VITA

Open Standards, Open Markets

Market Research

VITA Market Developments in 2020

Quarterly Report

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Embedded Market Research

Contents

Brian Arbuckle Autobiography

Brian Arbuckle is a market analyst specializing in embedded computing. Brian has an engineering degree from the University of Warwick and an MBA. His career has spanned marketing management roles in industry for electronic and mechanical components and systems and communications networks. He has worked in analyst roles for technical market research organisations, IHS Markit and Informatech and in recent years has authored an annual market research report on the embedded computing industry.

Forward

VITA has commissioned this market research to gather information on data related to the most popular of VITA standards. We are planning quarterly updates on trends, contracts, and products. A survey is underway to gather market numbers from key suppliers to the industry.

This report reviews 2020 and the trends driving technology development for VITA-standard boards and systems.

Introduction

A year that will be remembered for global pandemic has not as severely affected the market for military embedded systems in perhaps the same way that it challenged commercial aerospace and industrial markets for embedded technology. While the pandemic has resulted in significant travel restrictions as well as negatively impacting supply chains, methods of working and production levels, VITA members continue to deliver products and services to customers, often in increasing numbers.

Defense Budgets

US Spending

The U.S. Defense budget serves as the leading indicator of growth in the global defense market. Following across-the-board sequestration under the Budget Control Act (BCA) defense spending and related supplemental budgets bottomed in 2015. However, growth has stabilized in recent years. In early 2018, Congress signed a bill to provide relief against the spending caps associated with the BCA. In addition, the Fiscal Year 2019 Defense Appropriations Bill, signed in September 2018, was the first to be signed into law on time in over a decade. Most recently, the two-year, Bipartisan Budget Act in August 2019 brought an improved sense of security to federal agencies, essentially canceling the last two years of the BCA and its sequestration caps, while setting solid top-line spending figures for 2020 and 2021 in excess of $700 billion.

Looking ahead, the Fiscal Year 2021 budget request is approximately $740 billion, essentially in line with the Fiscal Year 2020 budget. It is worth noting however that the 2021 budget request contains the largest Research, Development, Test, and Evaluation (RDT&E) budget in history ($106.6 billion) and is focused on the development of crucial emerging technologies, often referred to as Advanced Capability Enablers (ACEs) including:

- Hypersonics - $3.2 billion
- Microelectronics/5G - $1.5 billion
- Autonomy - $1.7 billion
- Artificial Intelligence (AI) - $841 million

The spend on embedded technology design and development, very much an enabling part of these ACEs, may therefore expect to increase at a significantly higher rate.

NATO Alliance

Looking at future spending trends of the wider NATO Alliance, a key report, published in March 2020, *Science and Technology 2020-2040*[1], considers science and technology trends and features a review of Emerging and Disruptive Technologies (EDTs). Four over-arching technologies are identified, each of which are enabled to a greater or lesser extent by embedded computing. These can be summarized as: AI; sensor networks; distributed

sensing, storage and computation; and digitalization. The report highlights the need for superior capabilities to help guide the investment required by NATO member countries to achieve it.

Technology development in Data, AI, Autonomy, Space and Hypersonics are seen to be predominately disruptive in nature as developments in these areas build on long histories of supporting technology development and will have an impact over the next 5-10 years.

