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# High Performance Embedded Computing





# Introduction

*Parallelism has been at the heart of supercomputing since the term was first used in the 1960s. Today, supercomputing has, in many instances, become high performance computing - but instead of vast rooms full of mainframe computers all working together on the same problem, high performance computing sees the deployment of numbers of server-class machines, each featuring multiple high performance processors configured in parallel.*

And now, high performance computing has come to the world of embedded systems – and, especially, to the systems being developed and deployed by the world's armed forces. To address the most demanding and sophisticated applications, such as ISR and electronic warfare, high performance embedded computing – HPEC – uses the power, not just of multiple single board computers working together, but also of multi-core and many-core processors.



## Unique Challenges

But HPEC in the military arena presents a unique set of challenges in two key areas as a result of how and where these solutions will be deployed. The first of these is the need to ensure 100% reliability – in what are often, literally, life-and-death situations - in the face of extremes of shock, vibration, temperature and contaminants. The second is that, increasingly, these solutions are being deployed in environments that are small, and that need to minimize weight, power and heat.

Both are fields in which Abaco Systems is

an acknowledged leader. No other company has Abaco's pedigree in the development of systems that are truly capable of withstanding the rigors of deployment in the harshest environments. And no other company is able to better Abaco's expertise in developing HPEC solutions that are small, lightweight, consume minimal power and dissipate minimal heat.

Abaco is well-known for its ability to develop and deliver leading-edge single board computers, multiprocessors, high speed switches, and so on. Much less well known is Abaco's ability as a mission

ready systems company, able to provide complete, rugged, ready-to-run subsystems – and a broad range of supporting services.

## Meeting new realities

It's not just about hardware. In an era of acquisition reform, without the luxury of extended, government-funded development cycles, the onus on development exists with the supplier. To meet these new realities, Abaco provides a complete integrated software development tool suite - AXIS - that reduces development time and cost and accelerates time to market.



There's more to Abaco's HPEC offering than just hardware and software, however. Abaco also has an unmatched understanding of, and commitment to, long term support – recognition of the multi-year (multi-decade, even) lifecycle of the typical military program.

Abaco Systems has been a long time champion of COTS – commercial off-the-shelf – solutions, because of what they bring to customers in terms of faster access to new technologies, high technology readiness levels (TRL), ease of interoperability through the use of open standards, reduced program risk and lower lifetime cost of ownership. Today, Abaco readily works with customers to create custom variants of

those solutions - variants that combine the advantages of COTS with the benefits of custom development.

Abaco is in the business of developing innovative solutions all the time, every time – for the long term. In an unpredictable world, only a company of Abaco's size, stature, resources and experience can work with customers to anticipate needs – and minimize the impact of the unforeseen. At the heart of everything Abaco does is the deep understanding of what is most important to customers: bringing value-added, differentiated, high performance, reliable and cost-effective solutions to market in the fastest time, at the lowest cost and with the minimum of risk – thereby creating



## Abaco's HPEC Innovation Center

Abaco Systems established the Boston HPEC Innovation Center specifically to support customer demand for high TRL COTS solutions that can shorten time-to-market, minimize cost and help to eliminate program risk, allowing prime contractors, system integrators and OEMs to focus on value-add and create competitive advantage. The Center takes advantage of Abaco's COTS Rugged Systems (CRS) capability to support the rapid deployment of systems to the field.

The HPEC Innovation Center also provides a focus for the future development of a range of powerful, flexible products and solutions for military/aerospace embedded computing.





# Software

Overarching Abaco's comprehensive high performance embedded computing offering is AXIS, an integrated, sophisticated yet easy to use software development tool suite that has led to software development time being halved, and to software testing beginning 30% sooner than would have been achieved with a 'hand-crafted' solution.



## Abaco's AXIS Software Development Tool Suite - Enabling Rapid Software Development

- > Initialize the system – quickly configure all nodes in the system
- > Check system configuration – automate system configuration validation
- > Map application to system – place tasks for best performance
- > Perform high performance communications between tasks
- > Run the application – download and run on multiple nodes with two clicks
- > Determine bottlenecks – locate and resolve bottlenecks in data flow and task performance
- > Measure real-time performance – profile runtime data across entire system
- > Maximize algorithm performance – identify opportunities for improvement
- > Rescale the application – move the application to larger or smaller systems
- > Rapidly create graphical user interfaces for the application

AXIS reduces the time taken to develop, test, debug and optimize complex software applications based on heterogenous, multiprocessor CPU and GPU platform architectures. Because of the high level of hardware abstraction it provides, it requires little or no developer knowledge of the underlying platform, freeing developers to focus on the application. As such, it reduces program risk; it increases productivity; it reduces costs; and it reduces time-to-market, creating competitive advantage.

