EXPANDING OPTIONS IN VPX CONNECTIVITY

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You can never have too much bandwidth. High-speed processing and growing amounts of data to be communicated require generous bandwidth from the board level to the I/O. VPX, with a backplane connector system supporting 6.25 Gb/s in a switched fabric architecture, is the latest generation of VMEbus and offers new levels of performance for embedded computer systems. VPX systems are designed for flexible application of demanding high-speed protocols, such as 10G Ethernet, RapidIO, InfiniBand, and HyperTransport protocols, in ground, aerospace, and marine applications.

VPX is presently most widely used in defense applications, particularly for C4ISR (command, control, communications, computing, intelligence, surveillance, reconnaissance). Signal intelligence (SigInt), electronic intelligence (ElInt), radar, and similar processor-intensive applications require a great deal of computing horsepower and bandwidth. VPX is a ruggedized approach to embedded computing that aims to satisfy high-speed processing needs in harsh environments such as flight, ground defense, and other military applications.

As a young, vibrant, and rapidly expanding ecosystem, VPX benefits from the global backing of both the computing and aerospace/defense industries. This widespread backing has driven the standardization to move forward relatively efficiently, with many participants at the various levels of supply chain – components, subsystems and platforms. A key to the success of VPX has been the heavy reliance on commercial off-the-shelf products, fostering a wide international supplier base, shortening time to market and further feeding the ecosystem's evolution.

As the ecosystem matures, two initiatives are underway that will allow VPX to evolve into a wider range of applications, including:

1. Connectivity modules for standardized power, optics, and RF
2. Small-form-factor systems proposed for the smallest of applications while emulating VPX

New Connectivity Modules

The initial success and enthusiasm for VPX brought to light that there was still some work to be done for the architecture to realize its full potential. VITA 46 was the founding architecture specification for VPX. It specifies the MULTIGIG RT 2 backplane connector from TE Connectivity (TE), with a focus on digital signals. This left designers creating ad hoc approaches to other connectivity needs. To remedy the situation, a series of related specifications have been introduced to address complementary power (VITA 62), fiber optic (VITA 66) and RF (VITA 67) solutions within the VITA 46 framework.

To assure connectivity and interoperability on an architectural level, OpenVPX (VITA 65) has been established as the governing standard defining profiles for various configurations at the chassis, backplane, slot, and module levels. The ultimate goal is to enable the promise of open architecture by creating compatibility between products from different vendors. In addition, the standard promotes two-level maintenance and system upgrades, allowing users to swap out line replaceable modules (LRMs) in the field.at-shrink tubing has been a staple in the electronics industry for more than 50 years. It is used for sealing, protecting, insulating, strain-relieving, and identifying wires and cables.

High-Density Power

The TE MULTI-BEAM XLE power connector, proposed as the interconnect for the VPX VITA 62 power supply standard, is derived from a commercial design that offers 50 A and 20 A contacts. Even compared to earlier versions in the same connector family, the XLE delivers up to 40% more power in the same space. The design is hot pluggable, tolerates mating misalignment, and has lower mating forces.

Optics and RF for VPX

VITA 66 and 67 were developed to further expand the VPX ecosystem by defining modules for optical and RF applications (Figure 1). Both demonstrate the advantages of using proven, existing technology and adapting it to new applications. RF and optics as separate modules assist design and manufacturing by allowing LRUs and LRMs to be disconnected at the backplane, which greatly speeds assembly, maintenance, and upgrades.

VITA 66, for optics, gives users the choice of MT array connectors, ARINC 801 termini, or expanded beam (EB) contacts using a common module. Each style of termini has aerospace pedigree and offers different benefits in terms of density, ruggedness, reparability, and other characteristics.

MT ferrules provide the highest-density interconnection with up to 48 fibers in a 3U system and up to 240 fibers in a 6U system.

ARINC 801 termini, based on industry-standard 1.25 mm ceramic ferrules, offer high-performance features that include physical contact technology for very low insertion loss, angled polishes for minimal reflection loss, and keyed orientation for optimal single-mode performance.

The EB insert supports up to four fibers per module, uses ball lens to tolerate less than pristine conditions and is the best at handling shock, vibration, or repeated mating/unmating. The EB interface is well suited to two-level maintenance or applications calling for frequent insertion/extraction, such as a secure storage device requiring removal after each flight operation.

