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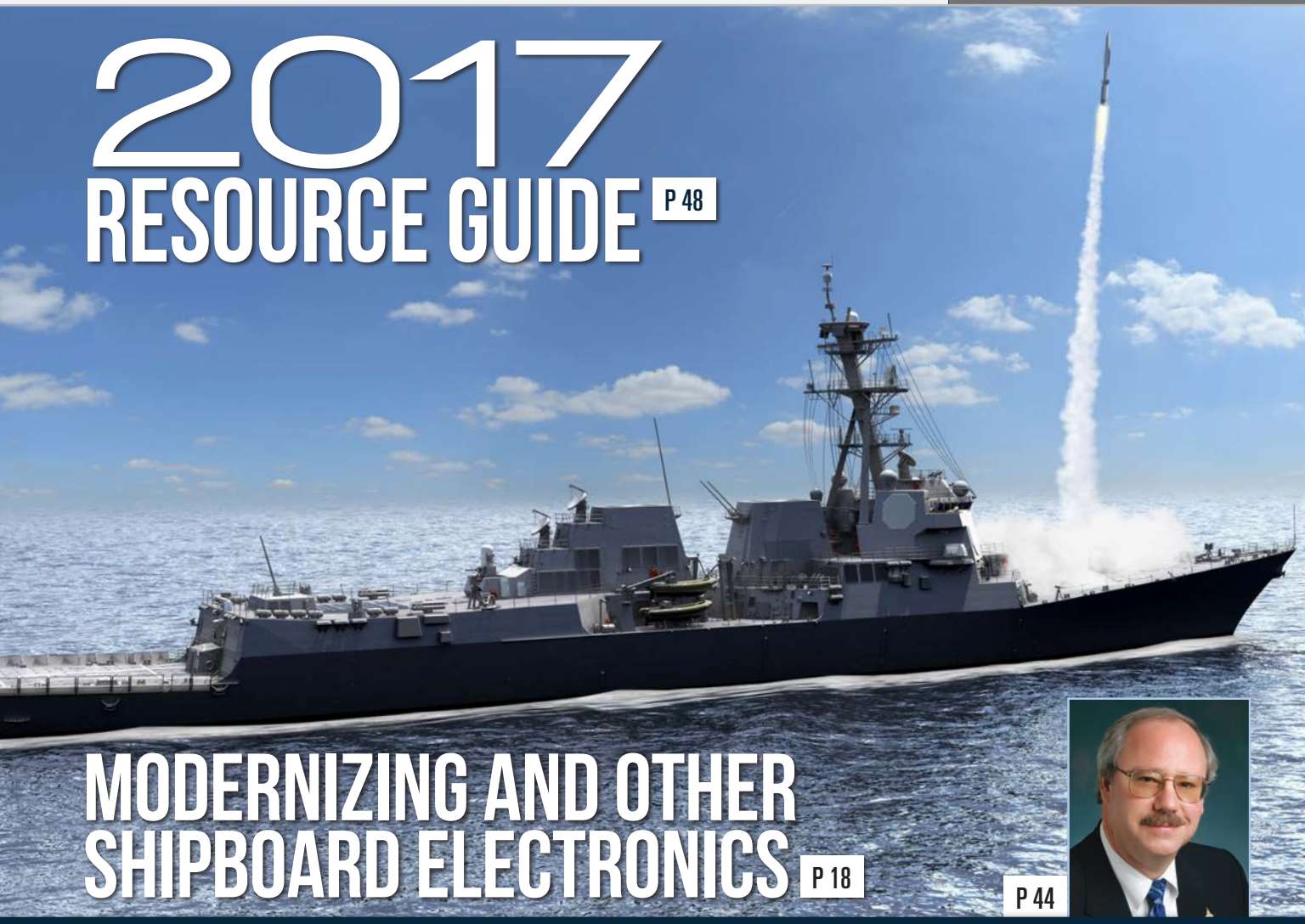

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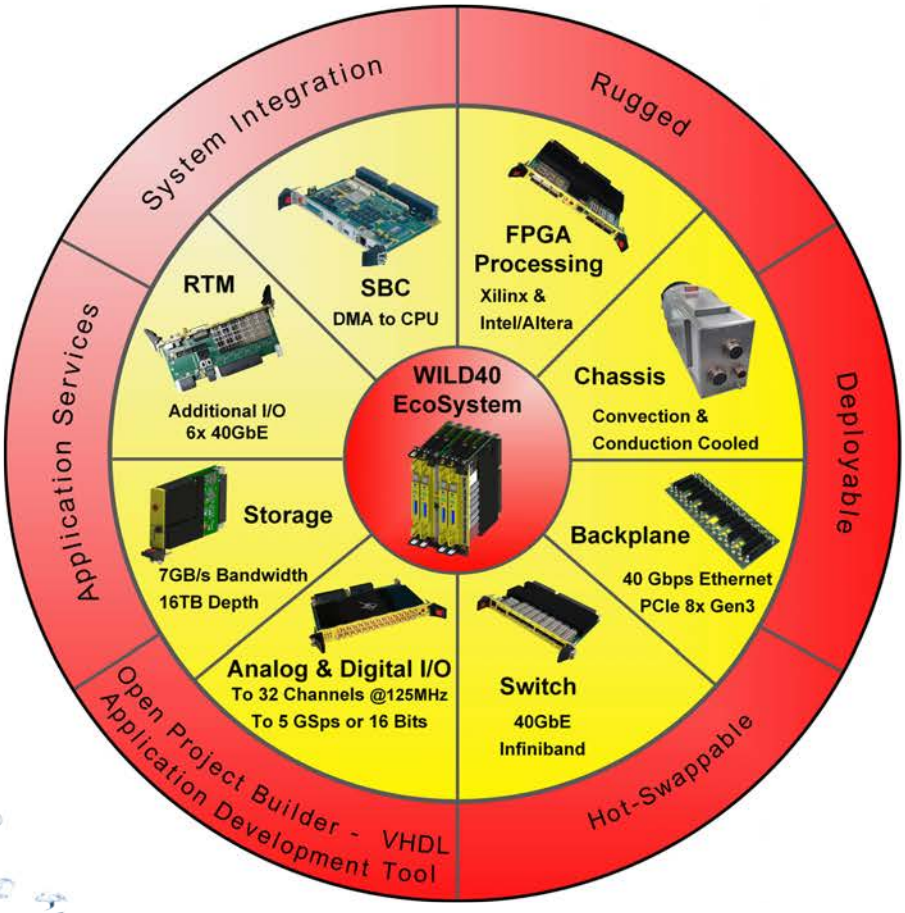

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ISSN: Print 1557-3222

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ON THE COVER:

Top image: The Flight III Arleigh Burke Destroyer will be equipped with the AN/SPY-6(V) Air and Missile Defense Radar (AMDR). Photo courtesy of Raytheon.

Bottom image: F-16 Fighting Falcons fly over the Emerald Coast [Gulf of Mexico] during a flight test. Photo courtesy of the U.S. Air Force.

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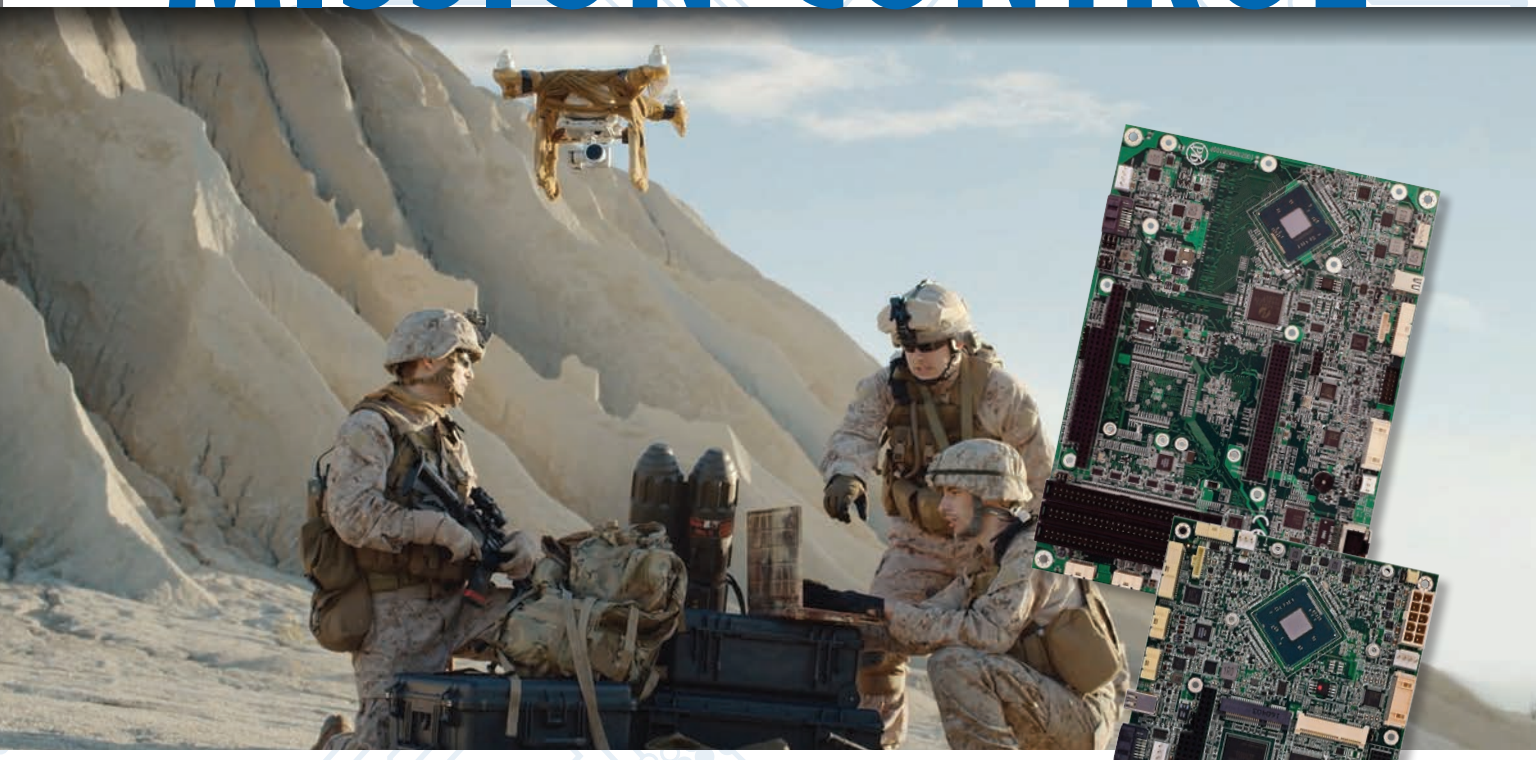

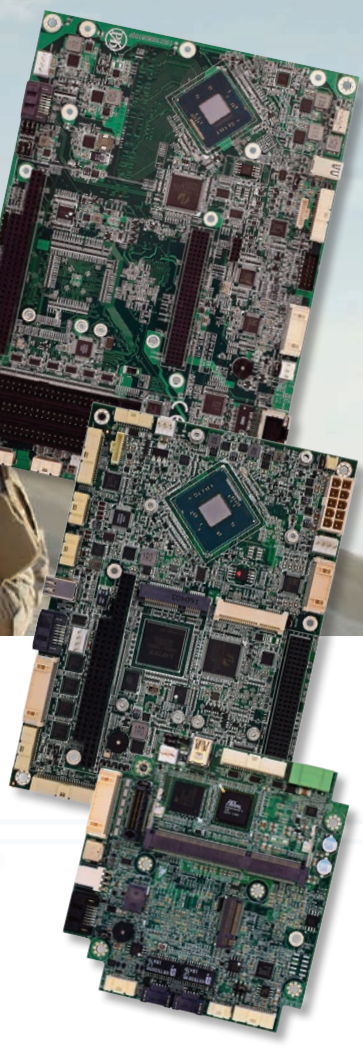

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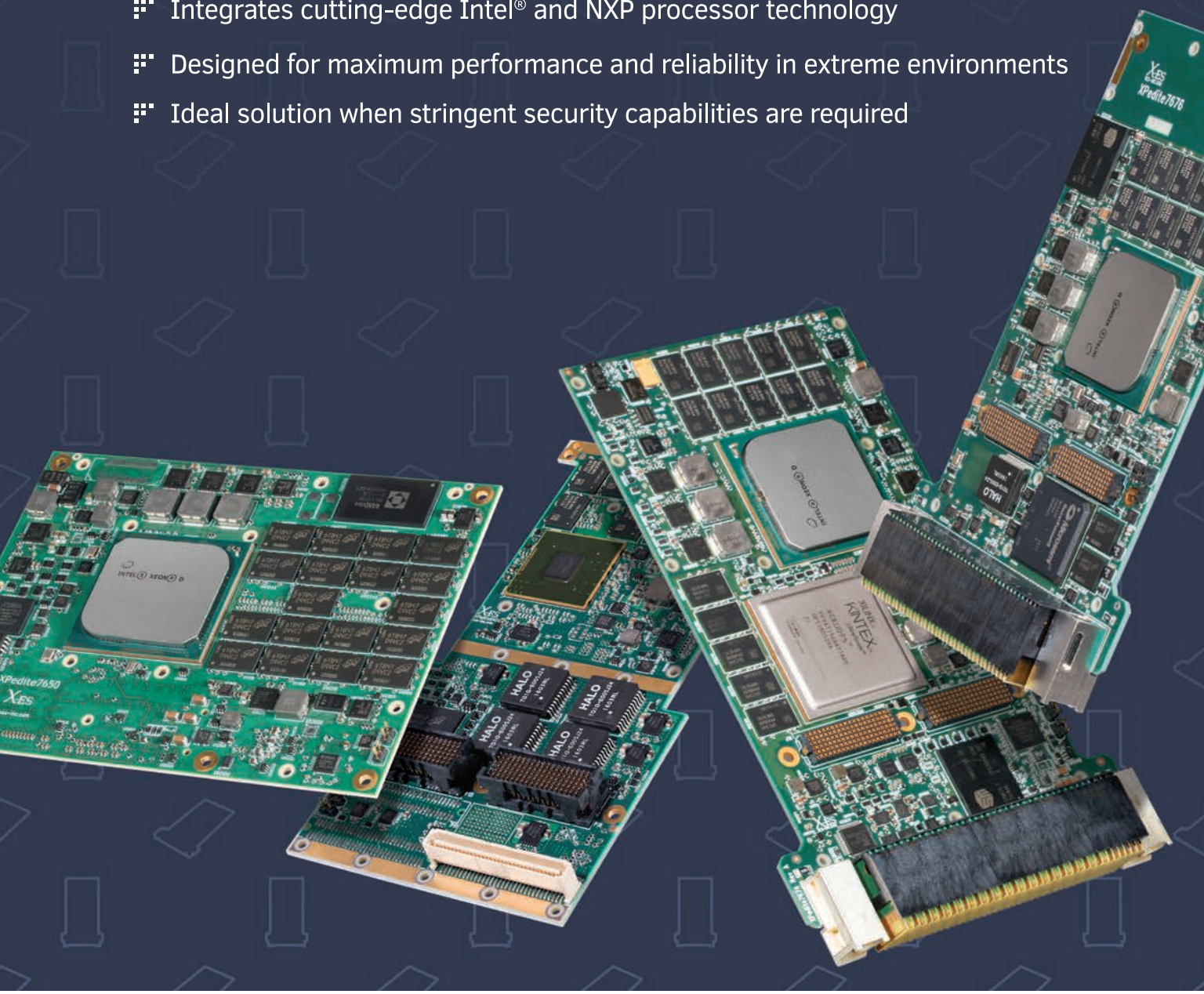

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Counter-UAV market heats up

By John McHale, Editorial Director

Unmanned aerial vehicles (UAVs), remotely piloted vehicles, drones, or whatever one chooses to call them are becoming more and more part of everyday life. While they provide unlimited potential in a variety of fields, they are also sparking new fears that they may be used for terrorism, drug trafficking, corporate espionage, etc. That fear in turn is firing up a new market for counter-UAV systems that will grow even faster in the commercial world.

Counter-UAV operations are now well beyond issuing drone-hunting licenses as a resident of Deer Trail, Colorado, pushed for in 2014 only to have his ordinance shot down by his fellow residents, according to stories in the Los Angeles Times. Solutions today cost a lot more than the $25 for that proposed license.

"There are two different markets for counter-UAV technology – commercial and defense with two different types of customers focused on two different goals," says Mike Blades, Senior Industry Analyst, Aerospace & Defense at Frost & Sullivan. "The defense focus requires systems that have multilayer detection – radar, RF [radio-frequency] scanner, electro-optical infrared for payload identification."

An example of a multi-layered system is the Anti-UAV Defense System (AUDS) from Blighter Surveillance Systems, Chess Dynamics, and Enterprise Control Systems that uses radar; electro-optics, cameras, target tracking software, and RF jamming technology.

While a solution from IXI Technology called Drone Killer (pictured) uses RF disruption technology in the form of a gun, enabling users to essentially shoot down a UAV by jamming its signals.

"The military market is currently valued at about $300 to $400 million and mostly driven by U.S research, development, test, and evaluation (RDT&E) and some procurement," Blades says. "The defense market started at about $75 million and will be right around a billion by next year, growing steadily after that. The market – including procurement and RDT&E should double by 2022."

Lasers are also being looked at to take down UAVs.

A future game changer for defense counter-UAV systems will be directed energy, Blades says. "I think counter-UAV operations will be an early adapter of laser weapons. They will be used early on at fixed sites as they are rather large and take a lot of power. However, they also are unlimited in how many shots they take, they don't run out of ammo, and they don't have to worry about collateral damage in general."

Commercial counter-UAS

"The commercial market started low," Blades says. "There's about 65 companies right now marketing solutions – about a quarter of them are pre-revenue. Last year the total market was about $30 million, as they just do not have a lot of contracts yet.

"The market will be closer to $100 million this year and spike six or seven times that and then drop off," he continues. "Right now there is a lot of fear out there driving it, irrational fear. Drones will likely not be as much of a threat as people are saying. There are many horror stories about ISIS using drones to drop bombs, etc. I don't see hundreds of drones flying around doing that in the U.S. so the commercial market may be subtly overhyped.

"The big thing with the commercial guys is having an open architecture so they can add on capability," Blades explains. "There will also be challenges with all the FCC rules against interrupting or jamming public sector frequencies. Many of the smart companies are also taking their business overseas as they will not have to deal with as many regulations about interfering with Wi-Fi systems when they fire their jamming weapons at drones."

The market size "has gone from ten companies to more than a 100 offering solutions," Blades says. "Gaining in popularity are handheld systems like Drone Defender and a slew of solutions aimed at catching drones in the airspace. There have also been efforts to integrate drones into counter-UAS systems by extending their detection capability.

The counter-UAV operations also have elements of strategy and tactics like other missions.

Users are starting to focus on "countering the counter," Blades says. "Prime contractors are looking at ways to make it more difficult to see a drone, designing anti-hackable GPS antennae, silent or low noise propellers, etc. Raytheon has developed something they call Electronic Armor to prevent drones from being hacked. It's becoming something of a cat and mouse game, with a lot of counters to counters to counters. It's turning into a little arms race."

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Image-processing programming: Hope for non-nerds?

By Charlotte Adams

An Abaco Systems perspective on embedded military electronics trends

Today's armored-vehicle and helicopter operators can detect, assess, and act upon threats with the aid of devices such as helmet-mounted displays and heads-up displays. Thanks to image processing, ground-attack vehicle commanders soon will be able to enjoy a 360-degree "window" on their environments, while pilots will obtain true spherical situational awareness around their airplanes.

Enhanced and augmented vision systems are becoming faster, smaller, and more capable, and the same is true for target-detection and tracking systems. Next in the pipeline will be automatic target recognition and artificial intelligence (AI)-assisted machine vision and robotics.

Where do we go from here?

Real-time computer vision algorithms are running faster on the latest generation of massively parallel embedded graphics processing units (GPUs), which enable the silicon to do more. Larger, more complex GPUs simultaneously run more math operations on larger volumes of sensor data, while traditional processors – making their own advances – weigh more outputs, apply more complex logic, and make more decisions. Future progress in the image-processing realm will also depend on new programming tools that will enable developers to write more complex and varied applications more efficiently.

Many operations are required to translate the inputs from complex, distinct, multispectral, and distorting sensors into displays that are intelligible to humans. Among these tasks are image stitching, rotation, and fusion. In traditional programming paradigms, however, each of these functions requires hundreds, maybe thousands, of lines of code to realize.

Image stitching, for example, is a technique that enables the creation of panoramic or spherical zones of situational awareness by weaving together the inputs from multiple sensors. Image fusion, a closely related processing function, can help operators when their vision is obscured by smoke or fog. An application that dynamically selects, combines, and displays the highest-resolution inputs from visual-spectrum and infrared cameras – along with lidar [light detection and ranging] devices, for example – can assure situational awareness in degraded environments. Just imagine how much code is typically involved to perform these tasks.

The rest of the story

The other half of the image-processing success story concerns the emergence of advanced software-development tools. These resources will make it easier for military users to develop more complex and various image-processing applications without large investments in graphics-programming expertise.

The key is middleware, which is the software that mediates between the operating system, the applications, and the hardware. Middleware often features libraries and tools that help application developers get the most from the underlying hardware. Moreover, middleware can also multiply the productivity of application developers by allowing them to generate complex, high-line-of-code functions – such as image fusion, stabilization, and distortion correction – more efficiently than was previously possible.

API libraries pay dividends

OpenGL is a language that is popular among groups, such as computer game developers, who use it for programming GPUs. Although the language was invented to simplify interactions with these chips, it can be difficult, cumbersome, and time-consuming for occasional users to learn. This complexity has led to the invention of lightweight abstraction layers sitting on top of prepackaged OpenGL routines. Using these, blocks of complex OpenGL code can be integrated into a program via simple application programming interface (API) calls, streamlining the task of developing image-processing, visualization, and graphics applications.

Figure 1 | ImageFlex provides rapid application development for Abaco's GVC1000 small-form-factor graphics and vision system.

These API libraries make programming chores easier and help programmers to be more efficient by enabling them to add functions to their applications with one or two as opposed to hundreds of lines of code, vastly reducing code-generation time and cost. In addition, the abstraction layers that are written in more accessible computer dialects such as C, can further simplify the programming task. (Figure 1.)

Easing the task of writing image-processing code means that capabilities can be created and deployed more rapidly and at a lower cost. Such tools also open the door to the development of next-generation applications such as self-driving vehicles.

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The advantages of netbooting for embedded systems

By Paul Davis

An industry perspective from Curtiss-Wright Defense Solutions

As a greater number of intelligent systems are deployed on platforms such as ground vehicles, aircraft, unmanned aerial vehicles (UAVs), and unmanned undersea vehicles (UUVs), it becomes increasingly challenging to ensure that each of the platform's multiple embedded computers has been updated with the latest and correct version of runtime and/or mission software. Unfortunately, the process of installing the required software onto an embedded module or intelligent system can be labor- and cost-intensive.

There are two basic options for booting an embedded system: either boot from a dedicated hard drive or remotely across Ethernet, via a netboot protocol. When booting is conducted via a dedicated hard drive (typically residing on the module itself), updating software requires that the subsystem chassis be removed from the platform. Next, the box needs to be opened to remove the module, which is then placed into another system, such as a test jig, whereupon the new software is installed. Many embedded modules write-protect onboard nonvolatile memory through use of a backplane pin that prevents writing any new data to the on-card drive. While write-protection ensures that the embedded software can't be inadvertently modified while installed, it also makes the chore of updating software more difficult. The process also increases the risk to critical hardware that results every time a module is removed and handled by a technician.

"... netbooting can also greatly enhance the security of data at rest if the platform is lost and captured by an adversary."

Netbooting provides a superior alternative solution for installing and updating software that delivers huge labor savings. In addition, netbooting can also greatly enhance the security of data at rest if the platform is lost and captured by an adversary.

As the number of platforms involved in a mission increases, such as a swarm of UAVs or UUVs, the benefits of netbooting – including time, labor, and cost – become even more significant. Netbooting eliminates the need to individually install the software on each and every embedded computer on a platform, whether it's a module or a standalone box. Instead, all of the relevant software, from the runtime software to the mission maps – as well as any other software needed for a specific mission – can simply be consolidated in storage on a server that functions as a network file system (NFS).

Figure 1 | The DTS1 Data Recorder subsystem from Curtiss-Wright – which supports Intel's PXE Boot netbooting protocol – can function as a networked server that hosts and protects all of the software for a platform's embedded computers.

When any of a platform's embedded systems start up, rather than using its own internal software, booting occurs over the network. Instead of loading software to each individual computer, the system developer or field technician simply uploads the software to a single file server, and as each machine on the network "wakes up" it obtains its software from that server. Consolidating the boot software (along with however many copies of software are needed for the platform's other embedded systems) onto a single server reduces labor during both deployment and maintenance.

Even better, if the server used for netbooting also provides encryption for data at rest, the runtime software used to boot all of the platform's embedded computers will be secured from prying eyes. Without encryption, if a vehicle outfitted with multiple embedded computers gets captured, the deployed software on each module or system is susceptible to intrusion, potentially enabling it to be reverse-engineered. In contrast, if the software resides on a single server that encrypts all of its data, the likelihood of malicious access is eliminated or greatly reduced. Using netbooting can limit the potential points of intrusion to just a single point – an encrypted server protected with higher levels of security.

Using a netbooting protocol – such as Intel's PXE Boot protocol – enables system designers to build a fortress around their platform's network server to ensure that critical data is secured if the platform is lost. (Figure 1.) As the number of deployed intelligent systems continues to proliferate, netbooting can greatly reduce the time, cost, and labor of loading software during development and updating software after the platform is fielded.

Paul Davis *is Director of Product Management, Data Solutions, for Curtiss-Wright Defense Solutions.*

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By Mariana Iriarte, Associate Editor

NEWS

Air Force tests Minuteman III missile with launch from Vandenburg AFB

A team of Air Force Global Strike Command personnel from the 90th Missile Wing (headquartered at F.E. Warren Air Force Base, Wyoming) launched an unarmed Minuteman III intercontinental ballistic missile (ICBM) equipped with a single test reentry vehicle from Vandenberg Air Force Base in California on August 2.

The ICBM's reentry vehicle, which contained a telemetry package used for operational testing, traveled approximately 4,200 miles to a target area at the Kwajalein Atoll in the Marshall Islands. This and similar test launches provide data to verify the accuracy and reliability of the ICBM weapon system.

F.E. Warren Air Force Base is one of three U.S. missile bases with crew members on alert 24 hours a day throughout the year, overseeing the nation's ICBM alert forces.

Figure 1 | An unarmed Minuteman III intercontinental ballistic missile launches during an operational test. U.S. Air Force photo by Senior Airman Ian Dudley/Released.

Gentex wins $13 million contract to deliver Apache aviator integrated helmets

Personal-protection/situational-awareness gear maker Gentex Corp. won a $13 million firm-fixed-price contract from the U.S. Army for the delivery of Apache Aviator Integrated Helmets (AAIH).

The AAIH – worn by crews on the Apache helicopter – is an integrated helmet, display, and sight system that provides situational awareness and targeting information to the wearer. The integrated helmet is a key component of the next-generation Apache helicopter, the AH-64E, which will be flown by more than 15 countries.

Work on the AAIH contract will be conducted at Gentex's manufacturing facility in Simpson, Pennsylvania. It is expected to be complete by June 2022.

U.S. Army Research Lab grants ICF $93 million to handle defensive cybersecurity operations

Data-management consultant ICF won a contract valued at as much as $93 million from the U.S. Army Research Laboratory (ARL) to support ARL's Defensive Cyber Operations (DCO) and ongoing defensive cybersecurity research. The contract terms include both base and option periods.

Under contract, ICF will support ARL's Cybersecurity Service Provider (CSSP) program and both basic and applied research, working to develop cyber tools and techniques and advance up-to-the-minute computer network defense.

ICF is tasked with supporting all cyber operations for ARL and its subscribers through on-site and remote reviews of network security and ensure alignment between policy, compliance, and assessment functions; the company will also support the information assurance management office, which sets policy for ARL.

Oshkosh Defense receives $195 million Joint Light Tactical Vehicle order

U.S. Army officials ordered additional Joint Light Tactical Vehicles (JLTV) from Oshkosh Defense. The order includes 748 vehicles and 2,359 installed and packaged kits for the program. It is valued at more than $195 million.

The JLTV program is currently in Low Rate Initial Production (LRIP) and remains on schedule and on budget, Army officials say. It is completing reliability and performance test activities as well as logistics supportability evaluations around the country.

The program anticipates a full rate production decision on the JLTV in fiscal year (FY) 2019, with the first Army unit equipped by mid-FY 2019 and both Army and Marine Corps Initial Operating Capability (IOC) in early FY 2020.

Figure 2 | Pictured is the family of Joint Tactical Vehicles. Photo courtesy of Oshkosh Defense.

NASA miniaturizing century-old component for use on CubeSats

A team of NASA scientists and engineers from the Goddard Space Flight Center is working on a project to upgrade and miniaturize the electronics on a prototype instrument, called the Concentration vs. Height for an Orbiting Electromagnetic Sounder – dubbed ECHOES – that would be used to "sound" or measure the ionosphere from either a ground-based observatory or, ultimately, from a constellation of CubeSats. ECHOES, according to NASA, is basically a radio receiver updated with modern signal processing.

To determine the electron density vertically in the ionosphere, scientists have long used radio sounders that operate by directing a range of different radio frequencies to the ionosphere and using a receiver to collect and measure the values of the returning signals or echoes.

NASA plans to initially use ECHOES on the ground; further out, NASA may be able to use ECHOES in a constellation of CubeSats that would make simultaneous, multipoint soundings of the topside of Earth's enveloping ionosphere.

Figure 3 | ECHOES, says NASA, is basically an old-fashioned radio receiver fitted with modern signal processing. Photo courtesy NASA.

LGS Innovations wins $7.5 million DARPA dispersed computing contract

LGS Innovations won a four-year, $7.5 million cost-plus-fixed-fee contract from the Defense Advanced Research Projects Agency (DARPA) under the Dispersed Computing (DCOMP) program. Under the terms for the first phase of the program, LGS will develop algorithms and protocols for identifying, connecting, and tasking dispersed computing assets for simultaneous users with competing demands at different priority levels in a dynamic network environment.

Innovations in these areas will be used to improve network performance during defense-related missions. DARPA's DCOMP program also seeks reinvention of and innovation in the network protocols that have traditionally guided Internet architecture.

Goals for the first phase of the LGS-DARPA contract, according to the company, include a significant reduction in latency and bandwidth consumption and significant, measurable gains in application performance utility.

Navy, Oak Ridge unveil first 3-D-printed submarine hull

The U.S. Navy recently unveiled the military's first 3-D-printed submarine hull, a joint project between the Oak Ridge National Laboratory (ORNL) Manufacturing Demonstration Facility (MDF), the U.S. Department of Energy (DoE), and the U.S. Navy's Disruptive Technology Lab. The submarine, called the Optionally Manned Technology Demonstrator, was printed on the Big Area Additive Manufacturing (BAAM) machine at ORNL's MDF.

The 30-foot-long proof-of-concept submersible hull is made of six carbon-fiber-composite sections. According to the DoE, a traditional SEAL Delivery Vehicle costs between $600,000 and $800,000 and takes between three and five months to manufacture. In contrast, this sub was fabricated for as little as $60,000 and shortened the actual production time to just several days.

The DoE reports that it is working on the next phase of the project: creating a second, watertight version of the hull that will be tested in the wave pool at NSWC Carderock. Fleet-capable prototypes could be introduced as early as 2019.

Air Force taps Northrop Grumman to upgrade radio terminals in E-8C Joint STARS fleet

U.S. Air Force officials selected Northrop Grumman to upgrade existing radio terminals aboard the E-8C Joint Surveillance Target Attack Radar System (Joint STARS) fleet and replace them with Air Force Tactical Receive System-Ruggedized (AFTRS-R) terminals.

AFTRS-R provides data feeds from airborne and overhead electronics intelligence collectors and allows Joint STARS to detect and track a host of mobile threats, including enemy air defense and theater ballistic-missile assets.

The AFTRS-R capability will modernize the Integrated Broadcast Service by replacing the current Commander's Tactical Terminal/Hybrid-Receive Only (CTT/H-R) radio. The modification also addresses cryptographic modernization and diminishing manufacturing source (DMS) issues with the CTT/H-R radio.

Figure 4 | Joint STARS offers battlefield commanders real-time situational information, while transmitting target locations to aircraft and ground-strike forces. Photo courtesy of Northrop Grumman.

C4ISR, radar, electronic warfare, unmanned markets continue growth

By John McHale, Editorial Director

As threats evolve globally the demand and investment continues to grow in military application areas such as electronic warfare (EW), radar, unmanned systems, and communications, computers, intelligence, surveillance and reconnaissance (C4ISR).

A U.S. Air Force F-15 Eagle aircraft (right) breaks away from an F-22 Raptor aircraft (left) as the two aircraft line up for landing. F-15s are getting funded for radar upgrades under a large contract led by Boeing. Photo courtesy of the Department of Defense by Tech. Sgt. Jason Robertson, U.S. Air Force.

The U.S. military market is trending upward in terms of investment under the new Trump Administration as evidenced by the increase in the Department of Defense FY 2018 budget request. Modernization of current radar, EW, ground, and sea platforms continues as well as investment in research, development, test, and evaluation (RDT&E) in new systems such as unmanned undersea vehicles. According to market analysts these application areas are not flat and are projected to grow over the next five years.

Overall C4ISR market

"The key for C4ISR at the strategic level will be missile defense and at the tactical level it will be sea and land platforms and electronic warfare," says Brad Curran, industry analyst at Frost & Sullivan. "Globally the emphasis is on making sure U.S. allies, NATO countries, Japan, Australia, have the technological capability to talk with us and share data and targeting. Foreign Military Sales (FMS) are going well financially and politically.

Frost and Sullivan's forecast numbers reflect that positive growth. "For 2017 there has been about $42 billion spent on C4ISR technology with a growth rate of 3 percent through 2022. For 2017 programs of record, the services each got about $11 billion in program spending a piece. Within the DoD budget request there was about 920 C4ISR program line items. The biggest area was surveillance and reconnaissance with almost $48 billion funded at 6 percent CAGR for a total of 920 programs total; [This is an increase of about] $3.0 billion over the prior year. The fastest growing C4ISR application area is electronic warfare, up 22 percent from last year's budget.

Among the leading prime contractors there are no surprises. "The biggest C4ISR company is Lockheed Martin with $5.4 billion in contract funding and with about 11 percent market share," Curran says. "Next up is Northrop Grumman at $5.26 billion or 10 percent market share."

The top ten primes received 47 percent of the money, he notes. "They are from the top: Lockheed Martin, Northrop Grumman, Raytheon, Boeing, General Atomics, BAE Systems, Booze Allen Hamilton, Microsoft, Leonardo, and Harris. At the end of 2016, there were 515 total prime contractors, There were also many little ones, but our numbers show a total of 1,274 major contacts totaling $51 billion."

Radar

Year after year the military radar market continues to show strong growth and investment and this year is no different. "The military radar market is still looking good with new missile defense requirements driving it via programs such as the Army's Integrated Air Defense System, Patriot radar upgrades, the Navy's AMDR, and counter-UAS (unmanned aerial system) solutions," Curran says. "When you look at

FMS for radar systems, there is also growth. Companies such as Raytheon and Lockheed Martin are supplying technology from Israel to Australia for everything from new systems to lifetime support contracts.

"A total of 49 U.S. military radar contracts were awarded in 2016 and were valued at $2.56 billion," Curran notes. "Boeing was on top with their win on the F-15 APG 16 Version 3 radar improvement program valued at $558.4 million. They are taking the fleet of F-15s and giving them much improved eyesight.

Other large programs include the Marine Corps Ground/Air Task Oriented Radar (G/ATOR) program led by Northrop Grumman, he continues. This is in procurement and low rate initial production (LRIP) and valued at $375 million.

"Something I believe to be important even though it does not cost the Army much money is CRAM," he says. "Operationally it's going to be huge because it can function as an early warning system for incoming missiles and also can provide counter-battery fire. The CRAM can track where incoming fire originates, triangulating the situation while warning troops of the threat. It will also be a future foundation for using kinetic or laser weapons to shoot down incoming artillery mortar shells and anti-tank shells. Lockheed Martin's T-53 falls into this category and is slated for another $16.5 billion."

Raytheon's biggest contract in 2016 was a $110 million LRIP for the AMDR S-band, Curran adds. "The company also received funding to Patriot configuration 3+ radar upgrade for the Army. Harris was also a player in 2016 with an IDIQ contract for 42 COTS precision approach radar 21 systems for the Navy, Army, and Air Force.

Electronic Warfare

"EW funding also continues to increase," Curran says. "Contracts awarded in 2016 totaled about $4.6 billion. Program funding increased $860 million for 2018. 2016 contracts increased $2.5 billion over 2015. The biggest one at $79 million went to Booze Allen Hamilton to run the Joint Improvised Threat Defeat Agency. This is an administration contract.

"For EW gear the largest contract went to Boeing, which received $308 million for the Next Generation Jammer for F-18 Growler," Curran continues. "Raytheon won $253 million for Next Generation Jammer development model pods. For engineering and manufacturing Boeing has the airplane while Raytheon has the actual jammer pod.