### Easy, fast, cost-effective

AXIS is also highly portable, allowing the easy, fast and cost-effective migration of a software solution to multiple hardware platforms as well as simplifying technology insertion during the lifetime of a program.

AXIS provides support for Abaco's latest multi-core and many-core hardware platforms including single board computers featuring the latest Intel® Core™ and Xeon® processors as well as those featuring the latest NXP PowerPC™ processors with Altivec™, and those featuring GPGPU (general purpose processing on graphics processing units) technology. This provides



AXIS Pro provides tools to visualize the hardware platform and how the application software is utilizing it.

customers with a highly integrated hardware and software platform that uniquely enables them to take maximum advantage of the enormous benefits of the latest processing technologies.

### Tuning to meet performance requirements

The AXIS Pro software suite includes an integrated graphical user interface. AXIS View provides tools for application development and system visualization. The developer exploits an iterative application development cycle, allowing the user to benchmark routines and tune the application to meet performance requirements.

In addition, AXIS Flow provides a high performance inter-processor communication library for high throughput, low latency data movement across multiple fabrics (PCI Express®, Gigabit Ethernet, 10Gigabit Ethernet, 40 Gigabit Ethernet and RoCE) scaling from one to many CPU cores and nodes across a single board, multiple boards and multiple system chassis. If open standards are required, then AXIS MPI offers an embedded computing-focused MPI library that will operate across heterogeneous systems.



AXIS DataView provides the unique ability to rapidly create graphical interfaces for embedded application without needing to write any GUI code. This can reduce the amount of code and effort for developing GUIs by two orders of magnitude. DataView is focused on SWaP; it is therefore lightweight and doesn't require a runtime engine like MATLAB® or LABVIEW™. It is much simpler to learn and use than a full GUI widget toolkit such as Qt™ or GTK+.

AXIS EventView provides a simple, focused event analyzer that allows detailed performance analysis of complex multi-threaded applications. It provides a much higher granularity of performance detail than traditional profiling tools, and is much simpler to use and interpret than operating system-focused event analyzers such as LTTng. It can also be used across multiple operating systems. It was used to great effect in a recent Air Force-sponsored Next Generation Radar study, where its focused analysis facilitated significant optimizations of both SAR and GMTI algorithms running on a HPEC system.

AXIS Lib provides DSP and math function libraries to support very high performance signal- and data processing routines with a standard VSIPL interface for portability across multiple processor platforms as well as a simpler C API for optimum performance.

The AXIS ImageFlex 2.0 toolkit provides an easy-to-use API framework for developing real-time image processing, visualization and autonomy applications utilizing the power of modern GPU architectures. It provides an abstraction layer on top of OpenGL® to allow developers with no OpenGL experience to rapidly create high performance graphics applications. System integrators can deploy ImageFlex across Abaco's 3U & 6U OpenVPX HPEC solution sets that include the latest generation of Intel® Core™ i7 and Xeon-D® multicore CPU/GPU combinations, as well as NVIDIA® and AMD GPUs.



## Software: The Abaco Advantage

- > AXIS MPI, AXIS Flow and AXIS Lib facilitate development of efficient portable and scalable multi-threaded code that can be distributed across multiple processing cores and CPU domains
- > AXIS EventView enables in-depth performance analysis of these distributed threads, allowing focused application tuning
- > AXIS DataView provides an innovative tool for rapidly building a graphical interface for embedded applications, helping developers visualize their data and interactive controls
- > AXIS ImageFlex 2.0 facilitates rapid development of high performance image processing, visualization and autonomy applications that take advantage of the huge processing power of GPUs.



# Solutions

Few, if any, embedded computing companies can offer the range of HPEC solutions that are available from Abaco Systems. In line with Abaco's strategy of enabling customers to enjoy – and maximize – the benefits that accrue from COTS solutions, all of Abaco's HPEC offerings are built around technologies that are industry standards and that represent 'best in class'.

## Demanding military applications

Processors come from Intel, with its industry-leading Core dual- and quad-core technology and 4- to 16-core Xeon-D, and from NXP, with its highly respected Power Architecture™ processors. From NVIDIA® comes its CUDA™ architecture and many-core GPU (graphic processing unit) processors – not just for graphics applications, but also for general purpose use in the most demanding military applications that can benefit from a high degree of parallelism, such as radar. With more than double the processing and I/O resources of previous FPGA technology, Xilinx® Ultrascale™ and Ultrascale+™ devices are ideal for high performance digital signal processing.

