

# VITA TECHNOLOGIES

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FALL/WINTER 2016 | VOLUME 34 | NUMBER 2



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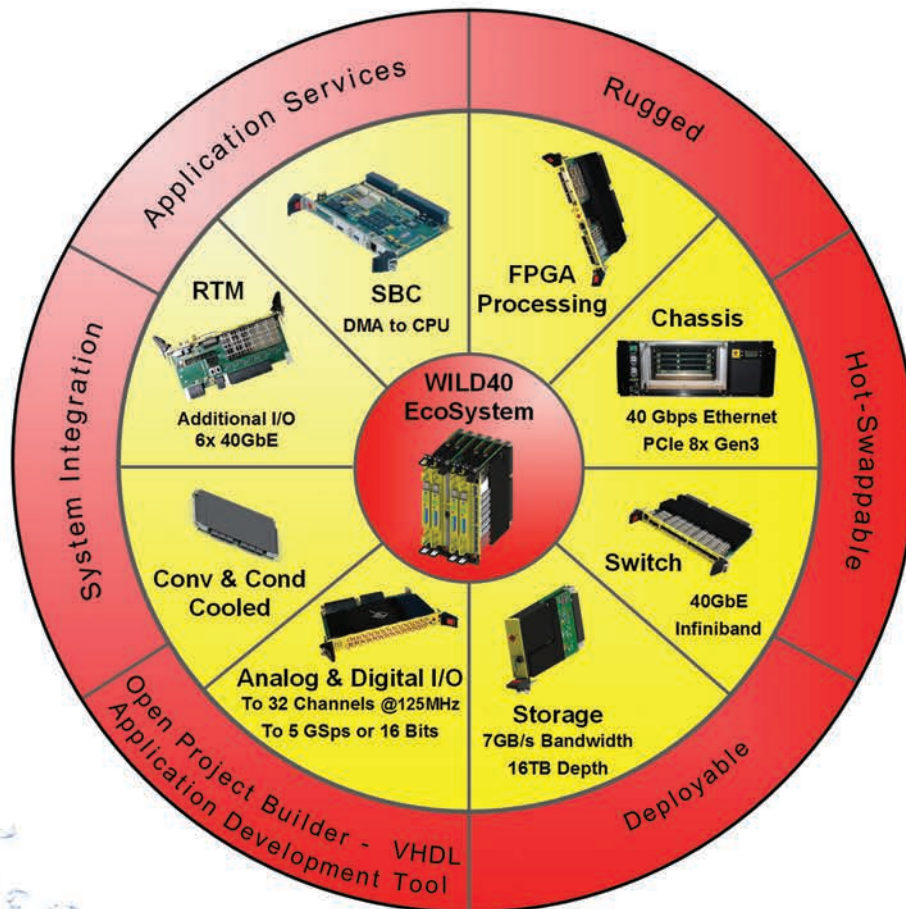
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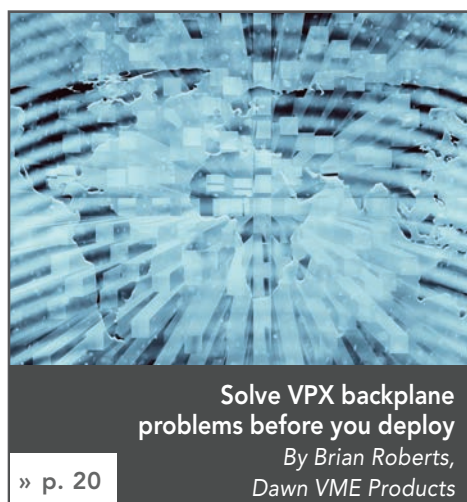
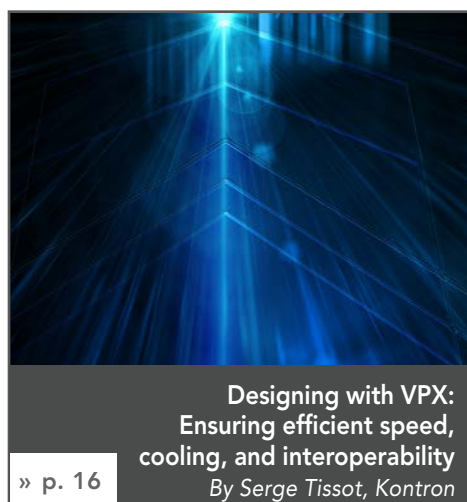
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## On the cover

This Fall/Winter issue of *VITA Technologies* highlights industry trends anticipated next year, as well as VPX design considerations, and features the 2017 Buyer's Guide, showcasing products such as the WILDSTAR UltraKVP DRAM & SRAM for OpenVPX 3U from Annapolis Micro Systems and the Rugged ATR Chassis and Backplanes from Atrenne Integrated Solutions.

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## Editor's Foreword

By Jerry Gipper, Editorial Director



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# Rally 'round technology roadmaps

Technology roadmaps are a key necessity in the industry. They are an important tool to help set the course of direction through the entire technology supply chain, highlighting performance goals and feature enhancements. Product suppliers use them to give a broad-to-specific direction for future product development. Their customers like to see them so that they can better develop their own level of a product roadmap or program rollout. The guidance they provide helps establish which features can be expected and when they might be introduced.

Trade associations and standards development organizations use roadmaps to show the expected direction that their responsible technology is headed. Roadmaps serve as a rallying point for members to focus their future standards' work and marketing programs. They help users navigate through complicated strategies for product evolution and migration. They set expectations for when certain standards might appear.

Roadmaps are multi-level within a technology and the supply chain, with detail building at each level and the inputs from one level feeding the next. If a roadmap is insufficient or missing at any level, then alternate solutions can be explored to fill gaps.

In the *VITA Technologies* market space, the roadmaps today are primarily driven by serial transfer protocols, which then feed into connector supplier roadmaps. VITA is particularly interested in the roadmaps of Ethernet, RapidIO, PCI Express, InfiniBand, and other serial fabric protocols. Because these are the foundation to many of the recent standards such as VPX and FMC, their direction is critical to the next milestones on the VITA technology roadmaps (see Figure 1).

But before the serial protocols can be incorporated into the VITA technology roadmaps, the transfer speeds must be supported on the roadmaps of VITA technology transceiver and connector suppliers. They must be comfortable with which transfer rates can be supported by their connector technology. The decisions connector suppliers make greatly influence which standards' work might be needed to support the performance goals and criteria of the technology roadmap. Will existing connectors be usable with tighter design parameters? Will new connector styles be needed? The obvious goal is to remain as backwards compatible as possible, but sometimes a major reset is required. The significance of this can have a huge impact on market direction.

Additional forces come into play; cost, availability, market goals, and strategies all influence what might appear at the next level of a roadmap.

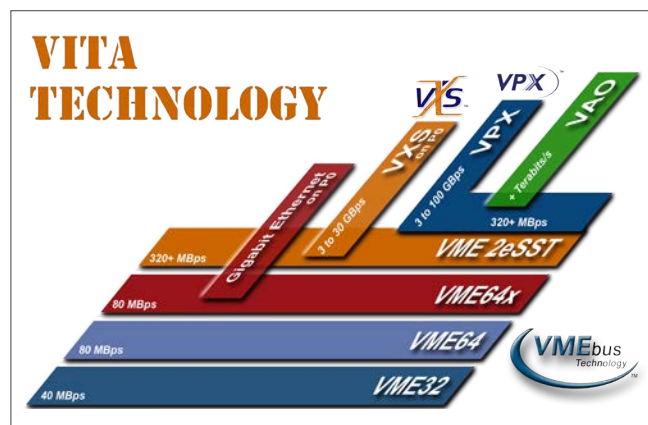


Figure 1 | VITA technology roadmap

The VITA Standards Organization (VSO), the standards development arm of VITA, is currently undergoing a review and update of key technology roadmaps. A study group has been formed to define and present priorities. The group is collecting input, formulating updates to existing roadmaps, and evaluating the need for additional roadmaps. I am anxiously awaiting the results and work product from the study group, hopefully by early 2017. If you are interested in participating, please give me a shout.

The 2017 edition of Embedded Tech Trends is being held in New Orleans January 23 and 24. Embedded Tech Trends is an industry-wide forum where suppliers of component-, board-, and system-level solutions can meet exclusively with members of relevant industry media to discuss technologies, trends, and products.

The theme for 2017 is "The Voodoo Behind Critical and Embedded Systems." The focus and emphasis will be on the magic behind the technology and solutions developed for high-performance computing. The agenda will be filled with market and technology presentations from recognized industry thought leaders. For more information, visit the Embedded Tech Trends website at [www.embeddedtechtrends.com](http://www.embeddedtechtrends.com).

Just before Labor Day weekend, I got word that my dear friend Joe Pavlat had passed away. Joe and I worked together for several years while at Motorola. He was the president of PICMG since its inception. We shared a passion for technology, enjoying the all too infrequent chance to exchange thoughts and stories. Joe was a respected voice for our industry and will be missed. Enjoy you new "wings," Joe.





## VITA Standards Organization activity updates

The September VITA Standards Organization (VSO) meeting was held in Germantown, Maryland, and hosted by DRS Technologies. This update is based on the results of that meeting. Contact VITA if you are interested in participating in any of these working groups. Visit the VITA website ([www.vita.com](http://www.vita.com)) for details on upcoming VSO meetings.

### ANSI accreditation

Accredited as an American National Standards Institute (ANSI) developer and a submitter of Industry Trade Agreements to the IEC, the VSO provides its members with the ability to develop and promote open technology standards. The VSO meets every two months to address embedded bus and board industry standards issues.

### VSO study and working group activities

Standards within the VSO may be initiated through the formation of a study group and developed by a working group. A study group requires the sponsorship of one VITA member, and a working group requires sponsorship of at least three VITA members.

### Work in progress

Several working groups have current project work underway; the following roundup summarizes those projects.

#### ANSI/VITA 42.0: XMC Switched Mezzanine Card Base Specification

**Objective:** This standard defines a PMC form factor with open-standard switch fabric interconnects.

**Status:** ANSI/VITA 42-2016 XMC Standard has been ratified by ANSI. The standard is available for download by VITA members and is posted at the VITA Store for purchase by the public. The update added the concept of using the preferred Paste-On-Pad (POP) connector.

#### ANSI/VITA 46.9: VPX: PMC/XMC Rear I/O Fabric Signal Mapping on 3U and 6U VPX Modules

**Objective:** This standard defines PMC or XMC mezzanine rear I/O pin mappings to VITA 46.0 plug-in module backplane connectors.

**Status:** Various updates and additions have been proposed for anticipated use in VPX profiles. The working group is currently reviewing comments from the first round of balloting.

#### ANSI/VITA 47: Environments, Design and Construction, Safety, and Quality for Plug-in Units

**Objective:** Supplying vendors' certification of COTS plug-in units to this standard will facilitate the cost-effective integration of these items into larger systems.

**Status:** ANSI/VITA 47-2005 (R2007) has been opened up for revision to improve interoperability, create less reliance on individual supplier ruggedization guidelines, and make sure environments are concurrent with recent VPX updates. The working group is actively scheduling meetings and working on revisions. Participation is encouraged.

#### VITA 48.4: VPX REDI: Mechanical Specification Using Liquid Flow Through (LFT) Applied to VPX

**Objective:** This standard will establish the mechanical design requirements for an LFT-cooled electronic VPX module.

**Status:** The working group has completed vibration testing and review of the results. Additional cases for testing have been identified. A draft version of the standard is under development. The goal is to have testing complete and a draft standard ready for review by the end of the year.

#### VITA 48.8: VPX REDI: Mechanical Standard for 3U, 6U Air Flow Through (AFT) Cooling

**Objective:** This standard will develop an AFT standard using VPX connectors without the need for retainers and uses jackscrews instead of levers.

**Status:** The draft of the standard has been reviewed by the working group. The document is being prepared for ANSI balloting, and is in the final step. Anyone interested in participating in this open public ballot should contact VITA.

