Rugged Systems Evolve to Meet UAV SWaP Needs

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All Eyes on the F-35

With current estimated acquisition costs approaching $400 billion, the F-35 Joint Strike Fighter (F-35), also known as the Lightning II remains the Department of Defense’s most costly acquisition program. As a result, never has there been a program more in need of scrutiny. It’s getting that scrutiny with the GAO playing its role. Recently along those lines, the GAO this month released its latest report entitled “F-35 Joint Strike Fighter: Continued Oversight Needed as Program Plans to Begin Development of New Capabilities”. Also this month, the GAO summarized its results in testimony before Congress.

A little background: The F-35 program comprises developing and fielding a family of strike fighter aircraft, integrating low observable (stealth) technologies with advanced sensors and computer networking capabilities for the United States Air Force, Navy, and Marine Corps, as well as eight international partners.1 The F-35 family is comprised of the F-35A conventional takeoff and landing variant, the F-35B short takeoff and vertical landing variant, and the F-35C carrier-suitable variant.

Over the years the program has made a number of changes affecting the planned quantities and associated costs. According to current projections, the U.S. portion of the program will require acquisition funding of $12 billion a year, on average, from now through 2038 to complete development and procurement of 2,457 aircraft. DoD also estimates that the F-35 fleet will cost over $1 trillion to operate and support over its lifetime, which poses significant long-term affordability challenges for the department.

In his statement before Congress, GAO Director Acquisition and Sourcing Management Michael J. Sullivan said that although the estimated F-35 Joint Strike Fighter (F-35) program acquisition costs have decreased since 2014, the program continues to face significant affordability challenges. DoD plans to begin increasing production and expects to spend more than $14 billion annually for nearly a decade on procurement of F-35 aircraft. Currently, the program has around 20 percent of development testing remaining, including complex mission systems software testing, which will be challenging. At the same time, the contractors that build the F-35 airframes and engines continue to report improved manufacturing efficiency and supply chain performance.

DoD plans to manage F-35 modernization as part of the existing program baseline, which has oversight implications. DoD has begun planning and funding significant new development work to add to the F-35’s capabilities, known as Block 4. The funding needed for this effort is projected to be nearly $3 billion over the next 6 years, which would qualify it as a major defense acquisition program in its own right.

As of now, the DoD doesn’t currently plan to manage Block 4 as a separate program with its own acquisition program baseline but rather as part of the existing baseline. As a result, Block 4 will not be subject to key statutory and regulatory oversight requirements, such as providing Congress with regular, formal reports on program cost and schedule performance. A similar approach was initially followed on the F-22 Raptor modernization program, making it difficult to separate the performance and cost of the modernization from the baseline program. According Sullivan’s testimony best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs with their own requirements and acquisition program baselines. The F-22 program eventually adopted this approach. The argument is that if the Block 4 effort is not established as a separate acquisition program, transparency will be limited. As a result it will be difficult for Congress to hold it accountable for achieving its cost, schedule, and performance requirements.

“Given that congressional oversight challenges are presented by DoD’s plan to manage Block 4 under the current acquisition program baseline, in our April 2016 report, we recommended that the Secretary of Defense hold a Milestone B review and manage F-35 Block 4 as a separate and distinct major defense acquisition program with its own acquisition program baseline and regular cost, schedule, and performance reports to Congress,” said Sullivan.

For its part, the DoD didn’t agree with the GAO’s recommendation citing that it views Block 4 as a continuation of the existing F-35 acquisition program. The DoD in turn is exploring ways to provide further transparency by establishing separate budget lines, instituting contract cost reporting, and developing an independent cost estimate. In his testimony Sullivan said the GAO continues to believe that its recommendation is valid. The April 2016 report therefore made a matter for congressional consideration suggesting that Congress direct DoD to manage F-35 follow-on modernization, Block 4, as a separate and distinct acquisition program.

Given the budget constraints of the past several years, keeping an eye on costs and best practices are higher priorities than ever. Hopefully better transparency will help keep the massive F-35 program on track. Getting it right will call for many eyes on the F-35, and all hands on deck.

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Curtiss-Wright’s Defense Solutions division announced that it was selected by TORC Robotics to provide its small form factor (SFF) rugged Gbit Ethernet switch subsystem for use in autonomous tele-operated unmanned ground vehicles (UGVs). Curtiss-Wright provided TORC with its rugged, SFF Parvus DuraNET 20-10 Ethernet switch. This fully managed 20-port network switch delivers comprehensive Ethernet management, security, and reliable design features sought by aerospace and defense platform integrators. Units ordered by TORC were delivered in 2015 and successfully integrated into TORC UGV platforms (Figure 1).

The size, weight, power and cost (SWaP-C) optimized and rugged DuraNET 20-10 switch features 20-ports of non-blocking, fully managed GbE switching for reliable LAN networking across extended temperature ranges (-40 to +71 degrees C) and extreme shock and vibration conditions. The unit serves as an ideal solution for connecting a large number of IP-enabled embedded devices at the network edge, including computers, cameras, sensors, and command-and-control equipment onboard aircraft and vehicles deployed with digital networked architectures. Able to reliably perform in the harshest conditions,

Wind River Technology used for Airbus Helicopter IMA Systems

Wind River has announced that Airbus Helicopters, a division of Airbus Group, is using Wind River VxWorks 653 Platform for its new Integrated Modular Avionics (IMA) system, Helionix. The new avionics system, which includes the certified H175 (Figure 2) and H145 civilian rotorcrafts, significantly improves helicopter management, and with its IMA approach provides unprecedented levels of performance and safety. VxWorks 653 powers the multi-function display, flight management and control systems, as well as the auto pilot of the new aircrafts. In addition, it provides resource management and partitioning capabilities that allow multiple independent applications of different safety criticality levels to run on a single target platform.

A part of the Wind River product portfolio for trusted systems, VxWorks 653 is a commercial off-the-shelf platform for delivering safety-critical, IMA applications. Used in over 350 programs by more than 200 customers on over 75 aircraft, and supported by 24 partners, it serves as a key technology in a wide range of commercial, space, safety and mission-critical programs, both manned and unmanned, around the globe. These include Airbus and Boeing commercial and military aircraft such as the Airbus A400M and Boeing 787.

Figure 2
The Helionix avionics system, used on the certified H175 (shown) and H145 civilian rotorcrafts, significantly improves helicopter management. Its IMA approach provides unprecedented levels of performance and safety.

Data Device Corp. to Acquire Maxwell Microelectronics

Data Device Corp. (DDC) has entered into an agreement to expand its space market capabilities and product offering with the planned acquisition of the microelectronics group from Maxwell Technologies. Maxwell is a developer and manufacturer of space-qualified microelectronics solutions for satellites and spacecraft. Maxwell microelectronics has provided space-qualified radiation-tolerant and radiation-shielded products, including semiconductors and single-board computers, to the space industry for more than two decades.

Data Device Corp. has agreed to acquire Maxwell’s microelectronics division, which includes design, engineering and manufacturing capabilities. Maxwell microelectronics has been a leading provider of space-qualified radiation-tolerant and radiation-shielded products, including semiconductors and single-board computers, to the space industry for more than two decades.
The INSIDE TRACK

System (PLS) CDU currently fielded on multiple aircraft platforms, including the Air Force C-130J fleet. While the redesign of the CDU was initially prompted to eliminate parts obsolescence, the application of modern COTS processors also provides several industry standard interfaces that allow for future expansion and additional interoperability with other aircraft systems.

The new 3.5” CDU provides full backward compatibility with the Control Display Sub-System (CDSS); but with the added Ethernet interface, comes new functionality that allows PLS output data to be displayed on the moving maps on external avionics displays. The Cubic PLS’s low-cost integration opens up new opportunities to expand onto other rotary-wing and fixed-wing aircraft. For example, the new system is also targeted for installation on legacy Blackhawk helicopters with obsolescence requirements.

Maxwell microelectronics specializes in understanding the radiation performance of commercial semiconductors, qualifying selected components for use in space, integrating them with proprietary radiation mitigation technologies, and manufacturing and screening these products in their DLA approved MIL-PRF-38534 facility. Meanwhile, DDC has served the space industry for more than 3 decades, is approved as a supplier by NASA, ESA and JAXA, and is certified by DLA to the highest quality level for hybrid microcircuits, Class “K”. DDC provides space qualified MIL-STD-1553 Data Bus Interfaces, Motion Feedback and Motor Drive and Controller solutions.

IEE’s 3.5-inch AMLCD Display Integrated on C-130J Aircraft CDU

IEE was awarded a contract for a new 3.5-inch Control Display Unit (CDU) by Cubic Global Defense (CGD). The 3.5 inch CDU provides an upgrade to the existing Personnel Locator System (PLS) CDU currently fielded on multiple aircraft platforms, including the Air Force C-130J fleet. Figure 3

3.5-inch Control Display Unit (CDU) provides an upgrade to the existing Personnel Locator System (PLS) currently fielded on aircraft platforms, including the Air Force C-130J fleet.

Figure 3

Merchant Embedded Computing Market Does $7 billion in 2015 Revenue

The overall MEC market has fully recovered from the trauma of 2008/2009 economic meltdown and the performance of various market segments, bus architectures, and companies are continuing to find new applications. So says a new market research report from New Venture Research called “The Merchant Embedded Computing Market - 2016 Edition”, report analyzes the performance of the industry from 2007-2020. Although there are several hundred companies, most are fairly small in revenue and highly specialized, focusing on specific application segments with unique product requirements. The report tracks and analyzes five application markets, nine bus architectures and four board functions.

Total revenue was nearly $7 billion in 2015, an increase of $2 billion since NVR’s last report of 2013 (Figure 4). With the worldwide electronics manufacturing market again thriving, the MEC industry is projected to grow at 5.5 percent through 2020 to approximately $9.1 billion. The MEC report targets five specific application markets: Communications, Industrial, Medical, Military/Aerospace and “All Other” categories.

According to the report, the usually healthy Military/Aerospace segment is now facing a rapidly declining defense department budget in the USA. Counter to this, the military is trying to use more and more electronics for the Internet enabled soldier and robotic weapons. Each of the nine unique architectures has a different rate of adoption depending on the needs of individual application segments.

Overall key trends concern power supply and usage, green technologies and system size reduction. The new 28- and 32-nm silicon for microprocessors, graphics, DSPs and high integration I/O IV chip packs provide a lot of processing power while greatly reducing power consumption. These powerful devices are changing the landscape of the embedded board market. High integration silicon and serial buses enable more small form factors than in the past and are making many older, parallel bus structures, such as PCI, look obsolete.

New Venture Research
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Figure 4

Total revenue was nearly $7 billion in 2015, an increase of $2 billion since NVR’s last report of 2013.
Market research from ASDReports says the military UAV market is set to be worth $7,447 million in 2016 as a result of sustained spending on military UAVs in both established and emerging national markets.
In the past couple years DoD UAV development has leaned toward technology upgrades of existing UAV platforms and payloads while limiting development of new ones. Feeding those needs technology vendors continue to roll out new integrated box-level systems with the proper size, weight and power (SWaP) for UAV requirements. For medium and large UAVs, the pressure is on to add more payload functionality in the same space or add more separate payloads on the same platform. System developers have to look at box-level computer systems and the trade-offs versus slot-card solutions and how system consolidation is impacting the radar, imaging processing and communications capabilities of next-gen UAVs.

According to market research from ASDReports—Military Unmanned Aerial Vehicle (UAV) Market Report 2016-2026—the UAV market is set to be worth $7,447 million in 2016 as a result of sustained spending on military unmanned aerial vehicles in both established and emerging national markets (Figure 1). The global military unmanned aerial vehicle (UAV) market is a dynamic one that will register strong growth during this period. According to the research ongoing security issues, rising defense spending and the emergence of new national markets will drive demand for COTS systems, while established market players will continue to develop more sophisticated domestic UAVs during the next ten years.

Jeff Child, Editor-in-Chief
**SPECIAL FEATURE**

RuggedBoxes or Slot Card Chassis?

In recent years the trend in large and medium UAVs in recent years has been to embed arrays of big slot-card board systems with general-purpose processors and more recently FPGA-based cards. But as that’s shifted toward the idea of stand-alone function-specific box-level systems are in some cases replacing traditional slot-card implementations. Thanks to that kind of box-level consolidation, the radar, imaging processing and communications capabilities of large UAVs by allowing more functionality in the same space. For functions like comms and networking systems sometimes it’s helpful to leave open for the end-user for reconfiguring fielded systems to their own needs. What’s happened in recent years, is that box-level solutions have emerged that have open architecture boards inside, based on VPX or PC/104 for example.

An example of box and board solutions used together, Acromag and Alta Data teamed up to integrate Acromag’s box-level ARCX product with Alta’s avionics interface cards. The ARCX embedded computer is a customizable-off-the-shelf Intel i7 with one or two PMC/XMC expansion sites. This rugged, small form factor box is designed to meet IP67 standards for a dependable, sealed, fanless system. Alta offers a wide variety of avionics PMC and XMC MIL-STD-1553 and ARINC high density interface cards that have been field tested with the ARCX. The rugged ARCX system is a 4th Generation Intel Core CPU and single or double PMC/XMC sites and 38999 connectors (Figure 2). SWaP-optimized for systems such as: payload management, as well as command and control for drones and robotics. For example, an ARCX i7 Quad Core system with Alta’s MIL-STD-1553 or ARINC PMC cards and Acromag’s advanced FPGA PMC provides a solution for DSP, video and avionics system capabilities.

**Tailored for UAV Use**

A recent example of a rugged box level system specifically designed for the kinds of needs UAV platforms require is Curtiss-Wright’s Defense Solutions newest member of its Parvus DuraCOR family of extremely small form factor rugged mission computer subsystems. Designed for applications such as unmanned systems that require an extremely size, weight, power and cost (SWaP-C) optimized mission computer. The new Parvus DuraCOR 311 Mission Computer combines 64-bit quad-core Intel “Baytrail” Atom modular mission processing capabilities with integrated Intel HD graphics in a lightweight, ultra-small form factor rugged design. The new ultra-small mission computer weighs less than 1.5 pounds and is less than 40 cubic inches in size.