From Mellanox comes 10 and 40 Gigabit Ethernet, switched fabric communications links used extensively in high performance computing and enterprise data centers.

As part of its unwavering commitment to open industry standards, Abaco also supports OpenVPX, an architecture framework that defines system-level VPX interoperability. Specifically developed for deployment in rugged environments, it is the natural heir to VME, the computer

bus standard that has been at the heart of embedded computing since the 1980s, and which Abaco also supports, along with the CompactPCI® industry standard.

## Support for industry standards

As well as hardware and technology standards, Abaco's range of HPEC solutions also supports industry software standards, such as Microsoft Windows® and Linux®, together with industry standard real-time operating systems including VxWorks® from Wind River Systems, INTEGRITY™ from Green Hills Software and LynxOS® from Lynx Software Technologies.

Software support also comes in the form of AXIS, Abaco's advanced integrated software development tool suite which has been shown to substantially shorten the development, debug and optimization cycle.

The OFED software stack from the Open Fabric Alliance is also fully supported, providing drivers and open standards interfaces along with RDMA-enabled communications protocols such as Open MPI, uDAPL and sockets direct. This allows developers to leverage the extensive landscape of commercial HPC software.

## Solutions: The Abaco Advantage

- > HPEC CoE helps with architecture definition, application development and performance optimization
- > Able to deliver short lead time software development platforms with a path to fully ruggedized deployable systems
- > Provide fully software integrated and tested 'application ready' solutions
- > Provide 'getting started' support and training

## Ground Vehicle Applications

- > Network Switch Units
- > Target Tracking
- > Embedded Training
- > Integrated Display Processing
- > SBCs, DSPs, Graphics, I/O Cards
- > Situational Awareness
- > Remote Interface Units
- > Launcher Control Units
- > Fire Control Computers
- > Hull/Turret Computers

## Aerospace Applications

- > Remote Interface Units
- > Network Switch Units
- > Radar Warning Receivers
- > Stores Management Computer
- > Integrated Display Processing
- > SBCs, DSPs, Graphics, I/O cards
- > Mission Management Computers
- > Navigational Control Units
- > IFF Controllers
- > Flight Management Computer

## Naval Applications

- > Integrated Display Units
- > Communications and IFF
- > Shipboard Network Control
- > Target Detection and Tracking
- > Fire Control Computers
- > Sensor Processing

## Embedded Rugged Systems

- > Mission Control
- > Flight Control
- > Sensor Processing
- > Vehicle Management

Abaco participates in industry initiatives that are generating new open architecture standards for specific application areas such as FACE (Future Airborne Capability Environment - open avionics environment for military airborne platforms), SOSA (Sensor Open Systems Architecture for interfacing sensor suites), OMS (Open Mission Systems standards for integrating subsystems and services into airborne platforms), and more.

## Extensive HPEC offering

Abaco's extensive HPEC offering includes single board computers such as the SBC627, based on the high performance Intel Core i7 processor. It features fully integrated graphics and memory controller together with dual or quad core processing up to 2.7 GHz, and offers outstanding performance per watt. Coupled with the Intel QM87 chipset, this provides an unmatched level of I/O bandwidth for both onboard and off-board functions.

Abaco's DSP282A is the latest in a long line of multiprocessors designed for the most demanding ISR applications. Like the SBC627, it is based on Intel Core processor technology – but features a dual quad core

architecture delivering, in effect, eight CPU cores on a single board and making it ideal for demanding DSP, radar, sonar, image and sensor processing across a wide range of platforms including manned, unmanned airborne, ground and naval vehicles. Multiple DSP282As can be interconnected via 10/40 Gigabit Ethernet fabric switches to create powerful HPEC clusters.

For applications that demand an even higher degree of parallelism, Abaco has introduced the IPN252 platform with a 640-core NVIDIA Maxwell™ GPU. In the case of the IPN252, the GM107 is augmented by an Intel Core i7 processor operating at 2.1 GHz to create a heterogeneous and computationally-dense processing platform for demanding applications that are constrained in terms of size, weight and power (SWaP).

The IPN252 is capable of delivering up to 1.4

TeraFLOPS (trillion floating point operations per second) of throughput from a single 6U chassis slot. It complements other Abaco platforms to allow the creation of complete systems capable of responding to the most exacting embedded computing challenges.

For I/O and DSP processing, Abaco offers the VP880 which has the latest embedded processor from Xilinx, the Zynq™ Ultrascale+, as well as an extremely large Virtex™ or Kintex™ Ultrascale FPGA. Each device is connected to a VITA 57.4 FMC+ interface for advanced I/O and high performance embedded signal processing.