Meanwhile "BAE Systems is still the clear leader when it comes fuzz busters, also known as radar warning systems," he notes. "A new company named Zel Technologies also received $165 million to help develop counter-threat technologies and urgent mission solutions. A very large program – the Surface Electronic Warfare Program (SEWIP), led by Lockheed Martin – is also still strong.

"Lastly, the Navy recently awarded a $180 million contract called Combat Environment Instrumentation Systems (CEIS) to 12 companies to study and

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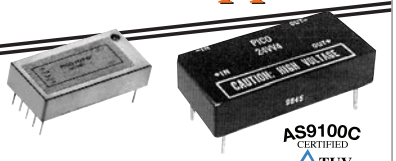

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develop a prototype system that integrates/fuses EW, radar, communications, and information operations into multifunction aperture to jam adversary computers and electronics," Curran says. "In other words using radar to essentially jam computer networks, other radars, etc."

Unmanned aircraft

The unmanned aerial systems (UAS) market continues to grow worldwide. "The unmanned aerial vehicle market is increasing at 7 percent from 2015 through 2021 with market value eventually reaching a little over $6 billion in 2021 with a CAGR of 6.9 percent," says Mike Blades, Senior Industry Analyst, Aerospace & Defense at Frost & Sullivan.

"When it comes to programs of record the Global Hawk is getting a good deal of funding from the Air Force for capability investment and payload sensors," Blades says. "Northrop Grumman is upgrading the sensors to bring U2 capability to the platform. They are spending $300 to $400 hundred million every year just for Global Hawk. "Actually, less than half of this is for procuring upgrades. A considerable amount is still for capabilities enhancements through RDT&E."

"The MQ-9 Reaper has obviously taken the place of the MQ-1 Predator in terms of procurement through 2021 with funding slowly decreasing over that period," he continues. "This funding peaks in 2019 then starts to decrease as the platform is built out.

"For other major programs it depends on when people are making a forecast especially with the Long Range Strike Bomber (LRSB), which depending on when and who you ask will or will not have an unmanned portion," Blades says. "I believe it will be optionally manned and have some portion unmanned. This program ramps up to $3 billion in funding in 2021 according the President's FY 2018 budget request. The unmanned portion will possibly be loyal wingmen and may or may not be part of the LRSB procurement."

Small UAS programs such as the RQ-11 Raven are slated to get about $300 to $600 million in funding through 2021, he continues. "Within the FY 2018 budget request Special Operations has a line item under unmanned and this is likely for a small UAS platforms with funding for $20 to $30 million a year."

Figure 1 | The Knifefish unmanned undersea vehicle (UUV) from General Dynamics Mission Systems continues to get funding for mine countermeasure applications. Photo courtesy of General Dynamics.

Other applications getting attention and funding include UAS as munitions and tethered UAS for persistent surveillance missions.

"Unmanned aircraft that function as loitering munitions are also having success such as the Switchblade, the L-3 Cutlass, and the Israelis have small loitering munitions of several different sizes," Blades says. "These systems are only going to become more prevalent. They also have the potential to be launched from other unmanned aircraft.

"Tethered UAS only account for 2 percent of budget, but these drones are getting steady use," he adds. "They provide a way around civil aviation regulations as they are not flying through the airspace, so fire departments and the like make use of them. The tethered platforms also function as test beds for testing sensors over long time periods."

Unmanned undersea vehicles

The unmanned undersea vehicle (UUV) market "has been one of the few I've seen where military technology was not driving innovation," Blades says. "Oil and gas companies were the ones funding development of these platforms. When the oil process market hit a downturn innovation started again from the military side.

"A lot of money was spent on extra large displacement UUVs, more of a submarine replacement. There was also a concentration of small UUVs that could form a swarm and do different things simultaneously. A lot of money is still being spent on LDUUV [large displacement UUV] and XLUUV [extra large UUV] as they are the largest contributors to UUV RDT&E funding.

Today "the primary mission of these platforms is mine countermeasures, which is the biggest segment and sees the most funding," Blades continues. "These platforms are still mostly in R&D phases as they take a long time for test and evaluation. In the 2017, DoD officials spent $338 million out of the budget in RDT&E – most of it DARPA funding – while total procurement was only about $65 million. The U.S. is still highly in RDT&E phase and the rest of world is the same way.

"Regarding programs, $28 million has been scheduled for an unmanned maritime system called Sea Mob," Blades says. "Other programs receiving funding include the General Dynamics KnifeFish, Swordfish, and Kingfish. Most of these are centered around mine countermeasures. Procurement for Swordfish and KingFish is around $3 to $6 million. That is not a lot funding and it mostly targets maintenance." (See Figure 1). **MES**

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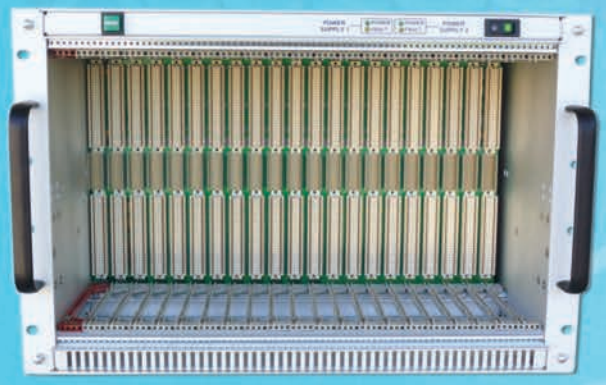

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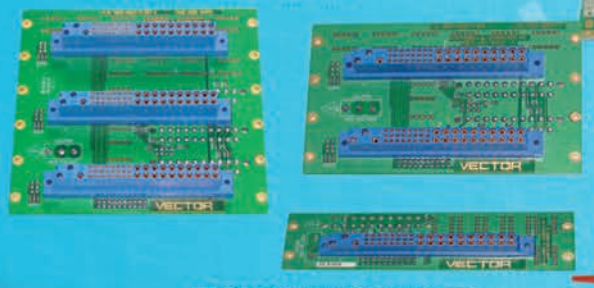

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Shipboard electronics trend both sophisticated and "retro"

By Sally Cole, Senior Editor

The Flight III Arleigh Burke Destroyer will be equipped with the AN/SPY-6(V) Air and Missile Defense Radar (AMDR). Photo courtesy of Raytheon.

As one of the world's most sophisticated scalable radar systems is poised to make its debut aboard U.S. Navy vessels, so is a "retro" version of an old approach to ship-to-ship communication. This old-style method enables sailors to use their vessels' signal lamps to text-message each other on handheld devices without knowing Morse code during communication-denied scenarios while at sea.

On the sophisticated end of advances in shipboard electronics, Raytheon's AN/SPY-6(V) Air and Missile Defense Radar (AMDR) is a next-gen integrated air and ballistic missile defense radar designed to fill a critical capability gap for the U.S. Navy's surface fleet.

Earlier this year, SPY-6(V) proved that it could search for, acquire, and track a ballistic missile test target during its first dedicated Ballistic Missile Defense exercise at the U.S. Navy's Pacific Missile Range Facility in Kauai, Hawaii.

Its second test involved a more complex, threat-representative ballistic missile target than the earlier tests, in order to challenge both the detection and tracking capabilities of the new radar. SPY-6 acquired and maintained the long-range missile target track from launch through flight.

What exactly differentiates SPY-6(V) from most radar systems for military ships? "SPY-6(V) provides greater detection ranges, increased discrimination accuracy, higher reliability and sustainability, and lower total ownership cost, as well as a host of other advantages when compared to the current AN/SPY-1D(V) radar onboard today's destroyers," says Scott Spence, director of Naval Radar Systems for Raytheon.

It also happens to be an active electronically scanned array (AESA) S-band radar, which "provides more sensitivity and resources to cover more missions and more targets," he adds.

Specifically designed for scalability, reliability, and ease of production, the SPY-6(V) relies on both innovative and proven technologies, including radar modular assemblies (RMAs), digital beamforming, and gallium nitride (GaN).

This is the first scalable radar built with RMAs, which are radar building blocks. "Each RMS is roughly 2 feet by 2 feet by 2 feet in size, and is a standalone radar that can be grouped to build any size radar aperture – from a single RMA to configurations larger than currently fielded radars," Spence says.

The array size, or the number of RMAs needed, can be customized to the mission needs of a ship to provide it with the capability "to spot and defeat potential threats such as ballistic missiles, cruise missiles, airborne adversaries, surface threats, electronic threats, or any combination of them," Spence notes. "Its cooling, power, command logic, and software are all scalable, which allows for new instantiations without significant radar development costs."

Using a wideband digital beamforming radar "supports better target detection and discrimination," he says. "Adaptive, wideband digital beamforming and radar signal/data processing functionality provides exceptional capability in adverse conditions, such as high clutter and jamming environments. It's also reprogrammable to adapt to new missions or emerging threats."

Commercial off-the-shelf (COTS) components and open architectures play an important role. The SPY-6(V) features a fully programmable, back-end radar controller unit built out of COTS x86 processors. "This programmability allows the system to adapt to emerging threats," Spence says. "And the commercial nature of the x86 processors simplifies obsolescence replacement – as opposed to costly technical refreshes/upgrades and associated downtime – which are savings that lower radar sustainment costs during each ship's service life. The radar's open architecture also facilitates integration with existing and future combat-management systems."

In terms of ballistic missile defense, the SPY-6(V) Air and Missile Defense Radar currently being developed for the U.S. Navy's DDG 51 Flight III destroyer stacks 37 RMAs together to form a 14-foot-diameter octagonal array.

"The system consists of four of these arrays that will be installed in the ship's deckhouse to provide 360-degree coverage for threat detection and response," Spence says. "This configuration enhances the Navy's ability to simultaneously detect, identify, and track any air, surface, and ballistic missile threats, delivering more than 30 times the sensitivity of the currently deployed SPY-1D radar. In other words: SPY-6 can simultaneously detect and track multiple targets of half the size at twice the distance of the radar it replaces."

SPY-6(V) use

By providing greater capability – range, sensitivity, and discrimination accuracy – SPY-6(V) "increases battlespace situational awareness and reaction time to effectively counter current and future threats," according to Spence. The radar enhances the ships' ability to detect air and surface targets, as well as ever-proliferating ballistic missile threats.

Another key consideration, since ships are at sea for extended periods of time, is that reliability and maintainability are critical. "In most cases, maintenance and repair is planned to be done during port visits, but in the event the radar needs repair while still at sea almost 95 percent of the array's maintenance comes down to just a few unique parts," Spence explains.

Technicians can switch them out within six minutes using only two tools. Simplicity, reliability, and design for manufacturing and assembly were top of mind for AMDR's engineers. The radar requires 70 percent fewer unique parts (line-replaceable units or LRUs) than the existing system on today's DDG 51 ship. Because of this, the time and effort needed to make repairs are minimalized," Spence notes.

At this stage, the SPY-6(V) continues its testing and will be stressed by "increasing the range and complexity of targets, and demonstrating the radar is meeting its performance," says Navy Captain Seiko Okano, major program manager for Above Water Sensors, Program Executive Office Integrated Warfare Systems. "AN/SPY-6 is the nation's most advanced radar and will be the cornerstone of the U.S. Navy's surface combatants for many decades."

Requirements and COTS procurement trends in Navy applications

By John McHale, Editorial Director

The Navy differs from the other services not only in its mission, but also in its requirements and how it leverages commercial-off-the-shelf (COTS) technology to meet modernization requirements.

"The Navy is different because a ship is a very different kind of platform than say a vehicle or aircraft in terms of area and power requirements," says Jason Wade, President, ZMicro. "A ship is kind of its own portable city as it's going around, so it's able to set up and handle the infrastructure differently than other branches of the military because it has that the ability to create a kind of centralized IT. That's not how other branches do it on airborne or ground-based operations because they can't. Instead, they do a distributed network."

The Navy also differs on its approach to modernization.

"The big difference between the Army and Navy is that the Army is renewing everything, not just modernizing," says Ben Sharfi, CEO of General Micro Systems. "Modernizing is retaining the basic chassis and basic equipment infrastructure architecture, while upgrading the processor. These are incremental upgrades and the Navy does a lot of them. For example, the chassis for the Navy Q-70 program, deployed 18, 19 years ago is still deployed, but the Navy has basically removed the old tech out of it, such as displays, storage, etc. and replaced it with modernized solutions.

"While the Army is more into renewal, renewing taking out the old chassis/box and bringing in an entire new one – with new processor, new cabling, new everything," Sharfi continues. "Due to budget constraints that have been well publicized recently, the Navy can't afford to do that for most applications."

Modernization also entails battling obsolescence while making use of the latest COTS processors, computers, software, etc. Here the Navy differs from its brethren in the Army and Air Force as well.

"Within the Navy it is application driven," says Mike McCormack, President of Chassis Plans. "Some with extreme requirements might not use COTS, but for the most part when it comes to Navy rugged computing they leverage modified COTS, for example taking a company's standard COTS product and tweaking it for a specific mission or program.

COTS is also key to the Navy's procurement strategy. "The Navy attempts to procure common parts at the highest LRU (line replaceable unit) available," says Robert Haag, Vice President of Sales and Marketing at Crystal Group. The expected result is to reduce the number of different LRUs in the supply chain. COTS items could be a whole system while other COTS items are components in a system. Unique requirements for shipboard operations do require developmental engineering to house COTS assemblies." (see Figure 1).

"One way the Navy is different is that it's a much larger purchase," Wade notes. "Consider the CANES [Consolidated Afloat Networks and Enterprise Services] program, the Navy's next generation tactical afloat network. They're committing to large-scale purchases so that they can achieve lots of commonality

Figure 1 | Sailor standing watch on the USS Kidd (DDG-100). U.S. Navy photo by Mass Communication Specialist 2nd Class Jacob Milham.

across their ships. So, the purchases are significantly larger. Typically, the Navy wants to have common architectures as much as possible throughout programs. Whereas other branches of the military are more program-centric, i.e. one program will use one set of equipment while another program will use a different set of equipment. In contrast, the Navy may want everyone to use certain computers, so to establish a common platform they will have a program like CANES that purchases computers that will get deployed across all Navy programs. They had another program, CEDS (common enterprise display), where they selected the display and that went across the programs.

While the Navy leverages COTS, it's not necessarily COTS in its purest form.

"It's more about custom-off-the-shelf these days rather than commercial-off-the-shelf as customers rarely buy a product for defense applications without modifying it slightly for their particular mission or program," Sharfi says. "Some new programs, however, are getting away from slightly modified COTS as they go to a quarter or half ATR box, where nothing is a slightly modified standard. Instead, the small-form-factor (SFF) boxes we see getting deployed meet the program's requirements for SWaP-C but are still considered by the DoD's definition as 'COTS,' because they are being developed on the supplier's nickel, not the government's.

"Often to fulfill COTS procurement requirements, primes will set up requirements for a particular application then go to a COTS supplier with their specs to build a product custom from the ground up," he continues. "The supplier will then build it with their own money, and then offer it as a standard COTS product. Now, once that prime gets its contract, it has an open bid for the COTS solution. In this scenario, the vendor that developed the product using their own IRAD [internal research and development dollars] in hopes of winning the contract probably has a better chance of securing the contract. If they win the award, then the prime and the government have possibly "funded" COTS technology procurement. However, let's be clear, the COTS vendor invested significant money up-front with no guarantee of success. Whether that is ok or not, I will leave up to the reader."

This discussion was part of a roundtable in the February 2017 McHale Report newsletter, which can be viewed here: http://promos.opensystemsmedia.com/?mchale=february-2017.

Old ship-to-ship communications approach gets a "retro"-style update

A new ship-to-ship communication system called "Flashing light to text converter" (FLTC), which is sponsored by the U.S. Office of Naval Research's TechSolutions program, features a camera that can be mounted atop a signal lamp to hone in on Morse code bursts from another ship's lamp within view. Handheld devices or laptop computers connected to the camera display text messages sent and received.

The process for sending messages using signal lamps hasn't really changed much since World War II, so this new system marks a significant improvement because sailors no longer need to know Morse code to send or receive messages.

Previously, someone trained in Morse code needed to operate the lamp's shutter by hand, which involves receiving, decoding, and replying to messages. Now, sailors can use FLTC to respond quickly and easily with fewer mistakes, according to the Office of Naval Research.

When the system was recently put to the test aboard the guided-missile destroyer USS Stout, the signal lamp flashed fast light bursts to the guided-missile cruiser USS Monterey, which was located 250 feet away. Aboard the USS Monterey, its signal lamp used a GoPro camera to receive the incoming Morse code and then converted it into text on a handheld device. The first message sent was "random." Scott Lowery, an engineer at the Naval Surface Warfare Center in Panama City, Florida, had asked the USS Stout to send a random message and was amused when they complied more literally than he expected. "Simple, but it shows the system is working," he says.

How exactly does the system work? By linking a commercially available camera and device with a proprietary converter that uses software algorithms to process the incoming light flashes into high-frequency signals, it converts those signals into text messages. To reply to a text, sailors can use the device to simply type a response that gets sent back in Morse code, thanks to specially powered LED lights that flash automatically.

What do sailors think of using the FLTC system? The best part of the converter, according to Lowery, is its ease of use. "It's very intuitive because it mirrors the messaging systems used on iPhones," he says. "You just type your message and send it with the push of a button."

During certain communication-denied scenarios at sea when satellite communications is either risky or unavailable, ONR Command Master Chief Matt Matteson notes that FLTC would be useful. It could be "extremely valuable if a ship's main communications go down or if it needs to maintain a low electronic signature to avoid detection by an adversary," he adds.

In the near future, standard retrofit kits might be placed on all existing signal lamps. Lowery and his team hope to see the system issued throughout the fleet as early as next year. **MES**

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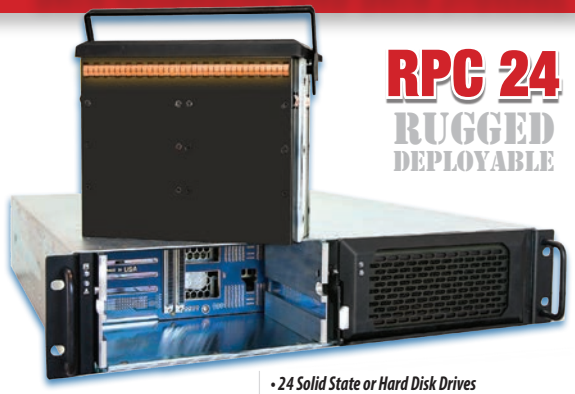

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New technology insertion driving legacy military and aerospace test and measurement market

By Mariana Iriarte, Associate Editor

F-16 Fighting Falcons fly over the Emerald Coast [Gulf of Mexico] during a flight test. Photo courtesy of the U.S. Air Force.

Officials at the Department of Defense (DoD) continue to push the useful lifetime of military and aerospace systems. For instance, the Air Force Times recently reported that the Air Force extended the life expectancy of the F-16 aircraft from 8,000 flight hours to 12,000 hours. Situations like this one are forcing test and measurement companies to contend with new technology insertion in legacy systems; the corollary to this: designers and manufacturers must also take a closer look at the acquisition process in order to stay ahead of the game.

Much like in other military electronics applications, designers test and measurement systems face ongoing obsolescence and technology insertion challenges as the users of their equipment continue to demand the latest in commercial technology and that it be compatible with technology that is sometimes more than a decade old – providing the challenge for the test engineer.

The reality is that "support of legacy test systems is always a concern," says Darren McCarthy, A&D [aerospace & defense] technical marketing manager at Rohde & Schwarz USA in Beaverton, Oregon. "Especially so when you are dealing with new technology insertion and customers want to leverage commercial technology as much as possible, whether it is IoT, 4G/LTE, or 5G for radio communications, or even just a new wideband waveform."

McCarthy points to an example, noting that "Customers are always looking for how they can add this new technology while still supporting the existing radios that they have. This might be an add-on or a new waveform added to a software-defined radio (SDR) that is currently supported."

One major aspect of extending the useful life of such systems is ensuring that the military user finds the right vendor as they "are always looking for vendors to provide extended life COTS [commercial off-the-shelf] instrumentation," says Adam Foster, principal marketing manager at National Instruments (NI) in Austin, Texas. "They've obviously been big adopters of COTS; the longer that they can hold onto legacy parts or legacy systems, they tend to be the ones who will call us up and talk to their account managers and ask life cycle management questions."

Common questions, Foster says, include "How long is this product going to be around?" and "Is there any way that I can do a lifetime buy of it for certain things?"

The "life cycle of these test systems are 15, 20, 30 years. They're looking to salvage form, fit, and function of the instrumentation. Anything they can do to mitigate or reduce the cost of revalidating a test system is an important one," Foster adds.

Even with this reality, users are expecting the latest, greatest technology to be inserted into their aging systems. That expectation includes an "interest in reducing rack space," McCarthy says. "The R&S FPS is a two-rack unit high, high-performance spectrum analyzer that has the entire legacy support as well as modern functionality."

Figure 1 | Rohde & Schwarz's SGS and SGU series products. Photo courtesy of Rohde & Schwarz.

"The R&S SGS/SGU and R&S SGT series signal generator products are one rack unit; half-width products that can cover up to 40 gigahertz CW and vector signal generation capability, respectively," McCarthy adds (see Figure 1). "These enable the flexibility of reducing rack space as well as having this legacy support for new technology insertion."

A closer look at DoD acquisitions: a smart move

Legacy military and aerospace systems compel companies to take a closer look at the acquisition process; thorough knowledge of acquisitions will give them a deeper understanding of where the market is heading. Ultimately the market is difficult to predict, as some segments have seen a flat market over the past few years, while other companies have enjoyed a bit of an upturn.

Instrument security in the test and measurement market

New technology insertion and software management lead to security concerns, and the best time to deal with this issue is during the testing phase.

As Darren McCarthy, A&D [aerospace & defense] technical marketing manager at Rohde & Schwarz USA in Beaverton, Oregon, explains, "Test equipment will typically utilize an embedded operating system; these embedded controllers can run on different versions of Windows or even Linux systems."

This setup leads to a few concerns, with one of them being that "users must make sure that there is no way that a virus or malware can get into the test gear and thus affect anything in their manufacturing line or secure R&D lab. This includes trying to do something like doing a screenshot or doing some type of measurement, data collection, or instrument control. They need instrument security in all aspects of command, control, and data collection. Most modern products today work with embedded controllers with the operating system as a Linux version, or it would be some version of Windows; this includes modular instruments."

Because of scenarios like these, security is crucial. "It's obviously a bigger deal for certain industries," Adam Foster, principal marketing manager at National Instruments (NI) in Austin, Texas. "For government and defense and aerospace, it's a big thing, and we work very closely with different agencies in the government to make that we're doing everything that we can, and that we're sharing best practices, things that we learned to help them secure their test systems."

"Whether one is using a modular system controller or standalone instrument such as a spectrum analyzer with an embedded Windows operating system," McCarthy says, "the fact that the device may be connected to the Ethernet means that it has the same susceptibility as any computer with regard to infection by malware. So people are very sensitive about what they connect to the networks. The instrument procedure to help customers must be approved by the security office in accordance with accepted practice and continued vigilance."

Overall, "the U.S. A&D business, in general, has been at about a two or three percent growth rate," McCarthy states. "But if you look at things like the breakout that A&D spend, the RTD&E, which is the test and evaluation part of the A&D spend, that's up nearly 16 percent. This bodes well for companies positioned to help with technology insertion."

Other driving factors in this area, McCarthy says, include "spectrum auctions, which are moving into the spectrum of installed radio and radar systems. This is causing reassessment and even redesign of systems to new frequencies. There are also new technology insertions, specifically in commercial satellite. The NewSpace technologies and the next-gen satellites tend to use a lot of the aerospace and defense infrastructure, launch vehicles, and monitoring stations.

"These are indirectly driving some aerospace and defense investments including the use of better component technologies like GaN [gallium nitride], low-phase noise systems design, and faster test processes to handle the volume of test," he adds.

In addition to that, "We also see moving away from older technologies like parallel digital lines to high-speed serial lines," Foster says. There is a definite shift of "some investments in that sense over to higher performance and cutting-edge RF [radio frequency], and SDRs, and then high-speed serial digital protocols."

A closer look at the acquisition process will help companies to move in a certain direction that actually allows them to position themselves with the right product line. According to McCarthy, "If you look at the budget for operations and maintenance (O&M) those two, year over year, have been up substantially, about six and 22 percent, respectively."

Cost is the driving factor to any decision made when it comes to managing the lifecycle of military and aerospace systems. "On the software side, these customers really appreciate

anything that vendors can do to make sure that the software doesn't have to be re-validated," Foster says. "I think it's upwards of $200,000 just for them to open up a test program set, change one value, then close that test program set back down, and ship it back out to their test system. It's super-expensive for them to do that, and that's one of the things that we take really seriously when it comes to our software."

PXI standard

Along with lower costs, users of test equipment also want more modularity, a desire that is moving them toward the PXI standard and away from VXI.

"We are seeing the trend for the legacy system shifting from VXI to the PXI standard," points out Mike Tseng, senior program manager at Adlink Technology in San Jose, California. In fact, he says, "the military and aerospace customers are looking for way to adapt into more modular concepts."

PXI has "been around for 20 years now," Foster adds. "The aerospace and defense and government agencies have definitely always been keen on using modular instrumentation."

The idea is to stay "modular, with multi-slot chassis and high computing controller technology with the CompactPCI form factor for ruggedness and with integrated timing and synchronization capabilities," Tseng says. "PXIe is a COTS product that can be configured to any modern computer and has rich software support."

The standard speaks for itself as it already has "over 60 active members with over 1500-plus PXI/PXIe modules, many of them designed specifically for ATE [automatic test equipment] aaplications," Tseng adds. "The PXIe standard also coupled with higher throughput bandwidth as its backplane leveraged the PCIe design and current in the transition to GEN 3 with up to 24 GB throughput; the GEN 4 spec has just been defined."

To a certain extent, VXI is becoming less and less common: "There are a few programs that still use it, just because of where they are and that's the best thing for them, but for the most part, everybody's switched over to PXI," Foster asserts.

"VXI and PXI/PXIe are directly competing standards," Tseng points out. "We are seeing much stronger growth in PXI over the years and other test standards like PXIe and AXIe (up to 100G bandwidth support) being used as multiple platforms for some ATE applications."

The pros of using PXI instruments range widely: "The power consumption of PXI is a lot lower compared with older technologies," Foster says. "Then, you continue

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to reap the benefits of higher performance processing, and latest and greatest FPGAs [field-programmable gate arrays] for things like synthetic instrumentation. You can actually use an FPGA to emulate the behavior of a legacy instrument. You can come over to PXI, and you can actually use a PXI instrument that has an FPGA on it. You can write custom algorithms to actually emulate the behavior of that old instrument."

Using tools to extend the life cycle of a system is the end goal here. With FGPAs, "We use FPGA programming to put some – I would consider them to be old-school – legacy trigger types where you used to trigger off of some kind of riding edge or falling edge or some certain pattern that you were looking for in the signal," Foster adds. "That's considered 'legacy,' so if you go and try to buy an oscilloscope these days, that type of trigger's not going to be available off the shelf. With the power of an FPGA you can actually write a program to build that trigger yourself. That extends the life cycle and gives these program managers additional time for the test system to be around, and you get that same function out of it, which is a big benefit for them."

PXI becomes the go-to standard because "There's no longer innovation in VXI. If you've got a test system that's built off of that, you know, it's only a matter of time before you will not be able to find the majority of that instrumentation anymore."

For the new challenges that arise in the RF world, NI's engineers developed the PXIe-5840 module that includes a 6.5 GHz RF vector signal generator into a two-slot PXI Express module. (See Figure 2)

Figure 2 | NI's PXIe-5840 also includes 6.5 GHz vector signal analyzer, FPGA, and high-speed serial and parallel digital interfaces. Photo courtesy of National Instruments.

"The main point I'm getting at there is that software really is a key element in a PXI system," Foster says. "The system is built around the software, so to speak, when it comes to PXI. What that gives you is flexibility to change the functionality. As you need to insert technology, software's going be one of the biggest ways you overcome those challenges." **MES**

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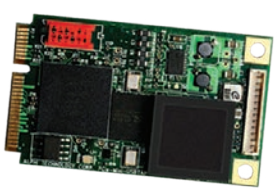

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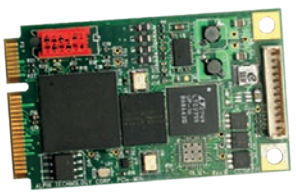

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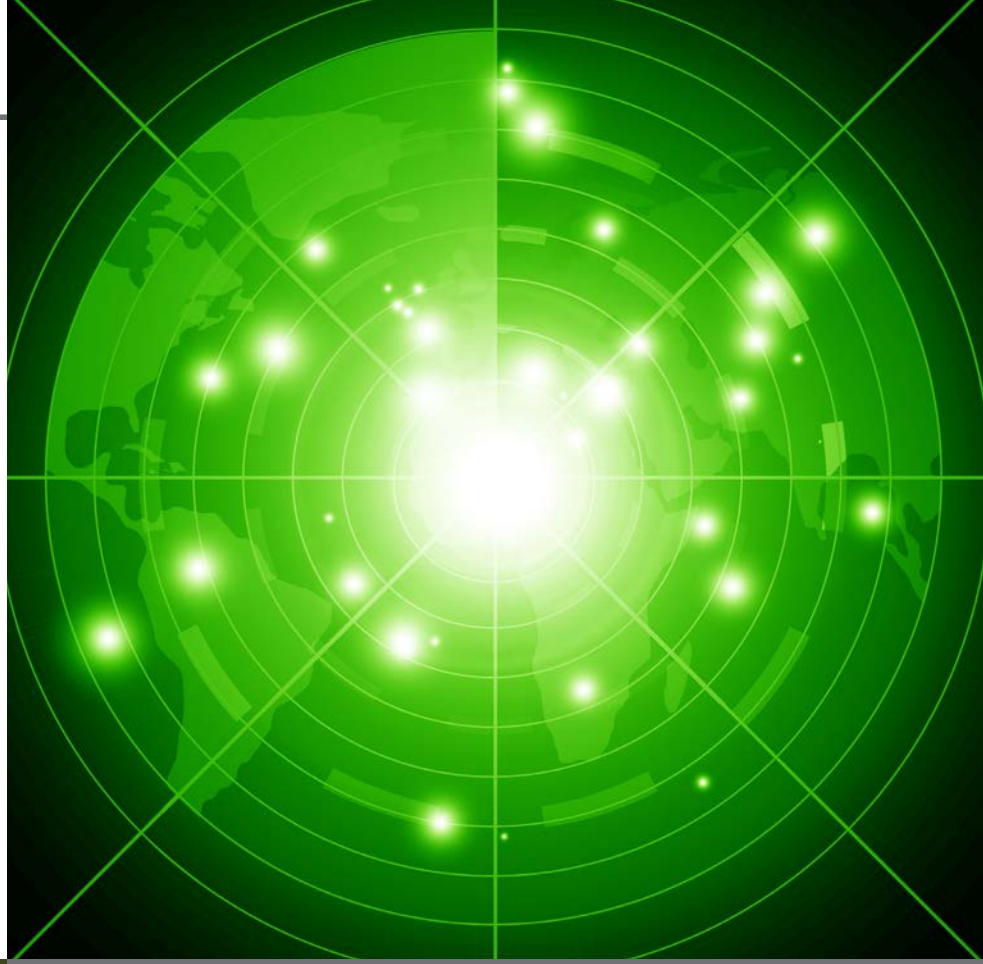

Analysis of modern radar and electronic warfare signals using advanced RF measurement techniques

By Philip Gresock

Modern radar and electronic warfare (EW) systems rely on sophisticated signal processing and complex radio-frequency (RF) modulation on pulse. Without proper signal design verification, these techniques may not be effective during critical engagements, which could be catastrophic for the operator. Determining the radar's ability to successfully detect and track targets or an EW system's ability to identify threats and avoid detection or tracking can be challenging. Advanced RF signal analysis and RF pulsed signal capture techniques (variable segment length, de-interleaving, duplex IF real-time analysis) that enable designers to measure signal parameters and confirm the proper operation of their radar or EW systems.

Modern radar and EW signals are dynamic and therefore pose a significant challenge for measurement platforms: To capture enough pulses to properly identify modes of operations/scenarios with respect to changing pulse width and pulse repetition interval patterns. Without proper capture of these dynamic scenarios, the modern-day warfighter may be vulnerable during critical engagements. Missing pulses generated by radars or EW systems may lead to inaccurate threat location and tracking or – even worse – a failed jamming attempt on a threat system such as a surface-to-air missile.

While a variety of methods exist to capture signals of interest, pulsed radar and electronic attack systems operate with high pulse densities over seconds of time per engagement. Traditional measurement techniques tend to have inefficient capture memory. Although tools like segmented capture tend to mitigate this memory issue, systems with new radar and EW signal profiles (e.g., staggered pulse widths, PRI [pulse repetition interval], etc.), need to use a more adaptive capture method to capture the complex scenario of interest. Considering a staggered pulse width and PRI scenario (see Figure 1), it is shown that a normal acquisition does capture some of the intended pulses. However, this technique lacks the memory depth to acquire the entire signal of interest, which occurs over a minute instead of in mere seconds. Segmented capture, although it alleviates some of these issues, does tend to waste precious capture memory for pulses that are smaller than the user-defined segment capture length; it can also miss pulses that occur before the fixed segment length is ready to rearm.

To solve the missed-pulse challenge, a variable-length gated acquisition is a better approach to using the efficiency of segmented capture that adds the flexibility to adapt to changing pulse parameters. Not only is the potential for missed pulses remediated, users are also able to increase the overall number of pulses captured.

Let us reconsider the case above:

- Capture memory depth = 500 MSa
- Capture sample rate = 100 MHz

The normal acquisition uses 100 samples per 1 us of capture; the example has a pulse density of 3 pulses in 15 us, which takes up 1,500 samples. Filling up the 500 MSa buffer with this pattern yields 99,999 pulses, or five seconds of capture time.

Let us now apply the variable gated acquisition method:

- Capture memory depth = 500 MSa
- Capture sample rate = 100 MHz

The variable gated method is still using 100 samples per 1 us of capture based on the sample rate; however, it is only capturing the "on" time of the pulses and ignoring the "off" time, regardless of the PRI changing. To capture the first three pulses (1 us + 2 us + 3 us), the example uses 600 samples. Filling up the entire 500 MSa buffer with this pattern yields 2,500,000 pulses, or effectively up to 125 seconds of pulses, which is a 25-time increase in memory utilization for this scenario.

Visualizing scenarios with statistical plots and emitter filtering

Now that the memory utilization problem is solved, with the capture of millions of pulses, there needs to be a better and more efficient method to gain meaningful insights into the radar's mode of operation or an EW technique. Designers must confirm proper frequency, pulse width, PRI, and other trends over time to ensure performance. More importantly, ensuring the proper modulation on pulse (MOP) over time is critical, given that complex modulations (e.g., polyphase codes, Frank code, etc.) are used to enhance a radar's Low Probability of Intercept (LPI) characteristics to ensure that antijamming measures remain operational.

Tools like scatter plots – statistical graphs with the flexibility to plot any two values on an X and Y axis – allow engineers to visualize massive amounts of data easily. The ability to see a few thousand pulses (see Figure 2a) shows captured radar information is trending over time with a linear pulse width ramp and two separate PRI modes. However, such a limited capture does not provide the complete picture in terms of its operational pattern.

By visualizing more than 100,000 pulses, it is clear that the radar repeats its pulse width pattern. However, it changes its PRI four times before repeating. With such a deep capture, now visible is another signal, with a short pulse width pattern and a declining PRI, that could be interfering with the original signal of interest.

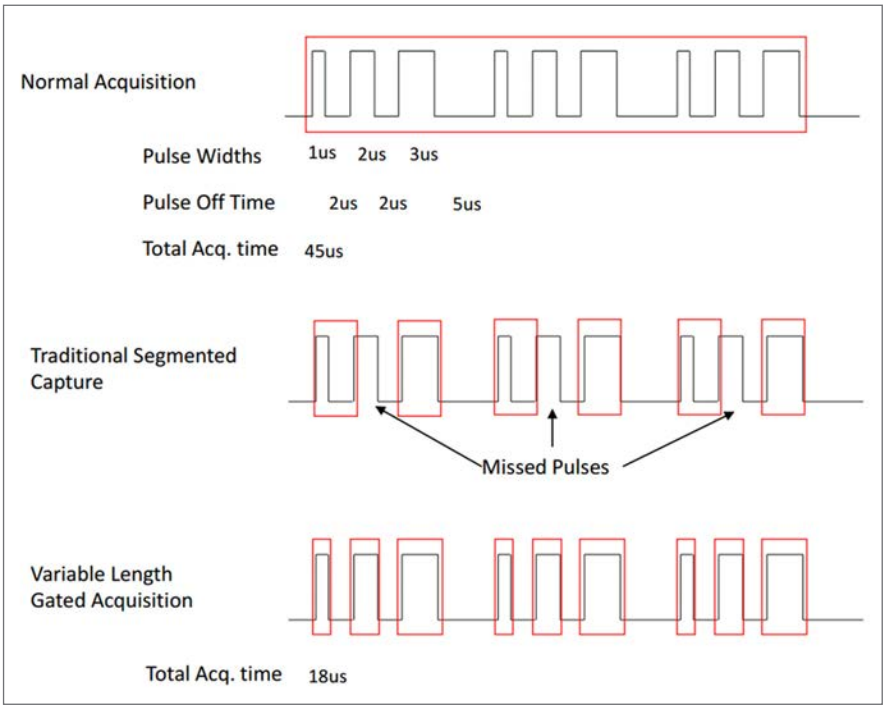

Figure 1 | Segmented memory

For situations with multiple emitters (e.g., radar and jammer), the process of filtering out the intended signal from unintended interference or intentional jammers is important to correctly identify and confirm proper operation. Figure 3 shows the same signal as presented in Figure 2b, with the difference that this signal has filtered (that is, deinterleaved) only the pulses of interest based on the acquired pulse parameters (e.g., amplitude, frequency, modulation on pulse, etc.).