#### VITA 49.2: VITA Radio Transport (VRT) Control Packet Rules

**Objective:** The VRT standard defines a transport-layer protocol designed to promote interoperability between radio frequency receivers and signal processing equipment in a wide range of applications. The VRT protocol provides a variety of formatting options allowing the transport layer to be optimized for each application. The VITA 49.2 standard specifies the rules governing control packets.

**Status:** The working group has developed a draft document for review and discussion. Interested parties are invited to join the working group.

#### VITA 57.4: FMC+

**Objective:** The goal of this project is to develop a next-generation specification calling for a new set of connectors to support higher-speed serial interfaces.

**Status:** The working group ballot has been complete, and comments are under review before the document will be submitted to public ANSI ballot. A new study group has been formed, VITA 57.5 Physical Tools to Aid in FMC+ Development, to define a set of development tools. Interested parties are invited to join this study group.

#### ANSI/VITA 62: Modular Power Supply

**Objective:** This standard provides requirements for building a power supply module that can be used to power a VPX chassis. The module will fit within

the standard envelope defined for VPX modules in the VITA 48.0 standards.

**Status:** ANSI/VITA 62-2016 Modular Power Supply Standard has been ratified by ANSI. The standard is available for download by VITA members and is posted at the VITA Store for purchase by the general public.

#### **ANSI/VITA 65: OpenVPX Architectural Framework for VPX**

**Objective:** The OpenVPX architectural framework specification is a living document that is being updated continuously with new profile information and corrections.

**Status:** The working group is reviewing clocking, keying, and nomenclature proposals for the next release.

#### **VITA 67.3: VPX: Coaxial Interconnect, 6U, Four Position SMPM Configuration**

**Objective:** This specification details the configuration and interconnect within the structure of VITA 67.0, enabling a 6U VPX interface containing multi-position blind mate analog connectors with up to four SMPM contacts.

**Status:** The first working group ballot was completed and comments addressed. A second ballot is being prepared.

#### **VITA 68.2: VPX: Compliance Channel**

**Objective:** This standard defines a VPX compliance channel including common backplane performance criteria required to support multiple fabric types across a range of defined baud rates. This allows backplane developers to design a backplane that supports required Bit Error Rates (BER) for multiple fabric types. This also allows module developers to design plug-in modules that are interoperable with other modules when used with a compliant backplane.

**Status:** The working group is updating the draft of this standard.

#### **VITA 74: VNX**

**Objective:** VNX describes a rugged small form factor subsystem intended to be rugged for deployed environments.

**Status:** The working group has started several activities to complete the work necessary to take this specification to ANSI accredited status. Several additional dot specifications have been introduced to expand the capability of VNX. Interested parties are invited to join the working group.

#### **VITA 78.1: SpaceVPX Lite Systems**

**Objective:** This document leverages the work done on ANSI/VITA 78 to create a specification with an emphasis on 3U module implementations. The most significant change from SpaceVPX is to shift the distribution of utility signals from the SpaceUM to the System Controller to allow a radial distribution of supply power to up to eight payload modules.

**Status:** The working group has developed a draft document of the specification that is currently under review.

#### **VITA 84: Hardware Open System Technology (HOST) Study Group**

**Objective:** This is a newly formed study group with the vision of creating a hardware technical reference framework for developing embedded computing systems through successful development of an overarching HOST strategy to maximize platform and system "openness," modularity, interoperability, scalability, sustainability, and reuse.

**Status:** The study group was kicked off in February by NAVAIR. The first public release of the HOST draft specification is awaiting approval.

Copies of all standards reaching ANSI recognition are available from the VITA website. For a more complete list of VITA standards and their status, go to [www.vita.com/Standards](http://www.vita.com/Standards).

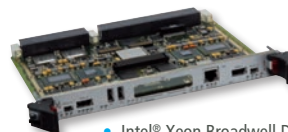
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## Leveraging VPX experience aids development of secure, rugged rackmount servers

Few companies in the business of manufacturing boards and systems using VITA technology exclusively develop products based on that technology. They also develop products in other form factors, depending on their market focus and the needs of their customers. Successful suppliers leverage the same core technology into various form factors in a way that minimizes the amount of development work and maximizes the reuse of their own core competencies.

Mercury Systems demonstrated this practice recently with the announcement of an ATX-class server (Figure 1) based on relevant technology from the company's VPX product lines. When I first saw this press release, I was not sure

what it might have to do with VITA technologies. But after a conversation with Shaun McQuaid, Mercury's Director of Product Management, and Rich Jaenicke, Director of Market Development and Strategic Alliances, about the sensors-to-servers strategy that drives Mercury Systems product development, I understood what an ATX form factor server had in common with VPX.

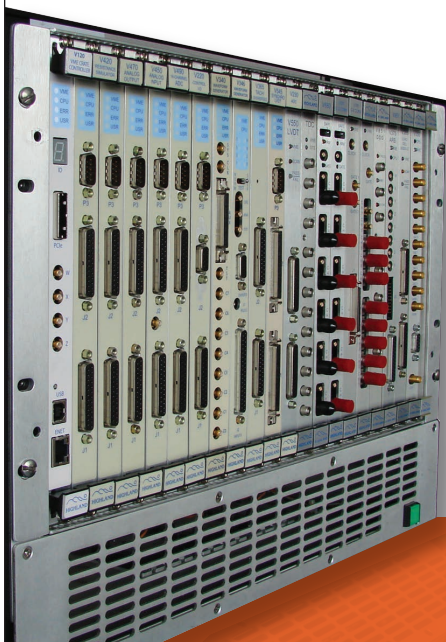
First was the common market focus. Mercury Systems is well known for its computing systems used in high-performance processing and sensor data collection for a wide variety of defense platforms. The ATX-class servers are designed for mission processing, sensor processing, and cybersecurity applications, addressing

the defense market's need for affordable and trusted solutions for mission-critical functions. Being a motherboard-based architecture, ATX is inherently lower in cost, which helps meet the budget constraints of many programs.

Second is security. Mercury secure servers are designed and made in the United States, using trusted devices from managed supply chains by U.S.-based employees working in domestic secure facilities. Not only must the hardware and software be sure, but also the whole supply chain must be impervious to security breaches.

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**Figure 1** | Mercury Systems Secure Rackmount Server.

class processors provide a secure software environment. An open-architecture middleware framework enables customers to easily port their applications to hardware. Configuration options include pre-integrated secure hypervisors and solid-state drive (SSD) storage, third-party component hardening, and commercial or rugged packaging configurations.

The third area of commonality is with technology reuse of designs for cooling and rugged packaging from chips to enclosures. Mercury Systems spends a lot of development energy on cooling strategies and design elements for rugged operating environments. The

experience gained for VPX can be leveraged by ATX-class servers.

"Mercury's secure servers are made from devices sourced from trusted supply chains, and the servers themselves have extended service lives and greater levels of ruggedness for military applications," McQuaid said. "These servers have extensible security and reliable ruggedness built right into them."

The servers support the DoD's 5200.44 directive, enabling the protection of mission-critical functions to achieve trusted systems and networks. Additionally, the servers are manufactured using commercial-off-the-shelf (COTS) processors, memory, and peripherals, preserving commodity affordability while incorporating design and packaging that meet DoD customers' security and ruggedness requirements.

Mercury's proven third generation of secure building blocks is trusted to protect the most sensitive customer program information. These building blocks comprise an adaptable security platform

that provides the foundation for customer personalization and innovation. The extensible nature of this security approach enables these secure servers to be easily upgraded with the latest technology advancements for built-in future proofing. Mercury continuously updates countermeasures to offset emerging threats and makes these available to customers via firmware updates.

"These open systems architecture (OSA) secure servers are application-ready and especially appropriate for technology refreshes," McQuaid said. "This creates an extremely low-risk adoption proposition for new or refreshed applications requiring robust system integrity. The servers can be seamlessly dropped into existing infrastructures as secure and trusted replacements for commercial servers with the same QPI/SMP processing capabilities – there are no processing compromises."

The ATX-class servers fit well into the Mercury Systems STAR strategy of secure, trusted, affordable, and rugged computing elements.

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2017

## Business barometer: 2017 trend predictions

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By Jerry Gipper

*Trend predictions during an election year are extremely challenging, especially in the circus election that is going on in the United States right now. By the time you read this, it will all be over, and there is a good chance that I may be headed to Australia for a few years! Here goes my attempt to share a few highlights for what developments I expect to unfold in the market next year.*

### Global defense spending on the increase

U.S. military spending the past 2-3 years has been relatively stable, as I have previously stated. But that was before anyone could have imagined the presidential candidates that have emerged from the U.S. election process.

I don't foresee any major shift in strategies or spending. It is difficult to predict what either U.S. presidential candidate might do to the budget. Either one could go either direction from what I can see from my perspective.

Global spending on defense is where the action is right now. The unrest in the Middle East paired with global power positioning by China, Russia, and the United States are keeping the cash flowing for defense spending around the world.

Technology will be focused on intelligence systems, drones, and autonomous weapon systems.

### Optical interconnect baby steps

The initial family of the VITA 66 standard for optical interconnection with VPX is now published. For now, the VPX community is satisfied with the options they have for optical interconnects with VITA 66, but they also realize that more is needed. Presentations on anything optical related at a VSO meeting always gets a good

crowd. The discussions about the next steps are still a whisper, but they are getting louder and more frequent.

You can see the innovation wheel slowly starting to turn in this area.

### Mezzanines blade performance

The standard for FMC+ is taking a bit longer to complete than expected; however, the work done has added substantially to the quality of the standard. The list of participating companies has grown significantly with major FPGA and user companies stepping up to join the effort. The performance improvements are pushing advancements in other areas, such as VPX. The FMC+ standard should be published early in 2017.

### High-end embedded processors

As expected, 2016 was full of product announcements using various 6th Generation Intel Core processors. SBC designers are getting more creative with cooling alternatives on small 3U and 6U form factors, now implementing several variations of Intel Xeon class processors that use 85+ W of power. Just when you think they can't pull any more heat out of a slot, they figure out something new. Several cooling schemes are now being implemented with VPX: air, conduction, air flow-through, and air flow-by. Liquid cooling is bantered about, but has not been practically implemented in many systems – yet.

More and more is being discussed concerning the limitations of the traditional von Neumann processors architecture. The bottlenecks to memory and I/O are becoming extremely difficult to overcome. Many system-level architectures are now incorporating FPGAs in the data stream so that processing can be taken to the data. For many types of applications, this is a preferred way to increase performance. Make note of the fact that Intel bought Altera, foreshadowing what we might expect in the near future.

Some of the leading contenders to the von Neumann architecture are various takes on neural networking based on threshold logic algorithms that take us away from binary states. Complex data-like images can be processed much faster with neural nets. It may not be long before this type of architecture lands in your smartphone.

Quantum computing exploits the bizarre and counterintuitive way that matter behaves at an atomic level to perform some amazingly fast processing. First-generation quantum processors are in action now. Quantum computing is especially interesting in the search for more secure computing due to the ability of quantum computers to factor very large numbers that support very challenging encryption algorithms. The more practical implementation of quantum computers will be in searching

and mining the massive amounts of data that we are collecting each day.

All this indicates a quickly approaching inflection point that is going to put past thinking about processors on its ear.

### Semiconductor supplier mergers

Mergers are reshaping the semiconductor supplier industry, having potential impact on high-end embedded processor roadmaps. NXP being courted by Qualcomm will likely throw yet another curve at PowerPC.

In July, Japanese Internet and telecommunications conglomerate SoftBank Group Corp. announced it was buying ARM Holdings PLC. While the plan of record is to continue the current course, we all know how that story tends to play out. I remain bullish on ARM-based processors as an emerging major player in the critical embedded computing markets, but the lower-end Internet of Things (IoT) markets have control of the roadmap. My biggest concern is what effect this activity is going to have on processor innovation. It makes me take a second look at some of the more out-there options like Quantum processors.

### Local manufacturing

Ten to 15 years ago it was trendy to move manufacturing to Asia as board suppliers looked for ways to reduce costs. Before the last pick-and-place machine was even positioned, this strategy started to fall apart. Labor costs in Asia started creeping up. Product development times doubled and even tripled in many cases. Product quality suffered. In the meantime, we were losing U.S. expertise in manufacturing while the labor pooled realigned to the reduced demand for manufacturing expertise.