3U VPX HPEC systems can be crafted from a similar set of technologies. The SBC329 offers a quad-core Xeon E3 processor and a PCIe™ Data Plane, while the SBC347D has a Xeon-D CPU with 4-, 8-, 12- or 16 cores, and connectivity via PCIe, 10GbE and 1GbE. The GRA113 graphics processor has the same GM107 GPU as the IPN252.

## Switches, subsystems and more

Other key members of Abaco's HPEC solution include the SWE540A fully managed 6U VPX 40/10GigE Data Plane Ethernet switch. The NETernity™ SWE540A is a fully managed (Layer 2/3) 6U VPX Ethernet switch designed to meet the most demanding requirements

for network switching in tactical applications. With its configuration options of up to 20 data plane ports and OpenWare™ switch management software, the SWE540A is available in both air-cooled and conduction-cooled versions, providing multiple OpenVPX configurations supporting a mix of dataplane and control plane ports. In addition, there is an available option to support four QSFP+ and two 1000BaseT ports. ECC protection on the management processor memory offers higher reliability in harsh environments.

The SWE540A delivers full wire-speed switching that can be fully managed and easily deployed. Proven, high performance architecture and a multilayer switching fabric provide a rich feature set, broad functionality, scalability, and product longevity.

The GBX411 brings 1GbE switching to 3U VPX systems, with 12 or 24 ports and two 10GbE uplinks. It too runs the OpenWare switch management software. 3U systems using PCIe can leverage the PEX431 multi-fabric switch, which can be configured with up to six x4 PCIe ports and up to eight 1GbE ports.

Abaco's peer-to-peer PCIe software makes it easier to configure and use the PCIe fabric as a data plane between multiple CPUs.

The most recent addition to Abaco's HPEC range is the rapidly-growing family of Mission Ready Systems. Designed for customers who need to eliminate the expense, time and risk of custom sourcing and development, these preconfigured, pretested, ready-to-run systems can be deployed in the field as soon as the applications is ready, or used as a starting point for multiple application-specific configurations.

Abaco's comprehensive HPEC product and system offering is backed by an extensive infrastructure of customer support programs designed to ensure that high performance, reliable systems are deployed in the minimum time, at the minimum cost and with minimum risk.



# Technology

Abaco Systems has long been a leader in taking COTS technologies and adapting them for the rigorous requirements of military organizations around the world.

## COTS: faster access to technology, lower cost of ownership

The advantages of COTS are many. COTS solutions allow military organizations to leverage the latest in commercial technologies far faster than would otherwise be the case. COTS solutions are significantly more cost-effective, because they obviate the need for extensive upfront investment in development – and they take advantage of technologies that are produced on a commercial scale. A COTS solution can typically be deployed more quickly, shortening time-to-market.

Total cost of ownership of a COTS solution is lower because the vendor takes responsibility for long term support – and COTS solutions are designed to ease technology insertion, maximizing performance over the lifetime of a program. Because COTS solutions are derived from commercially-proven technologies, they typically feature a high Technology Readiness Level (TRL) and minimize program risk.

## GPGPU solves complex problems faster

GPGPU – general purpose computing on a graphics processing unit – technology is an excellent example of how military organizations can leverage technologies originally designed for commercial and consumer applications. PC-based game playing has long driven advances in GPU technology as gamers strive for ever-greater realism – and that same search for enhanced realism



has seen GPU technology widely deployed in military display applications such as embedded training.

But: the inherent high degree of parallelism that brings ultimate graphics performance can also be used to deliver other types of processing – types of processing widely required in military applications such as radar, where the requirement is to process multiple streams of data simultaneously. Customers using NVIDIA's CUDA GPU architecture – such as the 640-core GM107 – for applications such as SAR simulation, pattern recognition, object detection and cryptography are reporting performance increases of between 10x and 500x. Using a GPU to augment the capability of a traditional CPU can therefore bring real size, weight and power (SWaP) advantages to high-end processing systems.

Dual NVIDIA CUDA GM107 GPUs are featured in the Abaco's IPN252 multiprocessor, combining the power of a GM107 with the performance of an Intel i7 processor for maximum application integration and flexibility.

The most demanding C4ISR and Electronic Warfare applications require high performance embedded computing which sees the deployment of multiple processors of either homogeneous or heterogeneous types, either on a single silicon devices, on a single board – or on multiple boards.