As seen in Figure 3, choosing to filter the repeating radar signal of interest highlights the intentional signal of interest and aids in the identification and detection of an unintentional signal.

Analyzing electronic attack techniques over time to determine effectiveness

Aside from parametric pulse analysis of radars and EW systems, there are times viewing both frequency and time domain characteristics is important to visualize technique operation. Tools like real-time spectrum analysis (RTSA) can aid with this challenge; however, there is a fundamental tradeoff between frequency resolution, acquisition time, and probability of intercept. This is an issue when attempting to simultaneously optimize both frequency and time domain analysis to validate rage and velocity effects for EW techniques such as coordinated range gate pull off (RGPO) and velocity gate pull off (VGPO).

Use a coordinated RGPO/VGPO technique as an example to better understand the methods to measure both range and velocity simultaneously: Typical RTSA platforms rely on overlapped fast Fourier transforms (FFTs) and fast processing engines to acquire time domain samples without gaps. This acquisition is only optimized for a single view. However, with multiple acquisition boards being fed from the same analog-to-digital converter, decimation can be performed on the same samples, allowing for each acquisition board to be tuned to a different span. This flexibility is imperative since to measure Doppler shifts effectively in the frequency domain, as seen in Figure 4, a Doppler velocity pull of 5.934 kHz over 10 seconds. Conversely, wider bandwidths are needed for accurate rise/fall time resolution in the

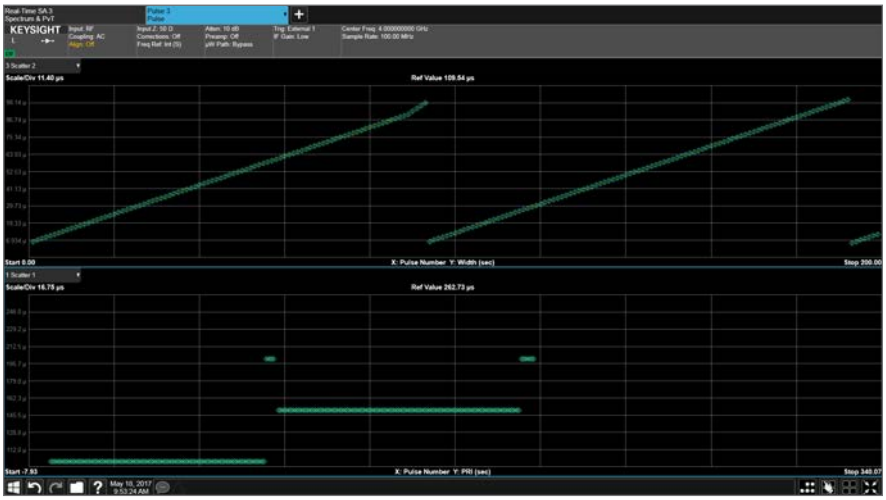

Figure 2a | Long gated acquisition pulse capture.

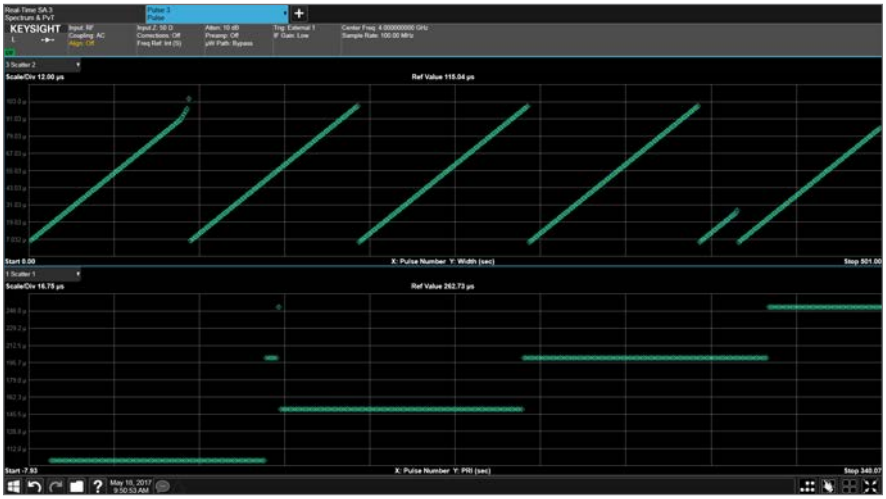

Figure 2b | Verocel's VeroTrace database can be exported to a DVD-ROM that allows hyperlinked browsing of all data and documents. Courtesy of Verocel.

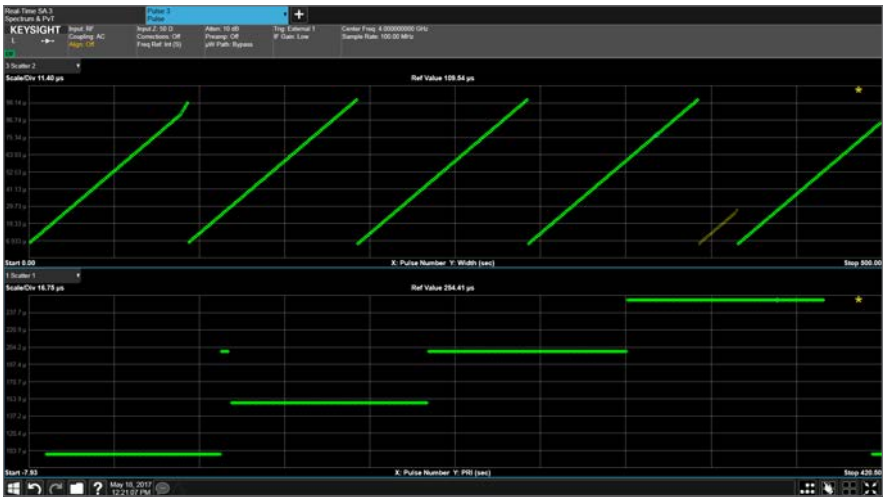

Figure 3 | Long gated acquisition pulse capture with emitter filtering.

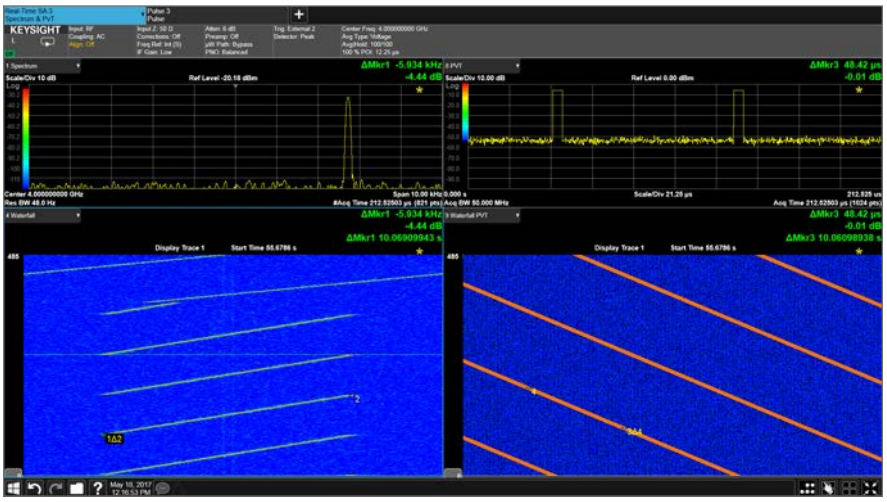

Figure 4 | Duplex IF analysis.

time domain, to see the pulses of interest changing 48.42 us over 10 seconds for the RGPO technique.

This duplex IF technique clearly shows the RGPO technique over time as shown in time domain as well as velocity effects in the frequency domain. It also enables the user to quantitatively understand if the desired jamming effect is correct based on technique rate and physics. This measurement technique presents a powerful method to visually confirm coordinated R/VGPO techniques.

Advanced measurement techniques, variable-length gated acquisition, and duplex IF RTSA greatly benefit the engineers designing and validating modern radar and EW systems being developed today as well as those who maintain legacy platforms that are still in service. **MES**

Philip Gresock *is an application engineer for the Aerospace and Defense group of Keysight Technologies, focusing on high performance radar and EW signal-analysis platforms and measurement techniques. He has been with Agilent/Keysight for eight years in application engineering and marketing. He received his BSEE from Michigan State University in 2007 and his MSEE from Lawrence Technological University in 2009.*

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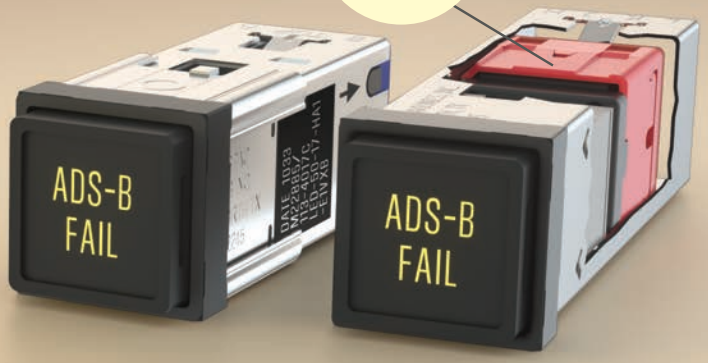

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Radiation testing of CMOS devices required for space use

By Ross Bannatyne

Radiation testing of semiconductors is time-consuming and expensive. There are limited test facilities available and often a long waiting list to get "beam time." It is, however, an important part of product testing that is required for devices that will be used in high-radiation environments, such as space.

Rad-hard microcontrollers are processed using a hardening technique that immunizes the device from latch-up and enables full operation of the device while a total ionizing dose is accumulated up to 300 krad (Si). Rad-hard devices also should include an error detection and correction (EDAC) subsystem and scrub engine to address single-event upsets (SEUs) in memory. Dual-interlocked cell (DICE) latches are also implemented to prevent SEUs in logic.

Total ionizing dose (TID) testing

When a CMOS device is present in a radiation environment, it may be subjected to a continual dose of particle radiation that causes degradation of performance, increase in leakage current, and ultimately failure of the device. Particle strikes cause electron-hole pairs to be produced in the silicon. Holes get trapped in oxide regions and as they accumulate over time, their presence creates leakage paths that result in increased current consumption and a shift in transistor Vt (threshold voltage) that causes device failure. The onset of the effects of TID can be observed through an increase of device current consumption.

TID testing on several rad-hard devices was performed at a facility at University of Massachusetts at Lowell. The high-dose rate gamma cave is an irradiation room having an equidimensional volume of 512 cubic feet. Several small ports penetrate one shielding wall to provide access for instrumentation cables. (Figure 1.) Irradiation and testing was performed in accordance with MIL-STD-883H Method 1019.8 Condition A.

Behind the metal plate shown in Figure 1, there is a Cobalt-60 source (immersed in water) that emits radiation to the devices under test (DUT).

Four devices were mounted to a bias board so as to be exposed to radiation. All irradiations and tests were performed on the devices in static bias conditions with checkerboard pattern loaded in memory and nominal VDD. Prior to the TID test, all DUTs were tested using the production ATE test program and log files were generated

Radiation condition	Specification	Units of measurement
Total Ionizing Dose (TID) tolerance	300	Krad (Si)
Soft Error Rate (SER) with EDAC and scrub engine disabled*	1e-7	Errors/bit/day
Soft Error Rate (SER) with EDAC and scrub engine enabled*	1e-15	Errors/bit/day
Latch-up immunity	110	MeV-cm^2/mg

* At geosynchronous global min. with 100 mils of aluminum shielding

Table 1 | Electrical tests performed under heavy ion irradiation.

Figure 1 | TID testing in the gamma cave irradiation room at the University of Massachusetts, Lowell.

for each DUT. During each TID test, irradiation was periodically halted so continued functionality of the parts could be verified and standby currents could be measured using the same test setup which maintained voltage bias on the parts during irradiation. The number of intermediate irradiation stops were kept to a minimum to reduce the annealing of TID-induced charge build-up in the device oxides. TID effects are annealed when radiation is not present – the device will return to its pre-irradiation state as the accumulation of positive charge in the oxide region naturally dissipates.

Following exposure, the devices underwent a full post-radiation electrical test. A sample of parts were placed on a 125 °C, 24-hour bake then retested. All characteristics returned to pre-irradiation testing levels (without overshoot). The complete TID test process is shown in Figure 2.

The testing confirmed that an appropriately rad-hardened device will operate within specification at up to the datasheet parameter of 300 krad(Si).

Heavy ion testing

The purpose of heavy ion testing was to confirm that the device meets the Soft Error Rate (SER) and latch-up immunity specifications detailed in Table 1. To confirm that the device under test meets SER specifications, multiple tests were conducted on with EDAC (rad-hard microcontroller with EDAC, scrub engine and DICE latches) and without EDAC (high temperature microcontroller without EDAC, scrub engine and DICE latches) to construct SEU Weibull plots for various modes of operation.

The Weibull plot parameters were used with the CREME96 modeling tool to determine SER performance under conditions of geosynchronous orbit solar minimum with 100 mils of aluminum shielding the conditions under which the device is specified). The linear energy transfer (LET) performance was observed directly by irradiating the devices using boron, argon, krypton, and xenon charged particles at various particle angles of incidence.

The heavy ion testing was performed at Lawrence Berkeley National Laboratory in Berkeley, California. The facility uses an 88-inch cyclotron to create charged particles and irradiate components that are located in a vacuum chamber in the irradiation room. (Figure 3.)

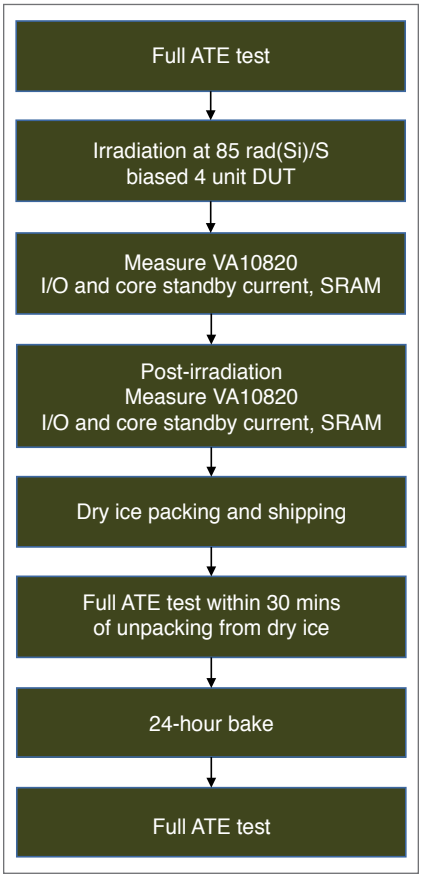

Figure 2 | TID test process

Figure 3 | Irradiation room at Lawrence Berkeley National Laboratory.

Two devices were mounted to the biased boards being exposed to radiation. The test procedure comprised of irradiating the Vorago devices VA10820 and VA10800 (control group) under four operating modes: static memory test, dynamic memory test, ALU test, and NOP test. These four tests were designed to examine radiation performance under different operating conditions and to help functionally isolate different parts of the circuits. These four tests are described in Table 2.

Tests were conducted for several charged particle types: boron, argon, krypton, and xenon. In addition, the tests were repeated with the ion beam applied at different angles of incidence to the die (0°, 45°, 60°, 76°, and 80°). In all, there were two hundred unique tests conducted. In addition to this test procedure, additional high fluence tests (requiring high particle flux in the range of 2,000 to 3,000 particles/cm^2/s) were performed with the objective to increase the probability of detecting single event latch-up, single event functional interrupt, and single event reset events. The complete heavy ion test process is shown in Figure 4.

Bit upsets on memory can be observed by loading known patterns into memory and periodically comparing actual data to expected data. From this spatial and temporal data, bit upset data can be observed to determine how many logically adjacent bits can be upset by a single particle strike. The ion beam was adjusted to implement different angles of incidence (0°, 45°, 60°, 76°, 80°) to increase the likelihood of adjacent bit cells being upset. The worst-case condition that was observed during testing occurred with krypton particles at 76° angle of incidence.

This test resulted in four physically adjacent bit cells along the word line recording bit upsets. As the adjacent bits in a single EDAC byte of the device under test are physically separated by eight cells, this worst-case condition would not result in an uncorrectable multi-bit error (MBE) from a single particle strike as the upset bits are located

Electrical tests under irradiation	Description of test
Static memory test	The memory is loaded up with a data set that is not altered during the irradiation procedure.
Dynamic memory test	The memory is continually subjected to READ and WRITE operations during irradiation.
ALU test	The CPU executes math and bit manipulation instructions continually through the irradiation procedure.
NOP test	The CPU executes NOP instructions continually through the irradiation procedure.

Table 2 | Electrical tests performed under heavy ion irradiation.

in different bytes and are corrected by the EDAC and scrub engine subsystems (that can detect two-bit errors and correct one bit error per byte).

The SER is specified as <1e-15 errors per bit-day at geosynchronous solar min. with 100 mils of aluminum shielding and appropriate SCRUB rate. To determine how the CMOS operates under this specific orbital/solar condition, it is necessary to use the native condition Weibull parameters with the CREME96 simulator. The CREME96 simulation software is maintained by Vanderbilt University and enables the user to select the orbital environment that the device will be operating in. The operation of the EDAC and scrub engine must also be factored into the calculation. Increasing the frequency of the scrub engine reduces the average accumulated errors in the memory array, reducing the likelihood of uncorrectable multiple single bit errors in the same EDAC byte. The input data to CREME96 consisted of the native bit error Weibull fit parameters and the orbital/solar conditions were configured as geosynchronous solar min with 100 mils of aluminum shielding.

When the programmable scrub frequency is set to 500 Hz (one memory address scrubbed every 2 ms), the SER results in 2.65e-16 errors per bit-day, comfortably exceeding the product specification (1e-15 errors per bit-day at higher scrub rates).

No latch-up events on the devices were observed during any of the testing up to an Effective LET of 165 MeV-cm^2/mg.

Terrestrial neutron testing

Terrestrial neutrons are a concern for operators of electronics that need to avoid equipment downtime due to neutron strikes in a terrestrial environment. Typical examples of such operators would be large server farms and telecommunications stations that use lots of electronic devices and memories.

Terrestrial neutron testing was performed using the neutron irradiation source at the Tri-University Meson Facility (TRIUMF) located at the University of British Columbia in Vancouver, British Columbia. The terrestrial neutron facility provides a neutron beam with a distribution of neutron energies comparable to those commonly found on the surface of the earth, but at much higher flux rates so accelerated terrestrial neutron testing can be performed.

The results of the testing are measured using a failures in time (FIT) rate. Terrestrial neutron FIT rate is the number of failures that would be expected due to terrestrial neutron-generated upsets in a specified amount of circuitry over 109 hours of device operation at sea level in New York City.

The rad-hardened devices demonstrated a lower FIT rate, although there was a low occurrence of errors so FIT rate is difficult to measure with precision. The system fault FIT rate is at a level one would expect purely from corrupted instructions in the memory code space, whereas the nonhardened system fault FIT rate was about two

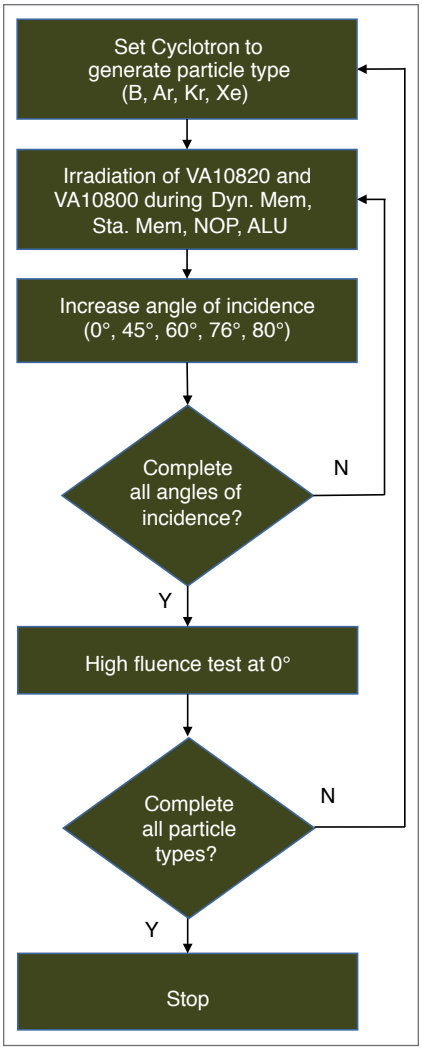

Figure 4 | Heavy ion test process

times what would be expected just from corrupted instructions in the memory code space.

The parts containing memory error detection and correction and other design-hardening techniques demonstrated terrestrial neutron FIT rates of < 1 FIT/device for device upsets and < 1 FIT/Mb for uncorrectable memory errors.

Rad-hard parts in use

VORAGO products are currently in operation on the International Space Station in the RHEME (Radiation Hardened Electronic Memory Experiment) project, a science study sponsored by NASA and created in conjunction with the United States Air Force Research Lab. The purpose of RHEME is to study the frequency and effect of high-energy particle strikes on CMOS memory chips in space. **MES**

Ross Bannatyne *is director of marketing for VORAGO Technologies, based in Austin, Texas. He was educated at the University of Edinburgh and the University of Texas at Austin. Ross has published a college text called "Using Microprocessors and Microcomputers" and a book on automotive electronics called "Electronic Control Systems" (published by the Society of Automotive Engineers); he also holds patents in failsafe electronic systems and microcontroller development tools. Ross can be reached at rbannatyne@voragotech.com.*

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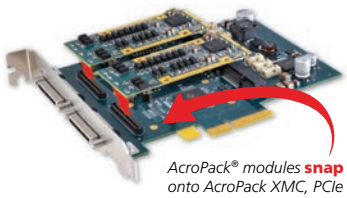

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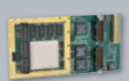
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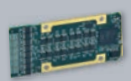
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Zen and the art of HPEC software debugging

By Tammy Carter

The age-old debate regarding art versus science: Some engineers take a romantic approach, while others take a more traditional approach. Whether debugging is an art or a science or a combination of both will continue to be debated, but all sides can agree the tools can make all the difference between timely success and riding a metaphorical motorcycle down the road of failure.

The author of the classic novel "Zen and the Art of Motorcycle Maintenance," Robert L. Pirsig, passed away in April 2017. His book, first published in 1974, has inspired many readers with its interweaving of serious philosophical explorations into the tale of a father and son coming to understand each other during a motorcycle road trip across the U.S. The ideas in Pirsig's writing could encourage a view of software debugging that integrates art and science, so that the high-performance embedded computing (HPEC) system developer can successfully tap both process and imagination to solve daunting everyday problems.

There has always been a debate about whether software debugging is an art or a science. Some engineers take the romantic approach to software integration: they write the code and debug by inspiration and intuition. Living in the moment, they forgo rational analysis or repeatable processes. When confronted with an issue, they follow their gut instincts and change their code, often without even making a backup in case their assumption was wrong. They doggedly stack patches on top of patches, or introduce more problems when trying to back the changes out later.

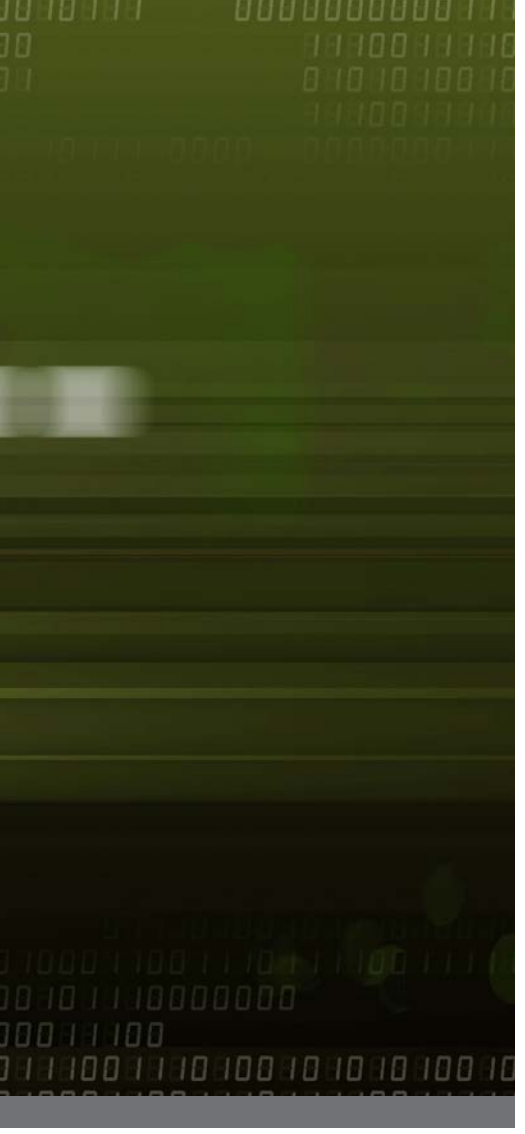
Taking a different tack, some software developers follow the traditional approach to debugging: they try to diagnose and solve the problem by rigidly following a step-by-step scientific methodology. This makes them frustrated when the real world does not function the same as the world described in the programming books. Because of their dedication to ritual, technology threatens to transform into magic, becoming unpredictable and time consuming. The traditional developer will try the same techniques over and over again, vainly hoping for a different result.

Perhaps the best programmer is one that embraces debugging as both an art and a science. This approach takes the best from both worlds, enabling bursts of creativity and intuition to work in harmony with rational problem-solving debugging skills while using debugging tools.

The three categories of software bugs

Most software bugs encountered in the development of HPEC programs fall into three broad categories: The first type is straightforward and repeatable; due to its nature, this type of bug is the easiest to find and to fix.

The next type of bug plays catch-me-if-you-can, and hides when you try to trap it. For example, every developer has tried to debug a problem by putting in "just a couple of 'print' statements," and amazingly the code starts working. After a few more 'print' statements are added the problem re-emerges, but dressed in totally different symptoms.



The third type of bug is the monster that haunts our nightmares, the one of such complexity and obscurity that it appears to be truly random and doesn't follow any discernable pattern. It might, for example, only happen once a week after you run mode A and then mode B for a thousand times in a complex sequence, and only when the moon is full and you have left to get a drink and a slice of cold pizza.

All these bugs create a range of problems. They can cause dismal failure, incorrect results, or a hard crash; they could even cause the program to get lost in the weeds. To make matters worse, the error is usually not where the failure is observed; a large part of the debugging detective work is tracing the error back to the root cause. Adding to the complexity, parallel programs' bugs can and will propagate across multiple threads, as well as multiple processors. If all of that is not enough, the bugs can also be timing-dependent.

As Pirsig observed, "Some things you miss because they're so tiny you overlook them. But some things you don't see because they're so huge." When debugging, some basic scientific tenets must be observed. One must always use a logbook to track what has been tried. Nothing is more frustrating than seeing a similar problem to one that has already been fixed, but not remembering how it was solved. Keeping a paper logbook is a great first step, but you still have to keep track of the logbook itself!

Fixing software with software

Users can call upon a debugger such as Allinea DDT, which provides a digital logbook that automatically records the entire debugging session and preserves the records of their scientific inquiry. For each stop in the program's execution, the reason and location is recoded along with the parallel stacks, variables, and tracepoints, which is a scalable "print" alternative. The only exercise left for the user is recording the hypothesis, noting the resulting observations, and then concluding using the annotation option. The formation of the hypothesis is part of the art of debugging. As Pirsig opined, "For every fact, there is an infinity of hypothesis."

Combining art and science for segment faults

Let's examine the straightforward problems that happen repeatedly, such as segment faults, aborts, or an exit without an error code, along with the tool features that can facilitate solving these problems. These common bugs are easy to fix with a debugger, a task that is much harder and time-consuming without one. The static-analysis tool will flag common mistakes when the user opens the code with Allinea DDT. An example of the type of errors flagged is shown in Figure 1.

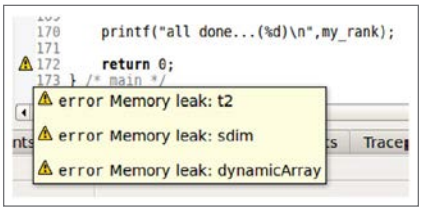


Figure 1 | Types of errors flagged with Allinea DDT.

To become familiar with the tool, let's look at a simple program that aborts when it runs with input arguments. As seen in Figure 2, the debugger stopped on the line where the error was detected. The "Stacks" view pane shows the function call tree to the point where the code was stopped. Looking at the "Variable" pane reveals "arg = 0," which is the problem. Most times, the answer will still not be obvious; one might be tempted to sprinkle some "print" statements, which would require the code to be recompiled.

Tracepoints are a superior option because they track the lines of code executing and the variables of interest without stopping execution across multi-processes. Visual line indicators, called "sparklines," quickly show the variation of the values across the processes and the range of the values as shown in Figure 3.

One could explore arrays using the previously described tools, but that could be painful, slow, and confusing for large arrays. The Allinea debugger also has a tool for analysis of arrays, complete with graphing and export capabilities. Complementing all the options the tool provides to analyze the data are flow-control features such as breakpoints, watchpoints, and step features add to the debugger's arsenal for proving hypotheses without ever having to change a line of code. A watchpoint is a variable or expression monitored by the debugger, such that when it is changed or accessed, the debugger pauses the application. One could say that the science is in the tools, while the art springs from the wielding of these tools.

Remembering the tricks for memory errors

The next family of errors are memory errors, which can be very painful to track down. Depending on the input data, the problem might not be triggered or the results will be incorrect with subtle, easy-to-miss differences.

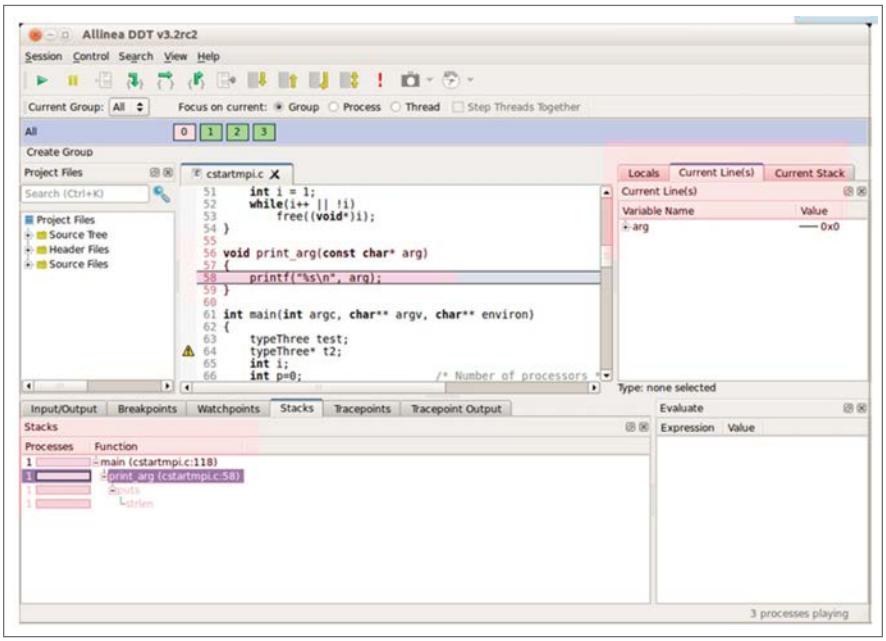


Figure 2 | The debugger stops on the lie where the error is detected.

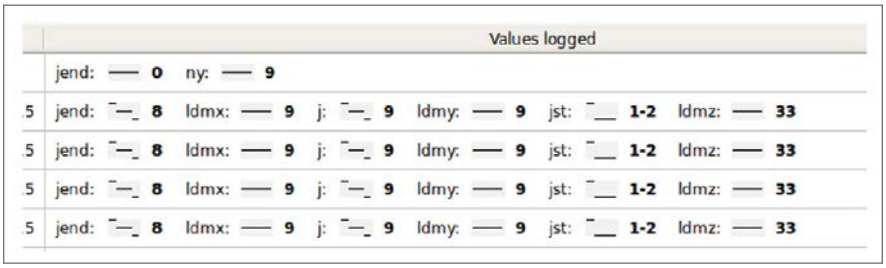


Figure 3 | For even more detail, the "Cross-Process and Cross-Thread Comparisons View" will present the data as a raw comparison, statistically or graphically.

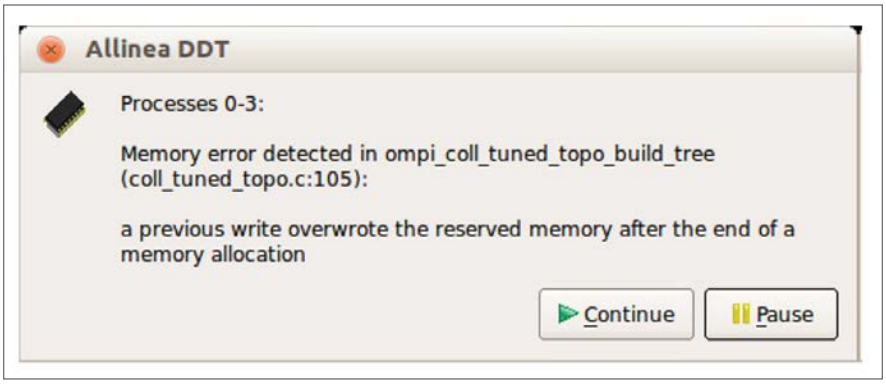


Figure 4 | Basic memory check traps a memory overwrite.

Overwriting or reading past memory boundaries can cause crashes or errors that don't occur until much later in the execution. Add to this the potential problems of deallocating memory multiple times, pointers to the wrong address, and all-too-common null pointers. The Allinea tool provides options to dial in the just the right amount of memory help. The more in-depth levels require more memory and time.

Figure 4 shows an example when a basic memory check traps a memory overwrite. By selecting the pause button, the debugger will stop with the offending line of code highlighted, then variables, pointer details, and expressions can all be evaluated as previously described. Given the art of the developer, these insights might be enough to reach a logical conclusion. If not, guard pages come to the rescue to check for read and writes beyond an allocated block. The pages can be added before or after the block, and the default of a single page catches most errors. When memory usage is growing faster than expected due to a dreaded memory leak, the currently allocated memory for selected processes can be tracked with the "Current Memory Usage" view as shown in Figure 5.