Now we are in a situation where many companies are looking to bring back local manufacturing. Cost is much less of a factor, and security concerns have moved to the forefront. This is going to take a long time to sort out despite what Donald Trump suggests.


Fortunately, many smaller board suppliers kept their manufacturing home-based, making them well positioned for the reverse in the outsourcing trend.

### Security

With military applications driving so much of the market for VITA technology, the urgency to address the issue of security has risen. Security touches the entire supply chain, forcing new decisions on suppliers, manufacturing strategies, and even the way products are being developed.

While it may not be as easy to take down the power grid of a country as it is portrayed on TV, it does make you start to wonder. With everything being connected through the IoT, you can never assume that a device will be 100 percent secure.

### Summary

2017 is sure to be full of surprises. The world is very complicated and becoming well-connected, making the rate of change increase faster with each passing year. Meanwhile, I'm shopping for property in Australia! 

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# BUSINESS ECOSYSTEM

## Continuous innovation harnessed via VPX ecosystem

By Jerry Gipper

*I am often approached by individuals and companies that are new to the world of VPX. One of the first questions they ask is, "What does the business ecosystem look like for VPX technology?" My first response is that it is a collection of suppliers and users with VPX as a common interest. But usually the question begs more detail; who the players are and what role they fulfill are foremost among the critical points. VITA has recently formed a study group to develop a map of the VPX ecosystem. This article takes a closer look at the VPX ecosystem and its benefits.*

### What is a business ecosystem?

A business ecosystem is a strategic planning concept originated by James F. Moore. In his book, *Leadership & Strategy in the Age of Business Ecosystems*, Moore defined this concept:

An economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organizations also include suppliers, lead producers (users), competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments and to find mutually supportive roles.

An ecosystem can harness innovation across a large number of diverse organizations, allowing progress to be made in a situation that is very difficult to manage except for the largest of organizations. Participants find it easier to develop solutions for which customers are willing to pay, have shorter time to cash, and have lower development cost.

The energy within an ecosystem leads to continuous innovation that is extremely important to technology leadership. Members with varying areas of specialization can work together to create well-developed solutions.

### Ecosystem types

Ecosystems are usually anchored around one of these types:

- **Single company:** A single company drives the spectrum of activity.
- **Consortia:** A trade association or consortia with suppliers and users share a common goal to develop a market.

Variations are developed depending on the goals and needs of the initiative. In the case of the VPX ecosystem, it is primarily driven by a trade association, in this case, VITA. While membership is not a rigid requirement to participate in the ecosystem, there are many advantages as highlighted in the sidebar "Working together to create mutual benefits." Members can help create and obtain access to an ecosystem of companies focused on a common goal of developing, promoting, and aiding adoption of VPX technology. They can benefit from VITA's liaison with

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THE ENERGY WITHIN  
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other organizations currently working on and promoting complimentary technology. Members can reduce development and technical support costs for new product developments by participating in the ecosystem with other members. Members often can network and partner with other members to create platforms that demonstrate comprehensive industry-leading solutions.

VITA plays multiple roles in the VPX ecosystem. First and foremost, VITA is a standards development organization (SDO) concentrating on establishing well-defined and structured standards that are properly vetted and administered. Accreditation through ANSI adds an additional level of credibility to the quality of the standards development process.

Second, VITA provides a venue for the VPX Marketing Alliance that is primarily focused on marketing activities for the VPX ecosystem. The marketing activities are separate from the VITA membership so that non-VITA members may participate in specific activities.

#### **Burning issues for the VPX ecosystem**

##### **Interoperability**

Interoperability is considered crucial because it constitutes a basic benefit of having a standard in the first place. This is one of the most common issues for VPX and has even led to the development of the VITA 80 working group dedicated to developing methods for testing interoperability among VPX modules.

##### **Awareness**

Awareness is a primary goal of the VPX Marketing Alliance. Educating the target audience to make them aware of the

VPX technology is an ongoing process. Trade shows, conferences, seminars, webcasts, publications such as *VITA Technologies*, and grassroots efforts are the most common tools for creating awareness. Events like Embedded Tech Trends provide a forum for networking among sponsors, industry media, and key players in the VPX ecosystem.

#### **Innovation**

Innovation drives new growth, pulls in new members, and helps create awareness. Coming up with innovation is a challenge. Innovation that is relevant and useful to the VPX industry is difficult but critical to success.

#### **VPX ecosystem map**

A visual representation of how an ecosystem works to create value can be helpful in understanding the operation and fabric of that ecosystem. The view you have of the ecosystem depends on your position within the ecosystem. A business ecosystem map can be drawn to reflect your vantage point. The key elements remain the same but can be termed and positioned differently based on your vantage point. Many types

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## Working together to create mutual benefits

The “strength in numbers” philosophy applies to the VPX ecosystem in terms of the collective power derived from multiple members working together to innovate and grow the market. Having a trade association, VITA, involved in the VPX ecosystems leads to several specific benefits to the members:

- Access to specifications and standards and participation in their development is available to members. Members can play several roles in the development of future specifications and standards – very active and influential to passive observation or something in between. Membership lets participants choose the role most appropriate.
- Early adoption of new and emerging technologies can be fueled through sponsorship by and endorsement from industry organizations. An organization backing a technology brings credibility individual members may lack. Members’ participation in the development of early marketing messages helps strengthen and foster ownership of them. VITA involvement gives members the chance to influence the marketing message before it goes public.
- Sound engineering practices are reflected in the collective work of the teams developing specifications and standards. Multiple sources can review the work, influence changes, and improve the quality of the finished standards product. Subject matter experts that may not have been available to individual members can be used collectively. In the end, the finished product reflects the best work of the industry technology experts.
- Market risks are reduced because multiple members are testing the waters and sharing the risk. The number of members usually increases after a successful introduction. Designers and managers can often judge the success of a technology by the size and constituents of the membership roster and how those members introduce products using the technology. Nonparticipants risk missing out on market share attained by members working together.
- Decreased development time and cost can be gained from the knowledge learned in participation as a specification or standard is developed and finalized. Direct access to industry experts can provide insight that reduces experimentation and trial and error compared to development done individually. Often, intellectual property becomes available to help design and development proceed on a larger scale.
- Branding and awareness drive broader adoption of a new technology. VITA helps create and support the perception of momentum, highlighting proof points of usage and floating new application ideas. This is often difficult to accomplish as a small or individual company working alone and takes large amounts of financial resources or many voices. The collective voices of VITA members can generate more awareness faster.
- Decreased trading costs and lowered trade barriers can be gained when standards are developed in a community, especially considering the increased pressure to license technology fairly to members. VITA has an *ex ante* patent policy that protects users of the VITA standard from later patent ambushes. The trading costs and barriers are also lowered when technology is more widely used. The increased unit volumes and market acceptance drive down the cost models.
- Increased product quality and safety is secured from the extensive vetting process that occurs when several companies are developing with the same technology and sharing results through technical committees. These committees can make changes to the specifications or standards that will improve the quality, safety, and other aspects of the technology.
- Protection against obsolescence is provided when many members participate and the market reaches critical mass. Strong incentives help retain existing users of the technology and give them a technology roadmap that will ensure members’ success. As standards are developed and ratified, the likelihood for changes to instantly make a product obsolete decreases.

In general, the advantages of participation in VITA outweigh the disadvantages. Sometimes announcing membership can signal advance intentions a company might not be ready to share publicly. Shrewd use of membership can be played in multiple ways to help create confusion among competitors, and if not played well can give the impression a company is struggling with their strategic direction. Participation requires application of resources, mostly in membership fees and time of key personnel. Larger companies are often involved in many consortia to stay “in the loop,” but strategically work with a core set. Good participation forms the perception of a company being an industry thought leader.



of maps exist, each with its own unique perspective of the ecosystem.

Figure 1 illustrates a value-add view of the VPX ecosystem. It starts with the suppliers at the base. Suppliers can be roughly broken into connectors, modules, and systems. Connectors seem to be the root of all VPX technology so the map starts there. The list of module and systems suppliers is long and growing. Modules are the basic building blocks of a VPX product. They include: backplanes, chassis, power supplies, processing modules, I/O modules, memory subsystems, and more. System suppliers build operational systems from the modules. A single company often provides both modules and systems. Others focus on very specific module technology and supply those up the value-add chain.

### Integrators

Level 1 integrators are distinguished from system suppliers by the fact that they can also add software and other technology outside of the scope of VPX. These are fully functional systems that can be delivered to users.

### Users/Integrators


Level 2 comprises the end user or a super integrator that takes products from the lower levels and adds application software for the end user. Prime contractors like Boeing and Lockheed are great examples of super or Level 2 integrators.

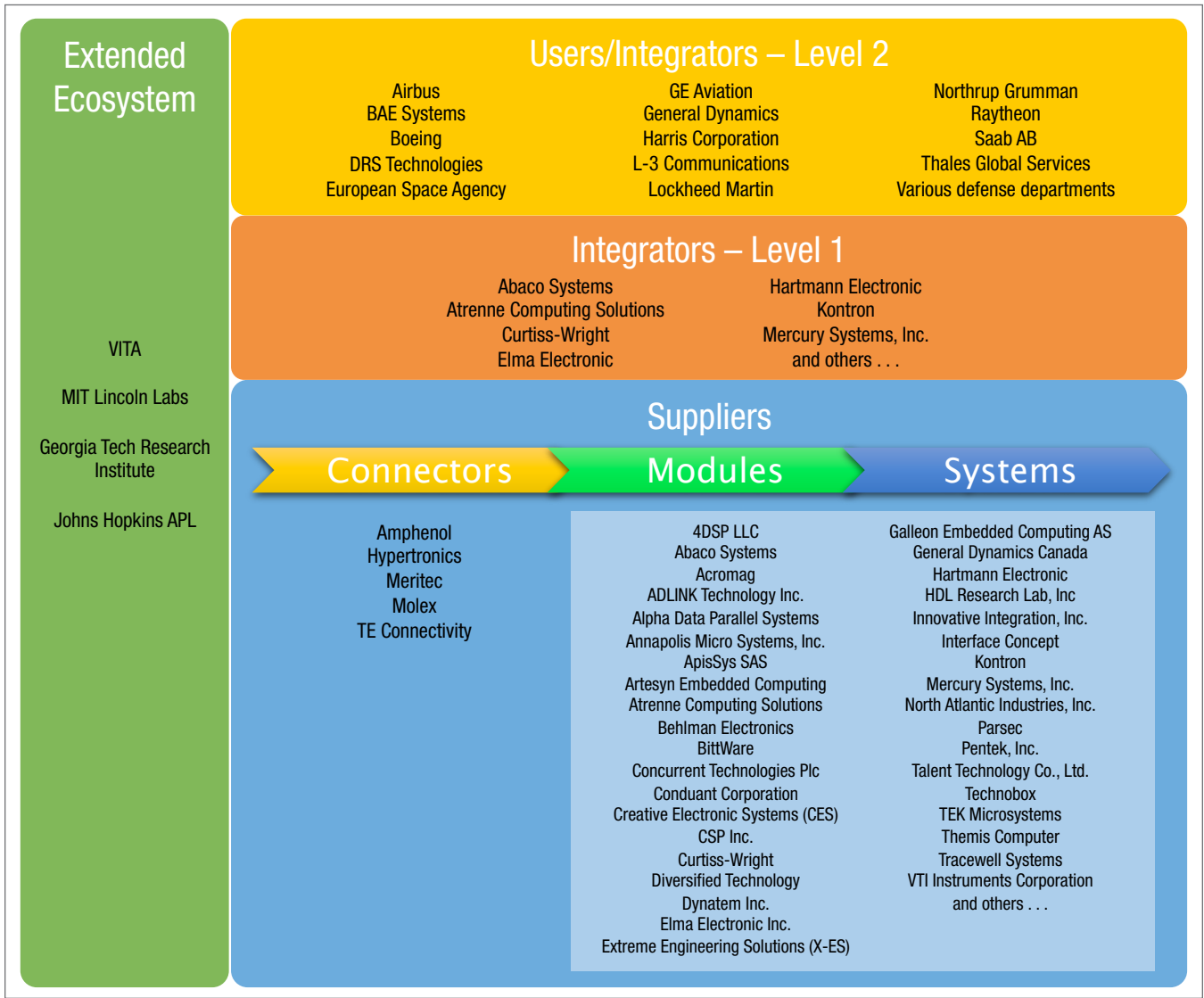
The extended ecosystem encompasses the value add from trade associations, think tanks, and other key contributors to the VPX ecosystem. The value

provided here is very diverse but key to the success of the ecosystem. Their contributions have added immensely to the standards development and promotional activities of the VPX ecosystem.