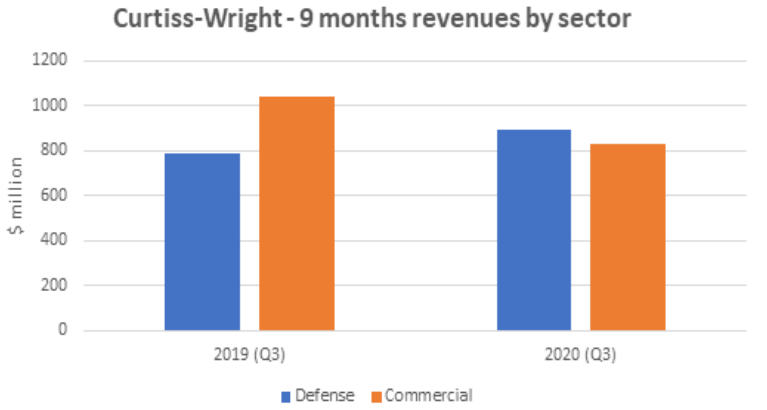
For example, information data collection and processing is a key NATO science and technology watch priority. This topic embraces electromagnetic sensors, their integration and networks, and advanced signal processing. It highlights the increasing processing power often embedded at the edge of networks, an environment very familiar to VITA members.

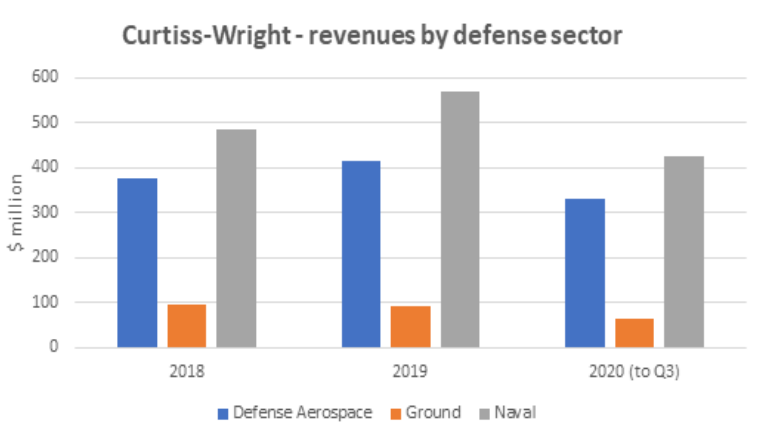
Company Financial Results

Looking at results published by two of the major players in the military embedded technology market, the difference between the buoyant defense market and the remainder has been stark.

Curtiss-Wright Corporation[2], for example, has reported 9-month figures to September 30th 2020 which feature a 14% increase in defense division sales and a 5% increase in operating income over the same period in 2019, primarily due to higher sales in the naval defense and aerospace defense markets. By comparison, figures for its Commercial/Industrial and Power divisions are down significantly.

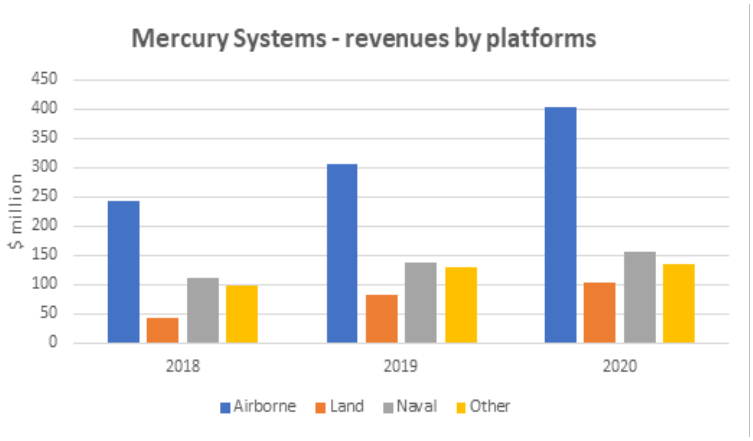
Curtiss-Wright reports that the naval defense market benefited from higher demand for valves and embedded computing equipment on the Virginia-class and Columbia-class submarine platforms and in the aerospace defense market, due to higher demand for embedded computing equipment on F-35 and various other fighter jet and UAV platforms. New orders increased $105 million from the comparable prior year period, benefiting from higher demand for embedded computing equipment in the commercial aerospace market. Demand in the commercial aerospace and general industrial end markets will undoubtedly be negatively impacted for the foreseeable future, the extent of which depends on future developments.