The pie chart presents a quick overview of total memory allocated for each process. In the stacked bar chart, each bar represents a process, and that bar is broken down into colored blocks for the contained functions. To drill down even further, clicking on a color block will provide detailed information about the memory allocations inside that function. Digging deeper still, the developer can enter the "Pointer Details

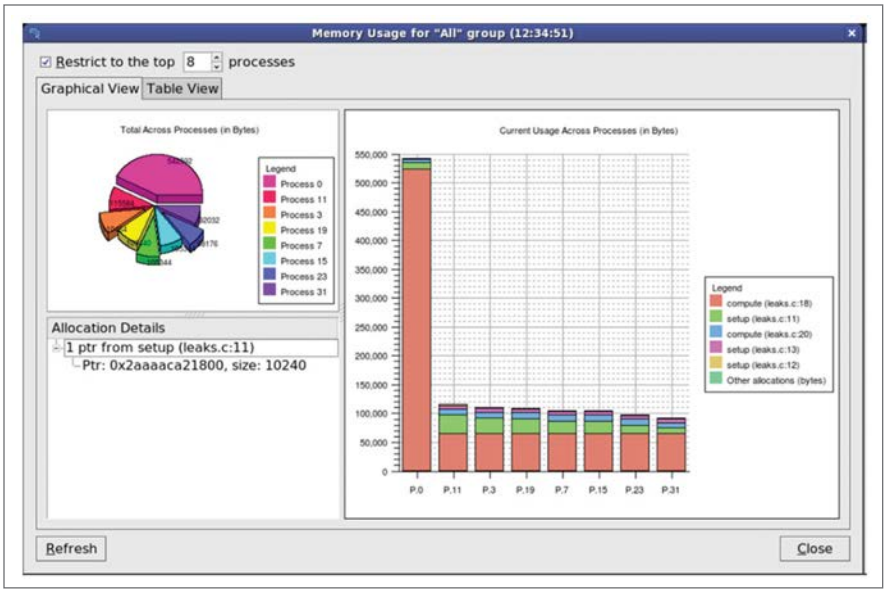
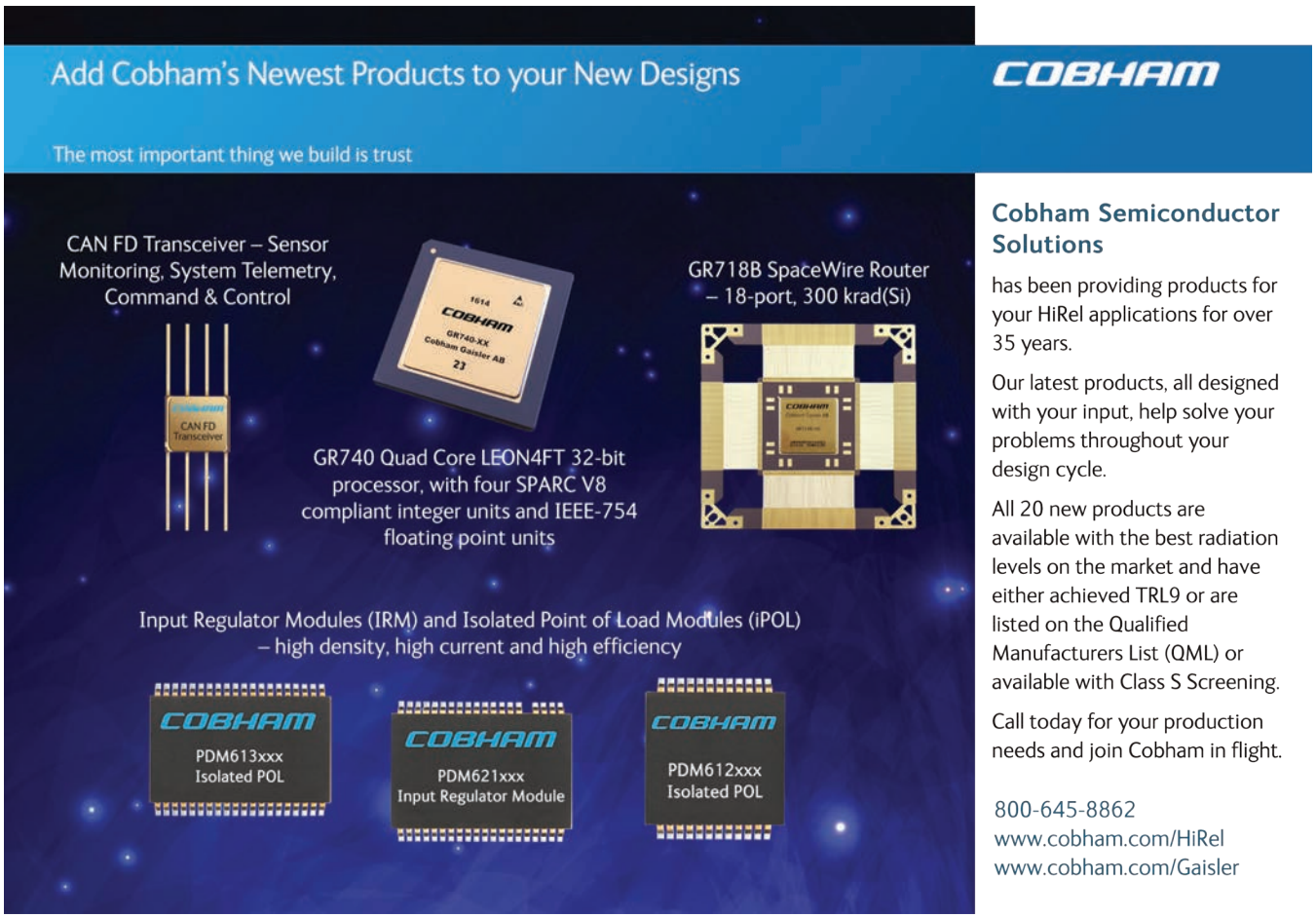


Figure 5 | Current memory usage view.



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View" to see exactly where the pointer was allocated, de-allocated, and the amount of memory allocated. One might wonder why complex tools like this debugger are needed. Pirsig – our "Zen" author – supplies the answer: "What makes this world so hard to see clearly is not its strangeness but its usualness. Familiarity can blind you too."

Solving the sleepless-night dilemma

Let's shift to the chaotic nonrepeatable bugs. These are the ones that lead to lost sleep, long weekends in the lab, and endless cups of cold coffee or warm Mountain Dew. The tracepoint tool can be configured to capture only unexpected values or to search for interesting patterns. Here, the art requires imagination.

For example, use this feature to capture variables to determine why a function is called numerous times, but crashes only occasionally (usually when you walk away from the computer for a minute!). In addition to the interactive mode described earlier, the Allinea tool also has an offline debugging mode in which the debugger directs both the running of the code and the storing of results without user intervention. This mode enables the system to collect data overnight, or however long it takes for the problem to occur. This offline mode supports a full set of tools such as tracepoints, memory debugging aids, and even breakpoints. In this mode, the debugger can also compile snapshots of the program state including the stacks and selected variables. The snapshots can be triggered periodically or by sending a signal from another terminal window to the front-end process.

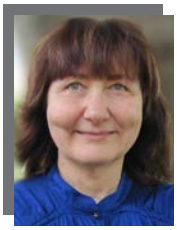
The final report produced by the offline session consists of four sections: messages, tracepoints, memory-leak status, and the output complete with time stamps.

Another tool that aids in the hunt for elusive bugs is checkpointing. A program's entire or partial subset can be stored in memory as a checkpoint for the duration of the debugging session. The application's state can then be restored from the saved checkpoint; execution then resumes from the restore point. This feature is useful when the user is unsure of what data will be needed to diagnose the problem until it is too late to retrieve it, and it is difficult to get back to this point in the execution. For example, the program crashes because a variable has been set to an unexpected value and it is too late to set a watchpoint on that variable. If the engineer had the artful insight to set a checkpoint earlier, the program can be restored to the checkpoint where the watchpoint can be set and the failure re-analyzed.

When hunting for those elusive bugs, this quote from Pirsig may resonate: "You look at where you're going and where you are and it never makes sense, but then you look back at where you've been and a pattern seems to emerge."

Taking the wheel

This whirlwind tour of the art and science of debugging for HPEC systems is intended to illustrate how debugging tools are expanding the ability to produce quality and more robust software with far less effort. **MES**



Tammy Carter *is the senior product manager for OpenHPEC products for Curtiss-Wright Defense Solutions, based out of Ashburn, Virginia. She has more than 20 years of experience in designing, developing, and integrating real-time embedded systems in the defense, communications, and medical arenas. She holds a Master of Science in Computer Science from the University of Central Florida. Readers may reach the author at tcarter@curtisswright.com.*

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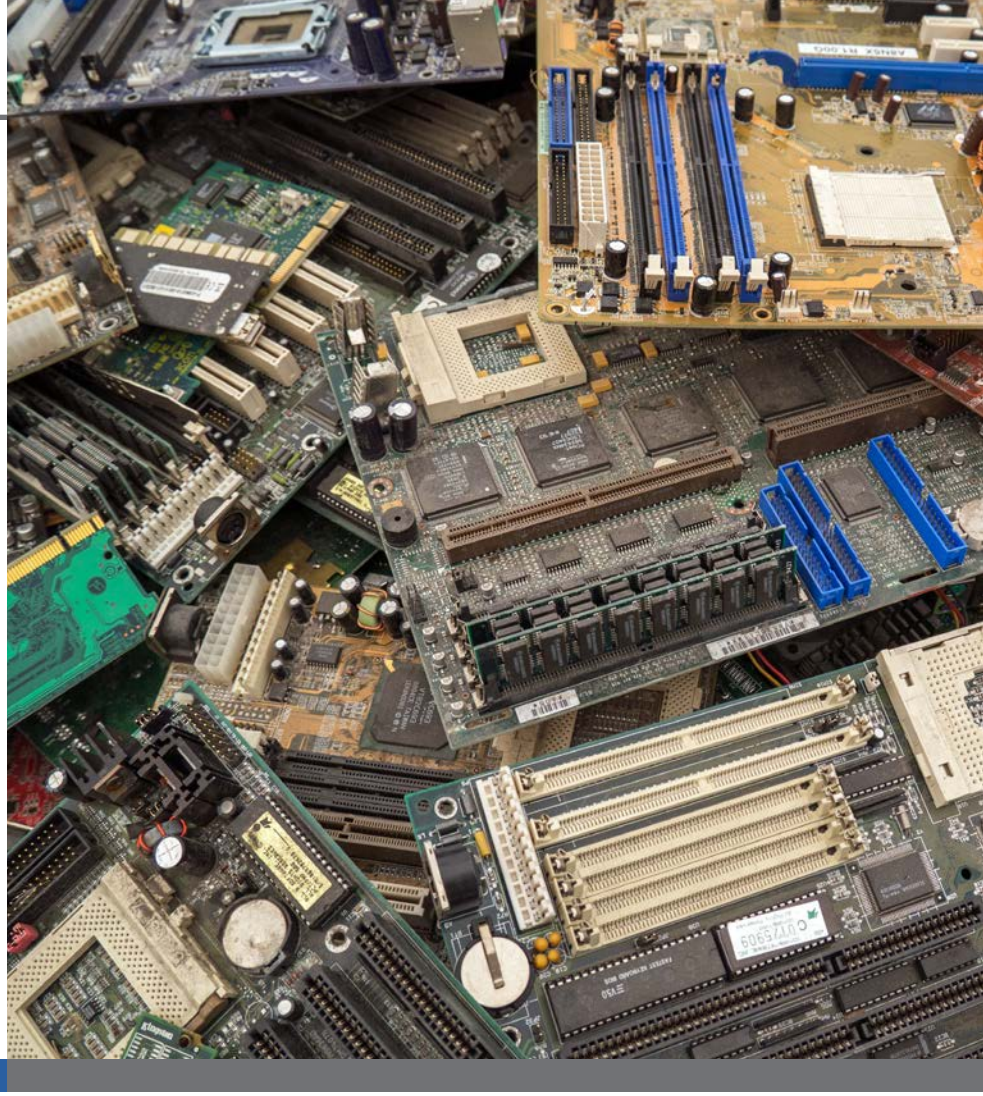
MANAGING SUPPLY CHAIN: OBSOLESCENCE, COUNTERFEIT PARTS

Combating counterfeit risks across the complex electronics supply chain

By Bryan Brady and Scott MacDonald

When it comes to thwarting counterfeit activity, choosing trusted partners to provide embedded systems equipment can actually be half the battle in guaranteeing a clean supply chain.



Accelerating innovation has been a priority for the Department of Defense (DoD) in recent years and momentum is expected to build as geopolitical tensions rise. With the current presidential administration pledging a "great rebuilding of the armed services,"[1] the aerospace and defense industry is planning for increased spending on U.S. military weapons and modern warfighter capabilities.

As other NATO nations boost their own defense spending, demand for American-made weapons continues to grow worldwide. Pentagon officials who attended the 2017 International Paris Air Show, one of the world's largest military and aerospace events, reported "seeing global demand from our partners in air, space, and cyberspace. We're busier than ever and people want the U.S. to be the partner of choice." [2]

The U.S. is indeed a partner of choice for military embedded systems as the need to maximize system performance while reducing size, weight, and power (SWaP) escalates daily. A recent report projected global growth in the military embedded systems market from $71.3 billion in 2016 to $134.9 billion by 2021, with North America leading the way.[3]

Fast-moving innovation at odds with military requirements

With demand signals intensifying worldwide, the defense and aerospace industries increasingly look to the commercial sector for solutions. To achieve lower costs and rapid availability, original equipment manufacturers (OEMs) rely on commercial off-the-shelf (COTS) components, along with more ruggedized COTS+ versions for their systems.

While COTS software and hardware enable the defense industry to leverage the rapid pace of technology innovation, it also brings challenges. The two- to three-year product life cycles of many commercial components, for example, is a mismatch with the 10- to 20-year shelf life requirements of the defense sector; this disparity fuels demand for obsolete components.

The increased rate of mergers and acquisition activity in the semiconductor industry is also accelerating obsolescence as product lines consolidate. What do these trends mean for defense contractors? Most likely, more headaches in managing the proliferation of product change (PCN) and end-of-life (EOL) notifications, which are not always timely or broadly communicated.

Supply chains at risk: counterfeit parts and malicious insertions

Navigating this challenging environment is a constant balancing act, especially when parts near EOL or become obsolete. OEMs striving to avoid the expense, time commitment, and impracticality of product redesign typically place last-time buys (LTB)

or negotiate components deals with brokers/non-franchised resellers. While both approaches procure parts, the costs may be too high, especially with the "gray market" opening a door to counterfeit components – reclaimed, remarked, reengineered, or otherwise fraudulently represented parts. Now the real problems begin.

Beyond the reportedly billions of dollars in annual economic losses tied to counterfeit parts, they also pose significant performance, reliability, and safety risks. Delayed missions, destroyed systems integrity, compromised critical infrastructure capabilities. All of these scenarios can ultimately endanger the lives of our service men and women.

The most insidious threat to our security is malicious components entering the supply chain via terrorists, rogue states, and other non-state actors. As reported in the political newspaper, The Hill:

"A federal advisory committee recently concluded that the U.S. military's weapons systems are at risk from what is called "malicious insertion" – when something is deliberately inserted into a system for a malicious purpose – and exploitation of undiscovered vulnerabilities. Of particular concern are weapons currently in the field, which were not covered by the Pentagon's current procedures for mitigating supply chain risks, the Defense Science Board's cyber supply chain task force said." [4]

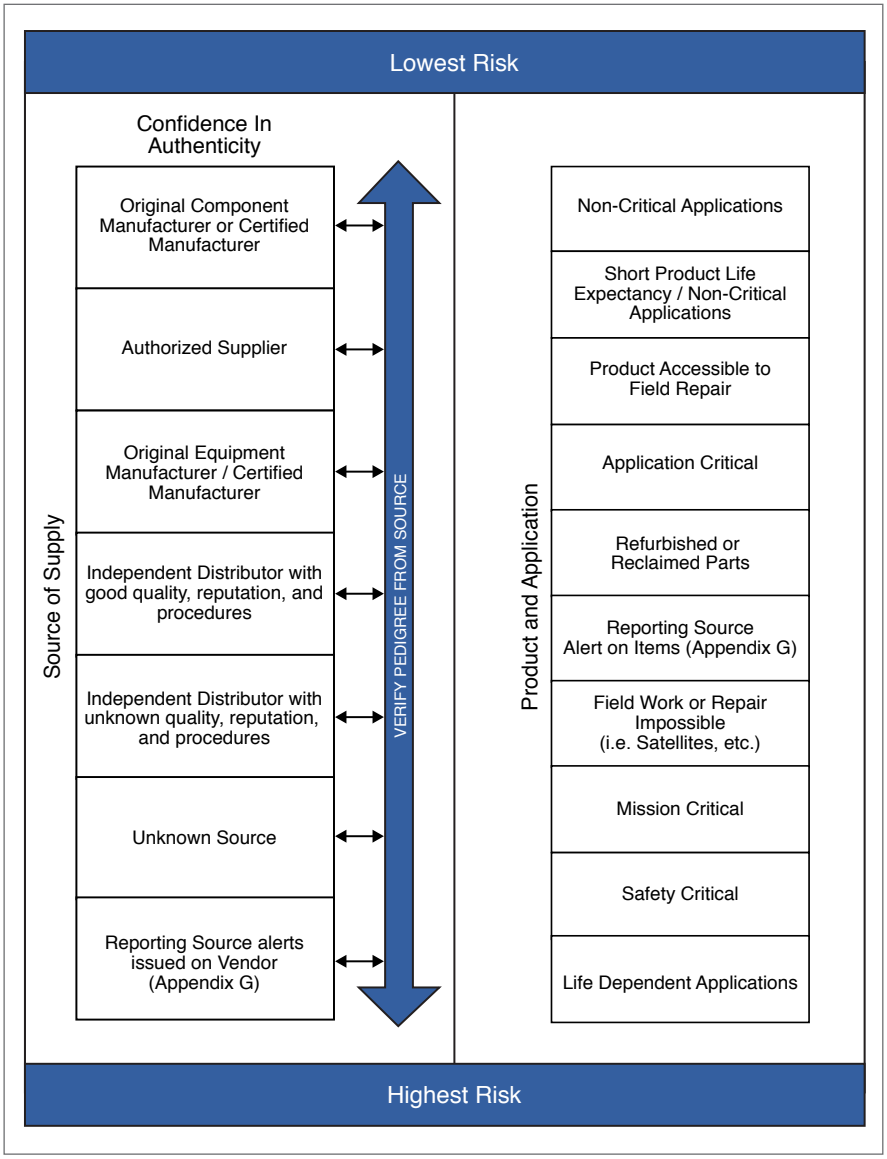


Figure 1 | SAE Aerospace Standard AS5553A "Risk Stack Chart" illustrates the authenticity of parts correlated with risk and application. Chart courtesy Counterfeit Parts/ SAE International.

While supply-chain vulnerabilities mount daily, so too does the number of opportunities for modern defense weapons platforms and next-generation technologies. Let's consider best practices for combating counterfeits and mitigating supply-chain risks while accelerating business goals.

Flow down standards across the supply chain

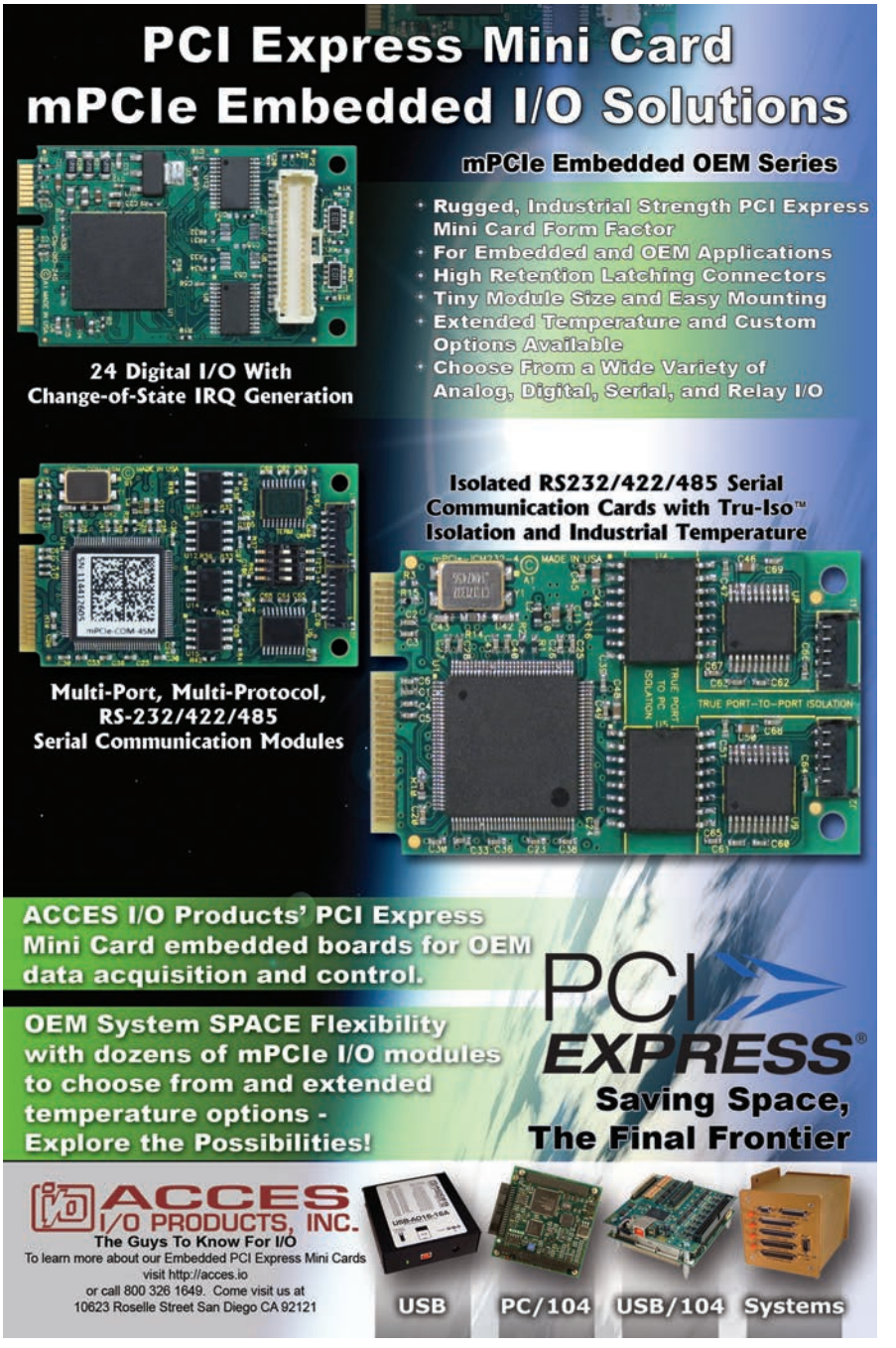
The first rule for combating fraudulent and counterfeit parts is to choose partners wisely by purchasing from original-component manufacturers or their authorized suppliers. It is incumbent on the OEM to establish disciplined processes and risk-mitigations system, and also to ensure that end-to-end supply chain partners do the same, by adhering to vetted procedures in compliance with SAE [the engineering-standards organization] fraudulent and counterfeit electronic parts standards (AS5553B and AS6496). These standards should be applied and flowed down through the supply chain to all organizations that procure EEE [electrical, electronic, and electromechanical] parts and/or assemblies. (Figure1.)

When an original or authorized source is not available, gray-market dealings should be contained to trusted, vetted, and managed brokers that comply with AS6081 – which handles avoidance of counterfeit parts – to reduce violation risks. The latest Department of Defense (DoD) requirements state that OEMs must essentially vouch for the quality and authenticity of the part, assuming all risks if the supplier delivers a counterfeit.

Keeping up with the latest compliance requirements and notifications is an arduous process. OEMs often fret that they want to be in the design and manufacturing business, not the parts-management and quality-control business. Here is where trusted, franchised distributors can help: By leveraging the global supply and design chain services of their trusted distributors from the component level all the way up to embedded subsystems, OEMs can focus on their core mission while minimizing counterfeit risks and managing obsolescence.

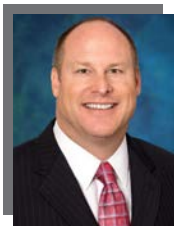
Services offered by trusted distributors can include:

- Proactively keeping pace with the PCN and EOL notifications that matter most. Wading through the tens of thousands of notifications issued monthly can be like finding a needle in a haystack. A franchised distributor should follow a product life cycle and obsolescence process that demonstrates intimate knowledge of its partner's systems or Bills of Material (BOM). For instance, if a company's system requires that a component be flagged as an LTB, the franchised distributor can ensure fast action on the requirement. Counterfeit risk and premium costs of the gray market can be avoided by partnering with an authorized distributor that can identify, analyze, and act on the notifications that affect systems.
- Promoting optimal part selection for standing programs or new designs by evaluating BOMs with procurement data and industry tools. OEMs struggle with so many options and unknowns when creating, managing, customizing, and purchasing BOMs, especially when considering parts obsolescence. Franchised distributors can share their unique insight on the part's viability, based on global sales data plus manufacturer- and application-specific factors, for a superior predictor of the parts' long-term availability.
- Shortened design cycles, reduced cost, and mitigated risk by fully evaluating a product's life cycle and roadmap. Whether creating a partial or full OEM product, company partners should understand a product's unique requirements and can recommend new technologies and flexible options to propel it from design and testing to production and deployment.
- Compliance with the latest DoD requirements and SAE standards with an electronic part detection and avoidance system, maintaining 100 percent control and traceability. The key to thwarting counterfeit parts entering the supply chain is working with authorized suppliers able to guarantee a supply chain through end-to-end visibility and traceability. When an authorized distributor is complying with the DFARS [Defense Acquisition Regulations System] flow down in a purchase order, they should never ship any parts that have been out of their control, unless given explicit consent. (See DFARS 252.246-7008 and DFARS 252.246-7007 for details.)
- Seeks full transparency with parts returned to stock. Franchised distributors have long been granting OEMs the convenience and value of returning unused parts to stock. While this practice enables another OEM to purchase a needed part, it contradicts the best practice of maintaining 100 percent parts control. Your authorized distributor should have a process to fully vet the returned part – validating that they have matched its traceability and date code – while completing a quality review. Even with



high confidence in the veracity of the parts returned to stock, authorized distributers should only ship returned parts to a defense contractor after making clear that the parts may carry risks.

Let's be honest. These best practices will not stop the escalating counterfeit activity happening worldwide. Just as technology advancements are enabling breakthrough performance, they also empower counterfeiters with new tools of destruction. As we stand on the brink of what many believe to be a major turn-around for our defense programs, we all need to remain vigilant. **MES**



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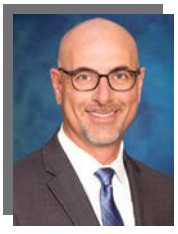

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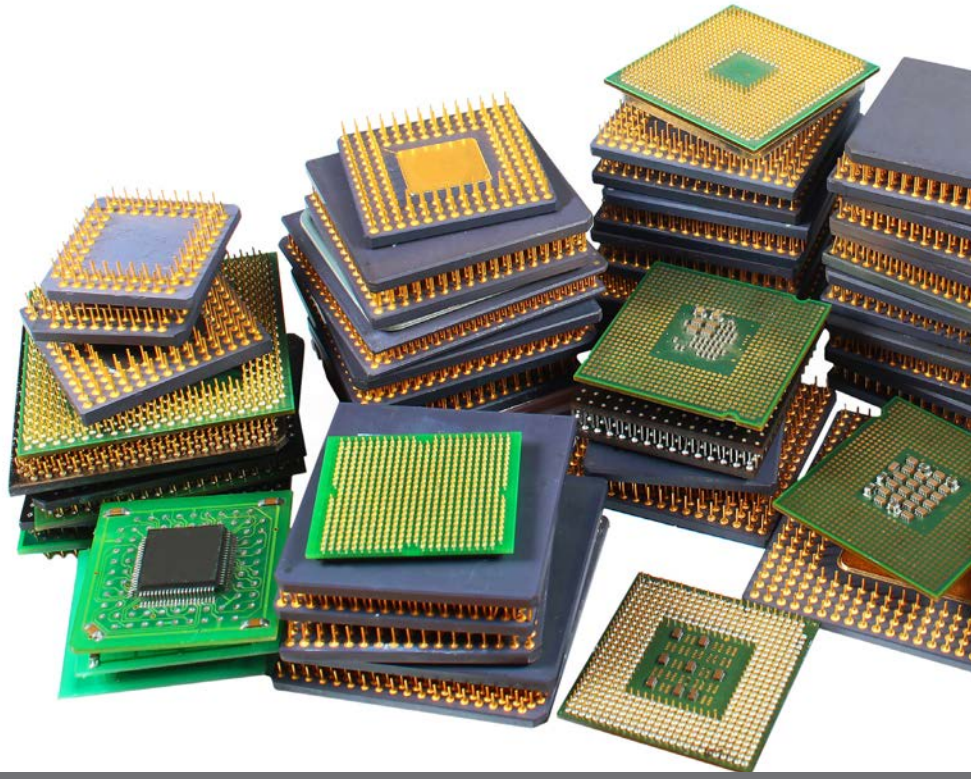


Component obsolescence is a concern across system development

By Doug Patterson

Component obsolescence is nothing new, and the problem isn't going away. While electronics innovations may move industry forward on one hand, the downside is that some electronics get left in the dust, no matter how widely adopted they may have been at one point.

Look at the PowerPC Altivec, for example: This powerful processing architecture had an extremely loyal install base, yet for reasons unknown to most of us, it was dropped for several years, forcing its customers to look for other processing alternatives. Although Altivec recently returned in the T4x series of the PowerPC system-on-chip (SoC) devices, the growing use of other processors supplanted the device series, effectively muting its once-untouchable popularity. Other examples of component obsolescence may not be as complex or daunting as the Altivec case, but the example stands as a warning: Component functionality that once existed in abundance can seemingly disappear overnight.

While the evolution of electronics is one main reason causing obsolescence issues, there are also a few other significant factors influencing this. For military and aerospace system designers and suppliers, these factors hit home harder than in some other industries.

Business factors affecting obsolescence

Unfortunately, the proper operation of mission-critical and highly sensitive military electronics sometimes takes a back seat to other, seemingly more pressing, concerns of semiconductor companies, such as increased yields and profits. The early demise of any one component basically moots these business factors. In fact, component obsolescence is occurring more frequently, and even sooner than was the norm, in many military program production cycles.

A recent point of contention regarding some electronic components in the defense community is the transition away from lead in electronic components [Pb <3 percent] (specified by EU mandate), allowing an almost-forgotten 80-year-old problem to rear its ugly head in the component supply chain: Yes, we're talking about tin whiskers.

For non-mission-critical applications, failure of a system may not rank as high as profitability, according to those in the early part of the supply chain. The use of non-lead solder balls on ball grid array (BGA) devices saves enough money that the component manufacturers tolerate certain criticism from system designers. For military missions, however, where the use of lead alloy ensures that tin whiskers do not occur, and security and human lives are on the line, any level of failure is unacceptable.

As suppliers continue to remove higher-cost lead alloys from components, the percentage of tin used is increasing. For telecommunications equipment and military/defense systems, components then need to be retrofit to meet the high reliability specifications of the application.

This spec is typically accomplished by replacing the >97 percent tin alloy composite with a mix that includes the proper amount of lead to offset the growth of the tin whiskers. The unintended result is yet another cost added to military components and their programs, a cost that most heavily scrutinized programs cannot bear.

Managing availability beyond the components

Having to deal with parts that are no longer in step with the higher reliability specs isn't the only aspect of component

obsolescence. The underlying technical expertise and long-term life cycle sustainability of a program are just as important. Even at the onset of product development today, component obsolescence must already be paramount in the mind of the product developer, with an eye towards mitigating the obsolescence costs in the future for users.

As embedded computing companies continue to design and build technologically advanced, reliable commercial off-the-shelf (COTS) products, they should also be thinking about how the customer will be supported long-term. In-depth technical knowledge needs to be shared cross-functionally to ensure continuity. Additionally, retiring talent with that expertise needs to be replaced with newer engineering resources to plan for future program developments.

In the military/defense and aerospace industries, in which programs can take years and millions of dollars to develop, test, and qualify, all of these aspects definitely figure into obsolescence concerns. These embedded systems aren't like the latest cellphones, easily discarded when the next upgrade comes along. They're comprised of rugged or even military-grade single-board computers (SBCs), enclosures, I/O, and graphics products that take time and money to create. They must be available for the long haul as programs move from low-rate initial production (LRIP) to full production cycles.

A process designed to mitigate

The lifecycle of COTS products needs to be managed according to a well-defined and forward-looking program. At Aitech, for example, the COTSLifecycle+ program is divided into three distinct program phases: Active, Supported, and Extended Support, each of which provides product availability for at least four years. The combined life cycle ensures a minimum COTS product lifetime of 12 years from product introduction, and usually far longer. Employing total program and life cycle support services ensure that the products that are designed in today will meet the functional, environmental, and operating requirements of the specifications of tomorrow.

Electronic systems have always consisted of both active and passive components. In time, these components are replaced by the next generation of more technically capable components, resulting in the obsolescence of the earlier devices. This is a natural progression, but by implementing a structured approach that thinks ahead of the next electronics evolution, designers can effectively guard against, or at least prolong, such obsolescence. (Figure 1.)

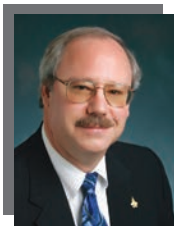
Figure 1 | Long-term program planning needs to start very early on in the development process. (Diagram courtesy Aitech.)

Designing for the future

No matter how you parse the problem, component obsolescence equals added costs – in many instances unplanned and unbudgeted – that translate into program delays and cost overruns. Even with a modular, preplanned technology insertion roadmap, early component obsolescence is hard to predict and even harder to counter, unless companies plan for it long before it happens.

Managing obsolescence needs to happen on many different levels and should be shared all the way from component manufacturer through to the end user. It's not the job of just one link in the supply chain to assume all of the burden to ensure longevity of these highly integrated, rugged embedded systems. From the actual parts to availability and through to design resources, many factors can impact how far from its starting point an embedded system design may need to wind up.

Warfighters must have access to the most advanced technology available, and military systems must be held to the most stringent standards of quality and reliability. Neither of these factors is going to change. While system designers may not be able to eliminate all the factors affecting obsolescence, recognizing them will enable proper planning in terms of time to market and preplanning for the resulting cost adjustments. **MES**



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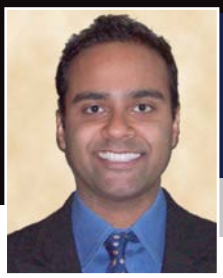

Coding standards – are they necessary?

By Jay Thomas, LDRA Technology

BLOG

As cyberwarfare becomes increasingly part of the norm, many, if not most, military embedded systems are safety- and/or security-critical in nature. To combat this increasing risk, it only makes sense that military systems should be constructed following some of the industry's most rigorous software development standards to ensure their safe, secure, and functionally accurate operation. Following these standards offers a double benefit: Not only does it reduce safety and security risk, but it also reduces cost. Software development standards improve maintainability, upgradability, reusability, and testability, delivering long-term benefits especially given the typical life span of these systems.

To address the need for improved safety and security, consistency, and to simplify future maintenance and testing, software development organizations must consider standardizing on a process for software development and a well-defined use of the software language. If this environment is not well-defined, there are of course huge potential problems further down the line.

Let's look at this issue in the C language, which has defined operators, syntax, functions, etc., in an extremely flexible way. It is possible to write code that may work but is nearly incomprehensible to others; it may also contain complexities and hidden errors that wreak havoc under certain conditions. Languages such as C++, Java, and even Ada – all used in military embedded systems – used indiscriminately, can lead to similar unsupportable conditions. Coding standards provide a consistent, mutually understandable language and approach to software development that can help developers avoid any ambiguities in the software language definition and ensures that teams get coding done correctly.

Having such a standards-based approach brings immediate benefits: A coding standard helps define a set of practices that can be understood and used across a team. By collaborating on a common set of coding constructs and practices, team members can easily communicate using the same approach and produce code that is more consistent, maintainable, and testable across the software development organization.

In the military and aerospace domain, there are now programs that must follow DO-178C, a software standard for developing safety-critical avionics applications. DO-178C requires companies to use coding standards to ensure that safety-critical applications are built on code that is safer and more secure by construction. Standards such as MISRA, CERT C/C++, and CWE help eliminate flaws and security vulnerabilities from entering the code in the first place. With languages such as C where many variants have been defined, coding standards ensure consistent, maintainable practices that help reduce risk and support future reusability and testability.

Getting it right

Replacing manual inspection, automated checking is done through static analysis of the source code and should be done throughout code construction. This only becomes practical (or bearable) when the tool lends itself to quick and easily comprehensible operation showing developers exactly what they need to know about compliance.

Look for a static-analysis tool that lets you select from established standards along with rules that have been adopted within an organization. These advantages enable teams on the same project to bring together their results based on the same set of practices and standards all have been using. With such tools, there are a lot fewer questions, conversations, and explanations trying to figure out what others are trying to do. Spending less time on comprehending the code and communicating about it can result in enormous savings over the life of a project.

Automated checking for compliance speeds the iterative development effort. With respect to security, coding standards help solve a piece of the overall security puzzle. They don't address encryption, isolation, or quarantining, nor do they ensure data is secured at rest and in transit, but they do help avoid subtle coding errors that could be exploited. Such standards would have eliminated the notorious "Heartbleed" bug that was caused by simply failing to limit the size of a variable – a risk that cannot be justified in a military system. A tool set up for in-depth analysis can also collect internal information about the code and understand more in-depth topics like true data coupling and control coupling, necessary for safety- and security-critical applications.

Dynamic testing goes beyond static analysis in that it involves actually compiling and running the code with inputs and looking for expected outputs. Dynamic unit and integration testing requires a set of test vectors and a test harness derived from a deep understanding of the code gained by the static analysis. The harness is a piece of software that surrounds the code under test and enables the presentation of test inputs and the extraction of the resulting outputs.

Standards – foundational!

So, yes, coding standards are necessary to form the foundation of a solid software-quality process. Development organizations that adhere to rigorous coding standards will create more consistent, maintainable, reusable, and testable code. Ultimately, this results in higher-quality application software.

***Jay Thomas** is a technical development manager for LDRA Technology.*

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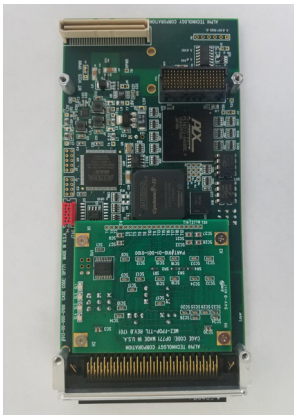

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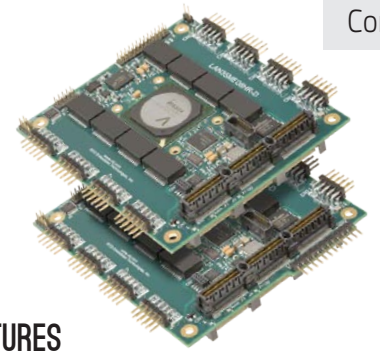
The LAN35MH08HR is an 8-port 10/100/1000 Managed Ethernet switch. This switch module has a total of 10 ports: eight ports are provided to I/O connectors, one port is available to the host CPU through a x1 PCI Express GigE controller, and one port is used as a stacking switch expansion port allowing full compatibility with RTD's managed and unmanaged StackNET™ Ethernet switch family. Additionally, this allows the CPU to use the switch without the need for external cables. The LAN35MH08HR can also be used as an expandable, standalone 8-port Ethernet switch.

The onboard CEServices Carrier Ethernet switching software provides a rich Layer 2 switching solution with Layer 3-aware packet processing. All of the industry-standard Managed Ethernet Switch features found in an enterprise rackmount switch are provided, such as VLANs, Spanning Tree, QoS, and SNMP. Additionally, the CEServices software provides features for carrier and timing-critical networks such as OAM, Synchronous Ethernet, and IEEE 1588. The switch may be configured via a web GUI interface, or a command-line console via USB, Telnet, or SSH.