The DuraCOR 311 comes with a full complement of standard I/O interfaces (including USB, Ethernet, Serial, DIO, Video, and Audio). I/O expansion is supported by three Mini-PCIe expansion slots and the broad ecosystem of rugged COTS Mini-PCIe modules (including MIL-STD-1553 and ARINC 429 avionics databus interfaces). The DuraCOR 311 also features MIL-performance circular connectors and a fully dust and waterproof chassis. In addition to internal mSATA and microSD card slots, the system offers an optional removable 2.5 inch SATA SSD storage option for high capacity storage and information assurance requirements. Initial software support includes pre-loaded Linux or Windows operating systems. The unit’s Intel processor supports HD-class video acceleration, including OpenGL, OpenCL, and OpenVG.

Also with a solution aimed specifically at UAVs, Advanced Micro Peripherals provides its microHydra is a COTS multi-channel video acquisition appliance ideally suited for UAV applications such as surveillance and reconnaissance where more functionality is essential in rugged, compact environments. The microHydra is implemented with multiple intelligent video processors on a PC/104 stack linked to a central processor and storage over a Gbit Ethernet fabric. The system has a conduction-cooled IP67 rated enclosure with sealed MIL-D38999 connectors. It supports up to 8 PAL/NTSC/RS-170 recording channels for capturing multiple live video cameras, RS-170 signals and FLIR. In addition, two HD-SDI inputs supporting KLV meta-data (to STANAG 4609) extraction and processing are provided to handle high-end imaging of EOIR HD sources including L3 -Wescam turrets. Also provided are optional sensors and features including Controller Area Network (CAN), 3-Axis Accelerometer, Altimeter, a 3-Axis Digital Magnetometer (e-compass), and Gyroscope.

**Figure 2**
The rugged ARCX system is a 4th Generation Intel Core CPU and single or double PMC/XMC sites and 38999 connectors.

**Figure 3**
The HDS6603 is a fourth generation Intel Xeon server-class, OpenVPX processing board. It provides over a Teraflop of general processing using dual Intel Xeon x86 processors, each with 12 cores.
Cloud Processing on UAVs

One important trend in large UAV systems is the desire to move the processing closer to where the sensor or antenna is bringing in signals. At the same time, there’s a move to pack in more processing power that can be used as needed throughout a system. This calls for server class computing on compact embedded boards. Mercury Systems calls this on-platform cloud processing at the tactical edge. An example along those lines is Mercury’s HDS6603 (Figure 3), its fourth generation Intel Xeon server-class, OpenVPX processing board. It provides over a Teraflop of general processing using dual Intel Xeon x86 processors, each with 12 cores, Haswell architecture and Wellsburg Bridge technology. The board can do unrestricted 40 Gbit/s Ethernet and FDR10 fabric bandwidth. Mechanical ruggedness and the effective Air Flow-By cooling technology ensure the highest MTBF even under full throttle, continuous processing conditions.

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Increasingly UAVs are expected to have longer persistence, remaining on station for durations measured not in hours but in days. The ability to loiter for surveillance and strike missions places a significant design emphasis on saving space and weight throughout the systems. An ounce here and an ounce there adds up to many pounds overall. At the same time, the sophistication of a UAV’s surveillance capabilities continues to expand. Capable of gathering massive amounts of data, multiple cameras and sensors cover a wide frequency spectrum from visible light to infrared and thermal with impressive resolution and field of view.

The ARGUS imaging system, for example, can spot a six-inch object within a ten-square-mile radius from 20,000 feet in the air. The ARGUS system uses 368 cameras and can capture, process, and download one million Terabytes a day. Combining images from multiple cameras and other signal processing needs require fast embedded computers and sophisticated software. Because of the enormous amount of data generated by the sensors, an additional system challenge is separating the wheat from the chaff via onboard processing so that only critical data is transmitted to satellites or ground stations. Even if the ARGUS system can process one million terabytes a day, the larger Intelligence, Surveillance, Reconnaissance infrastructure can’t handle such loads, even with hefty data compression.

### Embedded Computing Balancing Act

Embedded computing systems must balance a variety of competing needs. These include:

- **Higher processing loads**: the system must be able to be able to read high-definition sensors, process the information, and transmit the results to the ground.

- **Weight and space savings**: Lower weight translates into longer flight times and larger payloads. Space constraints are always an issue.

- **Ruggedness**: the system must be reliable, able to withstand harsh environments over long flight times.

- **Scalability**: one size doesn’t fit all.

Any one of those is easily accomplished, but achieving all involves compromises. Commercial systems run faster, but don’t have the ruggedness required. The most rugged systems may not have the flexibility, scalability, or performance to meet today’s data-intensive military and aerospace needs. Small, lightweight systems are easier to design if ruggedness and performance are not important.

### VPX Has Right Mix

VPX, which supports speeds of 3.125 Gbits/s, 6.25 Gbits/s, and higher in a switched fabric architecture, is the latest generation of the venerable VMEbus and offers new levels of performance for embedded computer systems. VPX systems are designed for flexible application of demanding high-speed protocols, such as 10G Ethernet, RapidIO, InfiniBand, and HyperTransport protocols, in ground, aerospace, and marine applications.

VPX is a ruggedized approach to embedded computing that also relies heavily on commercial off-the-shelf products, fostering a wide international supplier base, shortening time to market and further feeding the ecosystem’s evolution. Two other standards are important to the VPX ecosystem. VITA 65 defines OpenVPX, which...
establishes standard profiles for various configurations at the chassis, backplane, slot, and module levels. The goal is to create compatibility between products from different vendors to enable an open architecture and support two-level maintenance and system upgrades by allowing users to swap out line replaceable modules (LRMs) in the field. VITA 68 defines a VPX compliance channel including common backplane electrical performance criteria required to support multiple fabric types across a range of defined data rates.

**Connectivity for VPX**

VITA 46 is the founding architecture specification for VPX. It specifies the MULTIGIG RT 2 backplane connector from TE Connectivity (TE), with a focus on digital signals. Shown in Figure 1, the connector’s design uses plug-in module wafer in place of pin contacts, an approach well established in commercial applications. Wafers—available for differential, single-ended, and power needs—can be easily modified to support specific customer needs for characteristic impedance, propagation delay, and other electrical parameters. The pinless backplane half of the connector assures protection of the backplane, thereby protecting the system, vehicle, and mission. Signal integrity has been elevated in parallel with the mechanical integrity. The ruggedized commercial VPX connector supports speeds up to 10 Gbit/s, providing plenty of margin to support VPX’s standard speeds of 3.125- and 6.25-Gbit/s. The design is highly modular to support both 3U and 6U configurations.

Several competitive connectors, defined by other VITA standards, offer footprint compatibility with MULTIGIG RT 2 connectors, but not intermateability. TE’s MULTIGIG RT 2 connector’s wafer based design and sturdy thermoplastic housing create a connector with a lot of air and very little metal—in other words, a very light connector. They are about 50% lighter than other connectors aimed at being VPX alternatives. The connectors are also very modular to give users greater flexibility in building 3U and 6U configurations. The modularity also permits the modules to be replaced by modules for RF, optical, and power needs. They also support both 1.25-inch and spacing-saving 0.8-inch pitches.

**Rugged Beyond VITA 47**

The VITA 47 environmental standard has long been the measure of ruggedness for embedded computing applications. It defines levels and testing for mechanical and environmental stress, such as vibration, temperature extremes, and other criteria important for reliability in harsh and challenging environments. While VPX/VITA 47 is the current standard for high-reliability, high-speed embedded systems, designers also want to migrate VPX into more challenging environments. New testing methods by which to measure performance. Testing conducted by the VITA 72 Study Group provides such an evaluation.

MULTIGIG RT 2 connector has been “up-ruggedized” further to meet the even more demanding requirements of VITA 72. Intermateable with the original design to provide an easy migration path from rugged to ultra-rugged, the new MULTIGIG RT 2-R connector uses contacts have been redesigned so that each beam makes two points of contact—termed quad redundant—roughly doubling the contact patch area with the wafer. The new contact system may reduce mating forces by up to 10 percent while helping maintain reliable contact under extreme vibration levels. Because the two beams are not symmetrical to one another, each beam has different frequency modes in response to vibration, lessening the possibility of both beams being adversely affected simultaneously.

**Creating a Rich VPX Ecosystem**

The VPX ecosystem is rich, evolving to provide designers with an array of choices for single-ended and differential signals, mezzanine, power, optical, and RF connectivity. As VPX has evolved, new standards have been created to meet the widest range of interconnection needs. Figure 2 summarizes the main interconnections now available for VPX systems from TE and shows a notional configuration of signal, RF, and optical possibilities on a single card edge.

Not shown in the figure are VITA 61 XMC 2.0 mezzanine connectors. Mezzanine boards give additional plug-in flexibility for systems by providing for expanded functionality and modularity to a pc board. They allow existing boards to be re-configured, upgraded, or customized by the addition of the mezzanine card. Typical applications include application-specific high-speed input/output (I/O) protocols, graphics, mem-

![Figure 2](image-url)

The VPX system has evolved in a rich and varied ecosystem. VITA 66 is for multi-position backplane optical modules. VITA 78 is for SpaceVPX using MULTIGIG RT 2-R connectors.
ory, and digital-signal processing.

The VITA 67 standard specifies the SMPM series connector, chosen for the higher packaging density made possible by small size. The goal in designing the VITA 67 RF modules was to fit eight RF contacts into the space occupied by a single VITA 46 VPX signal module. The SMPM is a miniaturized version of the SMP series connector that is 30 percent smaller with similar performance and has a compact push-pull blind-mate interface. While the SMPM connectors have a maximum operating frequency of 65 GHz, the VITA 67 standard requirement is a frequency range of DC to 26.5 GHz.

Faster, Denser I/O

Fast processing by embedded computing also requires faster input/output speeds to help prevent communication bottlenecks. As I/O speeds increase, issues of signal integrity and power budgeting create new challenges. Simply put, high-speed signals are harder to manage than low-speed signals. The higher the interconnection speed, the more difficult it is to manage return loss, insertion loss, crosstalk, and similar factors that can degrade signals. While an ideal cabling system would have no intermediate connections between boxes, the real-world need for production breaks and modularity necessitates connectors in the path.

A poorly designed connector will appear as a significant impedance discontinuity. The impact of the discontinuity is frequency dependent—return loss and crosstalk increase with frequency—meaning that high-speed I/O connectors must be more carefully designed. Attenuation in the cable and insertion loss in the connector are also frequency dependent, making power budgets more challenging at high speeds.

Size, weight, and power (SWaP) issues remain tantamount to providing persistent surveillance, a better fuel-to-weight ratio, and the potential for smaller UAVs. While smaller, lighter connectors help meet SWaP goals, miniaturization can’t be accomplished at the expense of signal integrity or robust ruggedness. Traditional nanominiature and microminiature connectors already exist, but were not designed for high-speed signals. More recently, connectors supporting 10-Gb/s data have arrived in packaging ranging from nanominiature to traditional MIL-DTL-38999 shells. Figure 3 shows a size comparison of three such connectors.

Fiber Goes the Distance

Even as high-data-rate copper-based connectivity is evolving, fiber-optic transmission is finding increased use. Creating location-independent architectures means different subsystems must not be constrained by cabling distances. Optical fibers have the well-known advantages of long transmission distances, noise immunity, small size, and light weight. Fiber optics has also made strides in easier use, ruggedness, and choice. The VITA 66 standard, for example, offers a choice of: Ceramic ferrules for the best insertion loss and return loss performance; Noncontacting expanded beam termini for increased ruggedness; and MT ferrules for high fiber counts of 12 or 24 fibers per ferrule and multiple ferrules per module. The same options are available for a variety of military-style circular and rectangular connectors.

As VPX continues to evolve, it gives designers new levels of flexibility and capabilities in meeting the sophisticated signal-processing needs of UAVs. Adapting and evolving commercial interconnection technology has proven to be the preferred way to meet the ever-increasing needs of embedded computing. Commercial technology often leads in achieving new levels of speed and density, need only to be sufficiently ruggedized to meet the stricter requirements of high-reliability applications. While such ruggedization of commercial technology may not be a trivial matter, it often provides a lower risk and faster path to market than starting from scratch. Rather than reinventing new technology, you need only demonstrate that the existing technology—already widely used—works in a more rigorous environment.

TE Connectivity

Berwyn, PA

(610) 893-9800

www.te.com

Figure 3

Three 10-Gbit/s connector families give designers more choices in meeting SWaP goals.
NAI’s family of COTS rugged systems are highly configurable and enable NAI to meet your specific requirements with no NRE. Use NAI’s Custom-On-Standard Architecture™ (COSA™) to integrate multi-function I/O, SBCs, power supplies and software into a rugged enclosure of your choice. Pre-existing, fully-tested functions can be combined in an unlimited number of ways — quickly and easily.

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Machinery & Control  Motion Control  Sense & Response

---

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North Atlantic Industries
www.naii.com
UAV Data Imaging Solutions Push Limits of Embedded Technologies

The evolution of UAV-based image collection has a long mission-critical history for the U.S. military. Today’s high-resolution image capture technology requires 6,000 Terabyte-per-flight performance.

David Lippincott, Chief Technology Officer, Chassis Plans

Aerial surveillance systems mounted on UAVs generate huge amounts of imagery data, up to 6,000 Terabytes/flight per UAV. This data is more often than not created in remote global locations with poor or non-existent pathways for transmitting that data to the people that need it. One such system is the U.S. Air Force Gorgon Stare which utilizes a 1.8-billion pixel camera system to image a 50 square kilometer circle (Figure 1). Modern sensor systems used in persistent surveillance platforms can produce more than 100 Gbytes/s of data when tasked with wide area surveillance purposes. This article discusses the Gorgon Stare program, data management and a custom transit case data system manufactured by Chassis Plans that is used to securely transport that reconnaissance data.