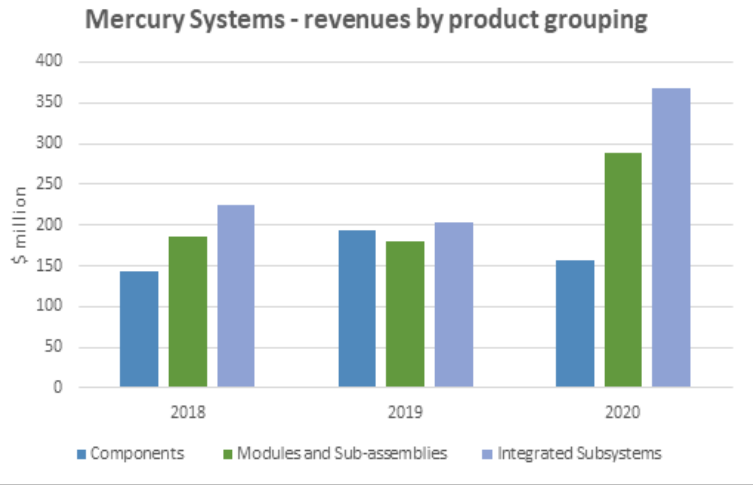




Mercury Systems[3] reported annual figures on July 3rd, 2020 and these were similarly good with sales revenue up 22% over the prior year. Even when the contribution of recent acquisitions is stripped out, the full year fiscal 2020 results

represent an increase of 14% organic revenue from fiscal 2019 (similar to Curtiss-Wright). Mercury Systems published Q1 results on November 3rd which were similarly up-beat, revising guidance upwards for 2021. Design wins (unspecified) of more than $300M in estimated lifetime value were also reported. Revenues for the quarter were up 16% on last year, the increase was primarily driven by increased demand for integrated subsystems, across radar, electronic warfare and C4I applications, within land and naval platforms. The organic revenues increase was driven by a classified radar program, as well as the Patriot, CDS, Galaxie and LTAMDS programs, Increases in demand for integrated subsystems were partially offset by decreases to modules and sub-assemblies and components.





Contract Wins

Not all defense contracts are announced publicly and for those that are, not all identify details of embedded computing technology on board. VITA encourages members to be as explicit as they can in their news releases to reinforce customer confidence in the standards through highlighting examples of deployments. Only contract wins that specifically mention VITA-standards are reported.

Airborne Platforms

In May 2020, Bell selected North Atlantic Industries (NAI)[4] for their SIU36 new Data Concentrator Unit (DCU) for the Bell 360 Invictus as part of the U.S. Army Future Attack Reconnaissance Aircraft (FARA) competition. The SIU36 is a Modular Open System with 3U OpenVPX with T2080 QorIQ PowerPC processing released by NAI in March.

In July 2020, Curtiss-Wright announced it would provide the U.S. Navy with an onboard advanced mission management system (AMMS) for the MQ-4C maritime patrol unmanned aerial vehicle (UAV) under terms of a $7.5 million sole-source contract. The Curtiss-Wright AMMS has a high-speed embedded computing suite for high-performance processing, and a modular, scalable open-systems architecture. AMMS is an open-systems VPX-based system with internal volatile data storage, new DIO subsystem and discipline rubidium oscillator module, VPX-based embedded computing modules, and Gigabit Ethernet switches.

In October 2020, Abaco Systems[5] announced that it has won orders from a major European technology company that will see Abaco's hardware platforms deployed at the heart of a new

helicopter cabin computer. The requirement was to replace the existing cabin computer, which was based on Abaco's DAQMAG2A rugged display computer which had ceased production, onboard a twin-engine helicopter designed to be suitable for long range operations. The challenge was to develop flight deck systems to make the pilot's job as easy as possible by reducing workload, delivering intuitively actionable information based on data acquired from a broad range of sensors, and enhancing situational awareness. Working with a channel partner, an evolution of the DAQMAG2A-based system was proposed. The new cabin computer will use Abaco's SBC329 3U VPX single board computer and NVP2102 XMC graphics output and video capture board, plus other modules designed by the channel partner.