FEATURES

- -40 to +85°C operation, passively cooled
- PCIe/104 stackable bus structure
- Eight 1000/100/10 Mbps Ethernet ports plus one host port and one stacking switch expansion port
- Onboard tri-color LED for each Ethernet Port
- RJ-45 jacks or 10-pin right-angle headers
- Fully-managed Layer 2 Ethernet Switch with Layer 3-aware packet processing
  - *Support for all major Enterprise switching features such as VLANs, Spanning Tree, QoS, and SNMP*
  - *Manageable via web GUI interface, SSH, Telnet, and Serial Console*
  - *Industry-standard CLI interface*
- Onboard PCI Express Ethernet Controller for interface to host cpuModule
- USB Device Port for Serial Console command-line interface
- Available in stackable, rugged enclosures

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RTD Embedded Technologies, Inc.
www.rtdstacknet.com
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Dolphin
INTERCONNECT SOLUTIONS

Dolphin eXpressWare PCIe Software

eXpressWare software enables Military applications to easily migrate to a PCIe Networks. eXpressWare's complete software infrastructure enabling applications to network using standard PCI Express over cables and backplanes. Serveral interfaces and APIs are supported including standard TCP/IP networking – IPoPCIe driver, a low level direct remote memory access API – SISCI API and a sockets API – SuperSockets. Each API has its benefits and can be selected based on application requirements.

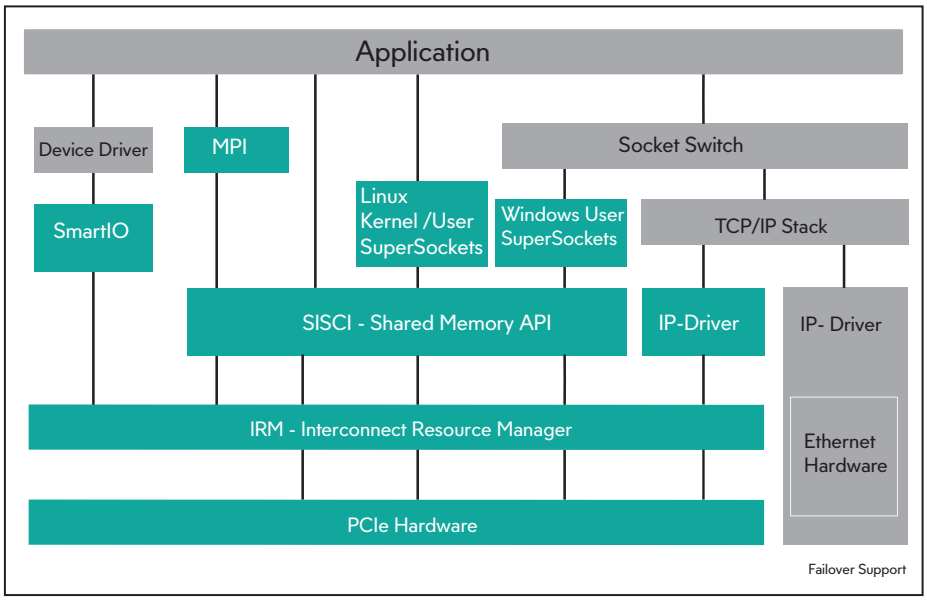
The SISCI API enables customers to fully exploit the PCIe programming model without having to spend months developing device drivers. The API offers a C programming API for shared/remote memory access, including reflective memory/multi-cast functionality, peer-to-peer memory transfers and RDMA capabilities. The SISCI API supports direct FPGA to FPGA, GPU to GPU, or any combination of communication with FPGA, CPUs, GPUs or memory over PCIe. SuperSockets enabled networked applications to benefit from a low latency, high throughput PCIe network without any modifications. With SuperSockets, a PCIe network can replace local Ethernet networks. The combination of Dolphin's PCIe host adapters and switches with SuperSockets delivers maximum application performance without necessitating application changes. The SISCI API supports Windows, Linux, VxWorks and realtime O/S such as RedHawk and RTX.

SuperSockets is a unique implementation of the Berkeley Sockets API that capitalizes on the PCIe transport to transparently achieve performance gains for existing socket-based network applications. Both Linux and Windows operating systems are supported, so new and existing applications can easily be deployed on future high performance PCIe networks.

Dolphin's performance optimized TCP IP driver for PCIe (IPoPCIe) provides a fast and transparent way for any networked applications to dramatically improve network throughput. The software is highly optimized to reduce system load (e.g. system interrupts) and uses both PIO and RDMA operations to implement most efficient transfers for all message sizes. The major benefits are plug and play, much high bandwidth, and lower latency than network technologies like 10Gbps Ethernet. The IPoPCIe driver is targeted for non-sockets applications and functions that require high throughput and performance.

FEATURES

- PCIe Gen 1, 2, 3 and beyond support
- Address based Multi-cast/reflective memory
- Point-to-point and switched network support
- Low latency direct memory transfers
- Operating systems – Windows, Linux, VxWorks, and RTX
- FPGA and GPU direct memory transfers
- Microsemi, IDT and Intel NTB
- Cross O/S low latency data transfers
- Peer-to-peer transfers
- Cascading of switches
- Network manager



The combination of API along with Dolphins new device lending SmartIO products will push the boundaries of next generation Military applications

eXpressWare, combined with the stability and longevity of PCI Express, is the ideal platform for next gen Military applications.

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- > 11,000 DSP48's
- > 6 TeraMAC/sec signal processing speed
- > 270 Terabit/sec memory bandwidth
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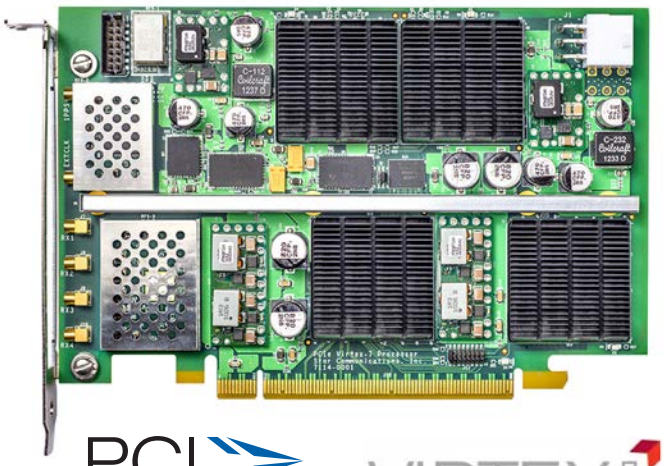
- Programmable sample rate (100-250 Msps)
- Free software development kit
- Simple, intuitive API's
- DMA to/from host system
- Less than 11 ounces and 24 cubic inches
- Plug & play in any PC or server



PCI EXPRESS® VIRTEX-7

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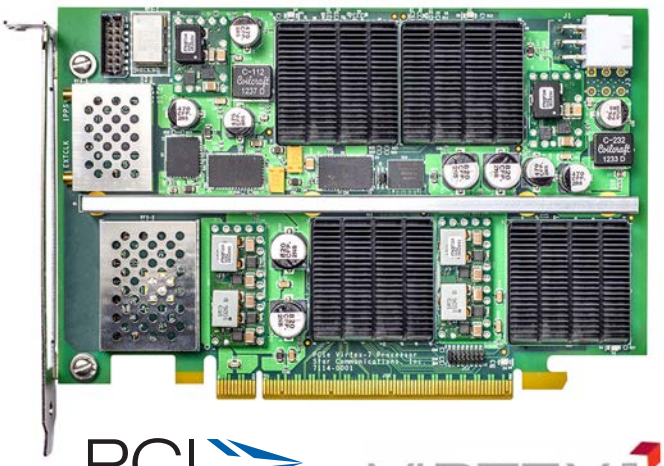
Computing Accelerators

PCA-70x

- Scalable, 1-4 high-end Virtex-7 (XC7VX485)
- > 65 TeraOPS/sec processing speed
- > 270 Terabit/sec memory bandwidth
- High-speed encryption
- Network security, deep packet inspection
- Image processing, cyberwar, biometrics
- Development libraries included
- Free software development kit
- Simple, intuitive API's
- DMA to/from host system
- Less than 11 ounces and 24 cubic inches
- Plug & play in any PC or server



PCI EXPRESS® VIRTEX-7

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X-ES

Extreme Engineering Solutions

XPand9011

The XPand9011 provides an industry-leading combination of security, performance, and flexibility for a rackmount server. It features dual Intel® Xeon® E5-2600 family v4 (formerly Broadwell-EP) processors with a tightly coupled Xilinx Kintex® UltraScale™ security FPGA, two 40 Gigabit Ethernet ports, and six PCI Express Gen3-capable expansion sites.

The XPand9011 is designed and manufactured in the USA, using COTS components from trusted domestic supply chains. Supporting a standard 2U rackmount form factor with six PCI Express expansion slots, it is a true Open Systems Architecture (OSA) design. The XPand9011 also integrates ruggedization features that enable it to perform in environmentally challenging applications without modifications or enhancements.

X-ES Enterprise Linux (XEL) BSP is standard, please contact the factory for additional OS support options.

FEATURES

- Secure 2U rackmount server with front I/O
- Supports dual Intel® Xeon® E5-2600 v4 family of processors (formerly Broadwell-EP)
- Up to 128 GB of DDR4-2400 ECC SDRAM across eight channels
- Integrated Xilinx Kintex® UltraScale™ security FPGA (XCKU060 or XCKU095)
- Ruggedized design
- Two 40 Gigabit Ethernet ports, six PCI Express expansion sites, two RS-232/422/485 serial ports
- Three 3.5 in. Hot Swap SATA drive bays

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Extreme Engineering Solutions (X-ES)
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abaco SYSTEMS

MCS1000

The rugged small form factor **MCS1000** mission or display computer reduces the time and cost of developing complex mission ready systems.

It is enabled by the new ***Lightning*** systems architecture from Abaco, and is designed to meet the requirements of a wide range of rugged applications in defense and aerospace programs. The MCS1000 features the Intel® Xeon® E3 processor combined with a CoreAVI (or AMD) E8860 GPU and Abaco's unique I/O technology to deliver high performance and remarkable flexibility.

Abaco's revolutionary expansion module allows the MCS1000 to accommodate almost any custom I/O requirements, minimizing or eliminating NRE costs and reducing development time. Available I/O capabilities include analog to digital conversion, general purpose discrete I/O, audio inputs, specialty avionics I/O and many others.

To make integration easier, the MCS1000 shares its footprint with other 3U ***Lightning***-enabled systems.

The MCS1000 benefits from a highly robust qualification test plan that ensures it will meet an application's toughest requirements with little to no additional testing needed, reducing time-to-deployment.

FEATURES

- I/O customization via four ECM modules and XPM I/O
- Qualification tests based on MIL-STD-461G, DO- 160G, MIL-STD-704F, MIL-STD- 810G
- Intel Xeon E3-1505M/E3-1505L CPU
- CoreAVI or AMD E8860 GPU
- Up to 16 GB DDR4 SDRAM with ECC
- -40° C to +71° C operating temperature
- VxWorks®, Windows®, Linux®
- Options: removable SSD up to 1 TB; 50 ms hold-up

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ACCES I/O PRODUCTS, INC.

mPCIe-COM Family PCI Express Mini Cards

ACCES I/O Products is pleased to announce the release of a new family of mini PCI Express (mPCIe) multi-port serial communication cards. These small, low-priced, PCI Express Mini cards feature a selection of 4 or 2-ports of software selectable RS-232/422/485 asynchronous serial protocols on a port by port basis. These cards have been designed for use in harsh and rugged environments such as military and defense along with applications such as health and medical, point of sale systems, kiosk design, retail, hospitality, automation, gaming and more. The small size (just 50.95mm x30mm) allows for maximum performance in applications where space is a valuable resource.

Each RS-232 port is simultaneously capable of supporting data communication rates up to 921.6 kbps. RS-422/485 modes support data communication speeds up to 3 Mbps. The cards provide ±15kV ESD protection on all signal pins to protect against costly damage due to electrostatic discharge. Existing serial peripherals can connect directly to industry standard DB9M connectors on the optional breakout cable accessory kits.

The mPCIe-COM cards were designed using type 16C950 UARTs and use 128-byte transmit/receive FIFO buffers to decrease CPU loading and protect against lost data in multitasking systems. New systems can continue to interface with legacy serial peripherals, yet benefit from the use of the high performance PCI Express bus. The cards are fully software compatible with current PCI and PCI Express 16550 type UART applications and allow users to maintain backward compatibility.

FEATURES

- PCI Express Mini Card form-factor (mPCIe) type F1, with latching I/O connectors
- 4 or 2-port serial communication cards with optional DB9M connectivity
- Software selectable RS-232, RS-422, and RS-485 protocols, per port stored in EEPROM
- High performance 16C950 class UARTs with 128-byte FIFO for each TX and RX
- Port-by-port field selectable termination for RS-422/485 applications
- Industrial operating temperature (-40°C to +85°C) and RoHS standard
- Supports data communication rates up to 3Mbps simultaneously, (RS-232 up to 921.6 kbps)
- Custom baud rates easily configured
- ±15kV ESD protection on all signal pins
- CTS, RTS, 9-bit data mode, and RS-485 full-duplex (4 wire) fully supported
- RS-232 only and RS-422/485 versions available

mil-embedded.com/p372691

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Embedded Hardware

ACCES I/O PRODUCTS, INC.

mPCIe-ICM Family PCI Express Mini Cards

The mPCIe-ICM Series isolated serial communication cards measure just 30 x 51 mm and feature a selection of 4 or 2 ports of isolated RS232/422/485 serial communications. 1.5kV isolation is provided port-to-computer and 500V isolation port-to-port on ALL signals at the I/O connectors. The mPCIe-ICM cards have been designed for use in harsh and rugged environments such as military and defense along with applications such as health and medical, point of sale systems, kiosk design, retail, hospitality, automation, and gaming.

The RS232 ports provided by the card are 100% compatible with every other industry-standard serial COM device, supporting TX, RX, RTS, and CTS. The card provides ±15kV ESD protection on all signal pins to protect against costly damage to sensitive electronic devices due to electrostatic discharge. In addition, they provide Tru-Iso™ port-to-port and port-to-PC isolation. The serial ports on the device are accessed using a low-profile, latching, 5-pin Hirose connector. Optional breakout cables are available, and bring each port connection to a panel-mountable DB9-M with an industry compatible RS232 pin-out.

The mPCIe-ICM cards were designed using type 16C950 UARTS and use 128-byte transmit/receive FIFO buffers to decrease CPU loading and protect against lost data in multitasking systems. New systems can continue to interface with legacy serial peripherals, yet benefit from the use of the high performance PCI Express bus. The cards are fully software compatible with current PCI 16550 type UART applications and allow for users to maintain backward compatibility.

FEATURES

- PCI Express Mini Card (mPCIe) type F1, with latching I/O connectors
- 4 or 2-port mPCIe RS232/422/485 serial communication cards
- Tru-Iso™ 1500V isolation port-to-computer and 500V isolation port-to-port on ALL signals
- High performance 16C950 class UARTs with 128-byte FIFO for each TX and RX
- Industrial operating temperature (-40°C to +85°C) and RoHS standard
- Supports data communication rates as high as 3Mbps – 12MHz with custom crystal
- Custom baud rates easily configured
- ±15kV ESD protection on all signal pins
- 9-bit data mode fully supported
- Supports CTS and RTS handshaking

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ACCES I/O PRODUCTS, INC.

USB3-104-HUB – Rugged, Industrial Grade, 4-Port USB 3.1 Hub

Designed for the harshest environments, this small industrial/military grade 4-port USB 3.1 hub features extended temperature operation (-40°C to +85°C), locking USB and power connections, and an industrial steel enclosure for shock and vibration mitigation. The OEM version (board only) is PC/104-sized and can easily be installed in new or existing PC/104-based systems as well. The USB3-104-HUB makes it easy to add USB-based I/O to your embedded system or to connect peripherals such as external hard drives, keyboards, GPS, wireless, and more. Real-world markets include Industrial Automation, Security, Embedded OEM, Laboratory, Kiosk, Military/Mission Critical, Government, and Transportation/Automotive.

This versatile four-port hub can be bus powered or self (externally) powered. You may choose from two power inputs (power jack and terminal block) to provide a full 900mA source at 5V on each of the downstream ports. Additionally, a wide-input power option exists to accept from 7VDC to 28VDC. All type A and type B USB connections feature a locking, high-retention design.

FEATURES

- Rugged, industrialized, four-port USB 3.1 hub
- USB 3.1 Gen 1 with data transfers up to 5Gbps (USB 2.0 and 1.1 compatible)
- Extended temperature (-40°C to +85°C) for industrial/military grade applications
- Locking upstream, downstream, and power connectors prevent accidental disconnects
- SuperSpeed (5Gbps), Hi-speed (480Mbps), Full-speed (12Mbps), and Low-speed (1.5Mbps) transfers supported
- Supports bus-powered and self-powered modes, accessible via DC power input jack or screw terminals
- LED for power, and per-port RGB LEDs to indicate overcurrent fault, High-Speed, and SuperSpeed
- Wide input external power option accepts from 7-28VDC
- OEM version (board only) features PC/104 module size and mounting compatibility

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Embedded Hardware

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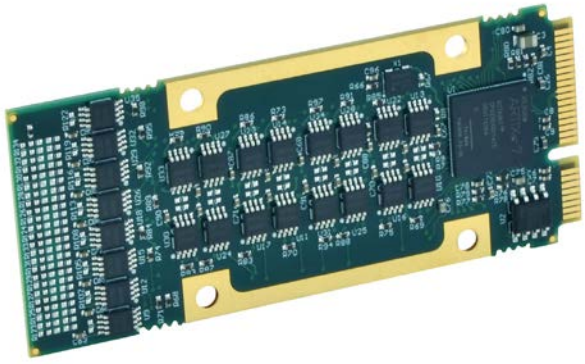
APA7-200



The **APA7-200** series provides a FPGA based user-configurable bridge between a host processor and a custom digital interface via PCI Express. These boards feature a best in class Artix®-7 interface to deliver the industry's lowest power and high performance.

Designed for COTS applications, these FPGA based digital I/O modules deliver user-customizable I/O, high-density, high-reliability, and high-performance at a low cost.

The APA7-200 series modules are 70mm long. This is 19.05mm longer than the full length mini PCIe card at 50.95mm. The board's width is the same as mPCIe board of 30mm and they use the same mPCIe standard board hold down standoff and screw keep out areas.

A down facing 100 pin Samtec connector mates with the carrier card. Fifty of these pins are available for field I/O signals.

The Engineering Design Kit provides users with basic information required to develop custom FPGA firmware for download to the Xilinx FPGA. Example FPGA design code is provided as a Vivado IP Integrator project for functions such as a one-lane PCI Express interface, DMA, digital I/O control register, and more.

FEATURES

- PCI Express Generation 1 interface
- Reconfigurable Xilinx® FPGA
- High-channel-count digital interface: RS485, LVDS and TTL interface options
- 32Mb quad serial Flash memory
- 33,280 logic cells
- 41,600 Flip flops
- Conduction-cooled options

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ADVANTECH

Enabling an Intelligent Planet

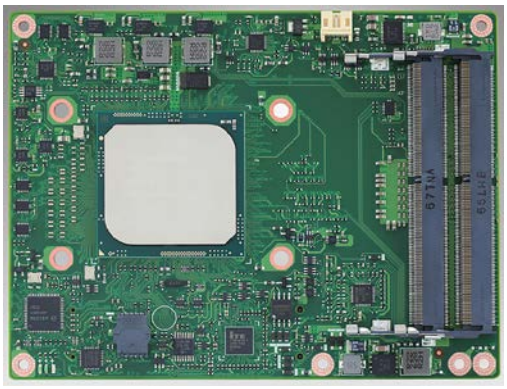
World's First Server-grade COM Express with 64G Memory Capacity

SOM-5992 delivers amazing computing performance as the world's first COM Express powered by a server-class processor with up to 16-core/32-thread scalability and up to 64GB of DDR4 dual channel memory w/ ECC support. Integrated with two 10GB Ethernet (10GBASE-KR), it provides high bandwidth interfaces for data transmission and reception. The outstanding computing capability and low thermal design power deliver excellent power efficiency making SOM-5992 ideally suited for use in embedded applications, servers, networking, or for use in cloud storage applications.

With a maximum of 64GB memory, SOM-5992 is suited for use in server or virtualization applications where it can take advantage of the extreme performance of the Intel® Xeon® 16-core processor within the 125mm x 95mm COM-Express Basic module. This is the first COM Express designed for servers or high compute embedded applications, which require maximum performance to process multiple tasks within the system simultaneously, as well as thousands of data exchange demands from clients worldwide.

SOM-5992 is the first module by Advantech to use the new PICMG COM Express Revision 3.0 type 7 interface. This new Type 7 interface increases the number of PCI-Express lanes up to 32 and provides up to 4 x 10GbE ports. These new 10GbE ports to be utilized as either KR-to-KR, KR-to-copper or KR-to-optical fiber based on the end user's baseboard/carrier design.

Note: *Modules are available for use in standard operating temperatures between 0 to +60 °C and optionally available for use in -40 to +80 °C environments as well.*



SOM-5992 FEATURES

- Intel® Xeon® Processor D-1500 Product Family
- PICMG COM.0 R3.0 type 7 COM Express Basic Module
- Up to 16 cores with TDP of 45W
- Up to 64 GB of Dual Channel DDR4 Low Power Memory w/ ECC
- Configurable Gen3 PCIe x16, x8 and 8x1 expansion
- Two 10GBASE-KR interfaces, and 1000BASE-T
- Supports iManager, WISE-PaaS/RMM and Embedded Software APIs

PAC-3004 3U Blade Server

Ultimate flexibility and performance within a compact 3U form factor

The **PAC-3004** is Advantech's latest blade server to boost compute, storage and networking performance across a highly available scale-out platform that packs up to four dual socket nodes based on the new Intel Xeon Processor Scalable Family. It's up to 400Gps of I/O directly connects to compute and storage elements by leveraging Mellanox Multi-Host technology, which allows for maximum data transfers at minimum complexity. High performance to build a wide range of data center applications from real-time analytics and workload acceleration to enterprise networking and Software Defined Storage bringing greater efficiencies to next generation intelligent cloud deployments.

The new PAC-3004 will be available later in 2017. Contact us to discuss your application requirements and learn how the PAC-3004 can meet your needs!

Advantech, a global leader in the design, manufacturing, integration, and fulfillment of industrial embedded computing products offers you a wide range of purpose-built form factors and solutions together with three U.S. ITAR certified design, integration, and support centers.

By partnering with Advantech, your program can benefit from our comprehensive system integration, hardware, software, customer-centric design services, a strong eco-alliance network and global logistics support to empower you with a wide range of mission critical solutions.

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PAC-3004 FEATURES

- Flexible configurations – Acceleration & Storage, I/O Acceleration, High Capacity Storage, and High Speed Storage
- Up to 4 dual socket Xeon nodes, up to 512GB RAM per node and AVX612 instruction set
- Built-in Acceleration – QuickAssist with up to 100Gbps per node
- Direct I/O 2 x 10GE ports per node with RDMA support
- Integrated Fabric up to 100Gbps node to node and 400Gbps I/O connectivity with RDMA support
- Up to 24 x 2.5" Hot Swap Drives; SAS/SATA/NVME support or up to 12 x 3.5" SAS/SATA
- Up to 8 x Full Height / ¾ length PCIe slots, Up to 16 x Low Profile PCIe slots (x8 gen 3)
- High Power Available with 2+2 or 3+1 redundant power 3600W AC or 1800W DC hot swappable

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Aitech Defense Systems, Inc.

Embedded Computing *without* Compromise

A176

Military intelligence now has access to enhanced data and imaging processing through Aitech Defense Systems' next generation **A176**, a rugged GPGPU system that incorporates the NVIDIA Jetson TX2 system-on-module (SoM).

Building on the company's field-proven A176 Cyclone GPGPU supercomputer launched in 2016, Aitech's latest high-performance embedded computer (HPEC) uses the Jetson TX2 to provide twice the performance of its predecessor, or run at more than twice the power efficiency, while drawing less than 7.5 watts of power.

The new A176 features the same fanless, conduction-cooled design and measures only 25.5 cubic inches for high performance in a small form factor (SFF) HPEC system.

The increased power to performance ratio of the Jetson TX2 makes the next generation A176 GPGP ideal for embedded deep learning, computer vision, graphics and GPU computing applications, especially in harsh environments.

In addition to incorporating the new NVIDIA Jetson TX2 module, the unit now supports more hardware I/O and software options (1553, ARINC 429, Camera Link Frame Grabber), allowing even faster integration to save development time and money.

The internal microSD storage enables more design flexibility to scale the supercomputer to more complex compute-intensive applications. This includes data convolutions and transpositions, image and data manipulation, application of digital filters, image and frame object edge detection, and image recognition and data analysis.

View Video
bit.ly/a176video

FEATURES

- Next-generation rugged GPGPU COTS system enables deep learning capabilities
- Faster, more accurate data and image processing for better military intelligence
- Offers high performance computing, while drawing very little power
- SWaP Optimized Rugged HPEC
- Ultra Small Form Factor (SFF) – 105 mm [5.1"] square, < 1 kg [2.2 lbs.]
- NVIDIA® Jetson™ TX1 or new TX2 System on Module
- Best Available Performance per Watt – 60 GFLOPS/W
- SATA SSD with Quick Erase & Secure Erase
- 4 GB LPDDR4
- Video Capture SDI / RS170 Compsite

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Annapolis Micro Systems

100Gb COTS EcoSystem for 6U & 3U OpenVPX

Annapolis Micro Systems is designing a breakthrough **100Gb COTS EcoSystem** for delivery starting in Q4 2017. The Wild100™ EcoSystem builds on Annapolis' proven Wild40™ EcoSystem, an integrated and agile FPGA system architecture that revolutionizes high-end data acquisition, processing, and storage.

The 100Gb EcoSystem utilizes blind mate optical and/or RF (VITA 66/67) for **2.5X** improvement in speed and bandwidth!

Other advantages include:

- *Easier to field and maintain – moves connections to rear or onto backplane*
- *Lighter*
- *Denser*
- *More rugged*

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

We offer training and exceptional special application development support, as well as more conventional support.

The New Wild100 EcoSystem Features:

› Higher ADC/DAC bandwidths (10+ GSps)

› Superior ADC/DAC density (1,000s of coherent channels per system)

› 100Gb backplane, switches, and FPGA processing boards

› Storage capacity up to 34 TB and 10-14 GB/s bandwidth, per 6U slot

› Blind mate optical and/or RF connections (VITA 66/67) for systems that are easier to field and maintain

Wild100 Maintains Best Features of Wild40:

› Wild FMC+ (WFMC+™) connectivity

› Compact, rugged, and thermally-controlled

› Synchronized ADC & DAC channels

› Hot swappable

› Secure

› Includes Open Project Builder™ – VHDL or GUI-based

What Can 100Gb Do for You?

Contact us now to have a FAE look at your application.

This breakthrough super high-performance EcoSystem is close to deployment!

Made in the USA

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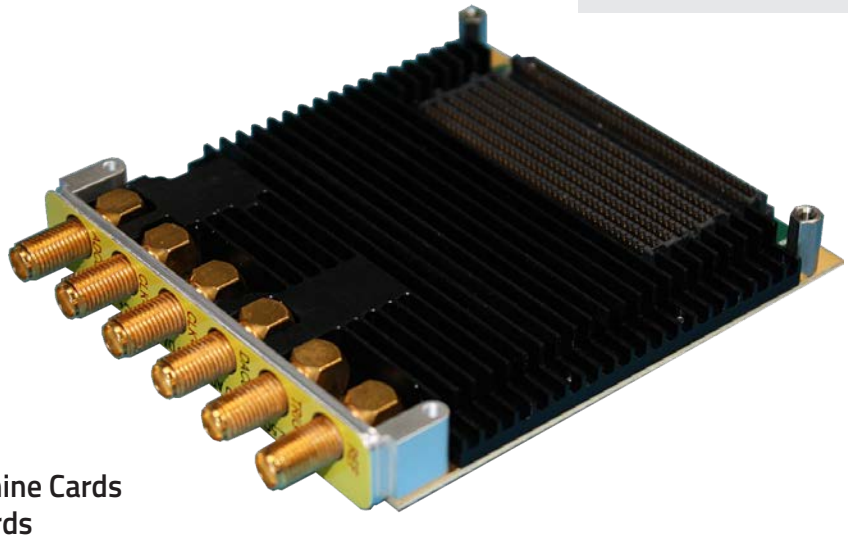
Annapolis Micro Systems



Ultra-Low Latency DRFM Mezzanine Cards & High Bandwidth Mezzanine Cards

Ultra-Low Latency DRFM-Optimized Mezzanine Cards have been designed from the ground up for latency sensitive DRFM applications. The Board Support Interface, which is available in VHDL or Open Project Builder, was also designed from the beginning to be suited for DRFM applications. This interface provides a Digital Bypass Mode to achieve the lowest possible latency and a Fabric Space Mode to allow the user to do additional processing of the ADC data before returning it out the DAC. The Fabric Space Mode adds as little as 13ns of latency. The Board Support Interface also includes a built-in Bypass Delay. This allows the user to "walk" the latency out from the minimum Digital Bypass latency to slightly beyond the Fabric Space latency, providing for a smooth transition between the two modes. Open Project Builder, Annapolis' Design Tool, allows the user to design a DRFM-optimized application in minutes.

FEATURES:

- Single or Dual Channel available running at up to 5.0 GSps each
- Ultra Low latency from ADC SMA input to DAC SMA output
  - *Digital Bypass Mode (SMA-to-SMA): as low as 15ns*
  - *Fabric Space Mode (SMA-to-SMA): as low as 23ns*
- Digital Bypass Mode has built-in run-time adjustable delay providing additional delay from 0ns up to 124 Sclk periods
- Firmware and Software Board Support Interface provided in Open Project Builder
- Converter channels can be synchronized

High Bandwidth Mezzanine Cards have been designed from the ground up for maximizing data throughput. WFMC+ enabled cards include 32 high speed serial lanes and 100 LVDS lines to accommodate even the most bandwidth-hungry ADC or DACs. All Annapolis wide-bandwidth mezzanine cards deliver high channel counts, allow for synchronization across multiple cards, and have flexible high-precision trigger options. These rugged COTS mezzanines are optimized for high-performance operation in Wireless Communication, SATCOM Uplink/Downlink, Phased Array RADAR, SIGINT, and EW.

FEATURES:

- Channels: 1-16
- Sample Rate: Up to 6.0 GSps
- Resolution: 10-16 bits
- Firmware and Software Board Support Interface provided in Open Project Builder
- Converter channels can be synchronized

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Annapolis Micro Systems, Inc.
www.annapmicro.com/product-category/mezzanine-boards/

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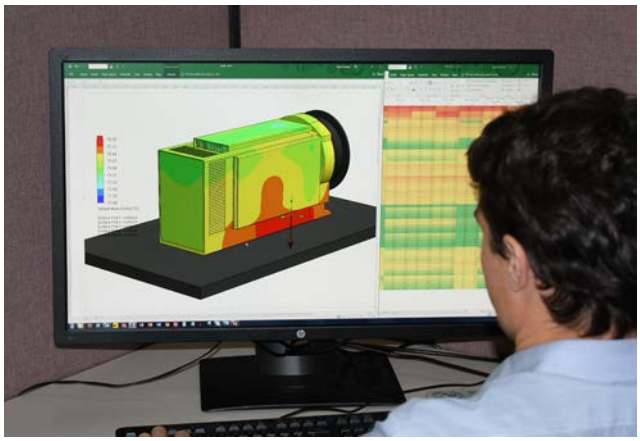
410-841-2514

Annapolis Micro Systems



Ruggedized Systems and Broad Temperatures

Ruggedized COTS Systems

Annapolis Micro Systems' FPGA-based Systems are built within our proven Wild40™ EcoSystem, an integrated and agile FPGA system architecture that is designed to perform at the highest levels in the harshest environments.

From the bitter cold of an Antarctic radar station to the hottest deserts of the Middle East, Annapolis equipment is real-world deployed in the most demanding embedded applications.

Ruggedized COTS Boards

Annapolis has developed a new set of WILDSTAR™ high-performance boards that thrive across a broad temperature range: -55° to +85°C. Board cooling is via air, conduction, or air-flow-through.

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Cooling Options

Depending on the application, Annapolis chassis are designed to utilize Air, Conduction, or Liquid cooling. During the design process, every board and system is simulated for thermal performance, then subjected to hours of grueling operation to verify its ability to withstand temperature stresses.

Independently Verified

Annapolis verifies environmental conformance of its equipment to stringent standards such as MILSTD-810 and RTCA/DO-160 (for airborne equipment).

Designed & Manufactured in USA

All Annapolis products are engineered and manufactured under one roof in the United States. This co-location of engineering and manufacturing allows for more aggressive design, and better quality control and production flexibility.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

We offer training and exceptional special application development support, as well as more conventional support.

Annapolis Micro Systems, Inc.
www.annapmicro.com

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Annapolis Micro Systems

Data Storage Solution Offers Highest Density

When Storage capability is needed, Annapolis offers the highest density OpenVPX storage solutions on the market. Available in 6U and 3U form factors, the **WILD Data Storage Solution** features a removable hot swappable canister with a connector rated for 10,000+ mating cycles. The WILD Solution comes with standard images to support XAUI, 40GbE and AnnapMicro Protocol (Annapolis low FPGA utilization, full flow control protocol ideal for inter-FPGA communication).

The **WILD Data Storage Solution** is comprised of two pieces fitting in a single 1" OpenVPX slot: the "Storage Canister" and the "Storage Carrier" that plugs into the VPX backplane and holds the disk canister.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

We offer training and exceptional special application development support, as well as more conventional support.

FEATURES

- 3U boards feature 8 TB (currently) or 16 TB (available in late 2017) Storage Depth and 5-7 GB/s Bandwidth
- 6U boards feature 16 TB (currently) or 32 TB (available in late 2017) Storage Depth and 10-14 GB/s Bandwidth
- Backplane I/O using PCIe or 40Gb Ethernet
- Scalable Depth and Bandwidth using multiple Storage Cards
- Hot Swappable Drive Canister with 10,000 Insertion Cycles & Hot Swappable Carrier (exclusive to WILDSTAR OpenVPX EcoSystem)
- 6U/3U OpenVPX (VITA 65) Compliant, 1" VITA 48.1 spacing
- Air Cooled or Conduction Cooled
- Proactive Thermal Management

mil-embedded.com/p372456

Annapolis Micro Systems, Inc.
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Annapolis Micro Systems

WILDSTAR UltraKVP ZPB for 6U & 3U OpenVPX

Annapolis' new rugged UltraKVP ZPB FPGA boards are designed from the ground up to withstand a broad temperature range: -55° to +85°C. Cooling is via air, conduction, or air-flow-through.

All Annapolis FPGA boards are engineered for superior performance and maximum bandwidth. Both Altera and Xilinx FPGAs are leveraged to offer the best FPGA technology available and to fit customer preference, design requirements and production schedule.

These FPGA boards, paired with Annapolis OpenVPX-compliant 6U/3U backplanes, enable even the most bandwidth-intensive applications.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

We offer training and exceptional special application development support, as well as more conventional support.

FEATURES

› **General Features**
- Up to two Xilinx® Kintex® UltraScale™ XCKU115 or Virtex® UltraScale+™ XCVU5P/XCVU9P/XCVU13P FPGAs
  - *Hard 4x (3U) or 8x (6U) PCIe Gen3/Gen4 endpoint for DMA and register access*
  - *FPGAs programmable from attached flash or Annapolis-provided software API*
  - *16 or 20-nm copper CMOS process*
  - *DDR4 DRAM ports on all FPGAs running up to 2400 MT/s*
- Xilinx Zynq® UltraScale+ MPSoC Motherboard Controller XCZU7EV (3U & 6U) or XCZU11EG (6U only)
- A Full Board Support Package using Open Project Builder for fast and easy Application Development
- System Management

› **OpenVPX Backplane I/O**
- 20 (3U) or 24 (6U) HSS I/O lanes to VPX backplane for 50 (3U) or 60 (6U) GB/s of full duplex bandwidth
- Two PCIe Gen3 4x (3U) or 8x (6U) Connections to VPX Backplane
- Backplane Protocol Agnostic connections support 10/40Gb Ethernet, IB capable, AnnapMicro protocol and user-designed protocols
- Radial Backplane Clock Support for OpenVPX backplane signals AUXCLK and REFCLK
  - *Allows reference clock and trigger from backplane to synchronize and clock compatible ADC/DAC mezzanine cards without front panel connections needed*

› **Front Panel I/O**
- Wild FMC+ (WFMC+) next generation I/O site
  - *Accepts standard FMC and FMC+ cards (complies to FMC+ specification)*
  - *Supports stacking (2 I/O cards per site)*
  - *Up to 32 High Speed Serial and 100 LVDS pairs connections to FPGA*

› **Mechanical and Environmental**
- Available in Extended Temperature Grades
- Air, conduction, or air-flow-through cooled
- Optional blind mate optical and/or RF connections (VITA 66/67)
- RTM available for additional I/O

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Annapolis Micro Systems, Inc.
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ARTESYN™
EMBEDDED TECHNOLOGIES

ATCA – A Modular Open Systems Approach for Defense

ATCA technology is an open, standards-based bladed system architecture defined by PICMG® in 2002 with high availability (99.999%) as a core tenet. It has as a long life cycle planned to the next decade and beyond.