## Serial switched fabrics for high system throughput

This presents two key challenges. The first is in the intercommunication between the processors – but here too, Abaco provides solutions. Abaco was among the first embedded computing companies to commit whole-heartedly to the interconnect technology that has rapidly become the standard for demanding military applications. VPX – and, subsequently, OpenVPX – grew out of the pervasive and hugely successful VME standard, and is an open standard which utilizes the familiar 3U and 6U card sizes of VME. It offers true rugged capabilities, including conduction cooling and resistance to shock and vibration. At the same time, it offers higher power budgets, more signal density and a far faster serial backplane.



Abaco has also chosen to standardize on 40 Gigabit Ethernet for intercommunication between single board computers, digital signal processors, graphics cards and other products that make up the system. 40 Gigabit Ethernet is an ideal choice as it offers high performance; Ethernet is ubiquitous; and it is supported by a substantial ecosystem of products, technologies and expertise. With the addition of our OpenWare switch management software, customers are able to take advantage of newer network capabilities such as data center bridging which helps with traffic prioritization, flow and bandwidth utilization for data-intensive applications such as high performance embedded computing.

Intel-based computers are dominant in the high-performance computing clusters that are often called 'server farms' – installations which deliver massive computing power by

coupling together multiple servers or blades. With the growing requirement in the military/aerospace market to gather, process and disseminate huge volumes of data, those server farms are increasingly being replicated in defense applications. For customers looking to create similar profiles, there are sound commercial as well as technical reasons why 40Gigabit Ethernet is becoming the standard for internode communications.

## Software rises to the development challenge

The second challenge is in managing the multi-faceted complexity of developing demanding, mission-critical applications on hardware platforms that can themselves be complex to master – and to do so in minimum time and at minimum cost. Here, Abaco offers the AXIS advanced integrated software development suite. AXIS is a set of software modules that can be used to accel-

erate the design, development, testing and deployment of complex DSP and multiprocessor platforms for real-time applications such as radar, sonar, communications and image processing.

AXIS allows tough questions – about system sizing, data movement, algorithm performance, configuration, application mapping and so on – to be answered quickly and easily, speeding the cycle of design, development, test, optimization and validation and reducing time to market.

Abaco's high performance embedded computing solutions combine the best in COTS technologies with open standards and advanced tools to make the development and deployment of demanding ISR applications easier, faster and more cost-effective.

## Technology: The Abaco Advantage

- > 100% commitment to COTS, industry standards
- > Innovator in key technologies such as truly rugged GPGPU, InfiniBand
- > Leadership in ruggedization
- > Focus on compelling SWaP characteristics, high performance





# Applications



## Radar

Developers of today's radar systems demand that their processing systems be founded upon the principles of Modular Open System Architecture. Designs must be scalable, open architecture and capable of sustainment for the long term with technology insertion plans.

In response, Abaco has adopted OpenVPX as the primary form factor, using widely-adopted processors from Intel and NVIDIA, connecting processing clusters with standard interconnects such as Ethernet and RoCE (RDMA over Converged Ethernet), and providing support for Linux, Open Fabrics Enterprise Distribution, MPI, DDS and so on.



## SIGINT

By using the rapid prototyping capabilities of AXIS View along with quick implementation of radar algorithms with AXISLib and AXIS Flow, a scalable signal processing system can readily be modeled to determine how many processors are needed. Abaco can produce such standard or custom radar backend processors scalable to dozens of TeraFLOPS. The AXIS tools can then be used to create a high performance deployable algorithm. Such systems can extend from sensor input via standard interfaces such as serial FPDP and 10/40GbE, through processing on clusters of Intel processors with optional NVIDIA GPGPU or FPGA co-processing, to output to a backend system via standard Gigabit Ethernet.



## Electronic Warfare

Electronic Warfare systems are typically defined by their need for low-latency processing. Many systems employ Abaco Systems' state-of-the-art line of advanced RF and DSP FPGA-based products to address the front-end requirements for modern EW systems.

For many Electronic Warfare systems, GPUs are now considered a viable technology with GPUDirect™. GPUDirect allows sensor data to be transferred directly into GPU memory,

bypassing the multiple copies and host processor involvement that were previously required. Testing has shown a reduction in latency of better than 25x, opening up the use of GPUs in applications that were previously not candidates. Development time and cost are also reduced.

Where nanosecond latency timeframes are required, Abaco has a range of FPGA boards using the latest devices available.

## Targeting

Targeting pods require increasing processing power to keep up with increased sensor resolution and added sensors. Typically, the system size is restricted by the existing pod profile and power.