The initial order is valued at $350,000. Total lifetime value to Abaco of the win is expected to be $1.5 million. Production is scheduled to start in 2021.

Ground Radar Platforms

In November, 2020 Abaco Systems announced a design win from a major European defense contractor which utilizes processing modules to implement real-time edge computing at the heart of a ground mobile early warning system. The challenge has been to identify a threat, extract the information, and deliver it to tactical decision makers with extremely low latency, and high reliability.

The early warning system will provide protection for ground force command centers using radar and LIDAR (Light Detection and Ranging) technologies. Integration of the input from these two sensor modalities will allow the system to extract highly accurate and detailed information about incoming threats from identification through to extraction of information.

The initial order is valued at $1.0 million while the win's total value to Abaco is expected to be $3.0 million over five years. Design and integration will occur during 2021, followed by production deliveries.

VPX Beyond Defense

While VPX is primarily associated with providing high performance solutions to the defense market, the number of markets that can leverage its capabilities is much wider. That includes commercial, industrial, transportation, energy exploration and many more industries that need rugged reliability allied with leading edge performance. That's particularly the case where the requirement is for sophisticated signal processing and analog to digital conversion – as with an application that resulted in a $1.725 million contract win for Abaco in September from a European astrophysics research institute.

Observation of the universe has become an increasingly demanding application, driving the need to retrofit radio telescopes with receivers supporting higher bandwidth, a higher number of channels and more powerful backends. In this case the high performance backend is equipped with Abaco's boards and is designed to be modular, flexible and scalable. The backend comprises two subsystems, each featuring a 3U VXP SBC329 single board computer.

Technology Trends in Military Embedded Computing

When measured in new product releases, design wins, and contract wins in military embedded systems announced in the public domain, the outlook remains optimistic as US Defense budget RDT&E spend is forecast to reach record levels in areas where embedded computing is a key enabler.

Open systems alignment was a constant trend in 2020 in new product announcements starting with the Tri-Service Interoperability Demonstration that ran concurrently with Embedded Tech

Trends in Atlanta in January 2020. The open system reference architectures being defined by The Open Group Sensor Open Systems Architecture™ (SOSA) Consortium will enable military embedded designers to create new systems and upgrade existing systems faster than today's technologies allow.

Modular Open Systems Architecture (MOSA) focuses on modular approaches between systems, components, and platforms with the objective of lowering costs and allowing the rapid deployment of new technology to maintain technical superiority. MOSAs share a common goal, to deploy the best technology more effectively and efficiently, which enables standards to converge.

Rapid field deployment means shortening time between development and production contracts, good for rapid revenue growth of new products. Ease of upgrade also means that product lifetimes will extend so these new design wins can expect to have a greater overall value. Finally, building to a common standard allows vendors to focus on enhancing the functionality of their defense products, and less on equipment interoperability or integration issues.

Vendor Approaches to Open Systems

Mercury Systems has been an early and leading advocate for open systems architecture in defense, offering Intel server class processing form factors across 3U/6U OpenVPX, ATCA and rack-mount architectures, and high density, secure solutions across multiple hardware architectures to seamlessly scale to meet customers' SWaP requirements. Mercury Systems has a portfolio of Open Standards Architecture ("OSA") technology building blocks across the entire sensor processing chain.

Curtiss-Wright has been taking an open architecture approach to OpenVPX to achieve performance goals, deploying data-center architecture as used in the commercial world. Unlike the commercial world however the war-fighter cannot rely on commercial cloud services to process data, so data processing is done on the embedded platform itself but in open architectures which are easily updated as required.