AdvancedTCA® or ATCA® technology has proven itself to be one of the most successful open, bladed architectures for high-performance, ultra-reliable network computing. Its compact, light and power-efficient design with moderate ruggedness now makes it the ideal choice for military, aerospace and security equipment makers.

ATCA technology embodies MOSA into system platforms by optimizing joint combat system performance and total cost of ownership (TCO) over the entire program life cycle. Its rich multi-vendor ecosystem ensures that the architecture is extensible and enables key technology refreshes into production programs over time, without the need for a full system upgrade. One of the specific benefits of ATCA technology is that it also enables forward and backwards systems compatibility via the use of standard system interfaces.

Artesyn offers an ATCA product portfolio that includes server blades, DSP blades, Ethernet fabric blades and fully integrated systems. We are committed to longevity and new technology insertions to span the next decade and beyond. Our products are deployed in defense applications worldwide in applications such as:

- ***Shipboard communications and data center consolidation***
- ***Naval tactical combat systems refresh***
- ***Airborne reconnaissance***
- ***Theater command centers***
- ***Mobile Tactical Operations Centers (TOCs)***
- ***Ground and airborne battle management systems***
- ***Net-centric converged solutions for voice, video, and data***
- ***C4ISR***

FEATURES

› Rich ecosystem of blades and systems with a strong history of deployment in defense applications

› Regular technology refreshes to enhance and extend applications

› Commitment to a long life cycle

› Support for real-time Linux

Visit our website
www.artesyn.com/atca

mil-embedded.com/p374341

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Embedded Hardware

ADLINK
Leading EDGE COMPUTING

Server-Grade 3U VPX Processor Blade with GPGPU

ADLINK's rugged **VPX3010 Series 3U VPX** processor blade offers server-grade performance for high-performance computing power and optional GPGPU acceleration for enhanced workload throughput.

The ADLINK VPX3010 Series features the Intel® Xeon® Processor D-1500 SoC with up to 12 cores. This SWaP-optimized rugged VPX blade can be equipped with a 384 CUDA core NVIDIA GeForce GT 745M GPU XMC module or paired with ADLINK's VPX3G10 VPX GPGPU blade for greatly enhance performance capabilities.

ADLINK recognizes the trend towards implementing general-purpose computing on graphics processing units (GPGPU) for parallel computing and increased processing performance, and our discreet VPX3G10 blade and XMC-G745 module GPGPU companion products target a variety of high-performance computing applications that can take advantage of this technology.

A VPX-R3010 Rear Transition Module is available to access rear I/O signals and a 9-slot 3U VPX Test Frame allows users to validate VPX3010 functionality in for their application.

The ADLINK VPX3010 processor blade is available in rugged conduction and air cooled versions with conformal coating, making it ideal for mission critical applications in radar; intelligence, surveillance and reconnaissance (ISR); digital signal processing; UAV/UGV platforms; and electronic warfare.

FEATURES

- Intel® Xeon® Processor D-1500 SoC, up to 12 cores, DDR4-2133 soldered ECC SDRAM up to 16GB
- Dual 10G-KR, up to three 1G Ethernet ports
- PCIe x16 Gen3 interface supporting non-transparent bridge
- XMC expansion slot, PCIe x8 Gen3 with rear I/O to P2
- Onboard soldered 32GB SLC SATA solid state drive
- Rear I/O via P1/P2: 4x 10GE, 2x SATA 6 Gb/s, 3x USB, 6x GPIO, VGA, RS-232/422
- OS support: VxWorks 7.0, Red Hat Linux 6.5 and Windows 7

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ADLINK Technology
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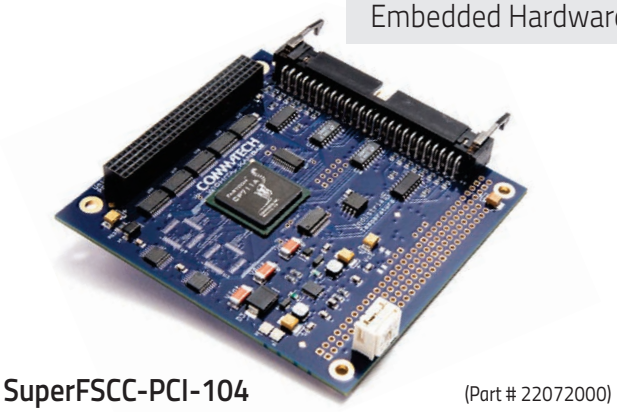
Embedded Hardware

Fastcom®

Hot, Dirty, Wet, Soft, Fast, Cheap, Rugged and Never Out of Style

- **Hot. Damn hot.** Expect the Fastcom® SuperFSCC-PCI-104 to operate normally, without performance degradation, at up to +85 C (and down to -40 C).
- **Dirty.** Dusty, grimy places. Fastcom® is READY.
- **Wet.** Optional conformal coating protects Fastcom® from moisture and other contaminates.
- **Soft.** Windows and Linux API developed and supported by us – Really.
- **Fast.** Up to 120Mbits/s. Fully programmable baud rate generator, fastest data rates in the industry. Period.
- **Cheap.** Not. When a project is your responsibility, Fastcom® is READY.
- **Rugged and Never Out of Style.** Fastcom® products are manufactured in the USA to IPC standards and feature a Limited Lifetime Warranty. Never obsolete. We promise.



SuperFSCC-PCI-104 (Part # 22072000)

Fastcom® Products presents the *Super*FSCC-PCI-104 adapter with data rates up to 120Mbits/s providing next generation communications at unsurpassed speed! The *Super*FSCC-PCI-104 adapter features dual channels – independently configurable as synchronous or asynchronous and is available with RS-422/RS-485 or LVDS drivers/receivers. For Factory Automation, Heavy Transportation, Test and Measurement or other tough environments – you need hardware that's ready to be *hot, dirty, wet, soft, fast, rugged and never obsolete* – Fastcom® products.

For technical information or to place an order, go to our website www.fastcomproducts.com

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316-636-1131

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Connect Tech Inc.
Embedded Computing Experts

3U VPX Solutions from Connect Tech

Connect Tech's VPX products are VITA 65 compliant, 3U embedded solutions. The newest offering, the **GraphiteVPX/CPU-TX2/TX1** is a 3U VPX single board computer that brings the NVIDIA® Jetson™ TX2 or TX1 embedded computing platform to the 3U VPX form factor.

The **GraphiteVPX/GPU** solution brings the NVIDIA® GeForce™ GTX 1050Ti to the highly rugged embedded VPX marketplace. The **GraphiteVPX/GbE** (pictured) provides Carrier Grade Ethernet switching capabilities in a small 3U embedded form factor. The **GraphiteVPX/XMC-PMC** is a VITA 65 compliant 3U peripheral carrier card with PCIe Gen 3.0 capable features.

FEATURES

- GPU Options: NVIDIA® Jetson™ TX2/TX1, NVIDIA GeForce™ GTX 1050Ti
- 36 Port Carrier Grade Switch/Router, -40 °C to +85 °C
- XMC/PMC Carrier card with PCIe Gen 3.0 capable features

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Embedded Hardware

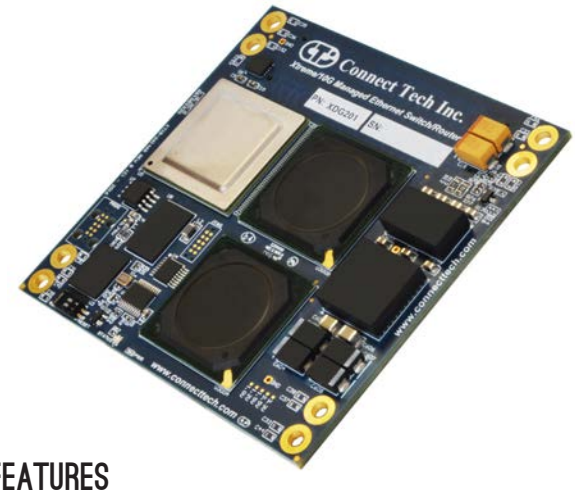
Connect Tech Inc.
Embedded Computing Experts

36-port Switch/Router from Connect Tech

The **Xtreme/10G Managed Ethernet Switch/Router** from **Connect Tech** targets managed Layer 2 and Layer 3 equipment in SMB, SME, and industrial applications where high port count 1G switching with 10G aggregation/uplinks are required.

This Managed 10G Ethernet Switch/Router is designed to act as a module allowing it to be mated to a Connect Tech off the shelf breakout board or with a custom designed breakout board to meet your exact application requirements.

Xtreme/10G Managed Ethernet Switch/Router provides a total of 36 switchable ports, with 4x 10G, 8x 1GbE (SGMII), and 24x 1GbE (Copper 10/100/1000Mbps) ports in an extremely small form factor 85mm x 85mm.



FEATURES

- 36 switchable ports (4x 10G; 8x 1GbE [SGMI]; 24x 1GbE)
- High-density board-to-board connector
- +4V to 14V input range
- 85mm x 85mm module
- Extended Temperature Range -40 °C to +85 °C

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CRYSTAL

A clear advantage.

RE1218M Rugged Embedded Computer

Rugged and Reliable, the **RE1218M** features a robust performance processor engineered for high-end workstation and storage capability. The computer is ideal for challenging environments where size, weight and power (SWAP) are a concern.

The RE1218M accommodates up to eight 2.5" solid state drives, one PCI 2 x16 expansion card, and may be mounted in any orientation, making it ideal for space-challenged applications that require powerful performance. The computer features options for an Intel® Haswell, Xeon D, or Skylake processor, and up to 128GB of DDR4 ECC on-board memory. The lightweight system is rugged, conforming to MIL-STD-810F (516) for vibration and can handle 20G of functional shock for 11 msec.

The versatile RE1218M can be tray-mounted or fixed-mounted and supports expansion for 1x PCIe 3.0 x16 while offering rugged MIL-C-26482 military circular connectors. The unit measures 4.1" h x 10.25" w x 14.4" d excluding connectors, and is cooled by quiet, high speed, high volume thermostatically controlled fans. The RE1218M is available in a lightweight aluminum chassis weighing between 14.5 and 16 lbs. depending on card content and is designed for peak performance at extended operational temperature ranges between -40°C to +60°C.

FEATURES

- Lightweight aluminum construction – 15 lbs. (6.8 kg)
- Tray or wall mounted
- MIL-C-26482 military circular connectors
- One to eight 2.5" SSD removable drives
- Haswell, Xeon D or Skylake CPU
- Modular power supply for multiple input options
- One PCIe x16 expansion slot

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Crystal Group Inc.
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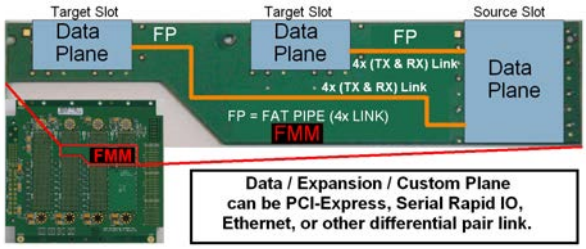
Embedded Hardware

Dawn VME Products®

Fabric Mapping Modules



Dawn OpenVPX backplane **Fabric Mapping Modules** simplify topology customization. Dawn VME Products FABRIC MAPPING MODULES automate optimization of OpenVPX backplane topologies. Newly patented FMM micro-overlays quickly customize off-the-shelf OpenVPX backplanes to mission requirements.

Fabric Mapping Modules allow designers to work with flexible configurations of high speed links. Off-the-shelf backplanes can be quickly customized to mission requirements without the time and expense required for new backplane designs, a critical advantage when schedules are compressed by late system changes. Dawn engineers have successfully used Fabric Mapping Modules to solve many OpenVPX application problems in the design phase.

Fabric Mapping Modules provide a natural migratory development environment for moving from the lab to the field with high speed OpenVPX backplanes.

FEATURES

- Off-the-shelf backplanes can be quickly customized to mission requirements
- Optimize the communication topology between slots within a system's backplane
- Customize inter-slot communications to meet unique system requirements
- Improve signal integrity between system cards beyond requirements of PCI Express, Serial Rapid I/O and 10Gbit (XAUI) Ethernet standards
- Directly connect PCI Express or SerialRapid I/O to multiple cards or cards and switches
- Link SATA from a CPU card to a Solid State Drive (SSD) carrier
- Enable XMC cards to talk to other XMC cards or other I/O like PCI Express links
- Facilitate rear backplane I/O connections and low profile connector interface systems when normal transition modules do not fit the system application envelope

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DDC
Connectivity Power Control

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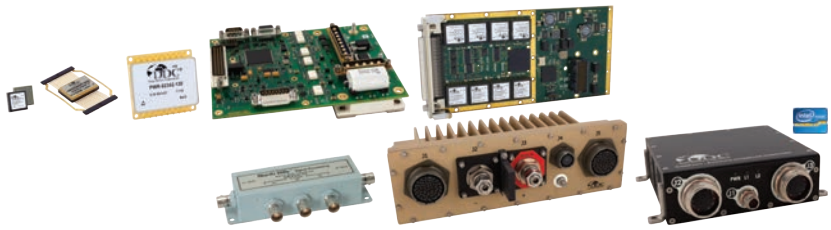

DDC is a world leader in the design and manufacture of high-reliability Connectivity, Power and Control solutions *(Data Networking; Power Distribution, Control and Conversion; Motor Control and Motion Feedback)* for aerospace, defense, and industrial applications. With awards for quality, delivery, and support, DDC has served industry as a trusted resource for more than 50 years ... providing proven solutions that are optimized for efficiency, reliability and performance. Data Device Corporation brands include DDC, Beta Transformer Technology Corporation, National Hybrid Inc., North Hills Signal Processing Corporation, Pascall Electronics Ltd., and XCEL Power Systems Ltd. DDC is headquartered in Bohemia, NY and has manufacturing operations in New York, California, Mexico, and the United Kingdom.

DDC designs boards, hybrids, and multi-chip modules (MCM) to meet ruggedness and reliability levels for performance in demanding environments:

- **Ruggedization**
  - Flyable boards for conduction or air-cooled applications
  - Extended temperature operation
  - MIL-STD-810/VITA 47 shock and vibration
- **Life Cycle**
  - Uninterrupted product availability, backwards hardware and software compatibility, and configuration control

Leader in standard and custom electronic solutions for commercial aerospace, defense and space ...

- **Connectivity**
  High reliability data bus solutions ...
  - MIL-STD-1553/1760, ARINC 429, ARINC 629, Fibre Channel, Ethernet, CANbus & serial I/O
  - Optimized avionics computers, modules, boards & components maximize system performance
  - Radiation tolerant single board computers, hybrids, and ASIC components
  - Cross domain solutions that enable secure "red/black" data communications
- **Power**
  High reliability power solutions ...
  - Power supplies
  - Solid-state power controllers with over 800,000 nodes installed
  - Transformer and magnetic solutions
- **Control**
  High reliability motion control solutions ...
  - *When off-the-shelf won't do ... DDC custom motor controllers and drives.* DDC has a proven track record of solving the most complex and technically challenging motor control requirements
  - Synchro/Resolver-to-Digital and LVDT converters for precision motor & actuator positioning for demanding applications – Rugged & reliable motion feedback solutions engineered for dust, fluid, shock, vibration, extreme temps (-55°C to +200°C) with precision performance – Accuracy (1 arc-min), resolution (16 bit), repeatability (1 LSB)

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www.twitter.com/datadevicecorp

ELMA
Your Solution Partner

3U Open VPX CMOSS C4ISR Convergence Backplane

This 12 slot 3U Open VPX backplane (12 payload +2 power supply slots) supports the defense industry's h/w and s/w convergence initiatives for modular architecture. It is an integration platform for modules addressing the DoD's CMOSS (C4ISR Modular Open Suite of Standards) providing the foundation for creating systems optimized for performance, reduced SWaP and lower lifecycle costs for rapid technology insertion. The backplane, in accordance with CMOSS, allows the integration of different instruments into the same chassis so they can share common sensors and communicate directly thus eliminating much external cabling. It enables the development of complex, high speed signal processing systems with the latest fiber and RF connectivity as well as precision radial network timing plus slot profiles for SBCs, switches, radial clock(s) and expansion. The backplane supports high speed signals on all data paths plus has leading edge VITA 67.3 modular connectors compatible with legacy VITA 67.1 and VITA 66.4 RF and optical I/O connectors.

Developers can deploy the backplane in its entirety or in part by working with Elma to identify the optimal configuration.

Elma is a key technology contributor to the Open VPX initiative and an experienced supplier of complete integrated systems – from development through deployment.

FEATURES

- Slot profiles as defined in MOSA, VICTORY, MORA, VITA 49, VITA 65, HOST, FACE, SOSA and RedHawk Linux
- Supports 1000BASE-BX, 10GBASE-KX, 10GBASE-KR, or 40GBASE-KR4 connectivity
- VITA 66.4 optical, 67.1 RF and VITA 67.3 RF/Optical modules
- Supports IEEE 1588 precision timing protocol with a radial clock card slot and seven supporting slots for sub-microsecond network timing and synchronization
- Slots 13 and 14 for two VITA 62 power supplies
- Extended operating temperature for hostile environments
- Extensible design enables custom slot profile configurations for the deployed system

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Embedded Hardware

ELMA

Your Solution Partner

Type 39 E-Frame Test and Development Chassis

Does your embedded system development chassis enable easy access to the payload cards and backplane connections for easy debugging and test probing? That's exactly what Elma's family of Type 39 E-Frame open access chassis provides.

Taking a new board level product or system from concept to deliverable requires feature rich development and testing tools. Elma's Type 39 E-Frame development chassis for VITA and PICMG bus architectures provide the platforms necessary to meet that need. The Type 39 E-Frame enclosure is ideal for lab development and provides open accesses for probing, debugging cards, system integration and application development. Type 39 E-Frames can be configured with one of a wide range of backplane types from our inventory including options supporting VME, VME64X, VPX, cPCI, cPCI Serial and VXS embedded form factors in 3U and 6U. Power supply options include both slot based pluggable units and chassis mount configurations meeting a range of voltage requirements. Slot counts and can be configured in chassis widths of 49HP and 84HP. High CFM fan cooling solutions plus optional conduction cooling slot inserts ensure your board set will remain at an acceptable operating temperature. System monitoring solutions are also available with the Type 39 E-Frame.

FEATURES

- Plug in and chassis mount PSUs
- Front accessible test points
- System monitoring with fan speed control
- Rear transition backplane slots for rear access
- Top handle for easy transport
- Front panel LED indicators
- Durable, black powder coat finish

For a more complete view of our products visit our website at www.elma.com

mil-embedded.com/p374327

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Embedded Hardware

EURESYS™

Excellence in vision

Coaxlink Duo PCIe/104

Transmission and acquisition of high-definition video over long coaxial cables

CoaXPress is a recent powerful standard providing a high speed interface between the camera and the PC frame grabber. High frequency real time triggering and exposure time adjustment to the low light situations can be accommodated.

Airborne ISR

Vision systems often integrate high resolution and high speed CoaXPress cameras for airborne Intelligence, surveillance and reconnaissance missions.

Transport, security

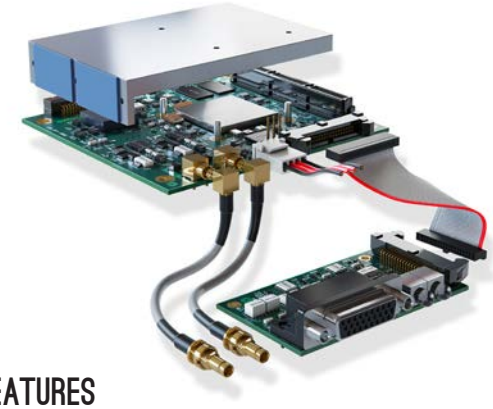
Thanks to a high resistance to extreme temperatures, shocks, vibrations and humidity, the Coaxlink Duo PCIe/104 board is particularly well suited for embedded security systems for rail and road transportation, police vehicles equipment or any mobile or outdoor video-surveillance applications.

Camera turrets for airborne surveillance or gun turrets

CoaXPress cameras can easily be integrated in 360°C rotating stations with slip rings to allow continuous panning. High resolution video provides sharper images and a larger viewing area thereby potentially reducing the number of cameras required.

Unmanned applications, vehicle-based video capture

The CoaXPress standard allows video transfer to the PC in a few milliseconds. The very low latency of the system will allow the control of land vehicles or remote control of UAVs.



FEATURES

- Ruggedized COTS board for industrial and military embedded applications
- Small stackable PCIe/104 form factor
- Extended temperature range: -40 to +85°C / -40 to +185°F with conduction cooling (ambient temperature measured inside the enclosure)
- Sustained shock: 20 g/11ms (all axes – half-sine and saw tooth)
- Optional conformal coating
- Two CoaXPress CXP-6 connections: 1,250 MB/s camera bandwidth
- Feature-rich set of 10 digital I/O lines

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GENERAL MICRO SYSTEMS, INC.

S2U "King Cobra" Rugged 2U Rackmount Server

The **S2U "King Cobra"** is a major breakthrough in **server/switch/Cisco router technology**. It is the smallest, fastest server on the market, with more I/O performance and storage functionality than any other server. It replaces up to 15U of 1U/2U servers, switches/routers, RAID controllers, and Auxiliary Power Units (APU) with a single 2U, 17-inch deep (short) rack-mountable (or freestanding enclosure.

One hundred percent of the "King Cobra" electronics are Line Replaceable Units (LRU) specifically designed for field replacement and upgrading. This 100% LRU functionality allows the user to replace any function of the system in the field within ***seconds***, thus providing ultimate flexibility and economy while minimizing down time. S2U also easily evolves as program needs change.

The S2U features a state-of-the-art rugged and proven OpenVPX architecture. Unlike PC motherboards, which virtually all servers use, the OpenVPX design allows much higher shock, vibration, and temperatures than standard servers. S2U's reliable, field-proven 100% LRU architecture also takes full advantage of commercial-off-the shelf (COTS) PCIe boards, such as high-end video boards, RAID controllers, GPGPU, and DSP modules, which may be quickly plugged and unplugged into the system within seconds. A complete Cisco Embedded Services Router is an optional part of S2U.

FEATURES

- Dual socket Intel Xeon E5, 1 TB DDR4 RAM, Cisco router, 22-port switch, 48TB RAID, Nvidia GPU
- VPX-based "motherboard" assures MIL-SPEC compatibility, P3I and reliability
- 23 Gigabit Ethernet ports (8 with PoE); 4 10Gigabit Ethernet ports
- Standards-based add-in modules for myriad I/O via PCIe, PCIe-Mini, XMC, M.2, 3U VPX
- Supports two 6U OpenVPX, modules, three 3U OpenVPX modules and four full-length/height PCIe modules
- Supports twelve 2.5" removable storage devices such as x4 PCIe NVMe SSD and SAS/SATA III drives
- Built-in 110/220VAC 60/400Hz or MIL-STD-1275 28VDC APU/PSU for holdup and smooth shut-down
- 100% Line Replacement Unit (LRU) for ultra fast service, upgradability and sparing
- Operates at standard temperature 0°C to +50°C or extended temperature -20°C to +75°C
- Ultra-low SWaP, only 17" x17" x 3.25" @ 30 lb and as low as 300W. Optional Auxiliary Power Unit for graceful shutdown
- 100% USA-based design, manufacturing and MIL-SPEC materiel configuration, logistics and life-cycle plan

All of General Micro Systems products are Trusted and Deployed Since 1979

New for 2017 Add-in I/O:

1553, ARINC, FPGA, GPGPU, A/D/A, RF and DDC

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HOLT INTEGRATED CIRCUITS INC.

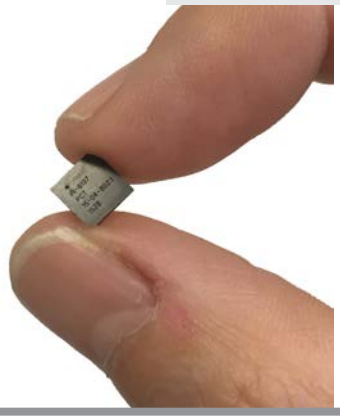
MAMBA™: World's Smallest MIL-STD-1553 IC Solution

Holt's 3.3V MIL-STD-1553 MAMBA™ family provides a complete single- or multi-function interface between a host microprocessor and MIL-STD-1553B bus. The family provides fully compliant Bus Controller (BC), Bus Monitor Terminal (MT) and Remote Terminal (RT) functions. Four device options are available; BC/RT/MT, BC/RT, RT/MT and RT only, with the ability to enable any combination of the included MIL-STD-1553 functions for concurrent operation.

The user allocates 8K x 17-bit words of on-chip static RAM between devices to suit application requirements, communicating with the host MCU via a 40 MHz Serial Peripheral Interface (SPI). Up to 32 programmable interrupts may be stored in a 64-Word Interrupt Log Buffer, providing terminal status to the host processor.

Each device may be configured for automatic self-initialization after reset. A dedicated SPI port reads data from an external serial EEPROM to fully configure registers and RAM and optionally start execution for any subset of terminal devices. In addition, a MIL-STD-1760 Boot Pin may be used to initialize the RT with Busy Bit set without host intervention.

All devices have integrated dual MIL-STD-1553 transceivers and are available in 48-pin plastic QFP or 6mm x 6mm QFN packages.



FEATURES

- World's smallest MIL-STD-1553 terminal: QFN package measures just 6mm x 6mm
- 4 product variants: RT, RT/MT, BC/RT and BC/RT/MT with concurrent multi-terminal operation possible
- Integrated dual transceivers on all product variants
- 40 MHz Serial Peripheral Host Interface (SPI)
- MIL-STD-1760 Boot Pin to initialize RT with Busy Bit set without host intervention
- Two temperature ranges: -40°C to +85°C, or -55°C to +125°C with optional burn-in
- DO-254 certifiable

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Holt Integrated Circuits
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Embedded Hardware

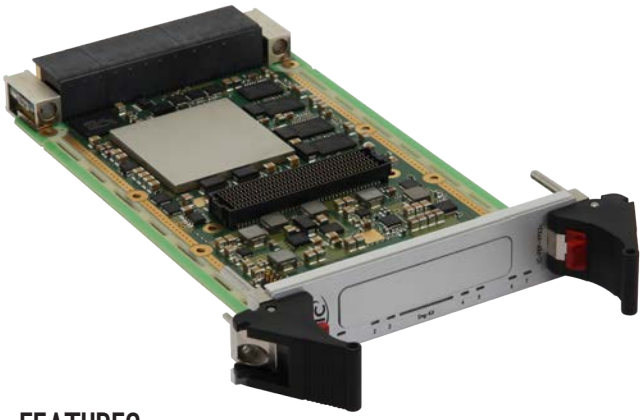
IC INTERFACE CONCEPT
ADVANCED ELECTRONIC SOLUTIONS

IC-FEP-VPX3d

3U OpenVPX Front-end processing board based on Kintex® UltraScale™ FPGA.

The **IC-FEP-VPX3d** front-end processing board combines a user programmable Kintex® UltraScale™ FPGA, two banks of DDR4, general purpose I/O, together with a FMC+ site (FPGA Mezzanine Card) in a single 3U OpenVPX slot. The FMC+ site that is compliant with VITA 57.4 standard, provides additional High Speed serial links to the FMC, while keeping a backward compatibility with the legacy FMC (VITA57.1). This board is ideally suited for demanding computing applications such as Radar, Electronic Warfare, etc. It is one of the core building blocks of next High Performance Embedded Computing (HPEC) systems. IC provides the remaining building blocks: COTS Ethernet Switching and COTS Intel/NXP Single board computers boards.

Web product link:
www.interfaceconcept.com/products/ic-fep-vpx3d.html



FEATURES

- One Kintex® UltraScale™ FPGA KU060, KU85 or KU115
- Two banks of DDR4 (up to 4GB each)
- Four * 128 Mbytes of QSPI Flash memory
- Four * 4-lanes fabric ports on P1/P2
- 16 differential pairs from FPGA on P2
- 1 * FMC+ site

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INTERFACE CONCEPT
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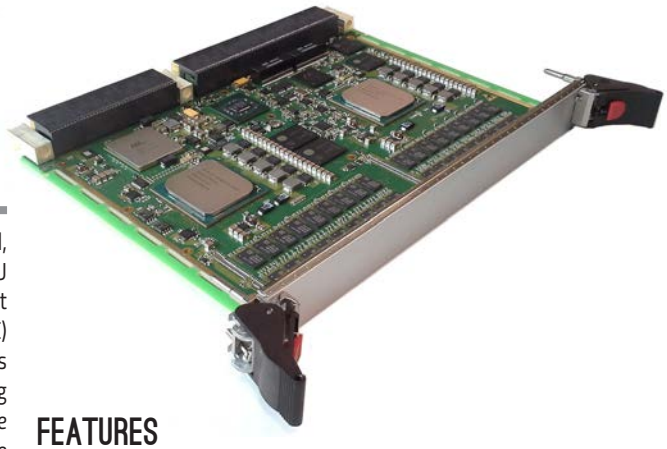
IC-INT-VPX6e



The **IC-INT-VPX6e** is a Server Class Digital Signal Processing (DSP) board, based on two Intel® Xeon®D-15xx processors (12-core version), in a 6U VPX form factor. The IC-INT-VPX6e combines unmatched performance at low power with the leading-edge Intel® Xeon® 14nm Systems-on-Chip (SoC) package, together with up to 64GB high-speed DDR4 memory. It features a PCIe Gen 2/3 switch and a GigaEthernet low latency switch, expanding the board rear interconnections capabilities: 16 lanes are available on the data and expansion planes via the PCIe switch, and 7 GigaEthernet ports are available on the control plane. In that way, it is easily "pluggable" in custom or standard full mesh backplane or in centralized system when interfaced with our ComEth4510a or ComEth4115a switches.

As for storage and comms, the board provides, for each node, one scalable and secured SATA Nand SDD, GPIOs, USB, SATA ports as well as one VGA interface. One core FPGA (dedicated to securisation) can be used to implement custom features on rear IOs. Interface Concept provides Linux® LSP (IC SDK, others...) and BSP for VxWorks® together with the board. Compliant with OpenVPX™ standard, it is available in air-cooled and conduction-cooled versions (compliant with VITA 47 classes).

FEATURES

- 2 * Xeon® Processor D-15xx (up to 12 cores)
- DDR4 with ECC (up to 2x16GB per processor)
- Secured Boot flash memory
- On-board Secured SATA SSD (32GB per processor)
- 1 * PCIe Gen 2/3 switch
- 1 * GigaEthernet switch
- 2 * 10GBASE-KR

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Embedded Hardware

INTERFACE CONCEPT
ADVANCED ELECTRONIC SOLUTIONS

IC-PPC-VPX3d

The **IC-PPC-VPX3d** is a 3U VPX high performance and low power Single Board Computer (SBC) based on the NXP QorIQ® T2080 multicore processor (64-bit e6500 core) running up to 1.8 GHz. The four processor's e6500 cores share a low-latency backside 2MB L2 cache, enabling efficient code and data sharing. Each of them implements the NXP AltiVec technology SIMD engine, increasing the performance of the platform.

The IC-PPC-VPX3d provides an ideal solution for applications requiring high performance, low power, as well as multiple I/O capabilities. It features up to 8GB of DDR3-ECC, one PCIe Gen2/3 x4 port, two PCIe Gen2 x4 ports, two Ethernet ports (10GBASE-KR or GigaBASE-KX), and general purpose I/O. The IC-PPC-VPX3d XMC slot provides the board with again more flexibility. An optional front 10 G Ethernet port substitutes this XMC slot. Together with the board, Interface Concept provides Linux® LSP (IC SDK, others...) and BSP for VxWorks®. The IC-PPC-VPX3d is compliant with the VITA 46.0 standard 3U module definitions. It is available in air cooled and conduction cooled versions (VITA 47 classes compliant).

FEATURES

- 1 * NXP QorIQ® T2080 multicore processor
- 2 * 10GBASE-KR or GigaBASE-KX Ethernet ports
- 1 * 10GBASE-T Ethernet port
- 1 * RS232 console port
- 2 * RS422/RS422 UART
- 2 * USB2 ports
- 2 * SATA ports

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LCR® EMBEDDED SYSTEMS, INC.

Customizable, Rugged Featherweight COM Express System

Weighing in at a SWaP-friendly 7.5lb, designed specifically for demanding field applications, and featuring COM Express technology, LCR Embedded Systems' fully integrated, forced convection cooled, customizable, featherweight COM Express Single Board Computer System breaks new ground for demanding applications that require lightweight, rugged, compact compute and storage such as harvesting and streaming sensor and video data in the field.

The COM Express System features a 6th generation Intel Xeon Core i7 (Skylake) Mobile Server/Embedded processor with up to 32GB DDR4 memory, and dual DisplayPort outputs. An optional Graphics Processing Unit (GPU) provides additional DisplayPort/HDMI options, and HD video processing support. In addition, LCR Embedded Systems' thermal layer is capable of removing up to 100W of heat, enabling you to take full advantage of processor performance.

For more information:
www.lcrembeddedsystems.com

FEATURES

- Weighs less than 8 lb; ideal for highly mobile field applications such as UAVs, man-pack, ground mobile
- 6th generation Intel Xeon Core i7 (Skylake) Mobile Server/ Embedded processor with up to 32GB DDR4 memory, and dual DisplayPort outputs
- Available in multiple configurations for demanding applications
- Optional wireless/WiFi capability for fast communications in a lightweight package
- Can ship with or without the operating system of your choice
- Space for up to two high-capacity removable SSD hard drives
- Customizable I/O to meet your application requirements

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LCR Embedded Systems
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Embedded Hardware

LCR® EMBEDDED SYSTEMS, INC.

3-Slot Featherweight VPX System

Designed in collaboration with industry leader ADLINK, and featuring ADLINK processors and Graphics Processing Units (GPUs) LCR Embedded Systems' fully integrated, conduction-cooled, featherweight 3-Slot VPX System (shown at right) breaks new ground in addressing the concerns of UAV application developers and allows for the massive expansion of payload performance and processing power for autonomous vehicles.

The 3-Slot VPX System features ADLINK's VPX3010 processor based on the Intel® Xeon® D, and the second payload slot can hold either a Gigabit Ethernet switch or an ADLINK VPX3G10 Graphics Processing Unit.

For more information:
www.lcrembeddedsystems.com

FEATURES

- Ideal for small UAVs, man-pack, ground mobile
- 3-Slot VITA 48.2 VPX featuring superior cooling and processing
- Super-efficient chassis design
- Available in multiple configurations for demanding sensor management applications
- Features ADLINK VPX3010 processor blade with the Intel® Xeon® D processor
- Supports high-speed signaling
- Optional MIL-STD-1553 XMC card for communication with avionics bus
- Removable SSD hard drive
- Input power compliant to MIL-STD-704/MIL-STD-1275

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LCR EMBEDDED SYSTEMS, INC.®

Rugged 6-Slot AdvancedTCA Chassis

Designed in accordance with PICMG 3.0 Rev3, and featuring a variety of power options, this chassis is sturdy, efficient, and ready to support your most environmentally demanding mission-critical military applications.

This rack-mountable chassis accepts two shelf managers for redundancy and is constructed with a steel outer shell and machined card guides housing a machined aluminum frame. It is highly configurable and customizable for your specific program needs.

The chassis employs side-to-side convection cooling of 300W per slot, with six redundant 189 CFM fans, with monitoring and control via PWM.

For more information:
www.lcrembeddedsystems.com

FEATURES

- Superior cooling (300W per slot)
- Six slots (2 Hub, 4 Node)
- Shock and vibe MIL-STD-810
- Altitude: 15,000ft
- Three 110/220 VAC inputs, 1500W per power supply, N+1 redundant
- Backplane fabric/profile full mesh bussed UPMB
- Fully customizable

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Embedded Hardware

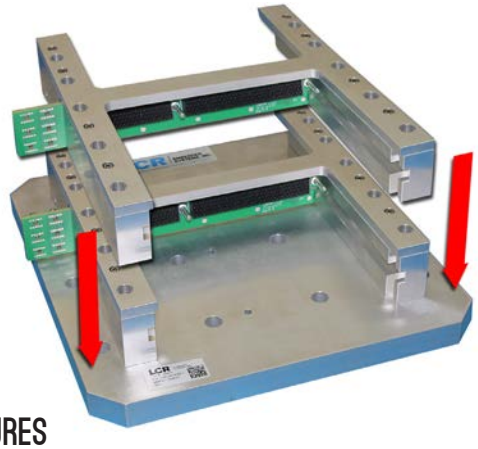
LCR EMBEDDED SYSTEMS, INC.®

Stackable Single-Slot Test Fixture

The VITA 48.2-compliant Stackable Single Slot Test Fixture can be used for development, validation, and environmental testing. In the vertical configuration, the fixture can be used on the benchtop or desktop for development and validation. In the horizontal configuration, it can be used for operational/non-operational environmental testing.

The fixture is compliant with VITA 46.0 (VPX base), with options for VITA 66 (optical interconnect) and VITA 67 (coax interconnect). Rear connectors for cables or RTMs are included, with optional support for VITA 46.10 RTMs.