Figure 1
MQ-9 Reaper showing Gorgon Stare ARGUS-IS installation.

Identifying enemy threats has always been a prime doctrine of any battle. The more so in the current battle space in Afghanistan. When your troops are surrounded by buildings in areas crowded with civilians, how do you keep track of the enemy who mean your troops harm? How do you track enemy combatants traveling in remote areas without a massive deployment of friendly troops? To this end, the military has been searching for the high ground in any battle environment; first hill tops, then balloons and now UAVs and aerostats.

Bandwidth has always been a problem; too much information and no way to efficiently transmit that information in real time to the battle commanders who need it. The advent of radio opened up more remote reconnaissance allowing real-time reporting but it was still word of mouth. Television after WW2 allowed true real-time remote surveillance but was still limited in terms of the area and resolution that could be observed.

The Age of the Predator

The Predator UAV was developed in 1994 with the first flight on July 3, 1994. Prior to the Predator, UAVs had been small, lightweight and unobtrusive drones. As such, they had very limited payload capability, perhaps offering a film camera or a low-resolution video image transmitted line-of-sight to their controller to help determine enemy disposition. Predators, on the other hand, are big with a wing span of 49 feet and an empty weight of 1,100 pounds allowing a payload of approximately 500 pounds. Predators are controlled remotely via satellite and can operate anywhere in the world with the operators being located in the U.S.A. Image data can be uplinked via satellite or by line-of-site to local commanders.

This payload capability of the Preda-
tor, much more than offered by small UAVs then in use, allowed the installation of sophisticated sensor suites including stabilized visual and infrared camera balls that transmitted images in real-time to ground stations for analysis and dissemination to troop commanders. Finally, the military had high-resolution eyes on the high ground, safe from enemy ground fire, mobile with long loiter times and able to dispatch to any part of the battle space, providing real-time reconnaissance night and day. These aircraft could be flown into areas denied to traditional manned aircraft as potentially too dangerous.

However, the early cameras on the Predator had a limited field of view and were likened by pilots to “flying the aircraft while looking through a straw.” They were a huge improvement over existing technology and were first deployed in Bosnia in 1995, providing valuable real-time intelligence. But the military wanted more. The Predator B, designated the MQ-9 Reaper by the U.S. Air Force, is a follow-on to the original Predator, is bigger with a 55 foot wing span, faster, offers longer loiter time and many improvements including a 3,850 pound payload capacity that includes 3,000 pounds of external stores.

But the sensor ball under the nose still suffered from a limited field of view, like “looking through a straw” as many operators have said. Operators could follow a single target, but multiple targets presented significant problems in tracking. The installed AN/AAS-52 multi-spectral camera system offers six fields of view, ranging between 19mm to 560mm. Thus, operators can zoom out for a wide angle view or zoom in to track a single target. The ball must be rotated to change the central target focus. The wide angle view showed a large area but lacked resolution.

Gorgon Stare

The Global War on Terror dramatically changed the way the U.S. Military used persistent surveillance to pursue terrorists and enemy combatants. The limited field of view of existing aerial platforms was a hindrance in keeping track of targets. It worked great for single or stationary targets but if the enemy scattered in different directions, it was difficult to reacquire the targets. Sierra Nevada Corporation was contracted to create a new high resolution camera which the U.S. Air Force planned to deploy in 2011 with a follow-on in 2012 and a third in 2014. This was Gorgon Stare Wide Area Airborne Surveillance System (WASS) and was conceived, designed and developed in less than three years (Figure 2).

As initially released, Gorgon Stare was...
housed in two 500 pound pods which were mounted on the inboard weapons pylons on the MQ-9 Reaper. The right-side pod housed the sensor ball, manufactured by ITT Defense, and an image processor. The left side pod contained a computer to process and store the images, data-link modem, two pairs of Common Data Link and Tactical Common Data Link antennas plus radios. The sensor ball contained five electro-optical (EO) cameras for daytime and four infrared (IR) for nighttime and poor visibility due to dust and smoke. These cameras were positioned at different angles to maximize ground coverage. The five EO cameras shot two 16-megapixel frames/sec each for an equivalent 80-megapixel sensor. The four IR cameras imaged 8-megapixels each for an equivalent 32-megapixel sensor. This was not true video which is normally 30 frames/s but was still better than fixed images. Data was captured at 15.3 Gbps. All video data was stored on-board for downloading after the Reaper landed for additional analysis.

Coordinated Operation

Gorgon Stare was operated independently, but in coordination, from the UAV pilots by two operators in a dedicated ground station in the battle theater. A separate processing, exploitation, and dissemination team co-located with the Gorgon Stare ground station coordinated with field commanders to get the images to the field. The data stream could be divided into 10 individual views allowing tracking of 10 targets and streamed to that many recipients via the Tactical Common Data Link. This was an order-of-magnitude improvement over the single camera carried in the nose-ball of the UAV.

Gorgon Stare would process the images from all the on-board cameras into a single mosaic for a wide-angle view which could be streamed to tactical operations centers. This relatively low-resolution image could provide an overview of the battle space. Instead of looking at a single building or vehicle, this image allowed examining an entire village. The mission data is stored on-board for post-flight download and analysis. Said Lt. Gen. David Deptula, deputy chief of staff for intelligence, surveillance and reconnaissance, “You can review [the data] and accomplish forensic study of the area by looking at movement and tracing activity. If you know where an improvised explosive device went off, you can ‘rewind the tapes’ and see where the activity was and what led to it.” Gorgon Stare was very much better than the existing systems to that time but the U.S. Military wanted more.

ARGUS-IS Goes Beyond

Wanting more capability, the U.S. Air Force commissioned Gorgon Stare Increment II with over twice the coverage area and much higher resolution. ARGUS-IS, or the Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System, was a Defense Advanced Research Project Agency (DARPA) program contracted to BAE Systems.
ARGUS-IS melded 368 5-megapixel cell phone cameras and four image-stabilized lenses to produce a single mosaic image with an effective resolution of 1.8 billion pixels (Figure 3). Compare that to your 20 megapixel Canon DLSR. While the official coverage area is classified, it is reported to be 35 to 50 square kilometers with the Reaper orbiting at 20,000 to 25,000 feet and an endurance of 12 to 14 hours. Two aircraft can provide 24 hour coverage. ARGUS-IS can resolve a six inch object while orbiting at 20,000 feet. Data is recorded at 15 frames per second as compared to 2 frames per second for Increment I and is detailed enough to resolve flying birds. The images are now in color versus the original black and white (grey scale) images.

ARGUS-IS is a two ball system with one ball providing daylight visual data (EO) and the other providing infrared images (IR). The balls are both gyro stabilized and mounted in separate pods. These balls are controlled by the Gorgon Stare ground station and the Reaper pilots retain control over the nose ball in the aircraft. On-board processing combines the data from the two balls into a single high-resolution mosaic image. Future enhancements include incorporating synthetic radar data for use in cloudy or dusty conditions. The Reaper has the payload capacity for additional equipment.

Of particular note is the system has the capability to stream 65 separate high-resolution moving images to that many users in real-time while the aircraft is in flight. Compare that to the original Predator with the nose ball able to watch only one target at a time and Increment I Gorgon Stare providing 10 image streams. In addition to raw image data, ARGUS-IS can provide latitude and longitude meta data for each pixel in the image.

Data Overload

Big data is good but the payoff is the actionable intelligence buried in the data. Analyzing the raw data to tease out the important information is as important as having the raw image data. High frame rate video streams and imagery from multiple sources in real time are becoming more common, making the requirements for high-performance data transfer and storage even more challenging.

The ARGUS-IS camera provides a resolution of 1.8 billion pixels. 1.8 billion pixels at 12 frames per second generates on the order of 600 gigabytes per second or 6,000 terabytes of video data per day. That is a stack of 1.44Meg floppy disks 44,000 feet high. Massive data crunching onboard the Gorgon Stare platform reduces the raw data to something significantly more manageable but this is still a lot of data. The system will stream an overview mosaic and 65 small high-resolution pieces of the image mosaic in real time but there is not enough bandwidth to transmit the entire 1.8 billion pixel image at full resolution while the Reaper is in flight. On-board storage takes up this slack by allowing the entire flight’s data to be downloaded once the Reaper is back at base.

Processing takes place at multiple locations where raw flight data is ingested and remains at the edge (battle space) for tactical use while some data is distributed for broader analytical use. With the entire flight’s data available for post-flight analysis in conjunction with prior flight’s data, even from other Reapers, a long-term history of the area can be compiled allowing analysts to build a profile of day-to-day life looking for anomalies that portend terrorist activity. They have a time machine allowing them to go back in time to follow the path of a vehicle or person to an origin. This is the valuable information in the raw data.

The other problem is after the flight, the aircraft will be parked on the ramp while being fueled and preflighted for the next mission and is not necessarily near where the mission data is needed. Wi-Fi is out of the question and not nearly fast enough. Even at Gbit Ethernet speeds, downloading the data via a Cat 6 Ethernet cable, should one be available and able to survive the flight line environment, is not fast enough to download that much data in a reasonable time frame.

Transportable Solution

Working closely with the customer, Chassis Plans provided a very complex custom solution to provide the ground crew a rugged portable intelligent data transportation system. The system, easily carried by one person, is carried to the aircraft and used to download the flight data. High-speed communications to the aircraft is provided by a 10 gigabit fiber link. Sufficient high-speed RAID disk storage with in-system intelligence for management allows an entire flight’s image data to be stored in the system. The transit case system has to be sealed and rugged enough to survive flight line conditions in Afghanistan which can be very hot, very cold, very dusty and wet. Chassis Plans packaged the electronics and disc storage in a small transit case (Figure 4). The small size makes this raw post-flight data easily transported to the central command or even back to the United States for inclusion in the overall theater database for near real-time analysis using beefy super computers.

Chassis Plans
San Diego, CA
(858) 571-4330
www.chassis-plans.com
The digital conversation requires the marriage of two key technologies: analog-to-digital converters (ADCs) and FPGAs. The trend has been to do that digital conversion as soon along the signal chain as possible. High-bandwidth A/D converters with high sampling rates must connect to extremely fast data transfer paths to store and process data with triggering or gating circuitry to digitize pulse waveforms at precisely the right time. To feed those needs, board vendors continue to push the barriers with solutions with ever faster ADCs and more sophisticated FPGAs. A number of digital receiver products combine ADCs and FPGAs on one VME, VPX, or PCI Express board, while others partition the integrate an FPGA processing engine with mezzanine-based ADCs using form-factors like FMC or XMC.

For this month’s Editor’s Pick section COTS Journal evaluated several FPGA-based digital conversion products based on three aspects: technology leadership, design innovation and market relevance. The winning product is the 71663 GSM Channelizer XMC module from Pentek (Figure 1). The board uses a single high-density Virtex-6 FPGA to implement 1100 digital receivers capable of capturing every possible up-link and down-link channel for both low-band and high-band GSM mobile telephone traffic. It has an exceptional dynamic range of greater than 85 dB allowing it maintain operation for very weak signals. The 71663’s re-sampling filter delivers an optimal 4x over-sampling output data rate to streamline symbol recovery by the system processor. The board also boasts an extremely efficient frequency-multiplexed super-channel output mode to reduce PCIe traffic by a factor of four.

Tricky Board Layout Challenges

In terms of design innovation, the 71663’s layout had to contend with packaging four high-performance A/D converters amidst a field of high-power digital logic required advanced techniques in printed circuit board layout, power supply regulation and filtering, shielding, and ground plane management. Numerous switching power supplies on board act as powerful transmitters of unwanted energy threatening sensitive analog signal paths through conducted and radiated emissions across distances measured in millimeters. Since any one of these factors can limit the dynamic range performance of the board, the design of the 71663 required many iterative steps to eliminate each of the worst offenders, one by one. Each step often required a critical modification of the printed circuit board, carefully guided through meticulous testing, analysis and experience.

Monitoring the overwhelming glut of radio signals to Capable of capturing all GSM traffic in any location, the Pentek 71663 is an ideal solution as the front end of monitoring systems. Such technology is key for gleaning actionable intelligence through monitoring GSM cell traffic. GSM accounts for the majority of worldwide mobile telephone networks—and is especially prevalent in regions currently under military and terrorist conflict. Meanwhile, the XMC form factor is rugged and small enough for portable or mobile platforms, especially important for battlefield monitoring, anti-IED systems, police and emergency responders.

Pentek
Upper Saddle River, NJ
(201) 818-5900
www.pentek.com

Figure 1
Jeff’s Pick this month is the 71663 GSM Channelizer XMC module from Pentek. It uses the Virtex-6 FPGA to implement 1100 digital receivers capable of capturing every possible up-link and down-link channel for both low-band and high-band GSM mobile telephone traffic.
6U Conduction-Cooled Signal Processing Module Sports Dual Virtex-7s FPGAs

Extreme Engineering Solutions offers the XCalibur5090, a dual Xilinx Virtex-7 based Digital Signal Processing (DSP) 6U LRM FPGA module featuring high-speed serial interfaces, DAC and ADC channels, external memory, and flexible, high-density I/O for customizable, high-bandwidth, signal-processing applications. The board is available in a rugged, conduction-cooled 6U LRM form factor. Each user-programmable Xilinx Virtex-7 XC7VX690T FPGA is coupled with a single 12-bit ADC chip, configured as a single 3.2 GSPS input or dual 1.6 GSPS inputs, and two 14-bit DAC output chips, configured as 2.5 GSPS outputs.