In January Curtiss-Wright introduced OpenVPX embedded computing modules for intelligence and surveillance uses. These applications include high-performance radar, SIGINT, EO/IR, data fusion ingest, processing and display, and autonomous vehicles. NVIDIA Quadro Turing (TU104/6) GPU/inference engine-based OpenVPX embedded computing modules

In October, Curtiss-Wright outlined its strategic roadmap for delivering Common/C4ISR/EW Modular Open Suite of Standards (CMOSS)-compliant and SOSA aligned OpenVPX system solutions in support of the US DoD Tri-Services mandate to use the Modular Open Systems Approach (MOSA) in all requirements, programming and development activities for future weapon system modifications and new start development programs to the maximum extent possible."

Curtiss-Wright has established a cross-functional MOSA Task Force to streamline the development and availability of these new interoperable solutions. The MOSA Task Force will bring to bear the company's expertise in system architecture, packaging, rugged OpenVPX module building block design, and advanced data storage solutions to address emerging customer requirements for cost-effective, high-TRL MOSA products.

In October 2020, Curtiss-Wright launched two new rugged open standards-based modules featuring 40Gb Internet connectivity. Based on Curtiss-Wright's VPX3-1260 core design, a rugged 3U OpenVPX SBC featuring the high-performance 9th Gen Intel "Coffee Lake Refresh" Xeon E-2276ME processor, an I/O Intensive Profile SBC and a Payload Profile SBC.

The family of 9th Gen Intel Xeon 3U OpenVPX Single Board Computers join Curtiss-Wright's previously announced processing solutions developed in alignment with the SOSA Technical Standard and CMOSS, including the 3U OpenVPX Intel Xeon D based CHAMP-XD1S digital signal processing module and the 3U OpenVPX VPX3-687 10G/40G Ethernet switch module.

Pentek[6] continues to be very active in the development of the SOSA technical standard and announced a new Quartz RFSoC board aligned with the SOSA Technical Standard. The Model 5550 is an eight-channel A/D and D/A converter, 3U OpenVPX board based on the Xilinx Zynq UltraScale+ RFSoC

Outside of the US, UK-based Concurrent Technologies[7] continued to increase its portfolio of VPX boards by providing one of the first 3U VPX processor boards with a 40G Optical Ethernet Interface that aligns with new profile requirements, allowing for a new set of capabilities. Launched in January 2020, in accordance with a proposed VITA 65.1 profile, developed in alignment with the SOSA Technical Standard.

In France in July 2020, Interface Concept[8] introduced a 3U VPX SBC aligned with the SOSA Technical Standard with the NXP Arm Cortex-A72-based LX2160A Multicore Communications Processor. This design meets requirements for 25-gigabit-per-second Ethernet interfaces on a 3U VPX system backplane and is aligned with the SOSA Technical Standard.

In Germany, in September 2020, Kontron[9] announced it was deploying 11th gen Intel Core in a VPX blade - the VX3060 with quad core processors that include vector neural network instructions (VNNI) for artificial intelligence, The pin assignment is compatible with VITA 65 OpenVPX profiles, and is aligned with the SOSA Technical Standard.

Also in September, Pixus Technologies[10], who provide embedded computing and enclosure solutions, announced versatile development enclosures aligned with the SOSA Technical Standard and OpenVPX. Pixus now offers backplane/chassis configurations geared for 3U and 6U OpenVPX enclosures starting with a line of 1-slot power and ground backplanes in various 3U and 6U configurations.

In October 2020, Israeli group Aitech Systems[11] joined the SOSA Consortium. Aitech's U-C8770, aligned with the SOSA Technical Standard, SBC claims to be the first to offer advanced cybersecurity features. It features an Intel Xeon D processor with 16 cores for high performance signal processing applications.

Many other vendors are lining up to announce SOSA aligned products in the coming months as this initiative gains further traction in the drive for open standards.