For more information:
www.lcrembeddedsystems.com



FEATURES

- Form Factor: VPX, VME, CompactPCI, or Custom
- 6U Card size, 3U optional
- Conduction cooling
- Bolted machined aluminum construction
- Can be vertically mounted as well
- Ideal for testing, development, and validation
- Fully customizable and stackable

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Embedded Hardware

mercury systems™

Mercury HDS9624 Secure Rack Servers

Mercury's HDS9624 Secure Rack Servers address the need for rack servers with system security features that can be forward deployed or sold to allies under Foreign Military Sales (FMS) or Direct Commercial Sales (DCS) programs. In addition to the unique, built-in security features, Mercury's Secure Rack Servers are rugged and use a fully trusted supply chain for both hardware and software.

Security comes through system security features that deter reverse engineering. Mercury provides these security features as a turnkey solution or as a customer-private, customizable portfolio of techniques. Mercury's domestic DMEA accredited design, manufacturing and testing facility is staffed by US personnel building trust in to our Secure Rack Servers. The board support package, BIOS, and network stack are available for inspection by government agencies. System security features and trusted supply chain help enable system integrators to meet U.S. DoD instruction 5200.44 (Protection of Mission Critical Functions to Achieve Trusted Systems and Networks).

HDS9624 Secure Rack Servers are ATX-class servers with dual 10-core Intel® Xeon® E5 v4 processors and are supported by a robust Diminishing Manufacturing Sources and Material Shortages (DMSMS) mitigation plan for a minimum of 10 years support. Learn more by visiting **mrcy.com/rackmount** and reading our Tech Brief.

FEATURES

- Rackmount servers for FMS and DCS with built-in security
- Dual 10-core Intel Xeon E5 v4 processors
- Open Systems complaint for deployment with drop-in ease
- DMSMS mitigation and 10 years support
- Made using hard and software from trusted and managed supply chain
- Designed, made and coded in trusted, domestic DMEA facility

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Mercury Systems
www.mrcy.com/rackmount

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Embedded Hardware

MicroMax

Rugged Gigabit Ethernet Switch M-Max SW21X/PS

M-Max SW21X/PS is a ruggedized 12/14/16-Port Gigabit Ethernet Layer 2+ Managed Switch providing reliable operation in tough environments including transportation (ground, rail, air and marine), agriculture and mining. It accepts a wide power supply voltage input, and is tested and guaranteed over a temperature range of -40 to +75 °C. Its rugged enclosure is designed according to the VITA 75 footprint. Extended salty fog protection is also available upon request. The rugged switch complies with MIL-STD-810G, MIL-STD-461F. The M-Max SW21X/PS has up to sixteen 10/100/1000 Mbps copper twisted pair ports. Support for control and management is through a web interface, and host processor access is through a Command Line Interface (CLI). The embedded power supply complies with MIL-STD-704F and MIL-STD-1275D specifications.

MicroMax, as a manufacturer of ruggedized industrial computers, takes a customized approach to each client. Our engineering group can design M-Max systems to fit customer-specific technical requirements.

FEATURES

- Layer 2+ managed switch with12/14/16 ports of 10/100/1000 Mbps Ethernet over copper
- Built-in microcontroller for configuration and management
- 8K MAC addresses and 4K VLANs (IEEE 802.1Q), 8K IP multicast group support
- Extended salty fog protection (available upon request)
- Operating temperature from -40 to +75 °C
- Shock handling up to 40g, Vibration up to 2.5g
- Complies with MIL-STD-810G, MIL-STD-461F
- Wide power supply voltage input from +5 to +34 V DC or +28 V DC (complies with MIL-STD-704F, MIL-STD-1275D)

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MicroMax Computer Intelligence
www.micromax.com

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Embedded Hardware

MPL
High-Tech • Made in Switzerland

Fanless Embedded Computers up to i7 QuadCore and Xeon Server

The **PIP Family** and **MXCS Server** are powerful, highly integrated, robust, and fanless embedded Computer Solutions. Selection of the parts are purely made on the subject for long-term availability (Embedded Roadmap). The systems can be expanded in a very modular way and represent a unique solution for today's demanding defense requirements. The products are designed to operate under extreme and normal conditions without the need of fans. MPL solutions are designed and produced in Switzerland to meet MIL STD-810F as well as other standards.

The systems include features like wide DC input power, reverse polarity protection and more. Additional GPGPU, GPS, WLAN, CAN, Sound, and UPS modules are available.

Think Long-Term – Think MPL

FEATURES

- Soldered CPU and ECCRAM
- Ethernet (up to 10Gbit), USB (3.0/2.0), Serial ports ...
- PCIe, PMC, XMC, mPCIe, PCI-104, MXM expansion
- Extreme low power consumption
- Certified: e.g. DO-160G, MIL-STD-461, -704E, -1275E
- Availability 10+ years (repair 20+ years)
- Optional -40°C to 85°C environment temperature

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MPL AG
www.mpl.ch

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Embedded Hardware

ORION
A Phoenix Mecano Company

Open Architecture Rugged Solutions

At Orion Technologies we specialize in the design and development of embedded computers and rugged chassis systems for military applications. Our service offering includes COTS and custom solutions for rugged systems, single-board computers, and backplanes.

All of our products utilize the latest-generation technology and come with long lifecycle support. With over 20 years of experience designing and manufacturing single board computers and components, our team is poised to provide an extremely high level of support for your system needs.

Whether it's a small quantity, one-time requirement or high volume production, we would like to be *Your Partner in Embedded Solutions.*

Certified System AS9100 Aerospace

Inc. 5000 America's Fastest-Growing Private Companies

FEATURES

- ATR and Small Form Factor Rugged Chassis and Integrated Systems
- VPX, VME, cPCI, PCIe104, and COM Express Single-board Computers
- Vita 62 Compliant 150W - 715W Power Supplies
- Quick react custom solutions
- Backplanes and Development Chassis
- AS9100 Certified Small Business
- CFD Thermal Analysis

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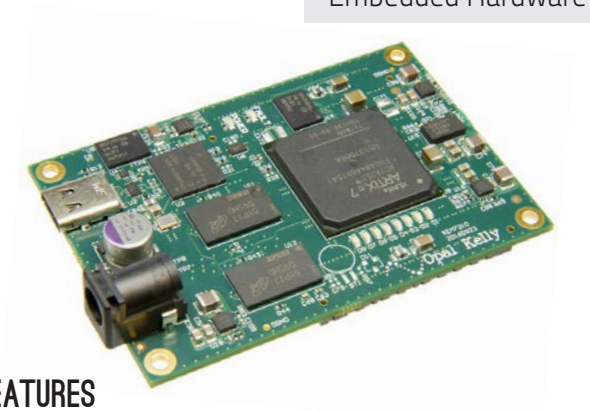
Opal Kelly

XEM7310

Reduce time and effort on product development by integrating the **XEM7310** into your next design. A production-ready module with a highly-capable Xilinx Artix-7 FPGA, 1 GiByte DDR3 SDRAM, and SuperSpeed USB3.0 host interface utilizing Opal Kelly's FrontPanel SDK, the **XEM7310** offers a small form factor for easy integration with your product. With ample logic resources, 126 user I/O, and two 80-pin Samtec connectors for high-performance peripheral connectivity, this module is well-suited to applications including ASIC/hardware-based simulation and verification, image capture and processing, cryptography, data security, and bioinformatics.

Celebrating over 10 years of USB FPGA connectivity, Opal Kelly's Front-Panel SDK fully supports the **XEM7310** for real-world transfer rates in excess of 340 MiB/s. FrontPanel includes a multi-platform (Windows, Mac, Linux) API, binary firmware for the on-board Cypress FX3 USB controller, and atomic HDL modules to integrate into your design. FrontPanel is the industry's most full-featured, high-performance, turnkey solution for professional grade USB connectivity.



FEATURES

- Xilinx Artix-7 (A75 and A200 densities available)
- 1-GiByte DDR3 SDRAM, 2x 16-MiB serial flash
- 126 user I/O including 4 MRCC pairs, 4 SRCC pairs, and 1 XADC pair
- Self-powered by external DC source
- Low-jitter 200 MHz clock oscillator
- Two 80-pin 0.8mm Samtec board-to-board connectors (BSE-040)
- Small form-factor (smaller than a credit card) at 75mm x 50mm x 15.8mm (2.95" x 1.97" x 0.62")
- Complete Application Programmer's Interface (API) in C, C++, C#, Ruby, Python, and Java

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Embedded Hardware

Opal Kelly

XEM7360

The **XEM7360** Kintex-7 based FPGA module offers a turnkey Super-Speed USB 3.0 host interface using Opal Kelly's FrontPanel SDK. System integrators can build fully-operational prototype and production designs quickly by integrating this device into their product. Manufacturers of high-speed devices such as JESD-204B data acquisition devices can launch fully-functional evaluation systems without the costly design and maintenance of an evaluation platform.

With ample logic resources, the Kintex-7 is well-suited to signal processing, image processing, and other logic-heavy acceleration tasks. Memory-hungry applications enjoy access to 2 GiB of on-board DDR3 memory with a 32-bit wide data bus.

Celebrating over 10 years of USB FPGA connectivity, Opal Kelly's Front-Panel SDK fully supports the **XEM7360** for real-world transfer rates in excess of 340 MiB/s. FrontPanel includes a multi-platform (Windows, Mac, Linux) API, binary firmware for the on-board Cypress FX3 USB controller, and atomic HDL modules to integrate into your design. Front-Panel is the industry's most full-featured, high-performance, turnkey solution for professional grade USB connectivity.

FEATURES

- Xilinx Kintex-7 XC7K160T or XC7K410T
- 2 GiB DDR3, 2x 16 MiB serial flash
- Two Samtec QSH-090 expansion connectors
- Up to 193 user I/O + 8 Gigabit Transceivers
- Low-jitter 200 MHz and 100 MHz clock oscillators
- Integrated voltage, current, and temperature monitoring
- Small form-factor: 100mm x 70mm x 19.65mm

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PENTEK

FlexorSet Model 5973-320

Model 5973 is a member of the OnyxFX® family of high-performance 3U VPX baseboards with a Xilinx Virtex-7 FPGA and an available FMC I/O slot.

As an integrated solution, the Model 5973-320 FlexorSet™ combines the Model 5973 and the Model 3320 Flexor® FMC as a factory-installed set. The required FPGA IP is installed and the board set is delivered ready for immediate use.

Designed to allow users to optimize data conversion rates and modes for specific application requirements, the FlexorSet provides preconfigured conversion profiles. Users can use these profiles which include: digital downconverter and digital upconverter modes, conversion resolution and A/D and D/A sample rates, or program their own profiles. In addition to supporting PCIe Gen. 3 as a native interface, the Model 5973-320 includes optional copper and optical connections to the Virtex-7 FPGA for custom I/O.

Extendable IP Design

For applications that require specialized functions, users can install their own custom IP for data processing. Pentek GateFlow® FPGA Design Kits include all of the factory-installed modules as documented source code. Developers can integrate their own IP with the Pentek factory-installed functions or use the GateFlow kit to completely replace the Pentek IP with their own.

Memory Resources

The 5973-320 architecture supports four independent DDR3 SDRAM memory banks. Each bank is 1 GB deep and is an integral part of the board's waveform playback capabilities, providing local storage for user waveforms.

PCI Express Interface

The Model 5973-320 includes an industry-standard interface fully compliant with PCI Express Gen. 1, 2 and 3 bus specifications. Supporting PCIe links up to x8, the interface includes multiple DMA controllers for efficient transfers to and from the board.

FEATURES

- Includes Xilinx Virtex-7 FPGAs
- GateXpress supports dynamic FPGA reconfiguration across PCIe
- Two 3.0 GHz A/Ds & Two 2.8 GHz D/As
- 4 GB of DDR3 SDRAM
- Sample clock synchronization to an external system reference
- PCI Express (Gen. 1, 2 & 3) interface up to x8
- User-configurable gigabit serial interface
- Optional optical Interface for gigabit serial interboard communication
- LVDS connections to the Virtex-7 FPGA for custom I/O and synchronization
- Ruggedized and conduction cooled versions available
- Available in 3U VPX & PCIe formats

Flexor

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PHOENIX INTERNATIONAL

PHALANX II

The Phalanx II is a rugged Small Form Factor (SFF) Network Attached Storage (NAS) computer system, specifically tailored for the avionics, military and rugged industrial market. The system offers the best utilization of Size, Weight and Power (SWaP) and adherence to Commercial Off the Shelf (COTS) standards in the industry.

Utilizing two military grade solid state disk storage devices (fixed or removable), the Phalanx II will support a variety of network based file systems that allow for multiple hosts to store and share information. Network connections are provided through four load balanced Gigabit Ethernet ports, and can support optional dual optical 10 Gigabit Ethernet ports for low EMI susceptibility.

Management is via a convenient web based GUI or CLI. System and storage health and performance monitoring capabilities include SMART, SNMP (read-only), and Email notification.

The optional dual removable storage bay is available for ready access to the storage media, allowing for fast data availability for ground station analysis, and quick mission turnaround and declassification.

FEATURES

- CPU: Intel Core i7-6822EQ
- Memory: RAM 8GB, SLC FLASH 32GB
- Two SSDs (fixed or removable) up to 8TB ea, 16TB total
- Network Services: NFS (V3/V4), SBM/CIFS, FTP, TFTP, RSYNC, SSH
- Weight: < 6lb with fixed SSDs
- Temp: -40°C to +71°C (Op.), -40°C to +85°C (Non-Op.)
- MIL-STD-810F, MIL-STD-461F, MIL-STD-704F/1275D

MADE IN THE USA

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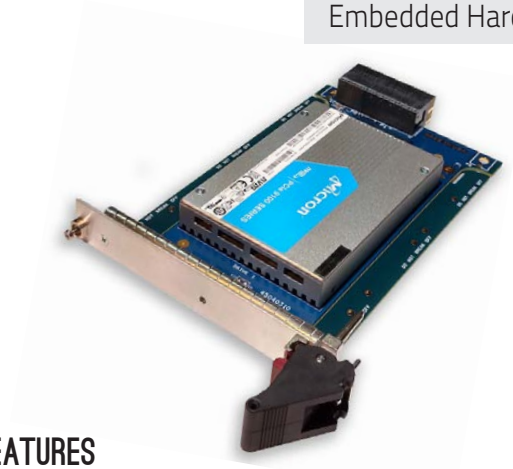
Embedded Hardware

PHOENIX INTERNATIONAL

VP1-250-eSSD

The VP1-250-eSSD is an Open VPX NVM Express (NVMe) SSD storage module that delivers extremely high performance via a single fat pipe (PCIe 4x). Designed from the ground up to remove legacy layers of hard drive interfaces such as SATA and SAS, it takes full advantage of the speed and parallelism of solid state nonvolatile memory. Streamlined efficient queuing protocol combined with an optimized command set register interface enables low latency and high performance.

NVMe is an industry standard registered interface designed to accelerate the performance of nonvolatile PCI Express (PCIe) SSDs. The NVMe protocol was established in collaboration by server industry leaders to standardize a scalable PCIe interface, making it easier for designers to unlock the full potential of PCIe. NVME provides opportunities for increased data throughput and reduced latency all while reducing the number of drives needed - both now and in the future. Adoption of this industry standard is driven by a strong consortium of storage technology providers and a robust ecosystem of drivers across multiple operating systems.



FEATURES

- Capacities to 11TB
- Optimized register interface and command set lowers latency
- Sequential 128KB read: 3.0 GB/s, write: 2.0 GB/s
- Random 4KB read: 750,000 IOPS, write 300,000 IOPS
- Streamlined protocol with efficient queuing mechanism to scale with multi-core CPUs
- 2,000,000 hours MTBF
- Available in air cooled and conduction cooled (VITA 48) configurations

MADE IN THE USA

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Embedded Hardware

POLY RACK TECH-GROUP

Rugged Air Transport Rack System

POLYRACK presents its ATR (Air Transport Rack) development system. The rugged MIL ATR system is designed according to ARINC 404A and has five 3U OPEN VPX slots. The rack conforms to VITA 65 and operates at a data transfer rate of up to 10Gbit/s. The dip brazed casing offers a completely sealed environment and assists by conducting the heat effectively away from the board and power supply unit. Wedge locks secure the board into the rack and supports thermal management. This robust and customize-able system provides excellent performance with the highest level of protection against shock and vibration, extreme operating temperatures, as well as dust and liquids in accordance with IP67 and other rough conditions.

FEATURES

- **Standard Dimensions:**
  - Height: 193 mm
  - Width: 124 mm
  - Depth: 211 mm
- **Surface Finishing/Material:**
  - 6061-T651 Aluminium plates, dip-brazed

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POLYRACK NORTH AMERICA CORP
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401-770-1500 or +49 (0)7082 7919-0

Embedded Hardware

rtd®

Intel Atom E3800-based SBC

The **CMX34BT** is an advanced PC/104 single board computer and controller with a PCIe/104 stackable bus structure. This Intel Atom E3800-based CPU is exceptionally suited for intelligent systems requiring low power consumption in harsh thermal conditions. The CMX34BT-series CPUs are available in quad-core, dual-core, and single-core configurations. Surface-mount Type 2 PCI Express connectors enable users to stack multiple peripheral modules above and below the CPU. All models include 4GB surface-mount single-channel ECC DDR3 SDRAM and a 32GB industrial-grade surface-mount SATA flash drive.

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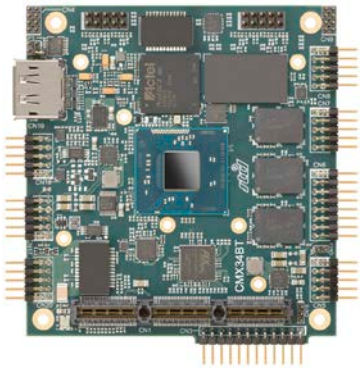

FEATURES

- PCIe/104 stackable bus structure
- Available in modular, rugged enclosures and eBuild systems
- Intel Atom E3800 Series Processor
  - *Clock Speed: 1.33 GHz, 1.46 GHz, and 1.91 GHz options*
  - *Max. Core Temperature: 110°C*
- 4GB Single-Channel DDR3 SDRAM (Surface-Mounted)
  - *Robust Error Code Correction (ECC)*
- 32GB Surface-mounted industrial-grade SATA flash drive
- 4 PCIe x1 Links, One SATA Port, 4 Serial Ports, 9 USB ports, Dual Gigabit Ethernet, Analog VGA, Embedded DisplayPort (eDP) 1.3 with Audio, on-board advanced Digital I/O
- -40 to +85°C standard operating temperature
- Thermal-optimized passive heat sink included

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Red Rapids

SigStream and SigFPGA Product Families

Red Rapids offers a catalog of signal acquisition and generation hardware products that target communication, telemetry, radar, spectrum monitoring, and instrumentation applications. The products are available in multiple form factors for seamless integration into an embedded chassis or traditional server/desktop environment.

Embedded products conform to the VITA conduction cooled XMC (CCXMC) specification. The CCXMC products can plug into any compliant host platform with no modification to the conduction frame. Temperature monitors distributed across each board provide in-system thermal performance measurements. Power monitors on each primary supply voltage also contribute to a comprehensive view of the operating environment.

All Red Rapids products include an on-board frequency synthesizer to produce a low phase noise clock source. The frequency synthesizer can be phase locked to the local 10 MHz TCXO or an external reference can be supplied to achieve system-wide phase coherence. An external sample clock input is also available to bypass the synthesizer.

A unified code base allows application developers to transition between products and across operating systems with a common API. Demonstration code exercises all of the API functions in a simple application example that includes high performance DMA scatter-gather operations. Windows and Linux drivers are provided at no additional cost to the product.

FEATURES

Plug and Play ADC/DAC

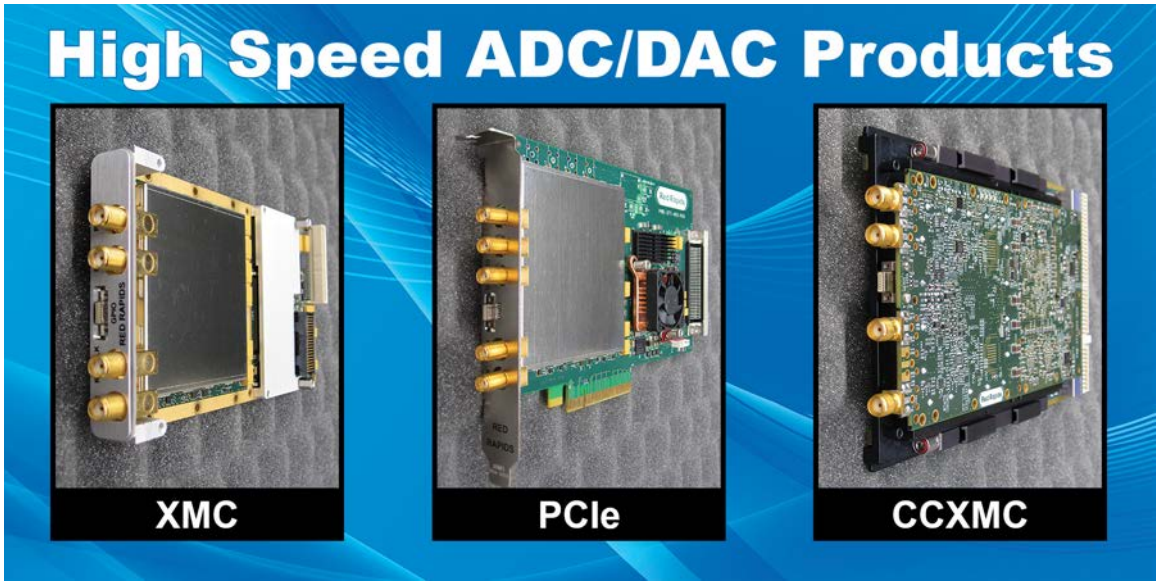
The **SigStream product family** instantly transforms a general pur-pose computer into a high speed signal acquisition platform. The hardware incorporates a rich set of software programmable features that include selectable operating modes (continuous, snapshot, periodic), external or timed event triggers, timestamped data samples, and flexible data formatting. Each channel can stream raw samples or data packets defined by the VITA 49 specification.

- **Model 271** Dual Channel Receiver (16-bit/250 Msps)
- **Model 273** Dual Channel Receiver (16-bit/310 Msps)
- **Model 276** Single Channel Receiver (12-bit/1.5 Gsps)
- **Model 277** Quad Channel Receiver (16-bit/250 Msps)
- **Model 278** Octal Channel Receiver (16-bit/125 Msps)

Xilinx FPGA Based DSP Accelerators

The **SigFPGA product family** provides an ideal platform to rapidly field application specific signal acquisition and generation functions minus the expense of custom hardware development. The products share a common Kintex-7 based FPGA processing architecture that features high performance QDR II+ SRAM storage.

- **Model 371** Dual Channel Receiver (16-bit/250 Msps)
- **Model 372** Dual Channel Transceiver (16-bit/310 Msps)
- **Model 373** Dual Channel Receiver (16-bit/310 Msps)
- **Model 376** Dual Channel Receiver (12-bit/1.6 Gsps)
- **Model 377** Quad Channel Receiver (16-bit/250 Msps)
- **Model 378** Octal Channel Receiver (16-bit/125 Msps)



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Red Rapids
www.redrapids.com
sales@redrapids.com
972-671-9570

RTD Off-the-Shelf Mission Computer

RTD's standard HiDANplus® embedded computer system provides a robust Commercial-Off-the-Shelf (COTS) solution enabling rapid up-time for mission-critical applications. The system includes a rugged single board computer, power supply, mSATA card carrier, and room for an additional peripheral module. Without increasing the enclosure size, functional upgrades can include high-performance data acquisition, versatile networking options, or enhanced capabilities from a variety of special-purpose add-in modules. Additional configuration options include a removable SATA drawer.

The milled aluminum enclosure with advanced heat sinking delivers passively-cooled performance from -40 to +85°C. Integrated tongue-and-groove architecture with EMI gaskets create a water-tight solution with excellent environmental isolation. Keyed cylindrical connectors offer easy cable connections while maintaining the integrity of the environmental seal.

FEATURES

- -40 to +85°C standard operating temperature
- Designed for high ingress protection in harsh environments
- Milled aluminum enclosure with integrated heat sinks and heat fins
- Rugged Intel and AMD-based Single Board Computers
- High-performance, synchronized power supply
- mSATA card carrier and optional 2.5" removable drive
- Designed to include an additional PCIe/104, PCI/104-Express or PCI-104 peripheral module without increasing overall enclosure size

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RTD Embedded Technologies, Inc.
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Embedded Hardware

Crypto Secure 2.5" SATA III SSD

Crypto Secure™ Solid State Drives have the Federal Information Processing Standard FIPS 140-2 encryption with up to 2TB density and 6Gb/s SATA III speed, making it the industry's fastest and highest capacity secure SSD.

Let Soligen's engineering team partner with your designers at the earliest stages to develop a solution to fit your needs perfectly. After qualification, we follow through to production, field testing and full roll out.

Soligen produces a full line of industry-leading rugged SSDs in all standard form factors. We have NVMe PCIe and SATA solutions up to 20TB. Also available are OPAL encryption, military data destruction, write-protect and hardware erase options.

FEATURES

- FIPS 140-2 encryption
- Up to 2TB density
- 6 Gb/s SATA III speed
- Key Management: session key, permanent key or custom 256-bit pass-phrase authentication
- Hardware authentication
- AES encryption with a 256-bit key
- Purge technology which destroys the key in less than 100 ms
- Full drive erase in less than 10 seconds

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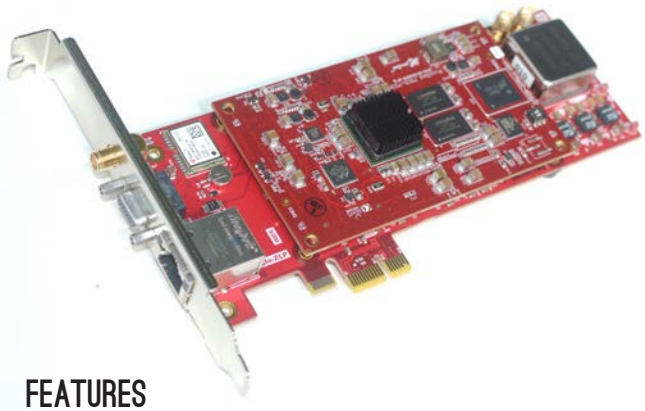
Embedded Hardware

StratumSystems

SS-PCIe-ZLP



PCIe GNSS Frequency and Timing Card with IEEE1588, SyncE and IRIG

Stratum Systems LLC released the SS-PCIe-ZLP targeting precise timing and synchronization in military, industrial and commercial applications.

The PCIe-ZLP is a low-profile PCI-Express card with Gen 2 PCIe x1 lane interface with the host system. The board has an onboard high precision OCXO oscillator, which is kept synchronized with a digital PLL (DPLL) to any selected reference such as an external IRIG input, Ethernet IEEE1588v2 (PTP) client, Synchronous Ethernet (SyncE) or time signal provided by an on-board Global Navigation Satellite System (GNSS) receiver. The board can operate as an IEEE1588v2 master if the GNSS timing signal is used to synchronize the local oscillator.

Multiple synchronized output signals are available such as low noise 10MHz, 1PPS and RS-422 IRIG timing. The board also provides NMEA messages and can operate as a standard network interface card (NIC) with a 1GBit Ethernet interface.

Software drivers and APIs for Linux and Windows are supported.

The PCIe-ZLP can be customized to fully meet specific application requirements.

Stratum Systems design and manufacture and market a full range of advanced, timing and synchronization products, test systems and FPGA IP cores for telecommunications industry.

FEATURES

- Concurrent reception of GPS/QZSS, GLONASS, BeiDou, Galileo
- IEEE-1588v2 master or slave
- SyncE
- IRIG Time Code Inputs and Outputs
- High stability low noise 10MHz/1PPS outputs
- Additional 10MHz differential output
- Two additional 1PPS differential outputs
- NMEA Protocol
- Holdover 1µs for 4 hours
- Low Profile PCIe x 1 card

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Stratum Systems
www.stratum-systems.com

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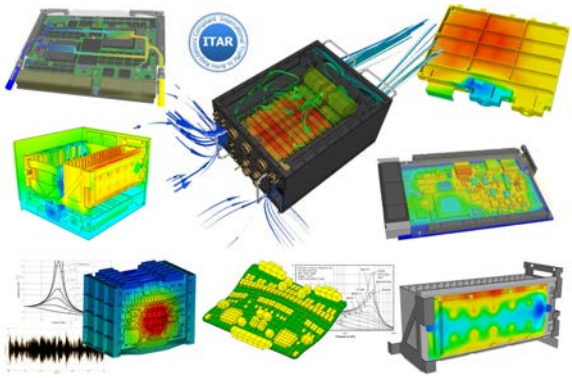
Embedded Hardware

TENTECH LLC
Services & Solutions

Military Embedded Systems Modeling & Simulation SME



TEN TECH LLC is an ITAR-Registered, Woman-Owned Small business that provides Subject Matter Expertise in the areas of Structural Dynamics, CFD and Thermal Analysis & Simulation through the use of advanced numerical techniques such as Finite Element, Finite Difference, Lattice Boltzmann and Boundary Element Methods.

Our core competency is in shock, vibration and thermal analysis of Embedded Defense Electronics systems such as Single Board Computers, RF & Microwave Components as well as complete rugged chassis and subsystems for Avionics, Flight Data Recorders, Guidance & Navigation, Radar Processing, Electronic Warfare and C4ISR applications.

A perfect understanding of MIL-STD-810G, MIL-S-901D, RTCA/DO-160G, GR-487-CORE and other environmental specifications, along with decades of experience in the design and analysis of Embedded Systems allows TEN TECH LLC to support the largest and most complicated of programs, being Air, Land, Sea or Space.

FEATURES

- Shock & Vibration Analysis for sine, random, sine-on-random, UNDEX & DDAM
- Thermal Analysis for Conduction, Convection & Liquid Cooling of Systems & Components
- Fatigue Life Analysis & Failure Analysis for high cycle and low cycle fatigue
- Thermal Stress, CTE mismatch and Thermal Cycling Analysis
- Computational Fluid Dynamics & Coupled Heat Transfer Analysis
- Reliability Analysis & DfR Analysis of Electronics Components
- Acoustics & Vibro-Acoustics Analysis

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Embedded Hardware

THEMIS

RES-XR6 1U Rugged Server with Skylake Architecture

The first rugged server to take full advantage of the latest **Intel® Xeon® Scalable** Processors with **Intel® AVX-512**, the RES-XR6 1U accelerates compute intensive workloads for applications such as signal intelligence, cryptography, AI, surveillance, sensor fusion, analytics, communications, and audio/video processing.

The system embeds **two Intel® Xeon® Gold** (Skylake) processors with up to **twenty-four cores** per socket, up to **1.5TB Memory**, **three PCIe x16** slots, **eight 2.5" front access drives**, and **two onboard 1Gbit Ethernet** (optional 10Gbit Ethernet) ports. System expansion is available through the addition of commercially available, off the shelf (COTS) networking cards, specialized processing such as encryption, and high speed storage.

Designed to be on the move, the RES-XR6 1U weighs only **22lbs**, is **20" deep**, and is enclosed in a lightweight, corrosion resistant aluminum and stainless steel chassis capable of meeting a wide variety of **MIL-STD specifications**. Advanced thermal and mechanical design features provide **superior resilience** to shock, vibration, dust, sand, and temperature extremes while a specially designed dust cover, new **memory retention + vibration dampeners**, and optional **tamper-proofing** and **tamper-evidence** features offer extra security in the field.

The SWaP optimized RES-XR6 1U provides greater performance and scalability for mission critical applications.

FEATURES

- (2) Intel® Xeon® Scalable® Gold (Skylake) Processors with up to 24 cores per socket
- up to 1.5TB ECC DDR4 2666MHz Memory
- (8) SAS3 capable 2.5" front access SSD or HDD drives
- (3) PCIe x16 expansion slots, IPMI v2.0, TPM 2.0
- (2) optional 10Gbit Ethernet ports
- Dual redundant, hot swappable AC or DC power
- MIL-STD-810G, MIL-STD-901D, MIL-STD-167-1, MIL-STD-461

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Embedded Hardware

VERSALOGIC CORPORATION

Very small embedded computer!

"Bay Trail" Embedded Computer

This embedded computer board, in VersaLogic's EPU (Embedded Processing Unit) format, combines processor, memory, video, and system I/O into an extremely compact full function embedded computer. The "Osprey" computer has a footprint just slightly larger than a credit card!

The Osprey was engineered to meet the military and avionic industries' evolving requirements for smaller, lighter, and more powerful embedded systems. Roughly the size of a credit card and less than 1.08 inches thick, the Osprey is a highly-integrated embedded computer. It combines the Intel® Atom™ "Bay Trail" processor, with newer system interfaces, in a form factor designed to withstand extreme temperature, impact, and vibration.

Osprey is available in single-, dual-, and quad-core models. The single-core is suitable for lower power systems, while the quad-core is ideal for UAV video and control applications where higher performance and lower weight are important.

The Osprey is backed by VersaLogic's 5-year warranty and product life extension programs that can continue delivery well past the year 2025.

FEATURES

- Size: 55 x 95 x 27 mm
- Weight: 140 grams (< 5 oz.)
- Power: < 8W (quad core)
- -40°C to +85°C operation
- Gigabit Ethernet (2 ports)
- Mini PCIe expansion socket
- MIL-STD-202G Shock and Vibration

mil-embedded.com/p374347

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503-747-2261

VECTOR
ELECTRONICS & TECHNOLOGY, INC.
A FINE TECHNOLOGY GROUP

cPCI, PXI, VME, Custom Packaging Solutions

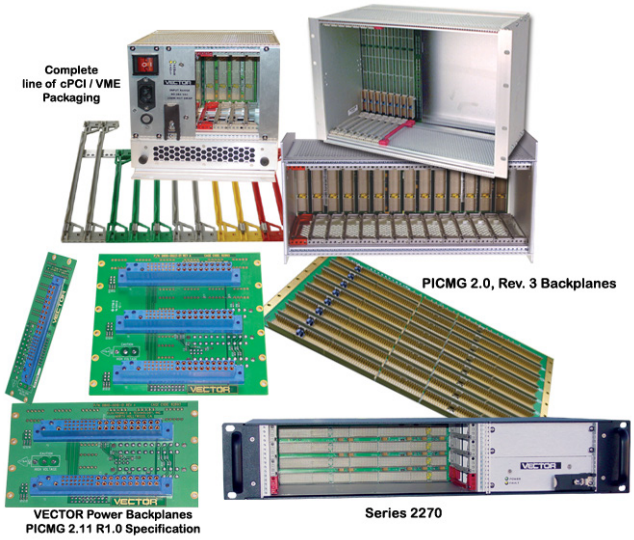
VME and VME64x, CompactPCI, or PXI chassis are available in many configurations from 1U to 12U, 2 to 21 slots, with many power options up to 1,200 watts. Dual hot-swap is available in AC or DC versions. We have in-house design, manufacturing capabilities, and in-process controls. All Vector chassis and backplanes are manufactured in the USA and are available with custom modifications and the shortest lead times in the industry.

Series 2370 chassis offer the lowest profile per slot. Cards are inserted horizontally from the front, and 80mm rear I/O backplane slot configuration is also available. Chassis are available from 1U, 2 slots up to 7U, 12 slots for VME, CompactPCI, or PXI. All chassis are IEEE 1101.10/11 compliant with hot-swap, plug-in AC or DC power options.

Our Series 400 enclosures feature side-filtered air intake and rear exhaust for up to 21 vertical cards. Options include hot-swap, plug-in AC or DC power, and system voltage/temperature monitor. Embedded power supplies are available up to 1,200 watts.

Series 790 is MIL-STD-461D/E compliant and certified, economical, and lighter weight than most enclosures available today. It is available in 3U, 4U, and 5U models up to 7 horizontal slots.

All Vector chassis are available for custom modification in the shortest time frame. Many factory paint colors are available and can be specified with Federal Standard or RAL numbers.



FEATURES

- Made in the USA
- Most rack accessories ship from stock
- Modified 'standards' and customization are our specialty
- Card sizes from 3U x 160mm to 9U x 400mm
- System monitoring option (CMM)
- AC or DC power input
- Power options up to 1,200 watts

For more detailed product information, please visit **www.vectorelect.com** or call **1-800-423-5659** and discuss your application with a Vector representative.

VISIT OUR NEW WEBSITE!

WWW.VECTORELECT.COM

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Since 1947

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zmicro

ZM3 Airborne Computer

COMPACT ISR VIDEO CAPTURE AND ENCODING SYSTEM

Focus on SWaP

The ZM3 rugged computer is designed specifically to minimize size, weight, and power for airborne ISR applications. Built to provide advanced compute processing in the smallest form-factor possible, the ZM3 offers full server capability in a small, rugged package. The system supports double-wide COTS high-end graphics cards and an additional PCI Express card for custom user expansion. Utilizing an advanced Type 7 COM Express module, the ZM3 utilizes a 16 Core Intel Processor with up to 48G RAM.

Designed to Survive Airborne Environments

The ZM3 is carefully engineered to handle the extreme conditions of airborne environments. Designed and tested to DO-160D requirements for vibration, shock, temperature, humidity, dust and EMI/EMC, the ZM3 provides powerful compute capabilities with robust environmental design to ensure your missions will be a success.

Removable Rugged Storage

The ZM3 introduces ZMicro's latest removable storage module, the TranzPak 1 (TP1). The TP1 offers industry leading storage capability in a compact, removable module. The TP1 utilizes NVMe technology to provide storage read/write speeds up to 3 times faster than SATA. Storage modules are currently 1 TB each with larger capacities entering the market soon.