These closely coupled ADC and DAC chips result in very low latency between inputs and outputs, making it ideal for applications like electronic warfare (EW) and SDR (Software Defined Radio), where a signal will need to be received and then rapidly transmitted. Channels can be synchronized to form an array of synchronized analog inputs, serving a critical need for applications like SIGINT that require beamforming. Each FPGA supports two banks of 32-bit, 1 GB DDR3-1600 SDRAM connected directly to the FPGA. With support for commercial and industrial temperature, as well as -1, -2, and -3 speed grades, the XCalibur5090 is well-suited to a diverse array of signal-processing and logic demands.

Extreme Engineering Solutions
Middleton, WI
(608) 833-1155
www.xes-inc.com

FPGA PMC/XMC Module Delivers Eight 310 MS/s ADC Channels

The X6-250M from Innovative Integration is a PMC/XMC I/O module that integrates digitizing with signal processing. The module has a powerful Xilinx Virtex-6 FPGA signal processing core and high-performance PCI Express/PCI host interface. Applications include software-defined radio, radar receivers and multi-channel data recorders. The card has eight simultaneously sampling A/D channels that sample at rates up to 310 Msamples/s (14-bit). The A/Ds have matched input delays and response. The A/D are supported by a programmable sample clock PLL and triggering that support multi-card synchronization for large scale systems.

A Xilinx Virtex-6 SX315T (LX240T and SX475T options) with four banks of 1 Gbyte DRAM provides a very high-performance DSP core with over 2000 MAC’s (SX315T). The close integration of the analog I/O, memory and host interface with the FPGA enables real-time signal processing at extremely high rates. The X6-250M power consumption is 23W for typical operation. The module may be conduction-cooled using VITA20 standard and a heat spreading plate. Ruggedization levels for wide-temperature operation are from -40 to +85 degrees C (conformal coating) and 0.1 g2/Hz vibration.

Innovative Integration
Simi Valley, CA
(805) 578-4260
www.innovative-dsp.com

...and the Runners Up
The **PC870 from 4DSP** is a PCI Express card combining an A/D channel, a D/A channel and a Kintex UltraScale FPGA. The low-latency data path of the PC870 enables 2.2 GHz of instantaneous analog bandwidth in both the receive and transmit directions.

4DSP, Austin, TX. (800) 816-1751. www.4dsp.com

**Acromag’s XMC-7A200 modules** feature a Xilinx Artix-7 FPGA enhanced, high-speed memory and serial bus interface. Front I/O processing is supported with plug-in AXM mezzanine cards. A variety of AXM I/O cards are available including the AXM-A30 with its two 16-bit 105 MHz A/D channels.

Acromag, Wixom, MI. (248) 295-0310 www.acromag.com

**Annapolis Micro Systems’ WILDSTAR UltraK 2PE for OpenVPX 6U** boards include two Xilinx Kintex Ultrascale XCKU115 FPGAs with High Speed Serial connections performing up to 16.3 Gbps. Dual FMC+ sites for cards like Annapolis’ 2.5 Gbps 10-Bit ADC FMC.

Annapolis Micro Systems, Annapolis, MD. (410) 841-2514. www.annapms.com

The **CHAMP-WB-A25G** is a board set from Curtiss-Wright that couples the dense processing resources of a single large Xilinx Virtex-7 FPGA with a high-bandwidth 25 Gsample/s 8-bit ADC module in a commercial grade 6U OpenVPX (VITA 65) form factor module.

Curtiss-Wright Defense Solutions, Ashburn, VA. (703) 779-7800. www.cwdefense.com

The **Echotek Series DCM-V6-XMC Module from Mercury Systems** combines the latest wideband high-performance ADC with a high-speed, high-resolution DAC, both working in conjunction with Xilinx Virtex-6 technology. The 12-bit ADC samples at up to 3.6 GSPS.

Mercury Systems, Chelmsford, MA. (978) 967-1401. www.mrcy.com

The **QuiXilica Gemini-V6 VXS from TEK Microsystems** is a 6U VME and VXS high-speed digitizer board that combines FPGA processing with 12-bit ADC and DAC technology. It is well suited for applications such as target generation, jamming, and CM / CHM techniques.

TEK Microsystems, Chelmsford, MA. (978) 244-9200. www.tekmicro.com

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Photo: U.S. Air Force / Sr. Airman Nathanael Callon
Established platform parallel bus protocols like VMEbus and CompactPCI still have their place in today’s and tomorrow’s harsh environment, real-time/hard-deadline embedded sub-system applications...especially when these products are upgraded and maintained to keep pace with the newest, fastest processor and memory technologies.

While there are some applications where high speed serial fabrics like VPX are ideal, there are others where VMEbus or CompactPCI still rule the roost.

One company continues to actively invest in maintaining – and not obsolescing – their military and space embedded computing products with a proactive 12-year minimum COTS Lifecycle+™ Program.

And one company continues to also invest in delivering the very best of the newest embedded COTS computing platforms with the new, serial fabric protocols.

And one company actively invests in technology insertion at the board level, creating backplane, pin-compatible products with the latest, next generation memory and processor technologies “on-board”.

And that same company still delivers their legacy bus products at full speed and full capability and full mil temp range (-55 to +85°C) with those latest technologies.

The one company to do all that? Aitech. Check our website to learn more about our technology roadmaps and how they protect your investments.
Major Programs Budget Modernizes Across Land, Sea and Air

While a few billion less than last year’s, the 2017 Defense Budget Request includes a robust focus on technology upgrades to existing platforms—providing continued opportunity for suppliers of embedded computing and electronic systems.

Jeff Child, Editor-in-Chief

Unlike the turmoil of the first sequestration years, this year’s release releases of the next fiscal year President’s budget proposal with on schedule. Its return a consisted schedule is perhaps a good sign of some return to a sense of certainty among stakeholders. The proposed budget request President Barack Obama sent in February to Congress calls for $582.7 billion in discretionary budget authority to fund the Department of Defense in Fiscal Year 2017.

The amount complies with the Bipartisan Budget Act of 2015 according to the DoD, giving the department both funding stability and protection from the damage of sequestration in FY 2016 and FY 2017. The base budget of $523.9 billion includes an increase of $2.2 billion over the FY 2016 enacted budget of $521.7 billion. DoD’s FY 2017 overseas contingency operations budget is $58.8 billion which was specified in the budget agreement and is nearly the same as the FY 2016 enacted level of $58.6 billion. The combined request represents a total increase of $2.4 billion, or less than one percent over FY 2016 enacted levels.

The request takes a healthy focus on technology and modernization in the proposed budget. For technology and capability procurement the budget invests a total of $112.1 billion. It increases funding for research and development accounts, which total $71.8 billion in FY 2017. Overall the 2017 DOD budget request asks Congress for a total of $583 billion, whereas the 2016 total request was for $585.2 billion—an overall reduction in Pentagon spending by $2.2 billion over last year. But as always, as military systems modernization, upgrade and enhance their capabilities the embedded computing, networking and electronics portions of those systems is always on an increasing trend.

Of the $183.9 billion acquisition budget, $72.7 billion is for programs that have been designated as Major Defense Acquisition Programs (MDAPs) or Major Automated Information Systems (MAIS). Within the MDAP definition the major categories include: Aircraft, C4 Systems, Ground Programs, Missile Defense, Munitions and Missiles, Shipbuilding/Maritime Systems, and Space Based and Related Systems. Mission

FY 2017 Modernization – Total: $183.9 Billion

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Figure 1

DoD FY 2107 Major Program categories. (Numbers may not add due to rounding).
Support and Science and Technology also fall under the MDAP scope. Figure 1 shows a breakdown of how major program funding is divided. The rest of this article hits the key programs under the MDAP scope. Figure 1 shows a breakdown of how major program funding is divided. The rest of this article hits the key programs that are of particular reliance to our military embedded computing industry.

**Old and New Vehicle Developments**

Although more than $1.5 billion more than last year, the DoD Budget request focused on modernizing ground platforms is among the smallest segments at $9.8 billion. The modernization strategy has the Army and Marine Corps equipping each soldier and Marine with the best equipment available with technology research in line with future Army and Marine Corps combat portfolios. The Army continues to modernize and upgrade select Major Defense Acquisition Programs in FY 2017, including Stryker vehicles, Abrams Tanks, Bradley Fighting Vehicles, and Paladin 155mm Howitzers. For the Marines, the ground force focus in FY 2017 is on the Amphibious Combat Vehicle (ACV). The ACV will deliver shore and sea-based infantry to the battlefield in vehicles designed for future operational environments. Both services procure the final year of Low Rate Initial Production (LRIP) of the Joint Light Tactical Vehicle (JLTV). Figure 2 show the allocation for ground systems funding.

Progress is moving forward for the Joint Light Tactical Vehicle which provides a light tactical vehicle capable of performing multiple mission roles. The design is transportable by CH-47, CH-53, and C-130 aircraft. The program achieved Milestone C in October 2015. Mission: There are two variants planned: Combat Support Vehicles (3,500 lb) and Combat Tactical Vehicles (5,100 lb). The FY 2017 budget request funds the third and final year of Low Rate Initial Production (LRIP), procuring 2,020 trucks. The plan also continues Full Up System Level (FUSL) testing including Live Fire testing.

As the Army’s main battle tank, the Abrams M1A2 remains the great success story of tech upgrades that to improve its capabilities. These together are called the System Enhancement Package (SEP) and the Tank Urban Survival Kit (TUSK). Modifications to the M1 Abrams include Vehicle Health Management and Power Train Improvement and Integration Optimization, which provide more reliability, durability and fuel efficiency. The FY 2017 budget request funds development of mine blast survivability improvements and continues Engineering Change Proposal (ECP) IB (lethality improvements) development. It also continues procuring hardware for ECP 1A for installation during vehicle recapitalization in FY 2018, as well as numerous approved modifications to fielded M1A2 Abrams tanks, including the Ammunition Data Link (ADL). ADL enables firing of the Army’s new smart 120mm ammunition, and the Low Profile Commander’s Remote Operating Weapon Station (CROWS).

**WIN-T and Tactical Radios**

For the embedded computing and electronics industry, the Command, Control, Communications, Computers, and Intelligence (C4I) Systems part of the DoD’s Budget tends to have the most direct relevance. FY 2017 budget request supports the net-centricity service-based architecture pattern for information sharing. It is being implemented by the C4I community via building joint architectures and roadmaps for integrating joint airborne networking capabilities with the evolving ground, maritime, and space networks. It encompasses the development of technologies like gateways, waveforms, network management, and information assurance. Figure 3 shows the funding breakout of the C4I Systems category.

Developments and deployments are moving ahead for the Warfighter Information Network-Tactical (WIN-T), the Army’s high speed, high capability backbone C4ISR network, linking Warfighters in the battlefield with the Global Information Grid. WIN-T program development consists of four increments. Increment 1 (Inc 1) provides “networking at the halt” by upgrading the Joint Network Node (JNN) satellite capability to access the Wideband Global Satellite. Increment 2 (Inc 2) provides networking on-the-move to the company level. Increment 3 (Inc 3) provides Integrated Network Operations development.

**Increments 1 and 2 of WIN-T**

The FY 2017 program funds the tech refresh of obsolete commercial off the shelf components for 34 WIN-T Inc 1 units. It also adds X-Band terminals to Regional Hub Nodes. The WIN-T Inc 2 funding supports procurement of 12 communications nodes (6 Tactical Communications Nodes and 6 Points of Presence), and continues fielding and support for previously procured Low Rate Initial Production equipment. Also called for is procurement and fielding 283 Battlefield Video-Teleconferencing Center III systems. The request also provides program management support for Single Shelter Switch, High Capability Line of Sight, and Troposcatter Communications systems as they are transitioned to sustainment by the end of FY 2017.

Meanwhile in the tactical radio space—under the program name Handheld, Manpack, and Small Form Fit (HMS)—asks for funding that is necessary to execute the required full and open competition contract strategy for the Rifleman
Radio and the Manpack radios. The budget request conducts testing for the Manpack and the Rifleman candidate products to demonstrate compliance with program requirements to assess effectiveness, suitability, and survivability and to obtain material release for Full Rate Production. It funds support safety, spectrum portability, and other certifications necessary to prepare the products for fielding. Funding is also including for the procurement of the Rifleman and the Manpack Radios, support equipment, fielding, non-recurring engineering, and platform vehicle integration.

Shipbuilding: Carriers, Subs and More

With the Asia-Pacific defense strategy a priority, Navy funding is once again a large segment and larger still in FY 2017 budget request. The procurement goals are designed to support forward presence, in order to promote conflict deterrence. With that in mind, the Shipbuilding Portfolio for FY 2017 (Figure 4) includes the funding for the construction of 10 ships (2 SSN 774 Virginia Class nuclear attack submarines; 2 DDG 51 Arleigh Burke Class destroyers; 2 Littoral Combat Ships (LCS); 1 Landing Helicopter Dock Amphibious (LHA) ship); 1 Moored Training Ship; and 2 Ship to Shore Connector craft. In addition, funding is included in the FY 2017 request for ongoing incremental costs for the construction of nuclear aircraft carriers USS John F. Kennedy (CVN 79) and USS Enterprise (CVN 80); and the initial Advance Procurement funding to support detail design activities for the Ohio Replacement Program (ORP) Fleet Ballistic Missile Submarine (SSBN).

As expected aircraft carrier funding is among the big ticket items in the FY 2017 budget request. The CVN 78 class ships include new technologies and improvements to improve efficiency and operating costs as well as reduced crew requirements. USS Gerald R. Ford is the first aircraft carrier designed with all electric utilities, eliminating steam service lines from the ship, reducing maintenance requirements and improving corrosion control. The new A1B reactor, Electromagnetic Aircraft Launch System (EMALS), Advanced Arresting Gear (AAG) and Dual Band Radar (DBR) all offer enhanced capability with reduced manning. The ship’s systems and configuration are optimized to maximize the sortie generation rate (SGR) of attached strike aircraft. The FY 2017 program funds fifth year of construction costs for USS John F. Kennedy (CVN 79), long lead items for USS Enterprise (CVN 80), outfitting and training costs, and continued development of ship systems.

