and operates in altitudes as high as 10,000 feet. The unit measures 5.9 by 2.5 by 1.35 inches and weighs 15 ounces. For more information contact Comtech PST online at <https://comtechpst.com>.

TEST AND MEASUREMENT

Test cable for high frequencies of 5G, automotive offered by Times Microwave

Times Microwave Systems Inc. in Wallingford, Conn., is introducing the Clarity 70 test cable to accommodate the high RF and microwave frequencies of automotive systems, 5G, and other advanced test and measurement applications.

new PRODUCTS



The Clarity 70 test cable is stable through 70 GHz with low attenuation, and offers steel torque, crush, and overbend protection with abrasion resistance -- all without compromising flexibility. The design includes an ergonomic stainless steel protective barrel strain relief and a hex coupling nut. Clarity 70 offers a phase stable cable assembly with a microporous PTFE dielectric, coupled with a helically wound metalized interlayer to maintain flex, phase, and amplitude stable test assembly for 5G applications. Additionally, 1.85-millimeter connectors come

standard with the Clarity 70, which are designed to handle frequencies to 70 GHz and the rigors of testing. There are three 1.85-millimeter connector types: male, female, and ruggedized female for use with vector network analyzers. For more information contact Times Microwave Systems online at www.timesmicrowave.com.

MOTORS AND MOTION CONTROL

Brushless linear motor for high-throughput manufacturing introduced by H2W Technologies

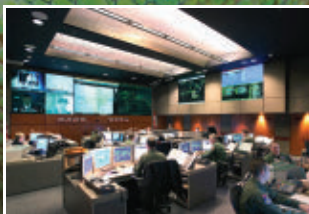
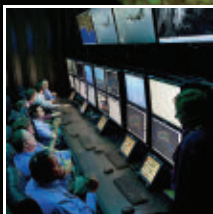
H2W Technologies Inc. in Santa Clarita, Calif., is introducing the Four-Axis Gantry (YY'ZZ') four-axis positioning stage for applications that require fast motion with a stroke over a couple of inches. The brushless linear motor stage will meet the needs of long travel and fast motion when coupled with a motion control system with servo amplifiers and a motion controller. Brushless linear motor stages can be coupled as a gantry for pick-and-place manufacturing or inspection equipment. The fast motion allows for high throughput when manufacturing or examining parts. The Four-Axis Gantry

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(YY'ZZ') consists of two SRS-007-03-006-01 brushless linear motor stages; each vertically mounted to two independently moving horizontal linear axis. It is for applications that require multiple independent motions on one travel plane. Each horizontal linear axis uses a BLDM-D04 H2W brushless linear motor to generate a continuous and peak force of 16.5 pounds [73.6 N]/49.0 pounds [220 N] with each moving table capable of a total stroke length of 47.1 inches. For more information contact H2W Technologies online at www.h2wtech.com.

DATA STORAGE

Data storage for military avionics and intelligence introduced by Mercury



Mercury Systems Inc. in Andover, Mass., is introducing a family of data recorder, data storage, and data-transfer systems to provide air and operations crews with high-speed secure and reliable data exchange. The ability to record, store, and transfer data to and from helicopters and fixed-wing aircraft can enable critical intelligence, surveillance, and reconnaissance (ISR) applications, Mercury officials say. The family of data recording, storage, and transfer avionics includes high-definition video recorders; data-transfer systems; and data-storage systems. The High Definition Video Recorder (HDVR) family consists of scalable convection-cooled

recorders for aircraft that need high-fidelity data capacity, video and audio compression, and fast read-and-write speeds. High-capacity removable memory enables large data loads and encryption options keep data secure. The Advanced Data Transfer Systems (ADTS) offer fast data transfer with 1000 megabyte-per-second data transfer speeds, 100-megabyte-per-second SATA read/write speeds, crash-survivable memory options, and encryption to speed information exchange and protect data. All systems are built with modular, open architectures. For more information contact Mercury Systems online at www.mrcy.com.

NAVIGATION AND GUIDANCE

Software-defined GNSS simulator offered by Orolia for scenario creation



Orolia USA in Rochester, N.Y., is introducing the BroadSim Solo global navigation satellite system (GNSS) simulator that supports advanced scenario creation and offers a software-defined architecture such as high-dynamics, 1000 Hz iteration update rate, and latency of 5 milliseconds. Nearly all civilian GNSS signals can be generated through its single RF output (one frequency band at a time), along with GPS AES M-Code, jamming, or spoofing signals. The BroadSim Solo GNSS simulator fits at a typical desk or workstation, and comes with the Skydel simulation engine that offers an intuitive user interface, software support for Python, C++, and C#, automation tools, and custom plug-ins to speed development cycles and increase performance. More information about the Orolia software-defined GNSS simulator is online at www.oroliads.com. ◀

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