FEATURES

- 16 Core, 1.5GHz+ Intel® Xeon® Processor
- Up to 48G RAM
- Two removable TranzPak 1 storage modules
- x16 GPU Support; Up to NVIDIA P6000 class GPU (or two PCIe slots x8 Gen3 slots)
- Additional x4 PCIe slot for user expansion
- 18-36V DC Power Input
- Status indicators for disk activity and fault detection
- Ultra-compact, lightweight aluminum construction
- Only weighs 7.3lbs (9.1lbs with NVIDIA™ P6000 GPU)
- 4.35"H x 5.75"W x 14.16"D

ZMicro's drive to implement leading edge technology empowers customers to build innovative, high-performance, network centric solutions for tomorrow's military and intelligence markets. Built with proven COTS components that are ruggedized to stand up to extreme temperatures, shock, vibration, and G-forces, our solutions are ready for your next mission whether it takes you in the air, under water, or on the ground.

The brand of choice by government and military customers, ZMicro serves as a one-stop-shop for a complete line of rugged, deployable computing solutions.

mil-embedded.com/p374348

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Embedded Hardware

VERSALOGIC CORPORATION

Fiber Optic Ethernet Interface

Ethernet Over Fiber – Mini PCIe Expansion Module

Ethernet over fiber offers an extremely dependable, highly secure Ethernet connection that operates over a much longer distance than copper. Where security matters, a fiber optic connection excels. Fiber optic cables have no electromagnetic signature, making them very difficult to tap compared to wired connections.

The "E4" expansion module is compatible with a wide range of systems (almost any system that has a Mini PCIe socket). This rugged plug-in module supports a bi-directional gigabit Ethernet channel over standard fiber cables and LC connectors. This industry-standard Mini PCIe module provides an easy and economical way to add a fiber-based Ethernet interface to embedded computer systems. The module features a wide operating temperature range (-40° to +85°C) and a metal housing around the transceiver to guard against EMI.

The E4 board is compatible with a variety of popular operating systems including Windows, Windows Embedded, and Linux.

As with all VersaLogic products, the E4 module is designed to support OEM applications where high reliability and long-term availability are required. From application design-in support, to its 5+ year production life guarantee, the VL-MPEe-E4 provides durable I/O expansion with an excellent cost of ownership.

FEATURES

- High security data transmission
- Long-haul Ethernet connections
- -40°C to +85°C operation
- Shock and vibe tested
- Bi-directional Gigabit operation
- Latching multi-mode LC connector
- Uses Standard OS drivers

mil-embedded.com/p374346

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503-747-2261
www.linkedin.com/company/versalogic-corporation

Embedded Software

Annapolis Micro Systems

Industry-Leading Board Support Package

Annapolis Micro Systems' high-performance FPGA-based Boards and Systems are supplied with the most comprehensive and easiest-to-deploy BSP, reducing programming time from weeks to just days.

Here's why:

- *Tested and proven interfaces to all board components with examples*
- *Dozens of valuable included IP Cores that conform to latest Xilinx and Intel Altera architectures*
- *Tight synchronization of 10s or 1,000s of A-D and D-A channels – with NO manual tuning*
- *Integration with latest technology, including full access to Xilinx Zynq+ MPSoC via PCIe*
- *Optional distribution via GitHub, for automatic updates*
- *All operating within the integrated and agile Wild40 EcoSystem™*

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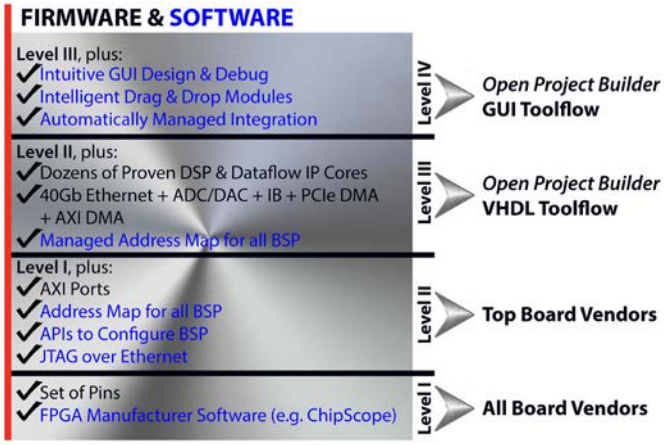

Note: *Annapolis supports customers at the level they are comfortable working at, Level I thru Level IV. The capability of Level III and Level IV are only available from Annapolis Micro Systems. All levels are included with every board purchase.*

One Tool, Two Paths

Annapolis Micro Systems' Open Project Builder software offers a VHDL Toolflow or GUI Toolflow. Whichever path you choose, you can rest assured knowing that your application is built on a solid foundation of 35 years of FPGA knowledge and experience.

Annapolis Micro Systems, Inc.
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LAUTERBACH
DEVELOPMENT TOOLS

Lauterbach Debugger for Intel x86/x64 Skylake/Kabylake

Lauterbach TRACE32 Debugger for Intel x86/x64:

In January of this year, Lauterbach introduced the new CombiProbe Whisker MIPI60-Cv2. The TRACE32

CombiProbe and TRACE32 QuadProbe now offer the same debug features for the Converged Intel® MIPI60 connector:

- *Standard JTAG, Intel® debug hooks with Pmode, and I2C bus*
- *Merged debug ports (two JTAG chains)*
- *Intel® Survivability features (threshold, slew rate, ...)*

However, these debug tools have different areas of application. The TRACE32 QuadProbe, which is expressly designed for server processors, is a dedicated debug tool that enables SMP debugging of hundreds of threads on targets with up to four debug connectors.

The TRACE32 CombiProbe with the MIPI60-Cv2 Whisker, designed for client as well as mobile device processors, can capture and evaluate system trace data in addition to its enhanced debugging features.

Trace capabilities include support of one 4-bit and one 8-bit trace port with nominal bandwidth.

The TRACE32 CombiProbe with the DCI OOB Whisker is specially designed for debugging and tracing of form factor devices without debug connectors. If the chip contains a DCI Manager, the target and the debugger can exchange debug and trace messages directly via the USB3 interface. The DCI protocol used to exchange messages supports standard JTAG and Intel® debug hooks as well as trace messages for recording system trace information.

FEATURES

- CombiProbe MIPI60-Cv2 provides debug and system trace capability
- Support for standard JTAG, debug HOOKs and I2C bus
- Support for merged debug ports (two JTAG chains per debug connector)
- Support for survivability features (threshold, slew rate, etc.)
- Support for system trace port with up to 8 trace data channels
- 128 MByte of trace memory
- SMP debugging (including hyperthreading)
- AMP debugging with other architectures
- BIOS/UEFI debugging with tailor-made GUI for all UEFI phases
- Linux- and Windows-aware debugging
- Hypervisor debugging

LEADING *through Technology*

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www.lauterbach.com/pro/pro_core_alt1.php?chip=COREI7-7THGEN

LAUTERBACH DEVELOPMENT TOOLS

TRACE32 Integration for Wind River Workbench

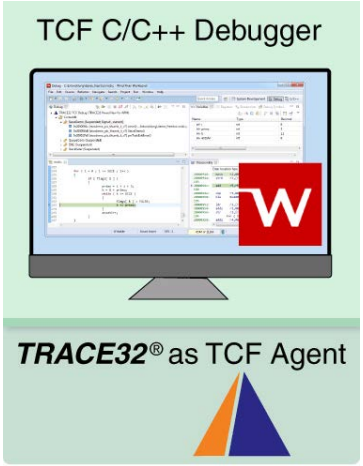
The Lauterbach TRACE32 Debugger now also operates as a TCF agent. This makes it possible to use the Wind River Workbench or the Eclipse debugger as an IDE and a TRACE32 debugger as a debugging back end.

The Target Communication Framework (TCF) was developed by the Eclipse Foundation as a protocol framework with the goal of defining a uniform debugging communication protocol between an IDE and a target system.

TCF defines a series of standard services. At the same time, the framework is open for the definition of proprietary services.

After the TRACE32 software is started as a TCF agent, it provides its services to the Wind River Workbench or the Eclipse debugger via TCP/IP.

Using its TCF services, the TRACE32 debugger can now provide an open communication interface for debugging with Eclipse or the WindRiver Workbench for all processor architectures and compilers supported by TRACE32.



FEATURES

- TRACE32 operates as TCF agent
- Support for various launch mechanisms
- Support for all debug relevant TCF services
- Synchronized debugging between TRACE32 and TCF C/C++ Debugger in Wind River Workbenchd
- Support for multiple projects (multicore)
- Applicable for all processor architectures supported by TRACE32
- Based on Target Communication Framework (TCF)

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LAUTERBACH DEVELOPMENT TOOLS

Hypervisor Debugging with Lauterbach TRACE32 Debugger

Lauterbach provides support for seamless debugging of hypervisor based systems. The introduction of the unique Lauterbach Machine ID allows the debugger to identify any virtual machine in the system. This gives the debugger full visibility of the context of all active and inactive virtual machines and provides a supporting framework to load OS specific awarenesses for each virtual machine.

The most important objective of the TRACE32 hypervisor-awareness is a seamless debugging of the overall system. This means that when the system has stopped at a breakpoint, one can check and change the current state of every single process, all VMs, plus the current state of the hypervisor and of the real hardware platform.

The TRACE32 hypervisor-awareness provides the debugger with all of the hypervisor's information running on the hardware platform. After the OS-awareness is loaded for each guest/VM the debugger can display an overview of the overall system.

TRACE32 assigns each VM a number, the machine ID (mid column). The machine ID is a unique identifier that is used by TRACE32 and appears as an address extension; a concept already familiar to TRACE32 users.

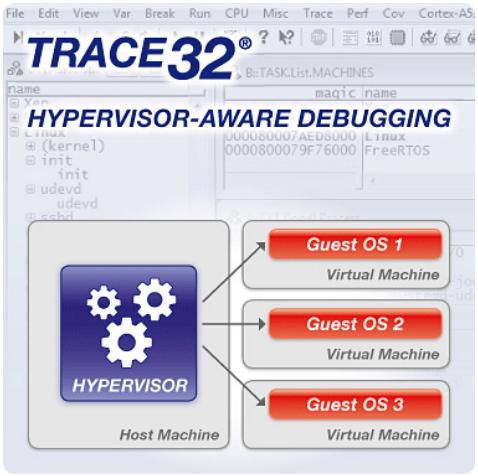
The Global Task List represents the heart of the TRACE32 hypervisor-aware debugging. It lists all tasks/processes/threads of the guest OSes and the hypervisor. TRACE32 can visualize the context of any task in its GUI. Just double-click to on the task name.

The TRACE32 CORE List window displays in detail what is currently running on the individual cores of an SMP system.

The TRACE32 GUI visualizes the context of the current core/task by a double-click on the task name in the TRACE32 Global Task List.

TRACE32 allows the visualisation of any task, even if its VM is currently not active.

Since Lauterbach has systematically extended the well known concepts for OS-aware debugging to hypervisor debugging, it will be easy for TRACE32 users to get started with just a little practice.



FEATURES

- Seamless debugging of the total system in stop-mode
- Hypervisor-awareness as a loadable debug extension is provided by Lauterbach
- Machine ID allows the user to uniquely identify any virtual machine in the system
- Machine ID provides full visibility of context of active and inactive virtual machines
- OS-awareness can be loaded for each virtual machine

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ORBIT POWER GROUP
Behlman Electronics

VP*Xtra*™ Power Supplies (3U and 6U)

Behlman announces the reconfigured Open VPX VITA 62 compatible 3U VP*Xtra*™ 500M1 Power Supply, and the VP*Xtra*™ Reconfiguration Program.

VPXtra™ 500M1

3U Open VPX VITA 63 compatible
High Power Multi-output Power Supply

Working within its new VP*Xtra*™ Reconfiguration Program, Behlman has modified the VP*Xtra*™ 500M to create the new VP*Xtra*™ 500M1, with 80 amps of 5 VDC output. This unit, in conjunction with the standard VP*Xtra*™ 500M, can supply 120 Amps of 5 VDC along with the customer-required 12 VDC and 3.3 VDC.

- **Open VPX VITA 62 compliant**
- **Wide input range**
- **High power DC output**
- **Efficiency of 90% typical**
- **Conduction cooled at card edge**
- **Conformal coating on PWA**

The Behlman VP*Xtra*™ 500M1 COTS DC to DC power supply is a rugged, highly reliable, conduction cooled, switch mode unit built for high-end industrial and military applications. It delivers 460 Watts of DC power via six outputs. The main outputs can be paralleled for higher power.

VP*Xtra*™ 500M1 can accept a 28 VDC input, IAW MIL-STD-704, and can supply a high-power DC output at various power levels. This power supply has no minimum load requirement and has over-voltage and short circuit protection as well as over current and thermal protection. The power supply is designed to support the rigors of mission critical airborne, shipboard, vehicle and mobile applications.

Designed and manufactured with *Xtra*-Cooling™, *Xtra*-Reliable™ Design and *Xtra*-Rugged™ Construction.

The **Behlman VP*Xtra*™ Reconfiguration Program** addresses the needs of system designers for non-standard features on VITA 62 compatible VPX power supplies that can vary significantly from system to system. Variables can run from different power levels of the standard voltages, to mechanical configurations, such as connectors, user-defined pins, and general interfaces. EMI filtering and hold-up requirements, as well as transient and lightning protection are other possible considerations. This program has already resulted in an impressive list of new, non-typical, COTS VPX power supply models (3U 3-phase AC to DC; High Voltage Hold-up card, Low Voltage Hold-up card; PS with extra 5 VDC, 6U 3-phase and single-phase AC to DC, PS with extra 12 VDC, PS with extra 5 VDC). But that is only the beginning. Behlman now invites all system designer to request additional system-specific VP*Xtra*™ reconfigurations, without the cost of full-custom development.

VPX POWER RECONFIGURED WITHOUT FULL-CUSTOM COST.

Behlman, The Power Solutions Provider!

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AdaCore

Build software that matters.

GNAT Pro Assurance

GNAT Pro Assurance is a complete Ada solution for software projects that have long-term maintenance requirements and/or the need for certification. It supports all versions of the Ada language standard (from Ada 83 to Ada 2012), and C support is an optional add-on. A full toolsuite is supplied, and, depending on the platform, a configurable run-time library and several specific run-times that are especially suited to high-assurance systems are also provided. The product includes a specialized service known as sustained branches, which allows a project to continue its use of a specific version of the technology, including upgrades to repair critical issues.

AdaCore has a long history of working with customers who need to meet certification requirements, and GNAT Pro Assurance offers a number of options that can simplify the development and verification effort. These include certification material for the run-time libraries, as well as qualification material for several of the tools.

The product's specially designed run-time libraries and comprehensive tool suite help reduce the cost of developing and certifying systems that have to meet industry standards including:

- *Avionics – DO-178B/C*
- *Air Traffic Management – DO-278/DO-278A*
- *Rail – EN 50128*
- *Space – ECSS-E-ST-40C and ECSS-Q-ST-80C*

GNAT Pro Pro Assurance is available on both native and embedded platforms.

Key Features

Full Ada Implementation

GNAT Pro Assurance implements all versions of Ada, up to and including Ada 2012 – the latest revision of the language. With features such as contract-based programming, **Ada 2012** helps reduce system life cycle costs by allowing low-level requirements to be expressed directly in the source code where they can be verified either at run time or statically.

Simplification of Certification Effort

Language features that complicate test coverage analysis can be restricted, even if they do not require run-time support. Examples include constructs that would result in code with implicit loops and conditionals (such as a slice assignment).

Advanced Static Analysis

The **GNATstack** static analysis tool is supplied with GNAT Pro Assurance. GNATstack statically calculates the maximum stack space required by each task in an application. GNATstack uses conservative analysis to deal with complexities such as subprogram recursion, while avoiding unnecessarily pessimistic estimates. The tool's output data can be used directly to satisfy DO-178B / DO-178C requirements.

AdaCore's **CodePeer** advanced static analysis tool, available separately, is a useful complement to GNAT Pro Assurance. This Ada source code analyzer detects run-time and logic errors that would otherwise only be found through labor-intensive debugging. Assessing potential bugs and vulnerabilities before program execution. CodePeer helps find errors early in the development life-cycle, when they are least expensive to repair, and it can also perform impact analysis when existing code is modified. CodePeer has been registered as CWE-Compatible for its ability to detect several of the Top 25 Most Dangerous Errors in the CWE (Common Weakness Enumeration) including CWE-120 (Classic Buffer Overflow). CodePeer has been qualified as a Verification Tool for DO-178B and as a T2 tool for EN 50128.

Configurable Run-Time Library

The configurable run-time capability, which is available in the product on certain cross platforms, lets programmers specify any level of support for Ada's dynamic features, from none at all to the full Ada 95, Ada 2005, Ada 2012 language versions. The units included in the library may be either a subset of the standard units provided with GNAT Pro, or they may be specially tailored to the application. This capability is useful, for example, if one of the predefined profiles provides almost all the features needed to adapt an existing system to new safety-critical requirements, and where the costs of adaptation without the additional features are considered prohibitive.

Code Coverage Analysis

AdaCore's **GNATcoverage** tool, available separately, performs non-intrusive code coverage analysis at both the source and object code level. This software verification tool reveals which parts of the program have or have not been exercised by a test suite. GNATcoverage supports analysis up to the MC/DC (Modified Condition/Decision Coverage) level and has been qualified under DO-178B/C and EN 50128.

For more information, please visit:
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Dawn VME Products®

PSC-6238

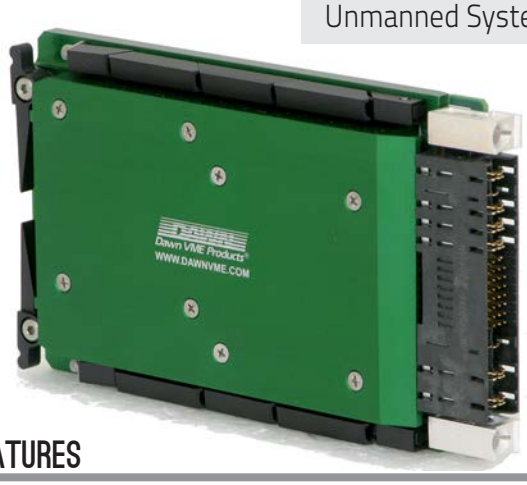
800 Watt 3U OpenVPX Conduction Cooled Power Supply

The **PSC-6238** is designed to operate in a military environment over a wide range of temperatures at high power levels, is extended shock and vibration compliant per MIL-STD-810F and features an onboard real-time clock with switchable Battleshort and NED (Nuclear Event Detect) functions.

Dawn's PSC-6238 is a wedge lock conduction cooled module on a 1 inch pitch with an operating temperature of -40°C to +85°C at the wedge lock edge. The up to 800 Watt power output true 6-channel supply provides full Open VPX support and is current/load share compatible with up to 4 PSC-6238 units.

The PSC-6238 front I/O panel includes a 3-color LED status indicator, VBAT battery access and a USB port for status display, access menu control and firmware upgrade.

Dawn's embedded RuSH™ Rugged System Health Monitor technology provides for intelligent monitoring and control of critical system performance parameters including voltage, current, temperature and control of power sequencing and shutdown of all voltage rails.



FEATURES

- True 6 Channel supply provides full OpenVPX support
- Wedge lock conduction cooled module
- Up to 800 Watts power output with 1 inch pitch form factor
- Onboard embedded RuSH™ technology actively monitors voltage, current, temperature and provides protective control
- Factory programmable power sequencing of all voltage rails
- Shutdown control for each power rail
- Over Voltage, Over Current and Over Temp protection

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OpenSystems Media works with industry leaders to develop and publish content that educates our readers.

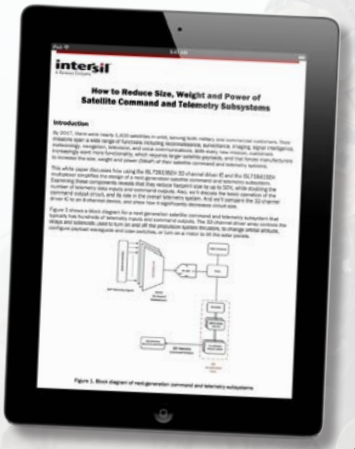
How to Reduce Size, Weight and Power of Satellite Command and Telemetry Subsystems

By Intersil

There are nearly 1,400 satellites in orbit today, with functions ranging from surveillance and imaging to transmitting television and voice communications.

With each new mission, customers need more functionality, which requires larger satellite payloads and forces manufacturers to increase the size, weight and power (SWaP) of their satellite command and telemetry systems.

In this white paper, designers can learn how using the latest rad-hard integrated circuits can simplify the design of their next-generation satellite command and telemetry subsystems.



Read more white papers: http://whitepapers.opensystemsmedia.com/

http://mil-embedded.com/white-papers/white-weight-power-satellite-command-telemetry-subsystems/

Amphenol
MILITARY & AEROSPACE

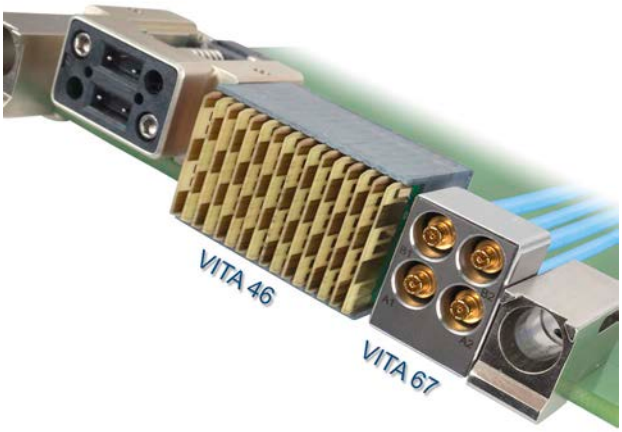
VITA 46 & 67

Looking for a one place for all of your VPX/VITA needs? Amphenol Military and Aerospace now has you covered!

SV Microwave offers a complete line of COTS VITA 67 coaxial/RF motherboard, daughtercard, contacts and 6" and 12" cable assemblies through distribution. SV cables VITA 67 contacts with male 2.92mm (SMK) connectors to Ø.047 and Ø.086 coaxial cable types. SV's unique connector retention mechanism makes installing and removing the cable assemblies easier than the competition! Additionally, SV's floating SMPM coaxial contacts ensure excellent RF performance in any mating condition. These parts are also designed for side-by-side implementation with VITA 46 hardware and are cabled to Ø.047 and Ø.086 coaxial cable types.

Amphenol Aerospace's R-VPX is a ruggedized, high-speed, board-to-board interconnect system capable of data rates in excess of 10 Gbps, meeting and exceeding VITA 46 standards. This connector system gives users modularity and flexibility by utilizing PCB wafer construction with customized wafer-loading patterns.

Amphenol Military & Aerospace Operations is perfectly aligned to provide the latest technologies, cost-effective manufacturing and supply chain management, and local support to solve any military and aerospace interconnect need.



FEATURES AND BENEFITS

VITA 46:

- Qualified to VITA 46 for Open VPX applications
- Fully intermountable and intermateable to existing VITA 46 connectors
- Meets and exceeds VITA 47 performance requirements
- Supports Ethernet, Fiber Channel, InfiniBand, and other protocols
- Modular COTS lightweight connector system
- Can be combined with high power modules, RF modules (VITA 67) and Optical modules (VITA 66)

VITA 67:

- High performance RF addition to the VPX platform
- High density form factor
- Excellent RF performance to 40 GHz & beyond
- Half-width (4 port) and full-width (8 port) formats
- COST parts readily available through distribution
- Can be combined with high power modules, Ruggedized modules (VITA 46) and Optical modules (VITA 66)

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DIGITAL VOICE SYSTEMS, INC.

The Speech Compression Specialists

AMBE-4020 Half-Duplex Vocoder Chip

Digital Voice Systems, Inc. (DVSI) the recognized leader in the development of low-data-rate speech compression technology announces the availability of the AMBE-4020™ Vocoder Chip. This new addition to DVSI's family of high performance vocoder chips is ideal for half-duplex communication systems. The AMBE-4020™ Vocoder Chip combines a small footprint design with minimal power requirements, at a low cost, to make it a logical choice for commercial, consumer, and military mobile radio communication applications.

The AMBE-4020™ Vocoder Chip uses the proven technology of an ARM Cortex-M4 32-bit MCU that is based on the ARMv7 architecture and Thumb®-2 ISA to deliver a level of performance and reliability typically associated only with customized ASICs, but without the associated risks and high development costs. The AMBE-4020™ Vocoder Chip implements DVSI's patented AMBE+2™ Voice Compression Algorithm that can operate at virtually any data rate from 2.0 to 9.6 kbps. With this high degree of flexibility, the user can optimize speech and FEC rates to provide excellent voice quality with superior robustness to bit errors and acoustic background noise. The unparalleled performance of this vocoder technology has resulted in it being recognized as the standard for voice quality in Land Mobile Radio and Satellite Communications systems around the world.

FEATURES

- **Low-cost**
- **High-quality voice**
- **Noise suppression**

High Quality Performance

- Superior voice quality, DVSI's latest generation half duplex AMBE+2™ Vocoder Technology
- Maximizes channel bandwidth efficiency and supports data-rates from 2.0 kbps to 9.6 kbps
- The **AMBE-4020™ Full-Duplex** model supports echo cancellation
- User selectable forward error correction rates – 50 bps to 7.2 kbps
- Excellent performance at low data rates and harsh environments
- Robustness to acoustic background noise and channel bit errors
- Advanced features like Noise Suppression, Improved Error Mitigation, and Soft Decision FEC Decoding
- Supports a-law and u-law companding via I2S interface
- DTMF detection and regeneration with North American call progress tones

Design Flexibility/Low Cost Integration

- 80 pin 12mm x 12mm LQFP small package design
- Special order package available, such as 121 ball 8mm x 8mm BGA
- Integrated ADC/DAC for quality audio I/O
- Also can be interfaced with most low-cost A/D-D/A codecs
- Input Interfaces include: internal ADC or digital mic or I2S
- Output interfaces include: internal DAC or I2S
- Interface for low-cost digital microphone
- Very low power consumption – Ideal for portable mobile devices
- Small compact footprint design
- No licensing fees or royalties
- Off-the-shelf availability for quick delivery

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978-392-0002

DoD embraces bug bounty programs in push to get ahead of cybersecurity vulnerabilities

By Mariana Iriarte, Associate Editor

Officials at the Department of Defense (DoD) recently initiated several seemingly unorthodox programs in its multiyear campaign to secure their networks from adversaries. To date, the "Hack the Pentagon," "Hack the Army," and "Hack the Air Force" bounty programs have yielded over 450 valid vulnerabilities among them.

The Air Force's Chief Information Office is sponsoring the latest event, "Hack the Air Force," as part of the Cyber Secure campaign. "Hack the Air Force," says Marten Mickos, CEO of HackerOne in San Francisco, is a bug bounty program that "falls within a broader contract with the Department of Defense, under which HackerOne will orchestrate hacker programs where we look for system vulnerabilities and report them to the agency in question so that they can fix those software bugs and thereby prevent criminals and adversaries from breaking into their systems."

The cybersecurity joint effort started about "one and a half years ago with 'Hack the Pentagon,' followed by 'Hack the Army' and the latest one, 'Hack the Air Force,' which we conducted in June of 2017," he adds.

The end results of "Hack the Air Force" found "a total of 207 valid vulnerabilities and out of those 207, nine were deemed critical or of high severity," Mickos says.

"Hack the Pentagon" found 138 unique and valid vulnerabilities, while "Hack the Army" found 118; according to DoD officials, all vulnerabilities have been resolved.

These unconventional programs show that the DoD is no longer waiting to solve its cybersecurity issues, but are instead proactively making sure their systems are secure. "Many times, in society, we believe that the government is lagging behind a bit and moving slower than the private sector, but with 'Hack the Pentagon,' the DoD is actually one of the pioneers of the whole industry," Mickos says. "They are doing more than many, many corporations in the business sector. I think it's a particular source of pride to see that the Pentagon was first out and did the first bug bounty program in the history of the federal government."

The programs are stringently monitored. Mickos explains that HackerOne staff take the reports and review them to determine if they are valid or not. "You get a relatively high number of reports in total, and then some portion of those are deemed valid. By valid, we also mean nonduplicates, because sometimes two separate hackers will find the same problem and then we record the first one that reported it."

What may not be considered valid are vulnerabilities that are not a "weakness of the system, or they misunderstand the severity of it; maybe it is a true bug but it's not so important or severe that it would have any meaning," he adds.

The increase in vulnerability finds with the Air Force initiative may be due to the fact that the program broadened its participation to include partner nations. The inclusion of other nations led to a "total of 272 eligible and background-checked vetted hackers who participated, with 33 of them coming from the U.K., Canada, New Zealand, and Australia," Mickos says.

From within this pool of talent emerged a 17-year old who, according to Mickos, was the "best-performing hacker in 'Hack the Air Force.'" He submitted 30 valid reports and earned the largest bounty sum during the term of the challenge.

With participants coming from all over the world, HackerOne had already started a community of white-hat hackers that will continue to find vulnerabilities within DoD systems. These vetted hackers maintain a reputation score with HackerOne in order to "make sure that they have a good level of skill," Mickos notes. "They need to have shown that they know how to hack and that they are professional. Even though technically they are amateurs, they are so good that they can find the really valuable vulnerabilities and report them well."

It's a pretty genius and benevolent way to ensure that security is kept at its peak; the reputation points then become bragging rights in the hacker community. This friendly competition leads to more secure systems. The beauty of it? "They are all trying to be the best," Mickos says. (View the HackerOne leaderboard at https://hackerone.com/leaderboard/all-time.)

To continue this effort, Mickos points out that the DoD also has a continuous program called the "DoD Vulnerability Disclosure Program," where anybody can report anything at any time. While the hackers don't get paid actual cash bounties for finds under the vulnerability disclosure program, that's where those bragging rights come into play. Moreover, for those looking to increase their skills, this approach is a great way to do it.

Although there is no "Hack the Navy" officially in the works, HackerOne is "under a multiyear contract with the DoD to do many, many challenges," Mickos says. "You could say that HackerOne stands ready to do them whenever the DoD wants to do them, and we'll see what the next one is, but I'm sure there'll be a 'next one' pretty soon."

Ultrathin materials show "rusty" promise for next-gen electronics

By Sally Cole, Senior Editor

Move over, silicon: Two semiconductors share an odd "rusty" trait with silicon when it comes to insulating circuitry, but go way beyond to outperform it in other ways that show great promise for next-generation (next-gen) electronics.

Electrical engineers at Stanford University are working with two semiconductors – hafnium diselenide ($HfSe_2$) and zirconium diselenide ($ZrSe_2$) – and discovered that these ultrathin materials share or exceed some of silicon's rather unusual, but highly desirable, properties. While their work is still in the experimental stage, the engineers report that these materials may very well open the door to the thinner, more energy-efficient chips that will be demanded by devices of the future.

The semiconductor industry has relied on silicon for electronics since the 1960s – it's had an extremely good run – but next-gen electronics will require computer chips to become merely a few atoms thick. After more than 50 years of adhering to Moore's Law, which essentially states that the number of transistors per square inch on circuits will double each year, chipmakers are on a quest to find alternative materials that behave like silicon, yet are capable of reaching way beyond the wall silicon has hit in terms of scaling.

One of silicon's downright weirdest properties that helped establish it as the foundation for electronics is that it acts as a good natural insulator, thanks to the silicon dioxide, aka "silicon rust," it produces.

Chipmakers typically expose silicon to oxygen during manufacturing to isolate the circuitry. Other semiconductors don't share silicon's "rusty" property and must be layered with other insulators, which poses many engineering challenges and can affect reliability.

But when the Stanford engineers put the hafnium and zirconium diselenides to the test, they made an intriguing discovery: These materials also form this elusive, high-quality insulating rust layer when exposed to oxygen. (Figure 1.)

As they began shrinking the diselenides to atomic thickness, the engineers realized that these materials share yet another of silicon's quirky properties: They can switch transistors on within a specific range of band gap. If it's too low, circuits leak and become unreliable; if it's too high, a chip will require too much energy to operate. Surprisingly, both ultrathin materials fall into the same ideal band gap as silicon.

It's actually a big deal because it means that these diselenides can be crafted into tiny circuits a mere three atoms thick, roughly two-thirds of a nanometer. This tiny size simply isn't possible with silicon: Eric Pop, an associate professor of electrical engineering at Stanford, points out that engineers haven't been able to make silicon transistors thinner than about five nanometers before the material properties begin to change in undesirable ways.

By combining thinner circuits and desirable high-k dielectric insulation (a material's ability to concentrate an electric field), it essentially means that it may be possible to make these ultrathin diselenide semiconductors into transistors 10 times smaller than anything made with silicon today.

Don't expect silicon to disappear overnight, but "for consumers, this could mean a much longer battery life and much more complex functionality if these semiconductors can be integrated with silicon," Pop says.

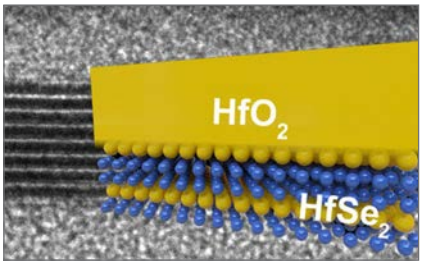

Figure 1 | In this greatly enlarged cross-section of an experimental chip, the bands of black and white reveal alternating layers of hafnium diselenide – an ultrathin semiconducting material – and the hafnium dioxide insulator. Credit: Michal Mleczko.

What's next? There's much more work ahead to refine the electrical contacts between transistors on the group's ultrathin diselenide circuits, according to Michal Mleczko, a postdoctoral scholar working with Pop. These sorts of connections "have always proven a challenge for any new semiconductor, and the difficulty becomes greater as we shrink circuits to the atomic scale," he adds.

Another big hurdle standing in the way of ever-tinier electronics is how to find a way to better control the oxidized insulators to ensure that they remain both thin and stable. Once these two key pieces are resolved, the engineers can start to integrate the new materials with others and then scale up to working wafers, complex circuits, and eventually complete systems.

Despite the need for further research and work, "a path to thinner, smaller circuits – and more energy-efficient electronics – is within reach," Pop says.

This work received support from the Air Force Office of Scientific Research, the National Science Foundation, Stanford Initiative for Novel Materials and Processes, the Department of Energy's Office of Basic Energy Services' Division of Materials Sciences, and a Natural Sciences and Engineering Research Council of Canada fellowship.

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CHARITY

Team Rubicon

Each issue in this section, the editorial staff of Military Embedded Systems will highlight a different charity that benefits military veterans and their families. We are honored to cover the technology that protects those who protect us every day. To back that up, our parent company – OpenSystems Media – will make a donation to every charity we showcase on this page.

This issue we are highlighting Team Rubicon, a 501(c)(3) organization that pairs the skills and experiences of military veterans with first responders, medical professionals, and technology solutions to provide disaster relief to those affected by natural disasters, both domestic or international.

Through continued service, Team Rubicon seeks to provide military veterans with three things they often feel like they have lost after leaving the military: a purpose, gained through disaster relief; community, built by serving with others; and self-worth, from recognizing the effect one individual can make. Team Rubicon aims to help veterans transition from military to civilian life through leadership development and other opportunities.

Two Marines, Jake Wood and William McNulty, formed Team Rubicon in January 2010 following the Haiti earthquake, when the pair led a medical team into Port-au-Prince three days after the quake. The team treated thousands of patients, traveling to camps deemed "too dangerous" by other aid organizations, venturing outside the traditional scale of disaster response and focusing on those who would be overlooked or untreated.

Since its beginning, Team Rubicon has deployed on more than 175 operations, including such U.S. disasters as Hurricane Matthew, Hurricane Irene, Tropical Storm Debby, Hurricane Isaac, Hurricane Sandy, and the tornado destruction of Moore, Oklahoma. The organization has also responded internationally during disasters in Pakistan, Chile, Myanmar, Sudan, Ecuador, Nepal, Greece, and Turkey.

For more information, please visit www.teamrubiconusa.org.

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This e-cast of industry experts covers the performance advantages of commercial off-the-shelf (COTS) signal processing technology as well as the challenges that come with using such technology, such as obsolescence, efficient thermal management, and reducing size, weight, and power (SWaP).

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WHITE PAPER

Hardware and measurement abstraction layers

By National Instruments

Hardware abstraction layers (HALs) and measurement abstraction layers (MALs) are some of the most effective design patterns to make test software as adaptable as the hardware. Rather than employing device-specific code modules in a test sequence, abstraction layers can enable engineers to decouple measurement types and instrument-specific drivers from the test sequence.

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In this white paper, readers will learn how to drastically reduce product development time by giving hardware and software engineers the ability to work in parallel.

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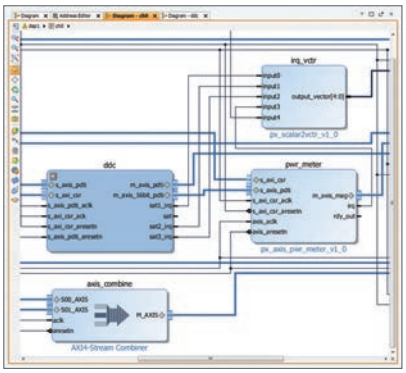

Navigator FDK shown in IP Integrator.

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