The DDG 51-71 represent the original design, designated Flight I ships, and are being modernized to current capability standards. DDG 72-78 are Flight II ships and DDG 79-123 ships are Flight IIA ships. In FY 2016 this plan is for DDG-124 to become the first Flight III ship. Flight III ships will feature the Air and Missile Defense Radar (AMDR) capability. The FY 2016 budget request funds two DDG 51 AEGIS class destroyers as part of a multiyear procurement for ten ships from FY 2013 to FY 2017.

Adding to AEGIS Destroyer Fleet

As one the Navy’s key platforms for fire Support to forces ashore and anti-ship gunnery
capability against other ships, modernization continues the various variants of the Arleigh Burke class destroyer. These ships provide air and maritime dominance and land attack capability with its AEGIS Weapon System, AN/SQQ-89 Anti-Submarine Warfare System, and Tomahawk Weapon Systems. The FY 2017 program funds two Flight III DDG 51 AEGIS-class destroyers as part of a multiyear procurement for ten ships from FY 2013 - FY 2017 and outfitting costs.

For its part meanwhile, the Littoral Combat Ship (LCS) acquisition plan procures two seafame designs which are a separate and distinct acquisition program from the mission module program. The two programs are synchronized to ensure combined capability. The FY206 budget request funds construction of two LCS seaframes, outfitting, trainers, and other support equipment. And the underwater side of Navy operations, the focus is the Virginia-class submarine. The budget request includes funding two subs as part of a multiyear procurement contract, advance procurement for two subs in future years, and outfitting and support items. It also continues funding for the development of the Virginia Payload Module, technology, prototype components, and systems engineering needed for design and construction.

**Aircraft: Manned and Unmanned**

The DoD continues to invest heavily in its aviation forces including fighter/attack, bomber, mobility (cargo/tanker), and specialized support aircraft, including unmanned aircraft systems. In summary the FY 2017 Base and Overseas Contingency Operations (OCO) funding provides for the procurement of 63 F-35 jets, 29 logistics support aircraft, 152 helicopters, and 35 Unmanned Aerial Vehicles (UAV) (Figure 5). In addition, the funding in this category provides for the development of aircraft related technology, the procurement of aerospace equipment and systems, various modifications to existing aircraft, and the procurement of initial spares.

The medium and large UAV platforms are of particular interest to the embedded computing industry. In the medium UAV space, Special Operations Command (SOCOM) divested the MQ-1 in FY 2015, and the Air Force is in the process of divesting the MQ-1 and replacing all aircraft with MQ-9s. Starting with the FY 2015 procurement, the MQ-1C Gray Eagle included the Improved Gray Eagle (IGE) Engineering Change Proposal (ECP), which extends the range and endurance of the Aircraft. Missions: The FY 2017 program calls for funding the continued development and integration of the Universal Ground Control Station and a signals intelligence capability for the MQ-1C Gray Eagle. The last year of procurement for the Army’s MQ-1C Gray Eagle was FY 2016.

For the Reaper (MQ-9), the FY 2017 budget request funds the continued development, transformation and fielding of Reaper aircraft and ground stations. The base request includes the procurement of 26 fixed ground control stations, a training simulator, and continues the modification of MQ-9s to the extended range configuration. The OCO request includes the procurement of 24 additional aircraft, updated multi-spectral sensors and payload modifications.

**The Biggest and the Smallest**

Turning to the DoD’s largest UAV, the Global Hawk, the U.S. Air Force continues to invest in its three variants RQ-4 Global Hawk, Navy MQ-4C Triton, and NATO Alliance Ground Surveillance (AGS) Unmanned Aircraft System. The RQ-4 Block 30 includes a multi-intelligence suite for imagery and signals intelligence collection, and the Block 40 includes multi-platform radar technology for synthetic aperture radar (SAR) imaging and moving target detection. The final three RQ-4 Block 30 aircraft will be delivered in FY 2017. Five NATO AGS aircraft are being procured with development funding and will complete deliveries by mid-FY 2017.

The FY 2017 program for the RQ-4 funds the development and modification efforts for the Block 30, Block 40, ground stations, and Multi-Platform Radar Technology Insertion programs; the Global Hawk modernization program; and the U.S. contribution to the NATO AGS. MQ-4C: The budget request also funds the procurement of 2 Low Rate Initial Production (LRIP) systems and continues to fund development activities associated with software upgrades and the multi-intelligence effort.

Finally, in the Small UAV category the focus is on the RQ-7 Shadow, RQ-11 Raven, RQ-20 Puma and RQ-21 Blackjack Unmanned Aircraft Systems. These aircraft provide organic Reconnaissance, Surveillance, Target Acquisition (RSTA) capabilities and are embedded in maneuver formations capable of providing crucial information to the ground commander. The FY 2017 program calls for funding upgrades to system hardware and payloads for the RQ-7 Shadow. It also procures upgrades and provides training and contractor logistics support for the RQ-11 Raven. Procurement is also provided for RQ-20 Puma systems for the USMC and SOCOM. A total of 8 systems (base and OCO) of the RQ-21 Blackjack will be procured along with contractor logistics support for that aircraft.
While today’s choice of embedded computing open architectures is large and growing, none can claim the long and successful legacy in military systems claimed by VME. One reason us that VME has been able to remain backward compatible and facilitate technology refresh in military programs. Even today there are hundreds programs in the military using VME. While not vendors publically reveal all these upgrade wins for VME, some of the highest profile over the years include the Abrams Tank Systems Enhancement Package (SEP) Upgrade; F-18 Advanced Multi-Purpose Display Program; Bradley Vehicle Electronics Upgrade; B-52 Mission Computer Upgrade; Aegis Guided Missile Destroyer Sonar Upgrade; B-2 Bomber Radar Upgrade; Boeing B-1B Bomber Avionics Upgrade; and C-130 Cockpit Upgrade. VME technology does lucrative business as a tech refresh solution in all of these upgrade programs and programs like them.

Another example is the VME PowerXtreme Power7E SBCs from GE Intelligent Platforms (now Abaco Systems) deployed as part of the Battle Force Tactical Trainer (BFTT) program that is designed to deliver optimum training and simulation capabilities to U.S. Navy ships. BFTT systems are fielded in all aircraft carrier (CVN 68/78), cruiser (CG 47), destroyer (DDG 51), dock landing ship (LSD 41/49), and amphibious transport dock (LPD 17) class ships.

The Power7E is one of a range of PowerXtreme 6U VME single board computers using Freescale PowerPC processor technology. The single board computer is a critical element of the BFTT system, providing advanced real-time data processing functions. BFTT is a highly flexible, interactive, single ship-, group-, or force-level tactical combat system trainer. The purpose of BFTT is to provide training to enhance naval combat readiness. BFTT provides a critical overarching training capability for developing and maintaining skillsets and training capabilities that are required for a complex modern shipboard combat system in today’s warfighting environment. BFTT in effect wraps around the ship’s combat system to provide a comprehensive and coordinated training environment.

Last summer Northrop Grumman was awarded a contract from Naval Air Systems Command to deliver its next-generation mission computer for Lot 12 of the Marine Corps’ H-1 helicopter upgrade program. The contract called for Northrop Grumman to provide FlightPro Gen III mission computers for the UH-1Y and AH-1Z aircraft. The FlightPro system functions as the central output distribution point for keyset inputs, display data and systems discrete signals. It embeds a ruggedized 6U VME PowerPC-based single board computer.

A hurdle associated with VME’s long life is that it faces obsolescence issues in more severe way than alternative technologies. Some but not all VME board designs used the Tsi148 VME bridge chip. When that de-facto VME bridge, available from a single source went going End of Life around the end of 2015 board vendors had to find a way to mitigate the problem. Several companies have crafted FPGA based bridge with VME interface functionality. The advantage of an FPGA based solution it that it provides independence from specific silicon obsolescence.
Abaco System’s line of products includes a board based on the quad-core 4th generation Intel Core i7 architecture (“Haswell”). The XVR16 6U VME has improved capabilities that suit existing command/control applications, but also more demanding High Performance Embedded Computing (HPEC) signal processing applications such as ISR, sonar and radar.

- Single slot 6U VME single board computer.
- 4th Generation Intel Core i7 quad core processor.
- Two channels of soldered DDR3 SDRAM with ECC up to 16 Gbytes.
- 2 XMC sites, 2, PMC sites.
- Front I/O: 2 Gbit Ethernet ports, 1 DisplayPort, 2 USB ports, 1x COM port.
- Rear IO: 2 Gbit Ethernet ports, 2 VGA, 2 DVI, 2 SATA Gen3 ports, 2 COM ports, 2 USB 2.0 ports, 12 GPIO.
- Optional conduction cooling.

Celeron-based 6U VME Board Features Locked-Down SODIMM

The XVME-6700 from Acromag adds is a high-performance SBC that features a FPGA-based VME to PCIe-bridge that solves the end of life issue with the TSI148 VME interface chip. It has ruggedized SODIMM removable memory that is surrounded by heat sink material to provide a robust hold-down mechanism. The SODIMM is secured with four screws so it is easy to replace faulty memory.

- Celeron 2002E Processor with 2M cache, 1.50 GHz.
- FPGA-based VME to PCIe bridge.
- Intel 8-Series QM87 PCH chipset.
- Up to 16 Gbytes of high-speed DDR3L memory with SODIMM lock-down mechanism.
- Front panel I/O includes dual USB 2.0 ports, VGA, dual Gbit Ethernet and RS-232 port.
- Backplane I/O includes dual Gbit Ethernet, dual SATA ports, dual USB ports, DVI-D, RS-232/422/485 and VGA.

Aitech’s C164 is a high-performance 6U VME SBC for embedded and harsh environment applications. The heart of the C164 is Intel’s Broadwell platform, featuring a 5th Generation Intel Core i7 Quad Core processor with integrated HD Graphics 5600, coupled with a companion Lynx Point QM87 I/O Platform Controller Hub (PCH).

- Rugged 6U VME Single-Slot SBC
- 5th Gen Intel Core i7 quad core 2.6 GHz CPU.
- 8 Gbytes of high speed DDR3L DRAM with ECC.
- Multiple I/O interfaces: Gbit Ethernet; two USB 3.0 and 2.0, SATA, Audio, Discrete, RGBHV, CANbus and HDMI/DVI.
- Two PMC/XMC slots.
- Up to 128 Gbytes on-board flash disk.
- Conduction and air-cooled versions.
- Vibration and shock resistant.
- WWDT, ETR, RTC, temp. sensors.

**Abaco Systems**
Huntsville, AL
(866) 652-2226
www.abaco.com

**Acromag**
Wixom, MI
(248) 295-0310
www.acromag.com

**Aitech Defense Systems**
Chatsworth, CA.
(888) 248-3248.
QorIQ P2010 SBC Serves up Multiple PCI Express Links

The RIO6-8096 is a CES 6U VME SBC based on the Freescale QorIQ P2010 processor, for airborne applications requiring conduction-cooled equipment. It is specifically designed for the most demanding applications, combining very high computing and flight-worthiness capabilities along with harsh environment criteria.

- 6U VME64x form-factor Freescale QorIQ P2010/P2020 processor.
- Xilinx Spartan-6 LX100T user-programmable FPGA (optional).
- One PCI Express switch.
- One PCIe x4 on VME-P0.
- Three PCIe x4 on XMCs.
- Four high-speed links on XMC (optional).
- Three GbE, one USB 2.0 and two UARTs on VME-P2.
- Two PMC / XMC sites.
- Static routing module (CES FlexIO).

VME Single Board Computer Features Freescale 2.0 GHz QorIQ P5020

The Artesyn Embedded Technologies MVME8105 is a high performance 6U VME SBC featuring the Freescale QorIQ P5020 2.0 GHz processor supporting high speed DDR3-1333 MHz with ECC. It offers expanded IO and memory features with multiple USB, Serial and Ethernet ports. The board provides technology insertion to prolong current programs while providing more computing performance and data throughput.

- Freescale 2.0 GHz QorIQ P5020.
- 4 Gbytes of 64-bit DDR3-1333 ECC SDRAM soldered down; 16 Mbytes SPI ROM for boot code.
- 8 Gbytes of NAND Flash with eMMC interface.
- VME64x and 2eSST on P1 and P2.
- PMC1 I/O (64 signals); Two USB 2.0; Four RS232/422/485; One 10/100/1000BaseT Ethernet; Two GPIO.
- Real time clock with battery backup; Real time counters; Watchdog.

Artesyn Embedded Technologies
Tempe, AZ
(888) 412-7832
www.artersyn.com

VME SBC Serves up 32 GB of DRAM and 3 External SATA300 Links

The VP F1x/msd from Concurrent Technologies is a 6U VME board based on a 4th generation Intel Core processor for high performance applications with enhanced graphics capabilities. It offers the maximum level of backwards compatibility given the component changes to enable continued manufacture. For reliable storage, there are customer selectable options including on-board CFast, application flash and a 2.5-inch drive mounting kit as well as SATA based storage via the rear connectors.

- 4th generation Intel Core processor—2 or 4 cores.
- Up to 32 Gbytes of soldered DDR3L-1600 DRAM with ECC.
- Dual PMC/XMC module sites.
- Up to 3 x 10/100/1000 Mbps Ethernet interfaces.
- Up to 3 x external SATA300 interfaces.
- Option for an on-board SATA300 drive and option for on-board CFast or SATA flash module.
- 3 x serial interfaces and up to 7 x USB interfaces.