### Measuring success

VITA has recently formed a study group to develop a series of maps and charts of the VPX ecosystem. Inputs are being gathered from members and the industry to support the VPX ecosystem. Be sure to visit [www.vita.com/VPX](http://www.vita.com/VPX) for additional information on the VPX ecosystem.

An ecosystem can declare itself successful when companies can produce outcomes and attract more resources with the ecosystem than without it. The VPX ecosystem is a clear winner by that statement. 



 **Figure 1** | Value-add view of the VPX ecosystem.

# Designing with VPX: Ensuring efficient speed, cooling, and interoperability

By Serge Tissot

*Of the two VPX mechanical form factors, 3U is very popular in certain applications, and 6U is sometimes necessary to build highly parallel systems with optimal computing density. While air and conduction cooling are often implemented to address cooling challenges, liquid cooling solutions can be effective for designs at the chassis, board, and chip levels. Today's designs must be standardized for VPX to maintain interoperability and availability of common building blocks, and to ensure the success of this modular architecture now and in the future.*

Modular computing architectures have been used for awhile, starting with the popular VMEbus for embedded systems in the early 1980s. A modular approach in system design provides great flexibility in computer sizing and helps meet harsh environmental constraints. VMEbus is still successful and viable today due to its large installed base, and the VPX successor architecture is now the *de facto* standard for high-speed interconnects backplanes, especially for harsh environments.

## **A high-speed board interconnect standard**

VPX is a high-speed board interconnect standard that defines modular computers based on interoperable building blocks.

In the development of next-generation applications, the VPX architecture is particularly useful in helping achieve parallel computing with multiple processing cards and designing redundant architecture for critical applications. The standard also facilitates the implementation of a large number of I/O when necessary. It provides a unified, standards-based means to promote interoperability among multiple vendors.

VPX is mainly governed by ANSI/VITA 46.0, defining the baseline for mechanical, power, and utilities infrastructure. The substandards VITA 46.x serve to establish implementation rules for the different high-speed protocols. In addition, OpenVPX (ANSI/VITA 65) is

dedicated to interconnect topologies over the backplane and pin assignment profiles for the high-speed links.

Among all the proposed high-speed protocols, some embedded computing suppliers such as Kontron have elected to use VPX as a board-to-board interconnect and concentrate on the popular Ethernet and PCI Express (PCIe) protocols. These protocols benefit from a large hardware and software ecosystem, ensuring the effectiveness of the system architecture as well as performance improvement over time. The current state-of-the-art data transfer rate of these two protocols over VPX are Ethernet 10GBASE-KR running at 10.125 Gbps per channel and PCIe Gen3 running at 8 Gbps.

Kontron has developed a white paper, "High data rates over the VPX infrastructure," which presents how to achieve 10 Gbps rates on a VPX backplane.

Inside the OpenVPX standard, a nomenclature was put in place – the slot profile and the module profile – to easily identify each module's high-speed link configuration/pin assignment. For example, a popular 3U slot profile is SLT3-PAY-2F2U-14.2.3 (Figure 1), meaning the module features two fat pipes (one fat pipe is four lanes = four transmit differential pairs + four receive differential pairs) and two ultra-thin pipes (one ultra-thin pipe is one lane). The module profile – for example, MOD3-PAY-2F2U-16.2.3-11 – identifies that the two fat pipes are running a PCIe Gen3 protocol, and the two ultra-thin pipes are running 10GBASE-KR Ethernet protocol.

An optical interconnect on the rear of the backplane can be used to link one module to another at very high speed, or to link a module to an external I/O connector on the chassis. It is the objective of the recently released ANSI/VITA 66.4 (Optical Interconnect on VPX – Half Width MT Variant) to standardize this connectivity for 3U modules. In this standard, the last eight lanes, normally made of copper, are replaced by an optical connector that can host 12 or 24 fibers. This paves the way for a potential large increase in bandwidth, but the cost of such assemblies is still significant for now and restricts adoption.

### 3U and 6U form factor ecosystems

3U VPX modules represent the VPX form factor with the richest ecosystem of functions, backplanes, and power supplies, with the classical dimensions of 160 mm x 100 mm. This form factor is generally enough to implement most processing functions including CPUs, FPGAs, and GPUs, as well all other required I/O and subsystems such as network, switch, and storage.

However, for larger systems with a high degree of parallelism, it might be impractical to increase the number of slots in 3U to accommodate many modules, as the chassis form factor would be too elongated. Therefore, the VPX 6U form factor is a good alternative

and might also be required when migrating from a legacy chassis configuration, for example, migrating a system based on 6U VMEbus to a newer bus architecture. But the ecosystem of supporting functions in 6U tends to be smaller, sometimes suggesting a mix of 6U and 3U auxiliary functions in the same backplane and chassis. An example of a 6U CPU module featuring two Xeon D subsystems on a single board is presented in Figure 2.

Sometimes, the choice of 6U is also dictated by the area required to implement high-end processing functions with very high power dissipation and a large amount of supporting memories and memory channels. This situation is expected to be more and more frequent in the future because of the natural trend to multiply the number of cores into the processor die, which demands more parallel memory channels to sustain the data throughput to feed all cores. The increase in CPU package size and shift to connect all memories in parallel are leading to a point wherein 3U is no longer practical.

### Cooling challenges

Every couple of years, the power requirements to supply embedded processing functions increase by 10 W or so to continue offering significant gaps in computation



**Figure 1** | The Kontron 3U VPX CPU module, based on the Intel Xeon D processor 8-core architecture, is an example of a module with the SLT3-PAY-2F2U-14.2.3 slot profile.

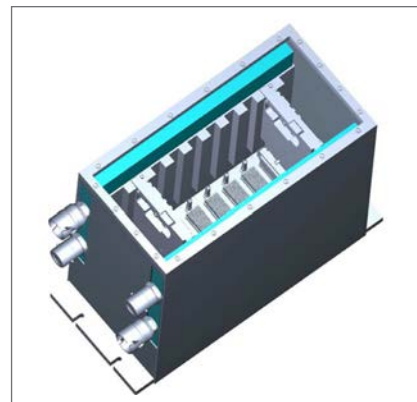


**Figure 2** | A 6U VPX module featuring two Intel Xeon D processor subsystems on a single board.



performance. Ten years ago, for embedded processors with a dual-core capability, 15 W was all that was needed to render a fair calculation performance. Today, high-performance embedded computers have to host quad cores, octo cores, and hexa cores, where they can now typically climb up to 55 W. Strategies to cool these hot spots have made progress, but it is still a challenge to keep higher-power processing functions at a temperature compatible with their maximum operating junction temperature, and also compatible with an acceptable circuit failure rate when operating within the average mission profile temperature.

The primary classical means to evacuate the heat in modular computing architectures such as VPX are through air cooling and conduction cooling of the cards. Air cooling, or convection cooling, has the advantage of simplicity, but suffers from the air's weak ability to transport the heat efficiently, not to mention the problem of dust or contaminants that the airstream could carry from the outside environment.

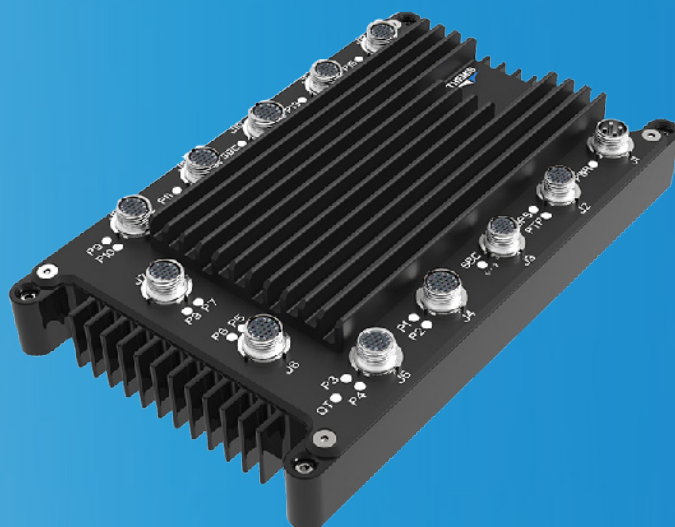


**Figure 3** | The liquid cooling method shown here by the blue bands is circulated through the chassis wall using standard conduction-cooled modules.

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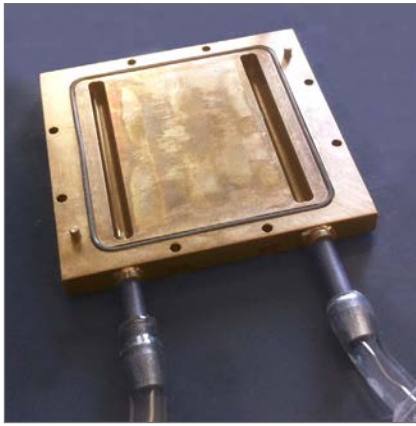
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Conduction cooling, on the other hand, conducts the heat from the hot spots to the edges of the board through a metallic frame by clamping the edges of the board to the chassis card cage. In this arrangement, electronic components typically do not see any contaminant, and the board is mechanically more robust because of the heat frame.

However, there are some drawbacks to conduction cooling. For one, the weight of the module is higher, especially when using high thermal conductivity metals such as copper, and the edge surface to exchange with the chassis is moderate, generally inducing a 5 °C to 10 °C temperature rise at the interface. A last difficulty in such solutions is to get an efficient thermal contact between the hot spot heating surface and the metallic heat frame, due to the possible mechanical dimensional tolerances between the chassis and the board's hot spot(s).

There is an ongoing trend to increase the adoption of liquid-cooled solutions to take advantage of the high capacity of most liquids to transport the heat efficiently. At least three possible options maximize the benefits of liquid cooling in modular computers. Kontron supports all of these options.

Illustrated in Figures 3 and 4, liquid circulation can be used to cool the chassis walls (followed by traditional conduction cooling), to cool the heat frame of the modules per the VITA 48.4 (Liquid Flow Thru Applied to VPX) standard, or to directly cool the hot spots.




**Figure 4** | A direct liquid cooling method can be used for electronic component hot spots. It can be combined with chassis wall liquid cooling for enhanced results.

These solutions offer significant cooling improvements over the traditional air or conduction cooling, but come with the additional burden of generating and controlling liquid circulation. Combining both solutions also makes sense, providing the ability to directly cool the hottest circuits with liquid circulation

infrastructure of VITA 48.4 and removing the heat of other components through the liquid-cooled chassis wall.

While direct liquid cooling seems the most promising of the available solutions in the presence of few but very high dissipative hot spots, it exhibits some technical challenges. For instance, given the effective heat transportation capacity of most liquids, the difficulty is not to ensure the liquid is flowing above the hot spot and carrying the heat, but rather to ensure that the calories on the hot spot heating surface will easily "jump" and "spread" into the liquid. Partnering with research institutes and industrial companies, Kontron is actively working to solve this challenge and release the full potential of liquid cooling for embedded computers.

All major options for electronics, mechanicals, and thermal designs have been standardized for VPX to maintain interoperability and availability of common building blocks. This continues to ensure the success of this modular architecture now and in the future while keeping the game open enough to adapt to new technology evolutions. 

**Serge Tissot** is Principal Architect within the technology platforms team at Kontron. He is in charge of digital security and HPEC platforms, and guides the technical directions for the company in this area. Serge is also involved in the innovation and patent process. At the beginning of his career, Serge developed graphics and central processing hardware at the board level. He holds an engineering degree in Electrical Engineering.