Abaco's range of OpenVPX products, spread across 3U and 6U form factors, allow for highly scalable solutions from the smallest to the largest pods. AXIS software tools allow seamless scalability of the application to match the hardware. Gigabit and 10/40Gigabit Ethernet offer standard connections between subsystems and to sensor suites.



## EO/IR Visualization

Increasing focal plane arrange size, faster frame rates and more sensors being fused mean that more capability is being demanded in the same or lower size, weight and power. GPUs are particularly well suited to processing the large volumes of pixel data present on today's ISR platforms. Abaco's AXIS ImageFlex software enables developers to harness the GPU's power without introducing the complexity of software layers such as OpenGL or DirectX.

Given the shock and vibration levels that many ISR platforms are subjected to, Abaco's policy of using chip-down designs fit well. The use of high speed fabrics with RDMA in addition to Abaco's AXIS Flow software allows the sensor data to be efficiently spread to the processing nodes.



# Product Examples



## DSP282A

6U OpenVPX Dual Intel 5th Generation Quad Core i7 Deployed Server Platform

### FEATURES:

- > Two Intel Core i7-5700EQ CPUs
- > 16 GB DDR3L 1600 with ECC per CPU
- > 16 MB BIOS Flash per PCH, 16 GB SATA NAND Flash, 512 Kbytes NVRAM
- > 10/40 GbE or PCIe gen 3 and OFED RDMA (data plane) - 665.6 GFLOPS per card slot
- > 2x Double Fat Pipes or 4x Fat Pipes - PCIe (expansion plane)
- > 2 x 1000BASE-T and 2 x 1000BASE-SERDES with IEEE-1588 PTP (control plane)
- > User I/O includes GbE, Serial, USB, SATA, GPIO, HD audio
- > Intel Trusted Execution, Intel ES new instructions
- > AXISPro, AXISFlow, AXIS MPI, AXISLib, Built-in Test, UEFI BIOS
- > Windows SDK, Linux SDK, WRS VxWorks BSP



## SBC627

6U OpenVPX 5th Generation Intel Core i7-based Single Board Computer

### FEATURES:

- > SmartFusion2 FPGA
- > Soldered DDR3 SDRAM with ECC up to 32 GB
- > Up to 32 GB SSD, up to 6MB shared cache
- > 10/40 GbE (data plane)
- > Multiple PCIe lane configurations, Gen 3 capable (expansion plane)
- > Both rear and front I/O ports, PMC/XMC expansion sites
- > Five levels of ruggedization (convection and conduction cooling variants)
- > AXIS and Deployed Test Software
- > Windows, Open Linux, RTOS support



## IPN252

6U OpenVPX VITA 46 / VITA 48 REDI GPGPU Multiprocessor

### FEATURES:

- > NVIDIA 640-core "Maxwell" GM107 GPU
- > 3rd Generation Intel Core i7 CPU
- > 2x 10 GbE (data plane)
- > x16 PCIe Gen 3 (expansion plane)
- > 4x Gigabit Ethernet (control plane)
- > Both front and rear I/O ports
- > XMC Site
- > NVIDIA CUDA, OpenCL, OpenGL, GPUdirect, PhysX
- > AXISLib VSIPL Math & DSP libraries; MATLAB; DirectX 11.2, Shader Model 5.0
- > Linux, Windows operating system support



## SBC367D

3U VPX Intel Xeon D-based Rugged Single Board Computer

### FEATURES:

- > Two channels of soldered DDR4 SDRAM with ECC up to 64 GB
- > Up to 32 GB NAND Flash
- > 2x 10G/40 GbE ports (data plane)
- > 12 PCIe lanes, Gen 3 capable (expansion plane)
- > 2x 10G Ethernet ports (control plane)
- > Rear I/O includes GbE, SATA, USB and GPIO ports
- > Five levels of ruggedization (convection and conduction cooling variants)
- > AXIS and Deployed Test Software
- > Windows, Linux and VxWorks support



## VP868

6U OpenVPX Dual Ultrascale FPGA Signal Processing Board

### FEATURES:

- > Zynq Ultrascale Onboard Processor
- > Conduction Cooled or Air Cooled
- > Dual Ultrascale FPGA, Kintex and Virtex
- > Dual FMC+ Interfaces: (VITA 57.1 / VITA 57.4)
- > 2x Gigabit Ethernet
- > 36GB Onboard DDR3 SDRAM