Emerging Applications for VPX – AI Accelerators

The application of Artificial Intelligence (AI) techniques to provide Inference at the Edge has generated considerable interest in consumer orientated applications such as autonomous driving. As AI technology has matured, this interest is being picked up by the defense and energy exploration markets. Embracing the latest processor technologies AI enables the development of autonomous or optionally-manned systems to reduce the burden on the war-fighter.

In January 2020, Concurrent Technologies announced its first, high performance 3U VPX Artificial Intelligence Accelerator Board based on an Intel Arria FPGA. TR AEx/6sd-RCx is focused around Inference at the Edge applications such as real-time object recognition and behavior monitoring. It has been designed to work in parallel with Concurrent Technologies processor boards that are aligned with the SOSA Technical Standard. This new AI Accelerator

Engine, enables a user to receive and process real-time actionable intelligence from vision, RF or other sensors, providing a faster solution to many problems faced at the edge.

Mercury Systems is addressing AI with its Ensemble Series HDS6605 general-purpose processing 6U OpenVPX blade server with hardware-enabled support for artificial intelligence applications. With the new second generation Intel Xeon Scalable processors, Mercury Systems OpenVPX blade servers embed the big data processing capability required for new, smarter and autonomous military missions.

In April 2020, Mercury Systems announced it received a $4.7 million order from a leading defense prime contractor to provide artificial intelligence (AI) processing technology for integration into an advanced airborne electro-optic system. This provides datacenter-quality processing architecture in an embedded solution to quickly extract critical information from electro-optical/infrared (EO/IR) imagery using the latest AI techniques.

In June, Mercury Systems announced the GSC6204 OpenVPX 6U NVIDIA Turing architecture-based GPU co-processing engine to address compute-intensive tasks such as artificial intelligence (AI), radar, electro-optical and infrared imagery, cognitive electronic warfare (EW), and sensor fusion applications requiring high-performance computing capabilities closer to the sensor for effectiveness.

Also in June, North Atlantic Industries, Inc. (NAI), announced the availability of the 68G5P-SC3AR1TE2 application-ready MOSA and aligned with the SOSA Technical Standard 3U OpenVPX Multifunction I/O board.

Aitech Systems, as of October 2020 is now offering its C530 GPGPU board with NVIDIA GPUs, based on NVIDIA's Turing architecture. The enhanced 3U VPX board helps designers overcome major hurdles in the rugged AI landscape by providing accelerated data processing of multiple streams simultaneously, while withstanding extreme environmental conditions. Based on COTS and open-standard architectures, the C530 can be easily utilized in a number of platforms and applications.

Developments in Enclosure Technology

Power-hungry OpenVPX modules require a thermal management solution guaranteed to keep the mission on course. In October, Elma released a rugged ATR Platform accommodating 6U OpenVPX modules needing VITA 48.4 LFT cooling. Each of the eight backplane slots handles 300 watts.

The VITA 48.4 Mechanical Specification Using Liquid Flow Thru Applied to VPX standard establishes the mechanical design, interface control, outline and mounting requirements to ensure the mechanical inter-connection of 6U VPX liquid-flow-through cooled plug-in modules within associated sub-racks. The standard enables more efficient cooling of circuit boards and electronic components via an integral heatsink with liquid flowing through it. The connector layout remains common with VITA 46 and quick disconnect coupling assemblies allow fluidic coupling to the chassis manifold.

In December 2020, nVent launched several new nVent SCHROFF Calmark VITA extractors for rugged applications in the aerospace and defense industries. (An extractor is a small lever that inserts or releases conduction cooled assemblies.)

According to nVent, this series assists customers looking for a broader commercial off-the-shelf offering for conduction cooled modules, especially for VITA 48.2 applications. The expanded extractor offering includes the 700, 701, 702 and 703 series designed specifically for VITA standard applications such as VITA 48.2, VITA 46.0, VITA 30.1 and IEEE 1101.2.