Concurrent Technologies
Woburn, MA
(781) 933 5900
www.gocct.com

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COTS Journal | April 2016
SBC Features an NXP Power T2080 and FPGA-based VME Interface

Curtiss-Wright Defense Solutions' VME-196 combines the performance and the advanced I/O capabilities of the NXP Power Architecture quad-core AltiVec enabled T2080 processor. The board is available in a range of ruggedization levels, both air- and conduction-cooled. The VME-196 is pin and feature compatible to previous generation SBCs from Curtiss-Wright including the VME-182, 183, 184, 186, and 194.

- NXP Power Architecture T2080 quad-core SoC running 1.8 GHz with AltiVec.
- 3 Gbit Ethernet ports; up to 6 serial channels; discrete and differential digital I/O, SATA, USB 2.0 ports and two PMC/ XMC sites.
- Supported by Curtiss-Wright's U-Boot, Green Hills INTEGRITY, Lynx Software Technologies LynxOS, Yocto NXP SDK based Linux and Wind River VxWorks 6.9 and 7 BSPs.
- NXP Secure BOOT.
- Optional on-card integrated MIL-STD-1553B interfaces.

Dynatem
Mission Viejo, CA.
(949) 855-3235.
www.dynatem.com

6U Core i7 VME SBC Eases Upgrades to VXS Enhancement

The CPU-71-17 from Dynatem, a Eurotech subsidiary, is a VXS/VME bus CPU board based on the Intel 4th generation Core processors. Thanks to the VXS P0 connector VMEbus users can enjoy high-speed serial communication capability without modifying their existing assets. The VXS serial bus standard improves the speed of the parallel VMEbus allowing transfers up to 6.25 times faster.

- Intel Core i7 or Core i5.
- Mobile IntelQM87 chipset.
- 8 Gbytes DDR3-1333 soldered DRAM.
- Advanced Vector Extensions AVX2.0 and enhanced security with AES-NI.
- Legacy VME or VME64 compatible.
- Extended temperature operation is an option.
- VXS P0 connector with 2 ports of Serial RapidIO Gen2 4x.
- x1 mSATA and 1x eUSB ports available.
- Dual PMC/XMC slots.

Extreme Engineering Solutions
Middleton, WI.
(608) 833-1155.
www.xes-inc.com

6U SBC Blends QorIQ T2080 Processor-and 8 Gbit Ethernet Ports

The XCalibur1931 from Extreme Engineering is a high-performance, 6U VME, multiprocessing, single board computer that is ideal for systems requiring high bandwidth processing and low power consumption. With four dual-threaded e6500 cores running at up to 1.8 GHz, each with a 128-bit AltiVec SIMD unit, the T2080 is well suited for the performance and efficiency demands of military embedded computing applications.

- NXP QorIQ T2080 processor with four dual-threaded e6500 cores at up to 1.8 GHz.
- Conduction or air cooling.
- Up to 8 Gbytes of DDR3-1866 ECC SDRAM; Up to 512 Mbytes of NOR flash; Up to 32 Gbytes of CPU NAND flash.
- Up to eight Gigabit Ethernet ports.
- One USB 2.0 port out the front panel (optional); Two RS-232 serial ports out the front/back panel; Two RS-232/422/485 serial ports out the back panel.
- Two PrPMC interfaces.
6U VME ARM Cortex-A9 SBC Boasts Modular I/O

North Atlantic Industries’ 64ARM1 is a 6U VME ARM Cortex-A9-based, SBC that can be configured with up to six intelligent function modules. NAI’s Custom-On-Standard Architecture (COSA) offers a choice of over 40 intelligent I/O, communication, and Ethernet switch functions.

- 6U VME SBC with support for 6 independent, intelligent function modules
- ARM Cortex-A9 Dual Core 800 MHz processor.
- 512 Mbytes DDR3L SDRAM
- Up to 32 Gbytes SATAII NAND Flash (4 GB standard)
- Less than 5 W MB power dissipation.
- 2x 10/100/1000 Base-T Ethernet, 1x RS232, 1x I2C.
- VICTORY interface services.
- Operating temperature: 0°C to +70°C commercial, or -40°C to +85°C rugged.

Kontron America
Poway, CA
(858) 677-0877
www.kontron.com

General Micro Systems
Rancho Cucamonga, CA
(909) 980-4863
www.gms4sbc.com

6U VME 2eSST SBC Sports 3rd Gen Core i7 Quad-Core Processor

Kontron’s VM6054 6U VME 2eSST Single Board Computer is built around Intel’s 3rd Generation Core i7 quad-core processor. The board provides exceptional I/O capabilities onboard and flexibility by providing support for PMC and XMC including flexible I/O, storage mezzanines, and personality modules.

- Intel Quad-Core 3rd Gen Intel Core i7 processor.
- 4x Ethernet GBASE-T, Multiple Graphic Heads, USB, Serial.
- SATA, Personality Module, PMC/XMC, Flexible I/O
- Commercial and rugged versions.
- Long term supply adapted to application life cycle.
- Has same front and rear interfaces as Kontron PENTXM2, PENTXM4 and VM6050 boards, making the VM6054 an easy replacement.

Kontron America
Poway, CA
(858) 677-0877
www.kontron.com

6th Gen VME SBC Blends 2.4 GHz Processing and Wide I/O Set

The VSB2105 “Albatross” from General Micro Systems is a sixth-generation VME SBC module based on GMS’s upgradable CPU technology. It is designed to provide the highest level of workstation performance possible in a fully ruggedized, single-slot VME slot. It may be operated in all VME backplanes with 3-row or 5-row VME connectors with or without VME P0. The board supports the latest Intel fourth-generation Core i7 processor with up to four physical CPU cores with Hyper-Threading for a total of 8 logical cores, each operating at up to 2.4 GHz with the ability to TurboBoost.

- 4th generation Core i7 processor with up to four 2.4 GHz CPU cores.
- Up to 32 Gbytes of 1600MHz DDR3 memory with ECC.
- Supports 4 Gbit Ethernet channels with TCP/IP offloading engine (TOE), 1 USB 3.0 and 2 USB 2.0 to front panel, 4 USB 2.0 to rear, mSATA up to 1 Terabyte.
- One 2.5-inch SATA drive (lose PMC/XMC), 1 VGA port and HDMI port to rear, 1 DVI-I to front panel, 4 COM ports, and 16 buffered GPI/O lines.
- Operates up to -20° to +75°C at full load (0° to +55°C standard).
ADLINK Technology has announced a thin Mini-ITX embedded board. For flexible embedded application development, the AmITX-BW-I offers enhanced display features with Intel Gen 8 LP HD Graphics in a low profile and scalable design. Measuring 170 mm square and less than 25 mm thick, the AmITX-BW-I fulfills requirements for applications in digital signage, infotainment, medical, and industrial automation that are running in limited-space environments. ADLINK’s first thin Mini-ITX board also follows the Form, Fit, Function design principle to offer standardized pinout locations and is compatible with the Micro-ATX and regular ATX chassis.

The board features the Intel Atom x5-E8000 processor. Intel Gen 8 LP HD Graphics supports three independent 4K displays and provides full hardware acceleration for encoding/decoding of HEVC H.265, H.264/263, SVC, AVS, VP8/9, and MPEG4. Video and 3D rendering is enhanced by DirectX 11.1, OpenGL 4.2, ES 3.0, and OpenCL 1.2.

The AmITX-BW-I supports high bandwidth connectivity with two single-lane PCIe bus interfaces. These deliver reliable Gigabit Ethernet for gaming, retail services, ATMs, slot machines, and kiosks. One Mini PCIe slot, one mSATA slot, and one SIM card slot are also available. A range of high-speed I/O, including two SATA 6 Gbit/s ports, enables real-time data processing and sharing for medical imaging and diagnostics applications. The AmITX-BW-I embedded board is equipped with ADLINK’s Smart Embedded Management Agent (SEMA) to provide detailed system data at the device level, including temperature, voltage, power consumption, and other key information.

ADLINK Technology
San Jose, CA
(408) 360-0200
www.adlinktech.com

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Middle Canyon’s server products incorporate the latest processor, memory and storage technology with thermally-optimized mechanical designs and advanced power solutions to increase your organization’s networking performance and energy efficiency.

PCI Express Card Blends UltraScale FPGA and Rich I/O

Alpha Data has introduced the new ADM-PCIE-8K5 board, based on the Xilinx UltraScale KU115 device. The ADM-PCIE-8K5 is a half-length, low profile, PCI Express Add-In Card featuring the powerful and efficient Xilinx Kintex UltraScale KU115-2 FPGA. The ADC-PCIE-8K5 features up to 32 Gbytes of DDR4-2400 ECC memory, dual SFP+ networking I/O ports, dual 4x16G FireFly expansion I/O ports, and built in USB accessible system monitoring and JTAG debug port. The hardware is supported by the Xilinx SDAccel tool for OpenCL, and Xilinx Vivado for HDL and HLS flows. Alpha Data offers Board Support Packages (BSP) including high-performance PCIe/DMA, OpenPOWER Architecture CAPI, FPGA example designs, plug and play O/S drivers, and a mature API.

Alpha Data
Denver, CO
(303) 954-8768
www.alpha-data.com

High-Performance Graphics XMC Boasts Safety-Critical Features

Abaco Systems has announced the XMCGA8 XMC High Performance Graphics Board. It is designed to deliver safety-critical applications certified to DO-178 and DO-254 with long term support. It can provide an industry-leading four DVI ports, giving the XMCGA8 unique flexibility. The VITA 42-compliant XMCGA8 is available with the AMD/ CoreAVI Radeon E8860 ‘Adelaar’ graphics processing unit. The CoreAVI chip set features parts that have been temperature screened and qualified. The XMCGA8 can provide up to four DVI outputs at resolutions up to 1,920 x 1,200 at 60Hz and up to two VESA VGA outputs at the same resolutions.

Abaco Systems
Huntsville, AL
(866) 652-2226
www.abaco.com

COTS PRODUCTS

COTS Journal | April 2016
BittWare has announced an OpenPOWER CAPI Developer’s Kit for its Xilinx FPGA-enabled accelerator cards. Providing a fast, efficient way to connect the Xilinx All Programmable FPGA to a CAPI-enabled IBM POWER8 system, the developer’s kit includes the FPGA accelerator card, IBM Power Service Layer (PSL) IP to provide the connection to the POWER8 chip, CAPI host support library, and an example CAPI design. The FPGA accelerator card included in the kit is BittWare’s XUSP3S, which is a 3/4-length PCIe board featuring the Xilinx Virtex UltraScale VU095, four QSFPs for 4x 100GbE, and flexible memory configurations with up to 64 Gbytes of memory and support for Hybrid Memory Cube (HMC).

Most FPGA accelerators use PCIe to connect to the host processor unit. IBM has developed CAPI (Coherent Accelerator Processor Interface) as an alternative that takes some of the overhead and complexity out of the I/O subsystem by providing a direct interface between the host and the FPGA. Developers can run their specific FPGA solutions as a peer to the IBM POWER8 cores, enabling higher system performance with less programming complexity.

Bittware
Concord, NH
(603) 226-0404
www.bittware.com

Rough & Ready Data Storage

Phoenix-developed state-of-the-art enabling technology provides users with products that ensure the highest performance storage and data network systems. These systems range in size and application from multi-terabyte Fibre Channel RAID, NAS and Storage Area Network (SAN) configurations to conduction cooled plug-in Open VPX solid state disk storage modules.

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Phoenix-developed state-of-the-art enabling technology provides users with products that ensure the highest performance storage and data network systems. These systems range in size and application from multi-terabyte Fibre Channel RAID, NAS and Storage Area Network (SAN) configurations to conduction cooled plug-in Open VPX solid state disk storage modules.

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www.phenxint.com  714-283-4800
Non-isolated Wide Range DC-DC Converters Provide Negative Outputs

TDK introduced the 75W rated TDK-Lambda i6AN series of negative output non-isolated DC-DC converters. Capable of operating from an input voltage of +9V to +40V, the step-down converter delivers an output voltage that can be adjustable from -3.3V to -30V and output currents of up to 8A. The series is designed to be used in a wide range of applications including medical, communications, industrial and test and measurement equipment. In a 1/16th brick form factor, measuring 33 x 22.9 x 12.7mm, the converters can be used in conjunction with a single output 12V, 24V or 36V AC-DC power supply to generate additional regulated high current outputs, with or without battery back-up.

With efficiencies of up to 94 percent, power losses are minimized allowing the products to operate in harsh ambient temperatures of -40 to +125 degrees C even with low airflow requirements. The need for external output capacitance is reduced due to an optimized dynamic voltage response, thus reducing board space requirements. The models include an output voltage adjustment pin, positive or negative logic remote on-off, remote sense, input under-voltage, over-current and thermal protection. All models are certified to UL/CSA 60950-1, IEC/EN 60950-1 and carry the CE mark for the Low Voltage and RoHS2 Directives.

TDK-Lambda Americas
San Diego, CA
(619) 628 2885
www.us.tdk-lambda.com/lp
COM Express and Thin Mini-ITX Boards Sport 5th Gen Core Processors

Congatec has expanded its product range with the 5th generation Intel Core processor platform up to Intel Core i7-5650U on COM Express and Thin Mini-ITX motherboards. The single-chip processors feature a low power consumption of just 15W TDP. The new Intel HD Graphics 5500 and 6000 found in the 5th generation Intel Core processors provides Ultra HD 4K display and additional codec support.

Both the COM Express module and the Thin Mini-ITX motherboard allow for the connection of up to three independent display interfaces via HDMI 1.4, LVDS and embedded DisplayPort (eDP). When using DisplayPort 1.2, the individual displays can be daisy chained to take advantage of simple wiring. Native USB 3.0 support provides fast data transmission with low power consumption. The two SODIMM sockets can be equipped with up to 16 Gbytes of SODIMM DDR3L memory.