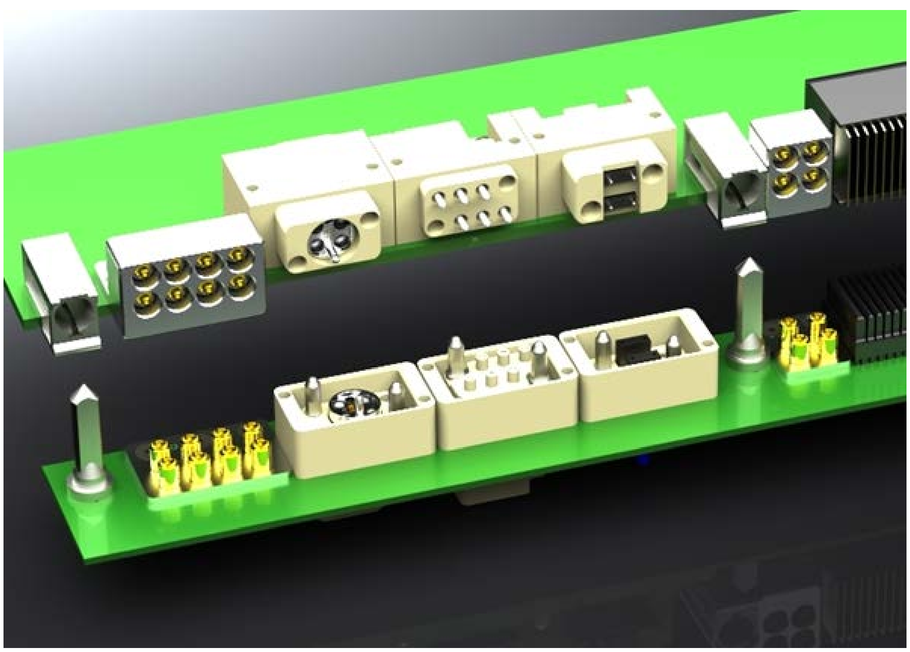

Figure 1. VITA 66 optical and VITA 67 RF modules (Source: TE Connectivity)

Small-Form-Factor (SFF) Systems

There is nothing new in the notion of the constant drive in electronics to make systems that are smaller, faster, and cheaper. The same is true with VPX, where the drive for smaller, lighter, and less power-hungry system opens up new application possibilities. Small-form-factor systems allow use in UAVs, ground robots, and similar applications. Such applications are highly constrained by size, weight, and power (SWaP) requirements. The intention is to create systems small enough and rugged enough for mobile field deployment.

3U VPX systems are not new, but they form the first generation of SFF. Even as interest in 3U architectures is growing, designers are looking toward even smaller VPX solutions.

While efforts toward standardization of SFF systems are still in early stages, there are three committees actively working on SFF standards.

- VITA 73, driven mainly by PCI-System's µPX, target drones and other unmanned air and ground platforms.
- VITA 74, based on the NanoATR system from Themis Computer, is the smallest system of the three.
- VITA 75 has the largest membership of the three working groups. This SFF architecture is driven by a consortium, including Curtiss-Wright Controls Embedded Systems, Mercury Computer, GE Intelligent Platforms, and others.

All three efforts share certain goals: smaller, lighter, cheaper systems that still meet ruggedness requirements. Heat management is important since small, closed systems can generate considerable heat. Conduction cooling allows thermal management while keeping the cube sealed to contaminants without fans or air vents.

One goal of the SFF programs is to produce "cubes" that meet military two-level maintenance requirements. This mandates that combat platform can be repaired within 30 minutes. For SFF cubes, it means swapping the cube for a new one, with depot repairs being performed within the cube. While offering the advantages of reduced SWaP and LRU field repairability, SFF systems also mean reduced functionality since they emulate VPX to accommodate the small form factor. Whether each finds a niche in the market or one succeeds while the others fall by the wayside, time will tell. VPX 3U and 6U systems will remain the mainstream choice in demanding processor-intensive applications.

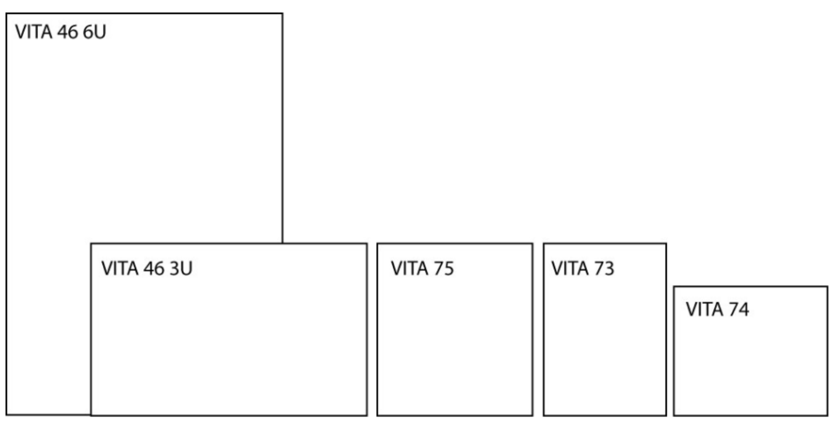

Figure 2. The relative sizes of 6U and 3U VPX boards and emerging SFF boards.

What's Next for VPX?

With the advent of the new VPX connector module and SFF standards, the stage is now set for VPX to proliferate into all kinds of rugged embedded computing applications, from large, static radar installations, to miniature UAV ISR systems. Lessons learned to date will speed solutions to market for future needs of higher speeds, higher density, ruggedness, and configuration management.

As defense organizations take a more integrated view of systems, more heavily relying on networking and interconnecting subsystems, fiber will take a larger role in VPX systems. Fiber allows high-speed box-to-box cabling that enables longer runs with inherent EMI immunity. As I/O speeds increase, fiber becomes an even more attractive media.

As has happened with other architectures, such as CompactPCI and ATCA, VPX will migrate to other industries requiring high-performance ruggedized solutions. This includes such diverse industries as rail and commercial transportation, medical and imaging, security, and high-reliability processing. In expanding its ecosystem, VPX will drive and thrive on diversity.

Author's Bio

Gregory Powers, Market Development Manager, Aerospace, Defense & Marine, TE Connectivity, has more than 25 years' experience in development engineering and field application engineering and holds two patents relative to optic datacom devices. His areas of expertise include: electronic systems and space, rugged embedded computer packaging, high data rate board level and input/output solutions, fiber optics, spaceflight connectivity.

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