The new series offers more options for customers to better meet application extraction force requirements. The extractors are available individually or as part of a kit that includes not only the extractor but the full mechanical conduction cooled module, card-lok and hardware under a single SKU. The kitting saves customers time and reduces costs by simplifying part number management, as well as supply chain complexity.

Finally we noted the foundation of POLYRACK Aerospace GmbH in the second half of 2020. This is how the case and system solution specialist intends to serve the aerospace industry supplier market with customer-specific products in the future. These include electromechanical components made of metal and plastic, including individual rugged system platforms in various housing designs with IP65+ protection and optimised heat dissipation according to military standards, Air Transportation Racks (ATR), rugged backplanes according to MIL standards for CompactPCI, VME/VME64x and OpenVPX for extreme requirements as well as mechanical components and the development and integration of I/O boards according to customer specifications.

VME Approaches 40

With all the focus on VPX and open standards, how is the venerable VME standard moving forward? Can VME customers take advantage of new technologies and the higher performance and greater functionality they bring, but with minimal disruption?

The ideal upgrade for the majority of customers would involve simply unplugging one card and replacing it with another card. No software redesign, no re-qualification, no testing – with all the associated cost, inconvenience and schedule risk that are involved – but just a simple, straightforward insertion of the latest technology.

A good example of this design philosophy is the Abaco PowerXtreme family of 6U VME single board computers, first launched in 1998 in the shape of the PPC1A with its 333MHz PowerPC processor and up to 336Mbytes of memory. The latest addition to the PowerXtreme family is the PPC11A, with 5x the processor speed and eight times as many cores, more than 20x the memory capacity – and all with significantly lower power consumption. The PPC11A is a simple slot-in replacement for earlier PowerXtreme boards.

New contract wins are still very much a feature of the VME market. In September 2020, Abaco Systems announced that it had received orders from a major US prime contractor that will see the company's XVR19 rugged 6U VME single board computers deployed on board several of the US Navy's highest profile destroyers as part of a comprehensive upgrade of the ships' computing capability. The value of the program to Abaco is more than $4 million.

The long-term viability of the VME architecture is reinforced by situations like this, where it made financial and operational sense for the Navy to upgrade, rather than completely replace, the destroyers' existing computing infrastructure. A key factor in Abaco being awarded the contract was the company's ability to modify an off-the-shelf product such that the customer's specific operational needs would be met. It was also important that Abaco was able to pre-test the single board computer and associated network interface card as an integrated pair, guaranteeing reliable operation and easing installation.

Building on this success, in October 2020 Abaco announced that it had received orders from a major prime contractor to support the upgrade of the computing capability of a European nation's fleet of 70 fighter aircraft. Two of Abaco's rugged 6U VME Power Architecture SBCs will be at the heart of each multiprocessor onboard mission computer. Insertion of the new single board computers enables four boards to be replaced by two, creating valuable onboard space for additional functionality.

As VME remains an ideal architecture for mission-critical applications requiring high reliability and extended life cycles, SMART Embedded Computing[12] (formerly Artesyn) continues to be committed to the technology. To underline its commitment, SMART EC has been investing heavily in its VME offerings and has secured a number of critical EOL components, to ensure that it can continue to offer an extensive portfolio of VME boards up to at least 2025. SMART EC's VME portfolio is based on Power Architecture processors and offers customers flexibility to migrate between boards when looking for optimal solutions for their applications.

Aitech and Concurrent Technologies also continue to support robust lines of VME boards utilizing the latest in processing technology.

An enormous ecosystem of vendors exists around VME, with hundreds of products and ready availability of support. Therefore, VME is likely to remain the primary architecture, particularly in event-driven control system platforms, for many years to come.

VMEbus will be celebrating its 40th anniversary of its announcement in October of 2021. Its longevity in the market demonstrates the impact it has had on the industry.

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VITA

Open Standards, Open Markets