The Type 6 module, conga-TC97, offers eight USB ports. Two of them support USB 3.0 SuperSpeed. Four PCI Express 2.0 lanes, four SATA ports with up to 6 Gbits/s, RAID support and a Gigabit Ethernet interface enable fast and flexible system extensions. Meanwhile the conga-IC97 is a Thin Mini-ITX measuring 25mm in height with I/O shield and it enables flat housings, such as those required for panel PCs. Four USB 3.0 SuperSpeed ports are directly available on the I/O shield. A total of two 5 Gbit/s PCI Express 2.0 lanes can be used as mPCIe Half Size and PCIe Full Size shared with PCIe x1 and mSATA. Fast and flexible system extensions are possible thanks to four SATA interfaces with up to 6 Gbits/s plus one mini PCIe. Two Intel I210 Gigabit Ethernet controllers each provide one Gigabit Ethernet LAN access via the two RJ45 sockets. The universal power source with 12 to 24 volts complete the feature set.

Congatec, San Diego, CA. (858) 457-2600. www.congatec.com

Model Library Enables Testing of Intel Bay Trail Processors

GOEPEL Electronics has announced the development of specific model libraries for testing and programming of Intel Bay Trail processors, which are part of the Intel Atom family. The libraries called VarioTAP models allow flexible execution of processor emulation tests using the native debug port. Users are now able to use the processor as an instrument for hardware design validation of prototypes as well as programming of Flash devices. The processors are integrated in µFCBGA packages with several hundred pins which are mounted directly on the board, not allowing direct contact with external instruments. VarioTAP offers embedded instruments for test, hardware debugging, Flash programming and design validation even after mounting.

Goepel Electronic, Jena, Germany. +49 3641 6896 739. www.goepel.com

Pelican Products, Inc. 23215 Early Avenue, Torrance, CA 90505
(866) 823.0127 (TOLL FREE)  Tel 310.326.4700
Fax 310.326.3311

Our new premium divider system uses tough and durable pre-installed wall sections and divider panels that are only 7/16” thick, so you can pack more gear than conventional dividers. The fool-proof cutting tool and locking pins let you customize TREKPAK™ dividers over and over.

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Pelican Products, Inc. 23215 Early Avenue, Torrance, CA 90505
(866) 823.0127 (TOLL FREE)  Tel 310.326.4700
Fax 310.326.3311

All trademarks are registered and/or unregistered trademarks of Pelican Products, Inc., its affiliates and/or subsidiaries. TREKPAK is a registered trademark of TREKPAK, Inc.
Acromag has released its PCIe-based AcroPack Series of general purpose I/O modules for embedded computing applications. These modules are an extended version of the mPCIe specification and feature a 100-pin connector to handle the I/O. AcroPack Series of I/O mezzanine modules and carriers provide a cost-effective solution for a modular approach to system assembly enabling application specific customization. The modules plug into connectors on AcroPack carriers to add analog or digital input and output or communication in any combination for embedded applications running on Linux, Windows, or VxWorks operating systems.

Acromag’s AcroPack PCIe carrier holds up to two mini-PCIe or AcroPack mezzanine modules. Four AcroPack mezzanine models will offer 32 isolated digital input model AP440, 32 isolated digital output model AP445, 32 I/O channels with 0 to 60V model AP408, and four or eight UART ports RS232 model AP50x.

For easy integration of the AP modules with real time software application programs, Acromag offers C libraries for VxWorks® and other operating systems. The libraries provide generic routines (source code included) to handle reads, writes, interrupts, and other functions. Demonstration programs enable the developer to quickly exercise the I/O modules before attaching the routines to the application program. This diagnostic tool can save hours of troubleshooting and debugging. The COTS product line of AcroPacks are ROHS compliant and ideal for scientific development labs, military and aerospace applications, the defense industry, and automation applications. Modules start at less than $650 and carriers $750.

Acromag
Wixom, MI
(248) 295-0310
www.acromag.com
Dawn VME Products has announced its newly released VPX-598x Series Gen3 3U OpenVPX Backplanes. Dawn’s Gen3 3U OpenVPX backplanes are designed for true signal integrity at up to 10.3 Gbaud performance (per VITA 68 backplane simulation models). Supporting PCIe Gen 3 and 10 GbE (XAUI) and the most advanced Gen3 bandwidth module configurations, Dawn Gen3 backplanes offer multiple connector choices, including a high vibration option.

Dawn uses VITA 68 S-parameter simulation models of signal paths across the backplane to insure compliance with signal integrity standards. In the simulation models a signal integrity budget is established for the backplane portion of a system. These models permit simulation of the backplane with available OpenVPX modules and connectors, so full system signal integrity can be achieved.

Using these simulations to guide the backplane designs, Dawn engineers use back drilling to remove stubs and then layout paths to eliminate impedance discontinuities. The goal is to optimize the path between any pair of transmitting and receiving chips in the systems, so communication proceeds without cross talk or other forms of interference. Dawn’s 598x Series VPX backplanes are designed to be compliant with the following released standards and December 2015 state of draft specifications: VITA 46.0, VITA 46.1, VITA 46.3, VITA 46.4, VITA 46.6, VITA 46.7, VITA 46.9, VITA 46.10, VITA 46.11, VITA 48.0(REDI), VITA 48.1(REDI Air Cooling), VITA 48.2(REDI Conduction Cooling), VITA65.0 (OpenVPX) ready. VITA 68 backplane models are available on request for system simulation. Pricing is $2,625.00 for quantity 1.
Stealth.com has released the new model LPC-175F, an Ultra Small Fanless Mini PC featuring wide range temperature operation and designed for a variety of demanding applications. Designed for wide range temperature operation -20 to 70 degrees C (14 to 158 degrees F) the LPC-175F Fanless Mini PC is barely larger than a deck of playing cards (3.30 - 5.71 - x 1.38-inches) the LPC-175F Ultra Small Fanless Mini PC provides low power consumption and completely silent operation. The LPC-175F operates from an external 12VDC power adapter or can be connected to an external DC source making it ideal for mobile and remote applications.

The LPC-175F computer operates without noisy cooling fans which could draw in dirt and dust potentially causing catastrophic failures. SSD (Solid State Drives) are also utilized to meet extreme temperatures, high vibration, high humidity, as well as high altitude specifications. Systems are compatible with Microsoft Windows, Linux, etc and can be custom configured to meet the exact needs of the OEM or end user. Basic configurations of the Ultra Small Fanless Mini PC start at $1,095 and are shipping now.

Stealth Computer
Woodbridge, Ontario, Canada
(905) 264-9000
www.stealth.com

Fanless Mini PC is Designed for Wide Range Temperature Use

Heat Sinks Target Cooling for Brick DC-DC Converters

Advanced Thermal Solutions (ATS) provides a family of high performance maxiFLOW heat sinks for cooling DC-DC power converters and power modules. The power brick heat sinks are available for full, half, quarter and one-eighth brick sizes. With proper thermal management, brick DC-DC converters can be used at their maximum operating temperature for optimum performance on PCBs. The ATS maxiFLOW heat sinks reduce junction temperatures (Tj) by more than 20 percent. Their patented maxiFLOW spread fin heat sink design maximizes cooling performance in low airflow environments. Their spread fin pattern reduces pressure drop on passing air and provides more surface area for heat spreading and convection cooling.

Advanced Thermal Solutions
Norwood, MA
(781) 769-2800
www.qats.com

6865 – 3U OpenVPX I/O & Comms Board

The rugged 6865 is a 3U OpenVPX multi-function I/O and communications board that can be configured with up to three intelligent function modules. Ideally suited for rugged military, industrial, and commercial applications, this low-power/high-performance board delivers off-the-shelf solutions that accelerate deployment of SWaP-C optimized systems.

- Support for three independent, intelligent function modules
- 40+ modules to choose from
- COSATM Architecture
- Control via Gig-E or PCIe interface
- 2x 10/100/1000 Base-T Ethernet: 2 to rear, or 1 to rear and 1 to front I/O
- Background Built-in-Test (BIT) continually checks and reports on the health of each channel
- Software Support Kits (SSKs) and drivers available
- Commercial and rugged models
- Operating temperature: 0°C to 70°C commercial, -40°C to +85°C rugged

North Atlantic Industries, Inc.
Phone: (631) 567-1100
Web: www.naii.com

COTS Product Gallery
Low Noise Amplifiers Support Multiple Global Navigation Schemes

Skyworks has introduced two new global navigation low noise amplifiers. The SKY65605-21 and SKY65611-21 are both designed for BeiDou/GPS/GLONASS/Galileo receiver applications and are optimized to operate from 1559 to 1606 MHz. Each device integrates all output matching components, thereby requiring only a single external input matching component. Ideal applications include smartphones, personal navigation devices, wearables, machine-to-machine systems, base stations, asset tracking instruments and professional radios. The devices provide high linearity, excellent gain, a high 1 dB input compression point (IP1 dB), and a superior noise figure.

Skyworks Solutions
Woburn, MA
(781) 376-3000
www.skyworksinc.com

1W Power Amplifier Supports 28 GHz, Point-to-Point and Ka Band Systems

RFMW has announced design and sales support for a Ka-band amplifier with 1W output power. Qorvo’s TGA4544-SM supports 28 GHz, point-to-point radio and Ka-band linear satellite communication systems in the 26 to 31 GHz frequency range. Available in a 5x5mm QFN package, the TGA4544-SM has 23 dB of gain, a P1dB of 31 dBm and Psat of 32dBm. OIP3 is rated at 41 dBm. Qorvo has designed this PA for ease-of-use so no matching components are required. The TGA4544-SM operates from a 6V supply and draws 1100 mA of current.

Skyworks Solutions
Woburn, MA
(781) 376-3000
www.skyworksinc.com

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www.militaryethernet.com
Creative Electronic Systems (CES) has announced the adoption of CoreAVI’s TrueCore technology, in the scope of its strategic partnership with CoreAVI. CES is currently integrating CoreAVI’s software GPU monitor, TrueCore, on its rugged GPU board: the VGP-2870. The integration of TrueCore on the VGP-2870 provides CES customers with a path to DAL-B certification (DO-254 / DO-178) for safety-critical video applications. Initially designed to comply with DAL-C, the VGP-2870 is a very powerful video processor board for system engineers and program managers looking to reduce cost, risk and development cycle of airborne display applications.

The enhanced feature set of the VGP-2870 addresses the guidelines provided by EASA memorandum (Europe) and CAST (USA) position paper (CAST-29) for the usage of COTS graphical processor in airborne display applications, specially addressing Hazardously Misleading Information (HMI) concerns. The safety enhancement of the VGP-2870 is performed in tight collaboration with CoreAVI whose GPU software monitor IP, TrueCore, plays a key role in the establishment of certification evidences for high Design Assurance Levels. The VGP-2870 is part of CES growing portfolio of safety certifiable COTS items which includes XMC processors, an I/O board with a comprehensive avionic I/O set as well as a modular packaged COTS system.

Creative Electronic Systems
Geneva, Switzerland
+41 (0)22 884 51 00
www.ces-swap.com

Safety Certifiable VPX Video Processor Integrates GPU Monitor Software

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EKF Elektronik has announced the SL1-COMBO, a 7-port Gbit Ethernet switch on a peripheral slot card for CompactPCI Serial systems. The on-board Marvell 88E6350R GbE switch is self-managed and provides a rich feature set. While 5 GbE ports are wired to associated RJ45 front panel jacks, the 6th GbE port is in use for backplane communication via the CompactPCI Serial connector P6. As an option, the SL1-COMBO is available with an Intel I210-IT Gigabit Ethernet controller (NIC) internally connected to the 7th port of the GbE switch. The Gbit Ethernet switch provides many features such as 802.1 Audio Video Bridging (AVB) and Quality of Service (QoS) support.

EKF Elektronik
Hamm, Germany
+49 (0)2381/6890-0
www.ekf.de

ConTech has announced the “TMX” Series of DC/DC converters that offer up to 50 Watts of fully regulated output power with an industry standard 2 x 1-inch footprint. The series offers a 4:1 input range with nominal input voltages of 24 VDC and 48 VDC. Single outputs offered are 3.3, 5, 12, 15, and 24VDC. The TMX Series operates with efficiencies as high as 92 percent. Features include Remote On/Off, Output Trim, and Short Circuit Protection. The operating ambient temperature range of the TMX is -40 to +105 degrees C case temperature. The unit is encapsulated with a thermally conductive potting compound in a six-sided metal case for improved thermal performance in still air environments.

ConTech
Concord, CA
(925) 609-1193
www.contech-us.com

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- Advanced Network features

ConTech
Concord, CA
(925) 609-1193
www.contech-us.com
Adapter Enables SOIC-Packaged ICs to Reside in DIP Sockets

Ironwood Electronics’ new adapter for the 14 pin DIP device allows use of the equivalent IC in SOIC package to be used in PCB boards developed for DIP packages. The PC-SOIC/DIP14-06 is mapped specifically for the Texas Instruments Linear Comparator LM139A. These adapters use an Ironwood exclusive technology that allow high reliability and cost effective package converters from SMT devices to DIP connection. The SOIC package is soldered directly to the top of the adapter and the assembly can then be plugged or soldered to the user’s target board. Package convertor consists of gold plated pins for reliable interconnection and substrate that is made of standard FR4 material. These adapters are priced at $77 each at quantity 10.

Ironwood Electronics
Eagan, MN
(952) 229-8200
www.ironwoodelectronics.com

Rugged Isolated DC-DC Power Modules Deliver 15 Watts

Murata has announced the BPM15 Series of isolated DC-DC power modules from Murata Power Solutions, designed to deliver 15W of isolated output power from ±5V, ±12V, and ±15V outputs. The BPM15 series addresses a growing demand for isolated DC/DC modules that accept 4:1 input ranges of 9-36V and 18-75V. These models have an isolation barrier that will withstand 1600 VDC with a basic insulation system. The device is specified to operate over the temperature range of -40 to +85 degrees C. The units are ruggedized and encapsulated in 1- x 1- x 0.40-inch, five sided package.