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# Solve VPX backplane problems before you deploy

By Brian Roberts

*The backplane is the backbone of a VPX system, contoured to the final system configuration. It would be extremely valuable for designers to have a way to evaluate the top options in a working configuration before the final backplane was developed. The following discussion presents an interesting case for using backplane overlays to effectively evaluate the best options.*

VPX systems are becoming widely deployed in many platforms using high-performance critical embedded computing systems. The flexibility in VPX system conformance is one of the primary factors driving this success. However, the same flexibility creates challenges for system designers using VPX. The abundance of options means that during the development stages, designers would like the ability to test various configurations to determine the best solution for a particular deployment. For low unit volume platforms, configurability is even more important, and the development configuration often ends up as the deployed system.

VPX (VITA 46) backplanes commonly implement high-speed signal standards such as Ethernet, PCI Express (PCIe), RapidIO, SATA, and SAS. It is important to know that when VPX backplanes use these types of signal paths they require point-to-point connectivity from slot to slot to maintain signal integrity and communication speed.

Connecting multiple plug-in cards, such as CPU processor boards, graphics cards, GPU math processors, and the like via a VPX backplane can be problematic because the nature of the extremely high-frequency signals used means that simple "busing" between multiple card slots no longer works effectively.

High-performance, mission-critical backplanes need more flexibility to meet the wide variations in point-to-point signal connection standards. Fabric mapping modules present an

effective solution with the necessary signal integrity improvements to meet these challenges, and their use allows many application problems to be solved in the design phase.

## From VME to VPX

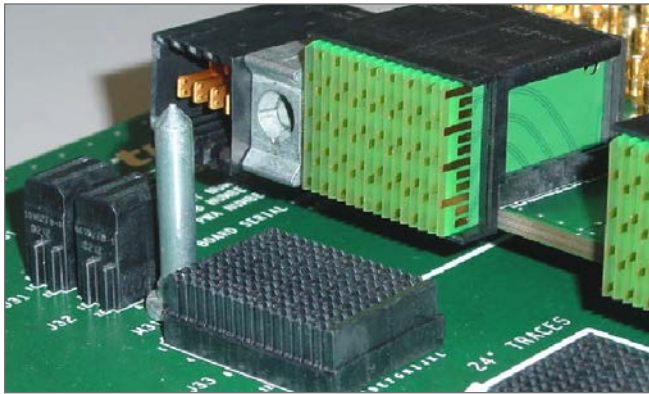
VMEbus systems (the predecessors of VPX) could accommodate parallel data buses. VITA members eventually developed new standards to accommodate switched serial fabrics that use differential signaling at multigigabit speeds. This necessitated a new connector technology. The differential signaling in switched serial fabrics uses pairs of pins that are physically very close to one another and shielded from other signals by ground pins.

The MULTIGIG RT2 from TE Connectivity was developed to meet the design requirements of VITA 46, now known as VPX. Among its most important features are its quad-redundancy in pin connectivity and the potential for electrical customization. Wafers can be manufactured for differential or single-ended signal paths, and impedance, propagation delay, and cross-talk specifications can be altered per customer requirements.

Consider some examples of backplanes that are built to accommodate the VPX connector:

1. A 3U VPX board with two 16-column, 7-row connectors and one 8-column, 7-row connector.
2. A 6U VPX board with six 16-column 7-row connectors and one 8-column, 7-row connector.





**Figure 1** | The MULTIGIG RT2 male and female connector with alignment pin.

VPX boards have alignment keys that also supply a safety grounding contact. The 6U board has three such keys; the 3U has two (Figure 1).

The density of the VPX connector is such that on a 6U board, there are 464 signaling contacts, which can be allocated as follows:

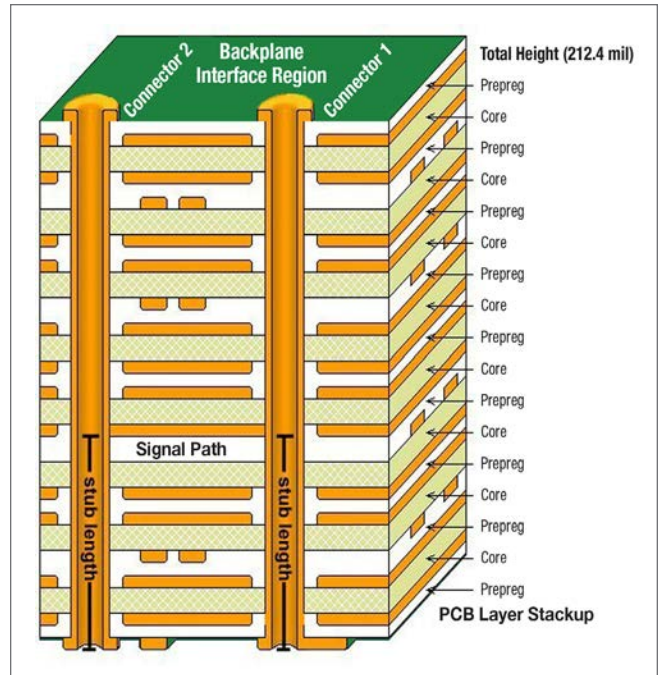
- 384 differential pins that can be implemented as 192 high-speed differential pairs for core fabric.
- 40 single-ended pins for customer I/O.
- 28 for system utilities.

Even with the impressive performance and capabilities of the VPX connector, the impedance variations imposed by it can create challenges when using the standard overlay techniques of circuit board design. PCB boards that support high-speed signal standards such as PCIe, RapidIO, SATA, SAS, and 10 GbE do so by providing point-to-point direct signaling paths to maintain signal integrity. Consequently, multiple plug-in cards on a backplane cannot share a signal path because communication is no longer done via busing between card slots; the differential-pair nature of the connectors keeps that from being an option.

### VPX point-to-point signal standards

The technology of differential-pair transmission is simply the linking of the signal from one transceiver output pair directly to the input of the receiving transceiver by way of two traces that make a 100 ohm transmission line. The VPX connector is made up of small blades, which are actually PC boards in themselves, and continue the 100 ohm transmission line path. The connector's contacts are a leaf-spring type, which is designed in such a way that any stubs or short lengths of the traces are as short as possible to minimize any signal reflection noise (Figure 2).

Any stub that is present on a signal path will at some frequency cause an additional signal wave front that is out of phase, thus causing destructive interference with the original signal transmission. This interference will diminish the signal seen by the receiving transceiver. The design goal is to optimize the path between the transceivers by eliminating stubs and impedance discontinuities. These factors are further enhanced by a serial protocol that implements pre-emphasis and equalization to make the signal transmission as optimal as possible.



**Figure 2** | The typical signal layer placement in a VPX backplane creates problems related to stub length.

Another aspect of VPX backplane design that one must consider is the adjacencies of the plug-in cards that go into the backplane itself. The closer the source and destination VPX cards are to each other, the faster communication links can be between them. That design aspect, along with the difficulties associated with balanced-pair transmission line implementation, explain why VPX backplanes need more flexibility to meet the wide variations in point-to-point signal connection standards. Micro-overlays – small PCBs for signal routing that are external to the backplane itself – can present an effective solution with the necessary signal integrity improvements to meet this challenge of linking the two requirements.

### Using signal mapping micro-overlays

Micro-overlays use ball grid array (BGA) solder connection technology to interface a PCB-based differential pair matrix with compatible backplanes. This reduces transmission line impedance variations and stubs associated with connector-based interfaces by employing the following techniques:

1. Stacked dielectric with alternating etched copper layers implementing signal shield plane and controlled impedance copper etched signal lines.
2. Sub-picosecond matched signal path length.  
The thickness of the dielectric stack-up is tuned for optimal impedance matching to the signal standard requirements. Off-signal path stub lengths are minimized by this overlay connection technique.

These techniques improve the signal integrity between system cards beyond the requirements of PCIe, RapidIO, and Ethernet standards. Additionally, micro-overlays can also facilitate rear transition modules and low-profile connector interface systems when normal rear transition modules do not

fit the system application from a mechanical standpoint (see Figure 3).

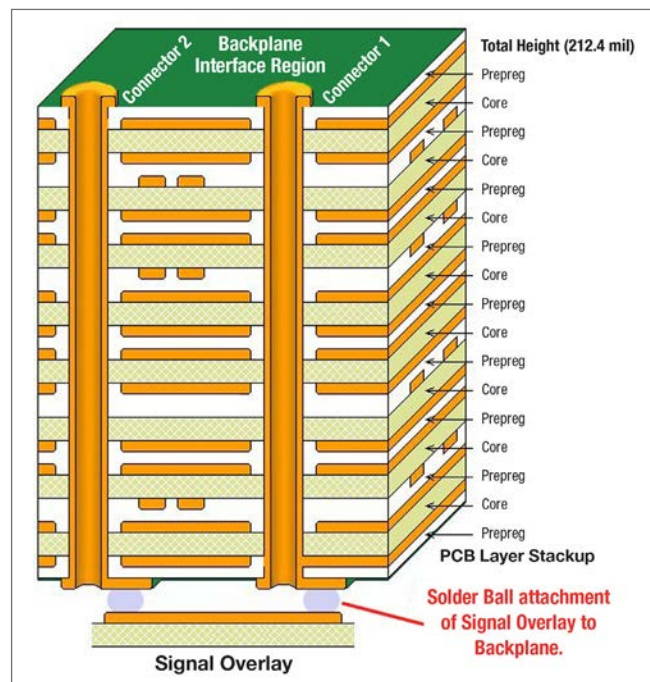
### Fabric Mapping Modules for VPX backplanes

Dawn VME Products' Fabric Mapping Modules (FMMs) are micro-overlays that provide benefits to designers of systems using VPX backplanes. Use of FMMs allows the backplanes to be semi-customized and quickly reconfigured according to user needs.

Consider a backplane with power and other utility planes that serve multiple plug-in boards. Those planes need not change or be redesigned when a VPX-based backplane is used for an iteration in the design because FMMs can make iteration-specific changes. Use of FMMs allows for a building-block approach to backplane design, as fundamental, housekeeping planes remain the same, while board-to-board fabric changes can be accommodated simply by changing FMMs. In this way, use of FMMs adds flexibility in system design (Figure 4).

One example is a primary defense contractor that needed help with a four-slot backplane to fit inside a cube-shaped form factor that must be conduction-cooled to fit into multiple vehicle types. Every time the payload plug-in cards are different, but every time the power supply plane is the same. The contractor used processor cards and graphics cards from different manufacturers. The changes in plug-in cards have not forced the design team to completely redesign the backplane because

they use FMMs to accommodate the necessary changes on the backplane that correspond to the differences in plug-in cards and front I/O pin-out.



**Figure 3** | The use of signal overlay mitigates problems associated with stub length.

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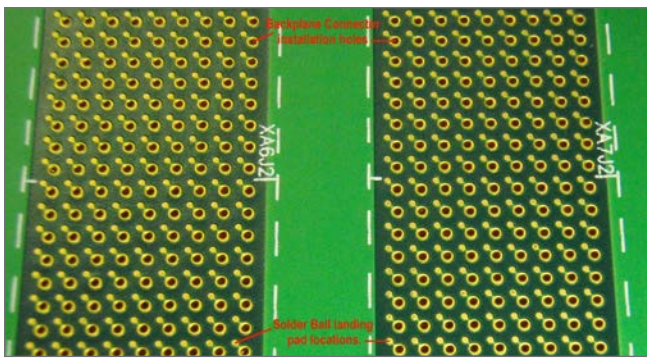
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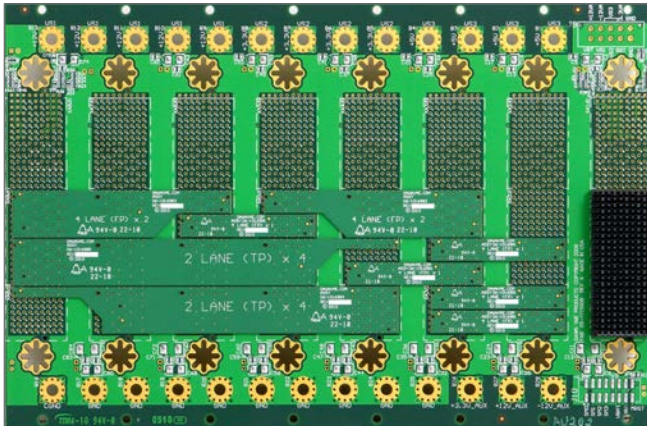
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**Figure 4** | BGA connection pads are shown adjacent to connector holes.