## VP880

3U VPX Ultrascale FPGA, Zynq Ultrascale+ and FMC+

### FEATURES:

- > Dual FPGA architecture - Kintex or Virtex Ultrascale - zync Ultrascale+ MPSoC
- > 8GB DDR4 mapped to FPGA
- > 2GB DDR4 mapped to zync
- > VITA 57.4 HSPC FMC+
- > VITA 66.4 optical interface via FireFly BLAST site
- > VP881 expanded backplane I/O option available
- > Operating system support (Linux, Windows, VxWorks)
- > Full featured Board Support Package (BSP)



## NETernity SWE540A

Fully Managed 6U VPX 40/10GigE Data Plane Ethernet Switch

### FEATURES:

- > VITA 65 OpenVPX compatible
- > Four QSFP+ and two 1000BaseT ports on front panel available for air-cooled models
- > 720Gbps overall bandwidth
- > Serial Console
- > OpenWare Switch Management Software
- > Data switching and routing at fabric speed including IPv6
- > Multicast support: IGMP Snooping Querier and MLD Snooping Querier
- > Allows up to 4,096 VLANs
- > L-3 protocol support including OSPF, RIP and VRRP
- > Precision Time Protocol 1588v2 Transparent Clock Support
- > Air-cooled and conduction-cooled
- > Rugged levels 1 through 5 available
- > Built-in Test
- > Denial-of-service attack prevention
- > Sanitization capability
- > IPMI Controller
- > Spanning Tree and Link Aggregation
- > Remote management via Telnet, SSH and SNMP
- > Support for Jumbo Frames up to 9KB
- > ECC protection management processor memory



## NETernity SWE440

Fully Managed 3U VPX 40/10GigE Ethernet Switch

### FEATURES:

- > Compliant with following OpenVPX profiles:
  - MOD3-SWH-8F-16.4.3-n (8 Fat Pipes)
  - MOD3-SWH-6F6U-16.4.1-n (6 Fat, 6 Ultrathin)
  - MOD3-SWH-2F4T16U-16.4.12-n (2 Fat, 4 Thin, 16 Ultrathin)
  - MOD3-SWH-32U (32 Ultrathin)
- > Eight (8) 40GBASE-KR4 or Thirty-two (32) 10GBASE-KR ports rear I/O Option for 10GBASE-KX4 and 10GBASE-T (32 Ultrathin)
- > Two front panel SFP+ 10GigE fiber ports (or two 1000BaseT) - air cooled models
- > OpenWare Switch Management Software
- > Wire Speed IPv4/IPv6 Switching and Routing
- > Rugged levels through 1 to 5
- > Using latest System-on-Chip (SoC) technology - provides a low power solution
- > Support for PTP 1588v2
- > Serial and Out-of-Band management ports



## NETernity GBX411

Fully Managed 3U OpenVPX Ethernet Switch

### FEATURES:

- > Compliant with following OpenVPX profiles:
  - MOD3-SWH-2F12T-4.8 (2 Fat, 2 Thin)
  - MOD3-SWH-2F24U-14.4.3 (2 Fat, 24 Ultrathin)
- > Two 10GBASE-KX4 ports rear I/O
- > Two front panel SFP+ 10GigE fiber ports: 10GBASE-SR/LR/ER
- > Rear I/O port options:
  - Twenty-Four (24) 1000Base-KX
  - Twelve (12) 1000Base-T ports
  - Eight (8) 1000Base-KX and eight (8) 1000Base-T ports
  - Sixteen (16) 1000Base-KX and four (4) 1000Base-T ports
- > VICTORY switch compliant
- > OpenWare Switch Management Software
- > Wire Speed IPv4/IPv6 Switching and Routing
- > Rugged levels through 1 to 5
- > Serial and Out-of-Band management ports
- > RTM's to support the different build options (GigE ports only)





# Support

## Product Lifecycle Management

Abaco has long been a pioneer in the provision of the infrastructure necessary to support a program throughout its multiyear deployment, ensuring minimum long term cost of ownership and maximum return on investment.

This commitment starts at the point a new product is designed, with a key design goal being maximum compatibility or upgradability over an extended period. The list of critical components will include only those for which vendors have committed to a long-term production run. It is typically the case that new generations of Abaco products are pin-compatible with their predecessors,

enabling straightforward, cost-effective technology insertion throughout successive product generations.

Several flexible, responsive options are available to customers to suit the specific needs of a program.

### Solutions

For example, once a product has been deployed, Abaco's Health Check program can alert the customer to potential obsolescence issues and provide possible solutions such as a last-time buy of the components, an appropriate replacement component, a redesign of the original product for form, fit, or func-

tion compatibility, technology insertion earlier than planned or a lifetime purchase of the components.