Murata Power Solutions
Mansfield, MA
(508) 339-3000
www.murata-ps.com
Red Rapids has introduced the Model 372 FPGA configurable dual channel transceiver. This is the latest addition to the SigFPGA PCIe/XMC product family. The board features a dual channel 16-bit ADC and dual channel 16-bit DAC clocked at 310 MHz. The converters are tightly coupled to a Xilinx Kintex-7 FPGA that is also connected to high-throughput SRAM. The product is available on a single XMC, CCXMC or PCI Express half-length form factor board.

The card is designed around the Analog Devices AD9652 16-bit ADC and AD9788 16-bit DAC. The 310 MHz sample clock is supplied by either the on-board frequency synthesizer or an external source. The frequency synthesizer can be phase locked to the local 10 MHz TCXO or an external reference can be used to achieve system-wide phase coherence.

The Model 372 is available as a PCI Express mezzanine card (XMC), conduction cooled mezzanine card (CCXMC), or half-length PCI Express (PCIe) adapter card. The CCXMC can be mounted to any VITA 20-2001 compliant host without modification. All form factors offer four lane (x4) or eight lane (x8) bus operation at Gen 2 performance. An optional user defined parallel bus is also available on the XMC P4 connector or a rear facing connector on the PCIe adapter.

Memory includes 32 Mbytes of QDR II+ SRAM operating at 500 MHz. The SRAM interfaces to the FPGA through separate 18-bit read and write ports to achieve a combined 8 Gbytes/sec data transfer rate. Conformal coating is also offered for protection in harsh environments. Single piece prices start at $3,990 (XC7K160T-2, no memory) with quantity discounts available.

Red Rapids
Richardson, TX
(972) 671-9570
www.redrapids.com
Inverter/Frequency Converter Series Uses New Comms Interfaces

Schaefer has announced the CI, IT, IV, and K Series of single or three-phase Heavy Industrial & Mil Inverters & Frequency Converters with CAN, Ethernet, Modbus and Analog communication interfaces for mission critical applications. These highly reliable, fully-customizable “built-to-project” pure-sine-wave inverters offer 10 VDC to greater than 1,000 VDC+ input voltage and 200VA-3MW output voltages. Features include continuous short-circuit protection, automatic restart after over-voltage shutdown and surge capability. Operating temperature is -20 to +75 degrees C, with -40 degrees C as an option.

Schaefer
Hopkinton, MA
(508) 436-6400
www.schaeferpower.com

Rugged 1U MicroTCA Platform Pushes Performance Density

Vadatech provides a rugged 6-slot MicroTCA chassis in a 1U height. The chassis is designed to meet MIL-STD-901D and 810G for shock and vibration and MIL-STD-461F for EMI. The VT950 offers the highest performance density of any rugged 1U backplane-based embedded chassis in the marketplace. Competing rugged architectures are typically at least 3U high for comparable slots/performance. The VT950 holds up to 6 AMCs and has an integrated MCH with IEEE1588/SyncE/GPS capabilities. This includes clock disciplining with arbitrary clock frequency output and holdover (Stratum-3 option) including 1 Pulse Per Second (PPS) regeneration and holdover. The MCH can use various fabrics such as 40GbE/10GbE, PCIe Gen 3, or Serial RapidIO.

Vadatech
Henderson, NV
(702) 896-3337
www.vadatech.com

On the outside, today’s aerospace designs are sleek and elegant machines. But on the inside, extreme temperatures and vibration demand the most rugged equipment. TE Connectivity’s (TE) Fortis Zd, Mezalok and MULTIGIG RT 2-R rugged modular connector systems for backplane applications were specifically constructed for high-speed aerospace projects that require design flexibility, incorporate power and signal and provide rugged reliability.

Connect with TE to learn more about our rugged, high speed backplane connectors for aerospace and military applications at te.com/highspeed

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MULTIGIG RT, Fortis Zd, Mezalok, EVERY CONNECTION COUNTS, TE, TE Connectivity and the TE connectivity (logo) are trademarks of the TE Connectivity Ltd. family of companies.
Diamond Systems has unveiled its compact, rugged HELIX PC/104 SBC based on the DMP Vortex86DX3 system-on-chip (SoC) processor. Helios is a low cost SBC offering high feature density in a compact size and providing optional integrated high-quality data acquisition circuitry, PCIe MiniCard I/O expansion, and rugged construction. Two standard Helix models are available off-the-shelf; one aimed low-cost basic applications and the other targeting data acquisition applications. The data acquisition model expands on the features of the basic model by adding a complete data acquisition circuit as well as other I/O. A variety of customization options are also available allowing customers to match the specific needs of their application with on-board features of the Helix SBC. The board uses an expanded PC/104 form factor measuring 102 x 102 mm (4.0 x 4.0 in).

Helix PC/104 SBCs combine the 1 GHz DMP Vortex86DX3 dual core SoC with a wealth of PC I/O and on-board data acquisition circuitry at a competitive price. VGA and LVDS displays are supported and the available PC I/O includes up to 6 USB 2.0 ports, 2 RS-232/422/485 and 2 RS-232 ports, 1 10/100Mbps Ethernet port, 1 Gbit Ethernet port, and 1 SATA port that supports both on-board SATA DOM and off-board SATA devices. The optional integrated data acquisition circuitry includes 16 16-bit A/D channels with 100 kHz sample rate, 4 16-bit D/A channels with voltage outputs, and 11 additional programmable digital I/O lines for a total of 27 lines.

With an operating temperature of -40 to +85 degrees C and memory soldered on board, Helix is an excellent choice for rugged applications. Aries is also available in Diamond’s off-the-shelf and highly configurable Octavio systems. Two standard models of the Helix PC/104 single board computer are available one with the full data acquisition circuitry and one only digital I/O. Single unit pricing starts at $425 without on-board data acquisition.

Diamond Systems, Mountain View, CA (650) 810-2500, www.diamondsystems.com
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TQ embedded modules are built for the most demanding tasks and conditions.

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Embedded Modules.net

Powered by Convergence Promotions, the N. American partner for TQ-Systems
Aitech Defense Systems has integrated the latest Intel 5th generation Core i7 processor (Broadwell) into a rugged 6U VME SBC that allows existing, legacy platforms access to the latest in high performance data processing. The new C164 features quad-core processing at up to 2.6 GHz and 6 Mbytes of last level cache. The new SBC combines extensive onboard memory resources, such as a large DDR3L memory, SATA Flash mass storage and dual BIOS Boot Flash, with multiple I/O interfaces to meet a wide range of system requirements.

Designed for system flexibility, the board's unmatched I/O includes up to eight USB 2.0/3.0 interfaces, two each of SATA 2.0 and CANBus ports, up to four GbE ports as well as four RS-232/422/485 serial interfaces and a total of eight discrete S.E. or differential I/Os. The C164 also features two DVI/HDMI and RGBHV video outputs and a stereo audio in + out interface.

The new SBC offers two industry standard PMC/XMC slots that provide added flexibility. The C164 is also pinout compatible with Aitech's C163 (Haswell platform) and earlier Core2 Duo-based C160 SBCs for easy, plug-and-play technology insertion upgrades. The SBC's advanced mechanical and electrical configuration adheres to VITA 47, guaranteeing operation in harsh environments across temperatures from -40 to +85 degrees C and altitudes up to 70,000 ft. Conduction- and air-cooled versions are available, as are commercial, rugged and military configurations that withstand the most severe VITA 47 V3 vibration and operational shock to OS2 (40g). For secure data encryption, the C164 can be equipped with Intel's Trusted Platform Module (TPM), a hardware-based security device that addresses the growing concern of boot process integrity and offers improved data protection.

Aitech Defense Systems, Chatsworth, CA (888) 248-3248. www.rugged.com
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Intelligent Systems Source is a new resource that gives you the power to compare, review and even purchase embedded computing products intelligently. To help you research SBCs, SOMs, COMs, Systems, or I/O boards, the Intelligent Systems Source website provides products, articles, and whitepapers from industry leading manufacturers--and it’s even connected to the top 5 distributors. Go to Intelligent Systems Source now so you can start to locate, compare, and purchase the correct product for your needs.

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**COMING NEXT MONTH**

**Special Feature: Military Vehicles Embrace Mobile Networking**

Today’s military views mobile networking as a capability that pervades all corners of the force, and that includes military vehicles. Onboard communications and control electronics are expected to multiply in sophistication for Current Force fighting vehicles. With budgets that shy away from new vehicle program starts, the focus is on tech upgrades of existing vehicles as the dominant activity in this space. Articles in this section explore the latest requirements and how these changes may be influenced by technology and the latest products available. Developments in the Army’s WIN-T program are looked at as well.

**Tech Recon Jeff’s Picks: Top Rugged Display Technology Innovations**

In 2016 our Tech Recon feature will directly leverage Jeff’s decades of experience covering the embedded computing and defense market. He will choose the top products in a different category each month and share his insights on why they’re significant in terms of design innovation, market relevance and technology leadership. May’s section looks at the technology and products in the rugged display category.

**System Development: PCI Express Over Cable vs. 10 Gbit Ethernet as System Interconnects**: 10 Gbit Ethernet is becoming entrenched as a favorite data plane interconnect fabric in compute-intensive applications like sonar, radar or any application that networks sensor arrays together. But PCI Express over cable has inherent advantages that make it better for control functions than Ethernet. This section updates readers on the product and technology trends driving board-level Ethernet switch products, and explores how system designers can benefit from the marriage of Ethernet and PCI Express with embedded computing form factors like VPX, VXS, Compact PCI Express, MicroTCA and AMC.

**Data Sheet: Small Non-standard Boards**: While standard open-architecture board form factors continue to dominate in military systems, non-standard form factors are still relevant. Non-standard form factors free designers from the size and cost overheads associated with including a standard bus. Portable military gear, unmanned ground vehicles and small UAVs are just some of the systems that rely on such technologies. Articles in this section look at the trade-offs between standard and non-standard form factors. A product album compares the latest representative small non-standard boards: 6U and 3U cPCI and cPCI Serial boards.
MPS — MINV  Military Power System

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- Frequency conversion: 60Hz to 400Hz or 400Hz to 60Hz
- Voltage conversion; 115V 3-Phase input to 230V Single Phase or 3-Phase output
- Power conditioning; “dirty” input power reformed to clean sine-wave output power
- System monitoring via RS-232 or Ethernet
- Total system output power 3600W

Military Power Supply
- AC Input: 200Vac\textsubscript{L-L}
- PFC at AC input
- DC Output: 28V, 30V, 48V, & programmable options
- 1U rack mount (17" x 19.6")
- Low weight — 25 lbs.

Military Power Inverter
- DC Input: -28 model: 22V - 33V 
  -180 model: 135V - 234V
- AC Output: 115Vac or 230Vac, Single Phase or 3-Phase
- 1U rack mount (17" x 22.4")
- Low weight — 30 lbs.
Value of the global unmanned surface vehicle (USV) market is estimated in 2016 to reach $861.37 million by 2021 according to a study from ASDReports.com. At a projected CAGR of 14.51 percent from 2016 to 2021, this growth can be attributed to the rising demand for maritime security, protection of shallow waters and ports, and the need for ocean data and mapping, globally. In North America, the defense segment comprises maximum market share of the global USV market and emphasis has been on USV autonomy and intelligence.

Number of its MicroGRAM GPS receivers that Rockwell Collins will provide up to Neya Systems and Northrop Grumman for integration in Neya’s Autonomous Behavior Capability Module, in support of Increment 1 of the Naval Surface Warfare Center’s Advanced Explosive Ordnance Disposal Robotic System (AEODRS). MicroGRAM enables military micro-users who require secure Position, Navigation & Timing (PNT) to comply with U.S. DoD policy that all combat and combat support systems use SAASM-based GPS devices.

Ceiling value of five-year single-award follow-on IDIQ contract Harris received from the U.S. Army Communications-Electronics Command. The follow-on contract was awarded under the Foreign Military Sales (FMS) program. Under the contract, Harris will provide a wide range of tactical communications equipment, including export versions of its Single Channel Ground and Airborne Radio System (SINCGARS); ground and airborne configurations of the SpearNet Team Member radio; associated products and spares; and training, installation, and field service support.

The number of orders Oshkosh Defense has received orders for its M-ATVs from the U.S. military and Middle East armed forces. Oshkosh is offering five Mine-Resistant Ambush Protected (MRAP) All-Terrain Vehicle (M-ATV) variants to meet a full range of mission requirements for armed forces around the world. Collectively, the battle-proven M-ATV Family of Vehicles offers a combination of protection and off-road mobility performance for peacekeeping, internal security, border security, special forces, counterinsurgency and conventional military operations.

Total number of licenses acquired so far by the U.S. Air Force for MetaVR Virtual Reality Scene Generator (VRSG) as part of the A-10 Full Mission Trainer (FMT) program. The USAF recently acquired 88 new licenses. In addition, software maintenance was purchased for nearly 300 licenses of MetaVR’s real-time 3D virtual world rendering software, which provides the A-10 simulator program access to MetaVR’s software enhancements, new 3D models, and terrain databases. The new VRSG licenses will be used to expand the field-of-view of the existing simulators, which will provide greater immersion and situational awareness for the pilot.
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Attach incredible compute power and flash storage to your servers.

Compute Accelerators
- 3U rack space
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- 6,000 watts of n+1 redundant power
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- Direct attach with four PCIe x16 Gen 3 cable connections to host server(s)

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with NVIDIA® Tesla® K80 GPU accelerators

OSS Compute Accelerators are qualified to operate with OSS EOS server; Intel S2600QC, Supermicro 7047GR-TRF, Dell R720, and IBM 3650-M4 servers operating NVIDIA Tesla™ GPU's. They can also be pre-configured with Intel Xeon Phi™ Coprocessors.

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- Direct attach with four PCIe x16 Gen3 cable connections to host server(s)

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