**Figure 5** | Assembled backplane with FMMs installed.

Another example in the use of FMMs is for a major supplier of deployable radio systems based on the VPX backplane. This company's system makes use of processor cards, storage cards, switch cards, and radio cards that go into different plug-in slots in the backplane depending upon the specific configuration the company needs. They rely on different FMMs to make the configuration-specific connections.

Additionally, this major supplier implements connectors on the FMMs themselves to pick off signals such as Ethernet, SATA, and RS-232, and then routes those signals directly to the system's front panel. None of these changes requires backplane redesigns because of the inherent flexibility granted by the FMMs.

Use of FMMs in high-performance, mission-critical VPX backplanes (Figure 5) gives system designers the flexibility they need to meet the wide variations in point-to-point signal connection requirements and allows many application problems to be solved in the design phase. 

**Brian Roberts** is senior designer at Dawn VME Products. He has 24 years of design experience in Silicon Valley developing electronic products for commercial and defense applications. He has worked with clients in the areas of system engineering, power supply design, and other PCB-based solutions.

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- » Up to 4 transmitters and 8 receivers channels for ARINC controller
- » Programmable label recognition for 256 labels per channel
- » 32 x 32 Receive FIFOs and Priority-Label buffers
- » Dependent data rates for Transmit and Receive
- » Meets the ARINC 429 specifications for loading, level detection, timing, and protocol
- » Software selected data rate of 12.5kbps or 100kbps with automatic slew rate adjustment
- » Burst and continuous mode available
- » Programmable word length selection, with the parity bit generated automatically
- » Programmable Interrupt support
- » Differential IIRIG B Input

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## Industrial

### Connect Tech Inc.

VPG101

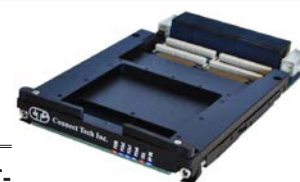
Connect Tech's **GraphiteVPX/XMC-**

**PMC** brings PCIe Gen 3.0 features to a mezzanine carrier. This VITA 65 compliant 3U peripheral carrier includes both a Gen 3 PCIe capable VITA 42 XMC interface and a 64-bit 133MHz PCI-X PMC site.

The I/O complement is available (based on VITA 46.9) with 64 PMC I/O (p64s) or 78 XMC I/O (x12d+x8d+x38s) with the option to support an XMC that has PMC I/O connectors.

The onboard PCIe Gen 3.0 switch allows for multiple dataplane options, a direct x8 interface, or the option of splitting the bus into two x4 interfaces, allowing for an additional downstream port.

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## Industrial

### Connect Tech Inc.

VPG201

Connect Tech's **GraphiteVPX/GbE Managed**

**Ethernet Switch** provides Carrier Grade Ethernet switching capabilities in a small 3U embedded form factor.

Excellent for demanding applications with rugged environments and extreme temperatures, this Managed Ethernet Switch is also a highly reliable way to communicate with 10/100/1000 Base-T devices in an embedded system. Powered by the latest generation Carrier Ethernet Switch engine, the Vitesse 7429 features an embedded MIPS 32-bit CPU, 1Gb external memory and DMA-based frame extraction and insertion support timing over packet, Ethernet OAM, and performance monitoring.

Available as conduction cooled (backplane only) or air-cooled with an additional four front panel ports.

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## Industrial

## Connect Tech Inc.

VPG301

Connect Tech's **GraphiteVPX/GPU** brings the NVIDIA® GeForce GTX 950M to the highly rugged embedded VPX marketplace. The VITA 65 compliant 3U peripheral card provides up to four DisplayPort outputs or 2 DVI outputs.

The GeForce GTX 950M delivers unsurpassed graphics, video, and GPU computing performance, with access to 640 NVIDIA CUDA® cores. It's an ideal solution for performance driven systems such as medical imaging, defense, and military/aerospace applications.

The onboard PCIe Gen 3.0 switch allows for multiple dataplane options, a direct x8 interface, or the option of splitting the bus into two x4 interfaces, allowing for an additional downstream port.

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## Radar

## Hartmann Electronic GmbH

OpenVPX Backplane, Power Supply, Filter, Fan Unit

Hartmann Electronic has worked in the field of Backplanes and System Platforms for the past 40 years and is one of the main VPX suppliers worldwide.

With controlled high speed layouts it is possible to route PCI Express and Ethernet signals over the Backplane with the maximum specified speed. The development department works on a backplane that handles 100 Gbit Ethernet signals.

In addition to the Backplanes, Hartmann develops and supplies VPX Power Supplies from 150W up to 1200W. With special filter boards and cooling concepts it is possible to have stable Power with low ripple and noise for Custom Applications.

[www.hartmann-electronic.com](http://www.hartmann-electronic.com)
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## Radar

## Innovative Integration

XU-TX for RADAR-Wireless MIMO Transmitter

**XU-TX – XMC Module with Two 5.1 GSPS, 16-bit DACs, 4.8GHz PLL, Xilinx UltraScale FPGA 8 GB DDR4 Memory.**

An XMC module featuring two AC-coupled, single-ended 16-bit DAC outputs with programmable DC bias. The DAC devices employed support synchronization and interpolation, and their unique output circuits allow improved frequency synthesis in the 2nd and 3rd Nyquist zones, to shift the Nyquist null frequency in the output spectrum by a factor of two. The DAC ICs may be clocked at up to 5.1 GHz via an onboard, ultra-low-jitter PLL.

Learn more and download data sheets now!

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## Industrial

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**Connect Tech Inc.**  
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VPG003



Connect Tech's **GraphiteVPX/CPU-TX1** is a VITA 65 compliant 3U VPX single board computer that brings the NVIDIA® Jetson™ TX1 embedded computing platform to the VPX form factor.

The GraphiteVPX/CPU-TX1 is the latest release in a range of NVIDIA Jetson TX1 solutions that Connect Tech has created in the past year, joining ranks with the Astro, Elroy, and Orbitty Carrier Boards, and the Rosie Embedded System.

This complete host solution delivers over a TeraFLOP of performance, with multiple USB 3.0 ports, multiple GbE channels, and 6 CSI camera interfaces to round out this 3U VPX solution.

The onboard PCIe Gen 3.0 switch allows for two x4 interfaces providing two additional downstream ports on the backplane. The GraphiteVPX/CPU-TX1 has a Quad Core 64bit ARM A57 processor.

## Features

- » 1 TFLOP, 256 CUDA cores with NVIDIA Maxwell™ GPU Architecture
- » Conduction Cooled
- » The onboard PCIe Gen 3.0 switch supports two x4 port dataplane connections
- » Extended Temperature Range -40°C to +70°C
- » Can be used with RTG004 GraphiteVPX/CPU-TX1 RTM to aid in development

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## Rugged

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COTS Rugged Chassis, Backplanes and Related Accessories



Imagine being able to deploy your electronics design in the harshest military, aerospace and industrial environments in the world. **Atrenne Integrated Solutions** specializes in providing rugged, deployed chassis enclosures, backplanes, and related accessories and services. If you've heard of Mupac, Carlo Gavazzi, SIE Computing, Hybricon, Xtech, AbelConn or CBT, then you already know Atrenne. We have the industry's most extensive intellectual property library of chassis designs accumulated throughout our 40+ year history. If your application has challenging shock, vibration, size, temperature/cooling, altitude, humidity, safety, EMI/EMC, 10 Gbaud signaling or other requirements, chances are we already have a platform design that we can use as a starting point. Working with Atrenne lowers your life cycle cost, reduces technical risk, shortens your schedule, converts fixed costs to variable and allows your team to focus precious resources on your unique value-add.

Our design library includes:

- » 1/4, 1/2, 3/4, 1, 1.5+ ATR enclosures
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- » Backplanes with 10 Gbaud signaling in a range of topologies VPX/OpenVPX, VXS, VME64x, VME, CompactPCI and other embedded form factors
- » Supported standards include: ARINC 404A, MIL-STD-1275, MIL-STD-167, MIL-STD-461, MIL-STD-704, MIL-STD-810, MIL-STD-91403, RTCA/DO-160, ...
- » Lightning protection (bulk cable injection, pin injection)
- » and much more

Atrenne can also serve as your one-stop-shop partner for value-add, build-to-print manufacturing of board CCAs. We can also design/build or manufacture fabricated metal components, custom I/O and cabling/wire harnesses. Additional services include connector obsolescence management, full assembly/integration and testing.

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## Radar

### Annapolis Micro Systems

WILDSTAR UltraKVP 2PE & 3PE for OpenVPX 6U



WILDSTAR UltraKVP™ 2PE & 3PE for OpenVPX 6U boards include up to three Xilinx Kintex® UltraScale™ or Virtex® UltraScale(+) FPGAs with High Speed Serial connections performing up to 16.3 Gbps. There is also an on-board dual ARM Cortex-A9 (Zynq-7000) Processor running up to 766 MHz, which can be used for hosting the FPGAs and local CPU processing requirements.

Each card has two WILD FMC+ (WFMC+™) next generation I/O sites. Compatible with FMC and FMC+, WFMC+ supports 32 HSS and 100 LVDS I/O for higher density ADC and DAC solutions, as well as I/O card stacking.

[www.annapmicro.com/products/wildstar-ultrakvp-3pe-openvpx-6u/](http://www.annapmicro.com/products/wildstar-ultrakvp-3pe-openvpx-6u/)  
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## Rugged

### Acromag

XMC-7A200



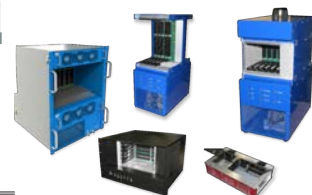
Acromag's XMC-7A modules feature a high-performance user-configurable Xilinx® Artix®-7 FPGA enhanced with high-speed memory and a high-throughput serial bus interface. The result is a powerful and flexible I/O processor module that is capable of executing custom instruction sets and algorithms. These boards feature 215k logic cells and 128M x 64-bit DDR3 SDRAM and 32M x 16-bit parallel flash memory for MicroBlaze™ FPGA program code storage. Lower level applications will benefit from the Artix®-7 FPGA with high-speed serial interfaces for a lower cost solution. These modules offer your choice of plug-in I/O or conduction-cooled options.

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## Rugged

### Atrenne Integrated Solutions

Lab Development Systems for VPX, VME, VXS, CPCI



**Atrenne Integrated Solutions** provides the industry's widest array of desktop, tower, open frame, and ATR development systems for usage in the lab environment. Chassis are available that support both 3U and 6U module form factors, and both air and forced-air conduction cooling methodologies. Atrenne offers lab chassis in a range of slot counts, power supply configurations, orientations and backplane topologies, and supporting 10 GHz signaling. From the small 849-S145 (2-slot, 3U, 200W) to the large RME13XC (6U, 16-slots, 3300W), and many options in between, Atrenne can provide a development platform that will support the success of your project.

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**Rugged****Concurrent Technologies**

TR C4x/msd

TR C4x/msd is a 3U VPX processor board based on an Intel® Xeon® D-1500 device with up to 16-cores and 32GB of DDR4 memory for server grade performance within SWaP constrained environments. It features 10 Gigabit Ethernet data plane connectivity for multi-board blade server solutions and allows high bandwidth co-processing resources to be connected via PCI Express® expansion plane connections. Enhanced security, built-in test and other firmware and software options are available to suit application needs. TR C4x/msd is designed for use in long-life applications across a range of military, aerospace, transportation and test markets.