When components are purchased in bulk, Abaco also can provide secure, climate-controlled storage for as long as required by the customer. Long-term product lifecycles demand that critical engineering knowledge is available regardless of personnel changes or corporate restructures. Similarly, testing, diagnostic and repair capabilities are maintained. The PLM program ensures that such knowledge, protocols and capabilities are available throughout the lifecycle of any program.



## Program Management

Every customer program is assigned an Abaco program manager – a highly qualified, experienced, knowledgeable individual charged with ensuring the success of the program. The program manager's responsibilities include:

- > Fully understanding the detailed program requirements
- > Acting as the voice of the customer to every part of the Abaco organization
- > Identifying potential risks and mitigating or eliminating them
- > Coordinating the necessary Abaco resources to ensure program success
- > The planning and execution of each phase of the program, from development to deployment – and beyond
- > Managing the program schedule, ensuring the achievement of agreed milestones



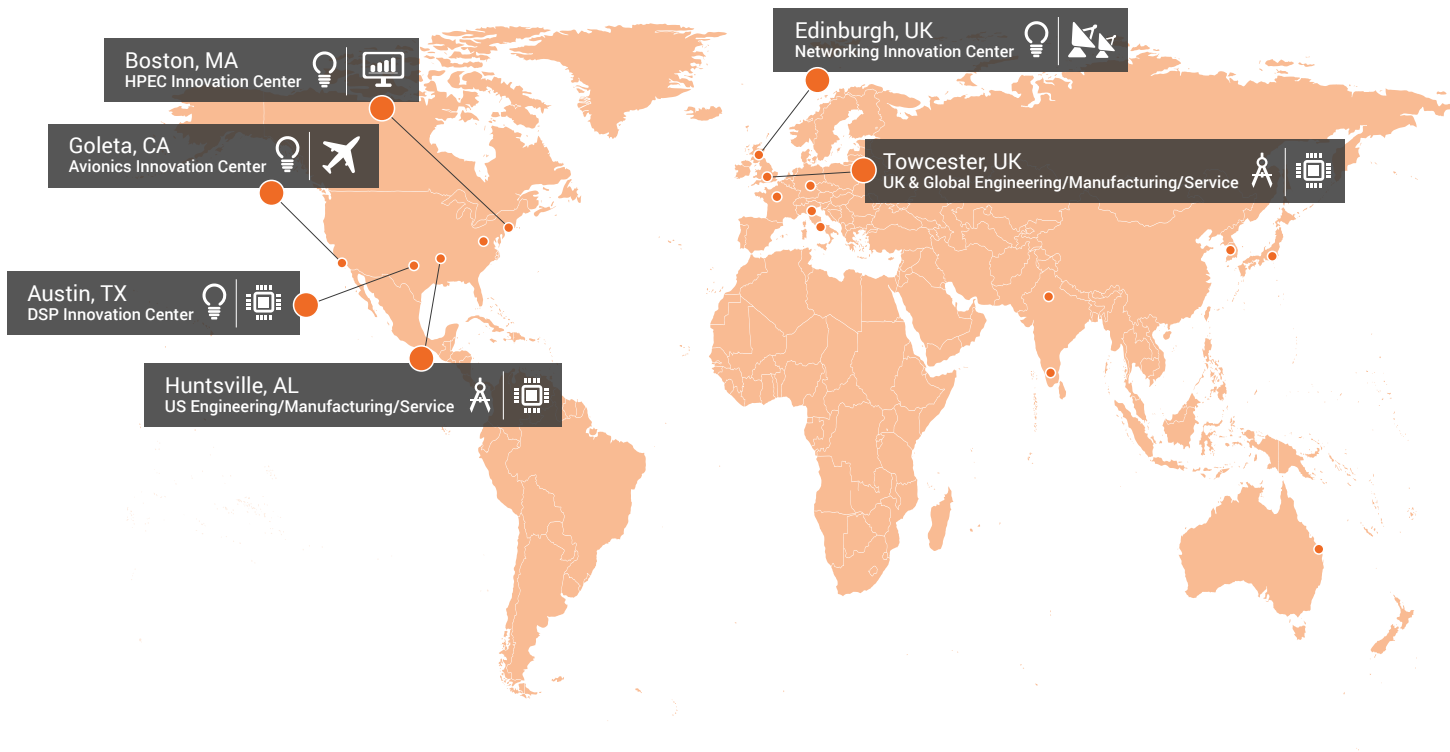
## Support: The Abaco Advantage

- > Unrivaled expertise in support of multi-decade program deployments
- > Tailored to specific customer needs
- > Makes significant contribution to lower lifetime cost-of-ownership
- > Range of support strategies help reduce risk





# Global coverage



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