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**Rugged****Concurrent Technologies**

XP B5x/msd

XP B5x/msd is a Processor XMC module based on 6th Generation Intel® Core™ processor designed to provide high performance control and management capability for any carrier card with an XMC site.

Based on a low power 6th generation Intel® Core™ processor, XP B5x/msd is suitable for rugged and extended temperature operating environments for long life-cycle deployments. It features a built in solid state drive for reliable storage and offers a range of standard I/O interfaces. Board support packages are available for Linux®, Windows® and VxWorks®, and other OSs can be supported on request.

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**Rugged****Dawn VME Products**

PSC-6265

**VITA 62 compliant 6U power supply for conduction cooled systems.**

Dawn's **VITA 62 compliant 6U PSC-6265** can operate continuously in diverse environments over a wide range of temperatures at high power levels. The standard model is conduction to wedge lock cooled with an operating temperature range of -40C to +85C and a nonoperating range of -55C to +105C. The PSC-6265 operates continuously at a power level of 580 watts. For systems that require higher power levels, up to three supplies may be operated in parallel. Fault monitoring and control circuits protect the system from over-voltage, over-current, and over-temperature conditions.

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**Rugged**

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**ALPHI** TECHNOLOGY CORPORATION

ATC-ETH-DIG-I/O



**Rugged, Small, Lightweight, Ethernet, FPGA-Based Multi-Function I/O Controller**

The ATC-ETH-DIG-I/O is an Ethernet based Multi-Function I/O module that employs dual Altera Cyclone® FPGAs for maximum deterministic performance and I/O capability.

The module provides an Ethernet network interface for Digital I/O, Analog and Serial communication. Although it is fully functional as delivered, the User FPGA can be modified for custom bus implementations, which allows maximum flexibility and pre-processing capability for time-sensitive applications.

To communicate with the host, the ATC-ETH-DIG-I/O uses a simple standard networking protocol – Modbus – that allows for control and data transfers.

The ATC-ETH-DIG-I/O uses a single 160 pin I/O connector for all system inputs and outputs. The I/O connector is a high density D-type connector with female pins. The mating cable end connector is available in a number of configurations to meet specific application requirements.

**Features**

- » User FPGA for applications requirements via RS-232/422/488 (encryption, custom communication protocols, etc.)
- » One GigE port with ModBus TCP
- » Up to three RS-232/422/485 ports via User FPGA
- » Thirty six general purpose LVTTTL lines with 1KΩ pull up resistor
- » Twelve buffered general purpose LVTTTL lines with 24mA drive per line
- » Four low-side open drain putout channels with 1A drive per channel
- » Eight RS-422 output channels, twelve input channels
- » One I2C interface channel
- » One SPI interface channel
- » Eight 16-bit A/D channels for external voltage monitor
- » Internal voltage monitor capability
- » Designed and manufactured in USA

**Environment**

- » Operating temperature: -40° to +85° C
- » Shock: 30G, 15ms sawtooth
- » Vibration: 15G, 5-2000 Hz
- » Input voltage: +12 to +28 VDC

**Mechanical**

- » Size: 5.4" x 5.5" x 1.6" (WDH)
- » Rear panel I/O: 160-pin Molex
- » Weight: 1.67 lbs
- » MTBF: >250,000 hours

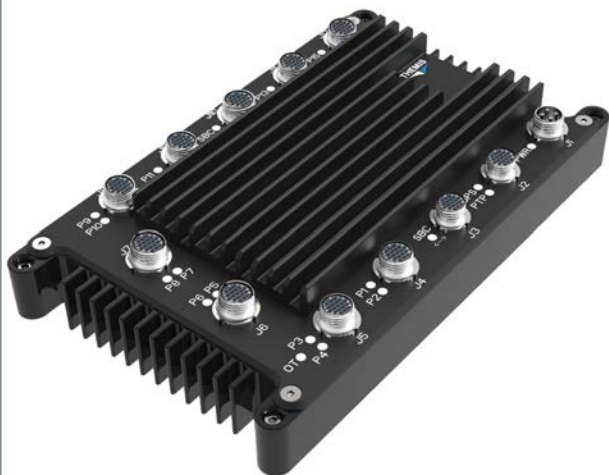
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## Rugged

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# THEMIS

NanoSWITCH™ Rugged 10 or 16 Port Gigabit Ethernet Switch



The Themis NanoSWITCH™ is a Size, Weight, Power and Cost (SWAP-C) optimized rugged multi-layer gigabit Ethernet switch with an embedded x86 PC. The NanoSWITCH brings enterprise level layer 2/3 switching into the rugged environments found in military ground, air and sea vehicles and unforgiving industrial environments such as offshore oil platforms. Typical applications include:

### Application Features

- » Vehicle network switching
- » Distributed architecture vehicle controller
- » VICTORY compliant switch, router, timing, and control
- » WAN – LAN interconnectivity and firewall
- » Shared processing and peripheral communications

### Environmental Features

- » P67 environmentally sealed for water, dust, and salt fog
- » Sealed MIL connectors
- » Operating temperature: -40°C to 71°C
- » Shock: 50g @ 25ms
- » Vibration: 5G RMS. 10Hz to 2KHz
- » Status LED blanking control

[www.themis.com/products/rugged-switches/nanoswitch](http://www.themis.com/products/rugged-switches/nanoswitch)  
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## Rugged

### Dawn VME Products

PSC-6236

### Universal AC Input VITA 62 3U Power Supply



Dawn VME Products **PSC-6236 universal AC input VITA 62 compliant 3U power supply** for air or conduction cooled OpenVPX systems. True 6 channel supply with up to 400 watts output. Mission critical wide temperature range at high power. Input 85 VAC to 264 VAC, 47 Hz to 400 Hz. Can be special ordered to support high current single channel applications. Embedded RuSH™ technology actively monitors voltage, current and temperature, and provides protective control. Ruggedized – VITA 47 compliant. Rugged, Reliable and Ready.

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## Rugged

### Innovative Integration

Digital Receiver K707 – for GSM Beamforming-GNU Radio



**K707 Digital Receiver** supports two FMC-310 plug-in modules providing up to 6 antenna inputs, 128 independent channels of DDC, and one spectrum analyzer embedded in a Xilinx Kintex-7 FPGA. It supports monitoring and/or recording of wide- or narrow-band spectra or channelized IF band data. The receiver supports contiguous recording at 1,300 MByte/s to four SSDs until running out of disk space.

Aggressively priced receiver combines an embedded PC running 64-bit Linux with an internal Xilinx K410T2 FPGA and optional 3-18 GHz RF receiver module to create a COTS digital beamformer, spectrum analyzer or custom software defined radio solution.

[www.innovative-dsp.com/products.php?product=Digital%20Receiver%20K707](http://www.innovative-dsp.com/products.php?product=Digital%20Receiver%20K707)  
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## Rugged

### Kontron

VX3058 Octo Core Intel® Xeon® Processor OpenVPX™ Server Blade



Kontron's 3U OpenVPX™ blade VX3058 is based on 8-core Intel® Xeon® D architecture, supporting Dual 10 Gigabit Ethernet, high bandwidth PCI Express 3.0, and high speed DDR4 memory. It is SWaP-C optimized with versatile mezzanine options for XMC, storage, graphics, M.2, and I/O. The M.2 interface can be used for storage or for integration of customized personality modules. Front I/O module options are selectable for DVI/HDMI, Ethernet or other interfaces.

The Kontron VxFabric™ provides a unique API that extends the TCP/IP protocol over the PCI Express infrastructure that when combined with Kontron's advanced switch technologies, enables significantly higher I/O bandwidth.

[www.kontron.com/industries/defense](http://www.kontron.com/industries/defense)  
<http://vita.opensystemsmmedia.com/p373879>

**Rugged****LCR Embedded Systems**

A New Family of  
Affordable Enclosures

LCR Embedded Systems has introduced a family of affordable, customizable, rugged, industrial, NEBS enclosures available in VME/VPX or CompactPCI, which provide our telecom, datacom, and military customers with an open-standards ecosystem for application solutions development.

These enclosures are available in 2U, 3U, 4U, and 6U sizes, and processor options include Intel Core i5/i7 quad core processors, as well as drive bays for slim DVDs and either one or two removable 2.5" SATA drives depending on the enclosure size.

[www.lcrembeddedsystems.com/a-new-family-of-affordable-universal-enclosures-for-development/](http://www.lcrembeddedsystems.com/a-new-family-of-affordable-universal-enclosures-for-development/)  
<http://vita.opensystemsmmedia.com/p373690>

**Rugged****Red Rock Technologies, Inc.**

XMC Removable CFast Module

The XMC Removable CFast Module is a mezzanine card with a PCIe SATA 3 controller that provides boot drive and/or disk storage for VPX, VME, cPCI SBCs with XMC slot.

- » Adds removable CFast SSD to SBC
- » CFast capacities currently up to 240GB
- » All parts rated for -40C to 85C
- » Air or conduction cooled
- » CFast Secured by rugged retainer clip
- » CFast connectors rated for 10,000 mating cycles
- » Windows, Linux, and VxWorks drivers available
- » Also available with 1.8" SSD or in PMC form factor

[www.RedRockTech.com](http://www.RedRockTech.com)  
<http://vita.opensystemsmmedia.com/p373865>

**Rugged****TE Connectivity**

CeeLok FAS-X Connector

TE Connectivity's new CeeLok FAS-X connectors combine rugged reliability with signal integrity to support current high-speed protocols and new, faster protocols on the horizon. The new connector features fast field termination and repair, and meets military and aerospace markets' 10 GB/s requirements and other high-speed protocols.



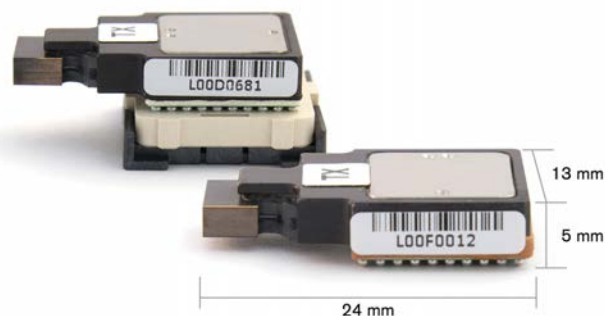
[www.te.com/smallcircular](http://www.te.com/smallcircular)  
<http://vita.opensystemsmmedia.com/p373846>

**Rugged**

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- ✓ **MIL-STD-883J** Thermal Cycling
- ✓ **MIL-STD-202G** Damp Heat
- ✓ **MIL-STD-810G** Cold Storage
- ✓ **Telecordia GR-468** Fiber Integrity Side Pull

### Photonics provides rugged embedded transceivers for harsh environment interconnect

By putting optics closer to processors, Reflex Photonics *LightABLE™* products enable customers in Defense & Aerospace, avionics, and industrial markets to offer higher data rate in smaller packages.

Our focus on reliability is supported by the intrinsically robust design of our products, making them the ideal choice for the most demanding environment.

**Features**

- » 12 Rx or 12 Tx channels per device
- » 4 Tx + 4 Rx channels per device
- » 10 Gbs per channel (28G coming)
- » Bit error rate down to  $1E^{-15}$
- » Sensitivity -12 dBm
- » Low profile (only 5mm high)
- » Surface mountable 1.27 mm pitch BGA
- » Pluggable 100-pin MEG-array® connector
- » Industrial grade (-40 °C to 85 °C) temperature range
- » Only 120 mW per channel
- » CML high-speed electrical interface
- » Health monitoring; LOS, RSSI, temp. etc...
- » Optional microcontroller

[www.reflexphotonics.com](http://www.reflexphotonics.com) • [sales@reflexphotonics.com](mailto:sales@reflexphotonics.com)  
<http://vita.opensystemsmmedia.com/p373856>



## UAV

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## WILDSTAR UltraKVP DRAM &amp; SRAM for OpenVPX 3U



Annapolis Xilinx FPGA boards are engineered for superior performance and maximum bandwidth. The WILDSTAR UltraKVP **DRAM** boards include up to 20 GB of DDR4 DRAM for up to 40 GB/s of DRAM bandwidth. The WILDSTAR UltraKVP **SRAM** boards include up to 18 MB of QDR-IV SRAM for 28.8 GB/s of SRAM bandwidth. All Annapolis COTS boards are rugged, open, deployable, and offer different cooling options, making them the most cutting-edge Xilinx-based products on the market.

## General Features

- » Hard 4x (DRAM) or 8x (SRAM) PCIe Gen3 endpoint for DMA and register access
- » FPGAs programmable from attached flash or Annapolis-provided software API
- » 16 or 20-nm copper CMOS process
- » Dual core ARM Cortex-A9 (Zynq-7000 SoC) running up to 766 MHz
- » A full BSP using Open Project Builder™ for fast and easy Application Development

## OpenVPX Backplane I/O

- » 20 (DRAM) or 9 (SRAM) HSS Protocol Agnostic I/O lanes to VPX Backplane for 50 (DRAM) or 22.5 (SRAM) GB/s of Full Duplex Bandwidth - Supports 10/40Gb Ethernet, IB capable, AnnapMicro protocol and user designed protocols
- » Two PCIe Gen3 4x Connections to VPX Backplane from FPGA
- » 6 (DRAM) or 24 (SRAM) LVDS lines to VPX Backplane
- » Optional optical VITA 66/67 connectivity

## Front Panel I/O &amp; Mezzanine Cards

- » Wild FMC+ (WFMC+™) higher density I/O site that accepts FMC and FMC+ cards
  - Up to 32 HSS and 100 LVDS connections to FPGA
  - Supports stacking (2 per site)
- » Dozens of Wild FMC+ high performance mezz cards
  - ADC & DAC: 100MSps up to 6.4GSps
  - 24x Optical Transceiver Card (up to 28Gbps per lane)

## Mechanical &amp; Environmental

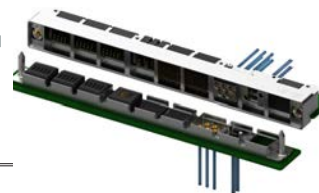
- » Air or Conduction Cooled
- » RTM available for additional I/O

[www.annapmicro.com/products/wildstar-ultrak-dram-for-openvp3-3u/](http://www.annapmicro.com/products/wildstar-ultrak-dram-for-openvp3-3u/)  
<http://vita.opensystemsmedia.com/p373851>

## Rugged

## TE Connectivity

Fortis Zd LRM  
Connector System



TE Connectivity's Fortis Zd LRM Connector System is an innovative modular connector system for rugged next-generation packaging, from avionics boxes to military ground vehicles. It features a rugged, lightweight, multibay shell that accepts high-speed digital signal, power, RF and optical modules.

[www.te.com/highspeed](http://www.te.com/highspeed)  
<http://vita.opensystemsmedia.com/p373847>

## Rugged

## Extreme Engineering Solutions (X-ES)

XPedite7670



XPedite7670 is a high-performance, 3U VPX-REDI, single board computer based on the Intel® Xeon® D processor. The processor can provide up to 16 Xeon®-class cores in a single, power-efficient System-on-Chip (SoC) package with native extended temperature support for up to 12 core count SKUs.

- » Up to 16 GB of DDR4-2133 ECC SDRAM in two channels
- » Two 10GBASE-KR Ethernet ports & two Gigabit Ethernet ports
- » Two USB 2.0/3.0 ports
- » Up to six RS-232/422/485 serial ports
- » Up to six SATA ports capable of 6 Gb/s
- » Two x4 PCI Express backplane fabric interconnects
- » XMC interface
- » Supports coreboot firmware powered by Intel® FSP, and Wind River VxWorks and X-ES Enterprise Linux (XEL) BSPs

<https://www.xes-inc.com/products/sbcs/xdpedite7670/>  
<http://vita.opensystemsmedia.com/p373877>

## Surveillance

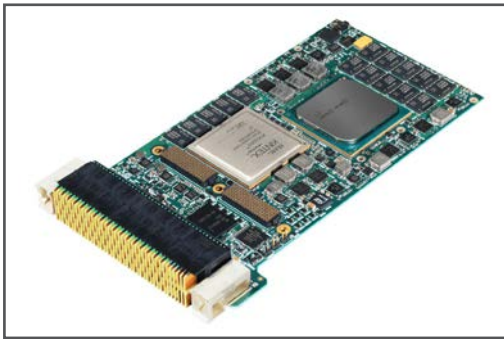
## Innovative Integration

Digital Transceiver K706  
for Surveillance-Arbitrary  
Waveform



**K706** supports two antenna inputs & four independent channels of DDC, two channels of DUC, & one spectrum analyzer embedded in a Xilinx Kintex-7 FPGA. Supports monitoring/recording of wide- or narrow-band spectra or channelized IF band data. Analog front-end is modularized via an FMC site, fitted with an FMC-1000, employs dual 1 GHz 14-bit ADCs+DACs. Supports contiguous recording 300 MByte/s to internal 1.8" SATA drives until running out of disk space. Aggressively priced, the COTS solution satisfies even the tightest schedule & budget constraints. Runs 64-bit Linux/Windows – touch screen available – ideal for custom wireless surveillance or SDR receiver instrumentation.

[www.innovative-dsp.com/products.php?product=Digital%20Transceiver%20K706](http://www.innovative-dsp.com/products.php?product=Digital%20Transceiver%20K706)  
<http://vita.opensystemsmedia.com/p373868>



## Server-class performance with secure custom I/O

The Extreme Engineering Solutions, Inc. (X-ES) XPedite7674 is a high-performance, 3U VPX-REDI SBC based on the Xeon D processor. The Intel Xeon D processor can provide up to 16 Xeon-class cores in a single, power-efficient System-on-Chip (SoC) package with native extended temperature support for up to 12 core-count SKUs.

A user-configurable Xilinx Kintex UltraScale FPGA delivers enhanced performance and security for a wide range of embedded computing applications. The XPedite7674 provides secure network interfaces by offering one 1000BASE-X Gigabit Ethernet interface from the FPGA and passing two CPU 10 Gigabit

10GBASE-KR Ethernet interfaces through the FPGA where a secure supervisor can monitor data packets.

The XPedite7674 supports additional I/O to the VPX connectors, including a SATA port capable of 6 Gbps, USB 2.0, RS-232/422/485 serial ports, GPIO, and High-Speed Serial (HSS) ports. The XMC site supports a x8 PCI Express Gen3-capable port and a SATA port, as well as XMC P16 I/O, mapping P1w9-X12d per VITA 46.9.

**Extreme Engineering Solutions, Inc. (X-ES) • [www.xes-inc.com](http://www.xes-inc.com) • [www.vita-technologies.com/p373852](http://www.vita-technologies.com/p373852)**

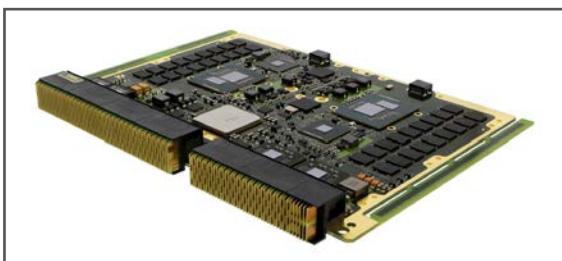
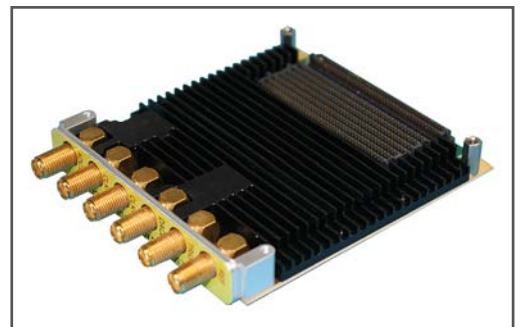
## When every nanosecond counts

The new FMC+ standard is nearing release, and the first products are showing up. The Annapolis Micro Systems single-channel 5.0 GSps 10-Bit ADC 12-Bit DAC WFCM+ card was specially architected for latency-sensitive applications where every nanosecond counts, as with Digital Radio Frequency Memory (DRFM) devices in sophisticated Electronic Warfare (EW) systems. It features Analog-to-Digital Conversion (ADC) of 10 bits and Digital-to-Analog Conversion (DAC) of 12 bits, running at a sample rate of 400 MSps to 5,000 MSps.

This rugged, ultra-low-latency card offers ADC SMA input to DAC SMA output under 15 ns in digital bypass mode and under 23 ns in fabric space mode.

The board support interface, which is available for VHDL or Open Project Builder, includes a built-in bypass delay that can be from 0 to 124 ADC sample clock periods. This allows the user to “walk” the latency out from the minimum digital bypass mode latency to slightly beyond the fabric space latency, providing for a smooth transition between the two modes.

**Annapolis Micro Systems • [www.annapmicro.com](http://www.annapmicro.com) • [www.vita-technologies.com/p373855](http://www.vita-technologies.com/p373855)**



## Manage the heat at max capacity

When it comes to High-Performance Embedded Computing (HPEC), thermal management and heat dissipation are key factors for enabling the system to provide its full performance when running at the highest temperature. Creative Electronic Systems' (CES) CIO5-2040 is a Size, Weight, and Power (SWaP)-optimized dual processor SBC combining 1.5 teraflops and 210K DMIPS of processing power.

Aimed at serving applications such as radars, Communications Intelligence (COMINT), Signals Intelligence (SIGINT), or Electronic Intelligence (ELINT), the CIO5-2040 is built using a mirrored architecture implementing two 5th Generation Intel Core i7 processors. The processors are fed with data through four 10 Gb Ethernet links and three PCI Express Gen3 x8 links routed in the backplane.

CES has designed a composite frame for the CIO5-2040, providing the thermal dissipation of copper while weighing as light as aluminum. As a result, the full performance of the board is available even at +85 °C, and the board together with the frame weigh 30 percent less than its copper-framed counterparts.

**Creative Electronic Systems (CES) • [www.ces-swap.com](http://www.ces-swap.com) • [www.vita-technologies.com/p373853](http://www.vita-technologies.com/p373853)**





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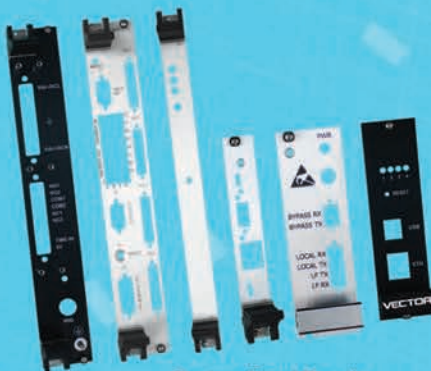


Series 445 Rugged Chassis



Series 440 w/dual-redundant embedded PSU's and status monitor

## Chassis and Rack Accessories



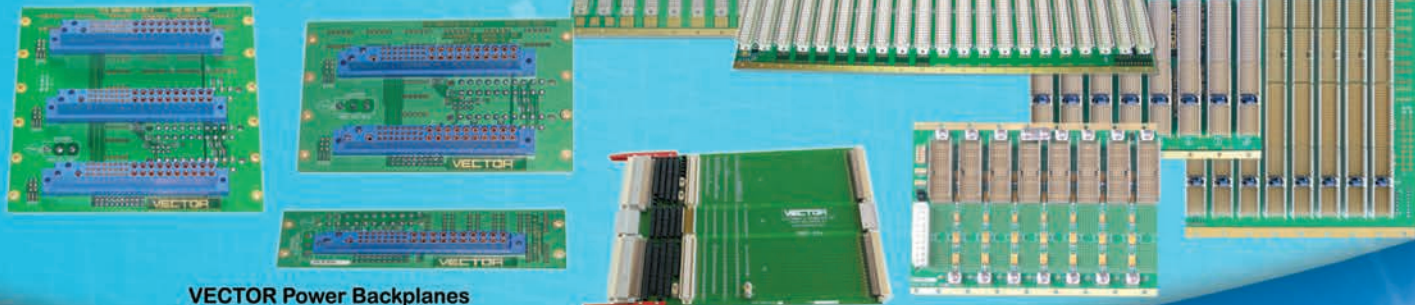
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