

3U VPX tackles needs of today's net-centric battlefield

By Nauman Arshad

The U.S. DoD's vision for the net-centric battlefield – to bring rich instant data to the war fighter at the edge of the battlefield – has been limited by several factors. However, a new breed of rugged COTS 3U VPX SBCs is helping to address many of the requirements of a networked battlefield. With its performance vs. power benefits, superior backplane and serial fabric support, GbE network connectivity, and advanced security features – DoD's net-centric vision is now becoming a COTS reality.

The emergence of 3U VPX (VITA 46) as a popular small form factor for rugged, high-performance embedded defense applications has made possible a new class of “pocket-sized super processor” single board computers especially well suited for meeting the unique needs of today's battlefield requirements at the “edge” of the network. Examples of applications this new breed of low-power, standards-based computers addresses include embedded security systems, manpacks, gateways, communications infrastructure, avionics, telematics, and more, where low power, high performance, and small form factors are a must. These new compact processor cards combine a plethora of features that include low power and high performance, fast serial fabric-enabled backplane connectivity, GbE network connectivity, and next-generation secure computing while addressing Size, Weight, and Power (SWaP) concerns in networked battlefield applications.

Performance vs. power: Finding a balance

In recent years, two conflicting technology trends have confronted designers developing rugged applications fit for the DoD's net-centric vision. First, system designers have tried to meet rapidly increasing requirements for processing speed while keeping power as low as possible as these systems need to operate using limited vehicle power – or they need to be battery operated. Typically the higher the processing speed, the higher the power. Until recently most 3U SBC cards with 1 GHz+ CPUs operated at 18 W or higher with a complement of basic I/O like GbE, serial ports, GPIO, and backplane interface. However, with new 45 nm technology, combination of North and Southbridge into a single System Controller Hub (SCH) chip, and small-sized components, it is now possible to have an Intel Architecture-based SBC that

Net-centric battlefield mingles with high-speed fabrics

To realize the DoD's vision of a ubiquitous net-centric battlefield connecting the war fighter with critical data in real time, embedded COTS vendors have begun to deliver innovative open standards-based rugged SBCs, high-speed switches, and router modules. The principles that define the net-centric model are:

- Increase the reach of the network
- Increase the network's richness (for example, to support bandwidth-dependent services such as video)
- Deliver that rich data right now – in real time

The goal of these principles is to significantly improve, reduce, and speed the “sensor-to-shooter” decision-making chain through the use of advanced fabric connectivity such as GbE. Figure 1 shows that by bringing advanced IP network interfaces to compact, rugged COTS modules, embedded vendors are helping to extend the network to every battlefield platform, from air and sea to land vehicles and individual soldiers. The use of these highly rugged, high-speed interconnects is enabling net-centric operations to propagate where they could not reach before, with a greater richness of data, all in near real time.



Figure 1: By bringing advanced IP network interfaces to compact, rugged COTS modules, embedded vendors are helping to extend the network to every battlefield platform, from air and sea to land vehicles and individual soldiers.

operates at 1 GHz+ under 10 W in a 3U form factor.

Intel's new Atom processor Z5xx series serves as a good low-power option for this new class of 3U VPX SBCs. The Atom features the new Intel Low Power Microarchitecture with advanced power management techniques such as the new C6 state (Deep Power Down Technology) Enhanced Intel SpeedStep technology, CMOS mode, and split I/O power supply support. These low-power features make the Intel Atom processor Z5xx series ideal for Size, Weight, and Power (SWaP) constrained and fanless embedded applications on real-estate challenged 3U VPX form factors.

High-speed backplane connectivity with 3U VPX

Previously, the lack of an open standard, high-performance, small form factor board architecture constrained the choices available to defense system integrators. System designers confronted with these challenging high-performance, low-power requirements had little choice but to compromise their design by either choosing less performance or higher power. Or they could eschew an open standard COTS solution, with its cost advantages and long life-cycle support, by turning to proprietary and costly integration options. For a number of years, 3U CompactPCI represented the best option for a small form factor open standard board. However, a 32-bit CompactPCI bus can achieve 132 MBps (33 MHz). Also, implementing a switched serial fabric such as PCI Express (PCIe) on CompactPCI requires the use of serial-to-parallel bridge conversion chips, a burdensome real-estate requirement on small form factor cards. Additionally, the pins in CompactPCI backplanes do not support higher-speed signaling.

3U VPX, the small form factor variant of the VPX and VPX-REDI (VITA 48) open standards, satisfies both sides of the seemingly incompatible demands for more performance from smaller cards. VPX's MultiGig RT2 connector significantly raises the performance bar, with support for two PCIe (x4) interfaces for the data-plane, which can support an aggregate 4 to 5 GBps for eight fabric lanes of PCIe.

GbE network connectivity

Previously, the greatest impediment to the DoD's vision of net-centricity (see sidebar, opposite page) and bringing the network to the edge of the battlefield was the performance limits of slower legacy data buses. These include CANbus

or MIL-STD-1553 interconnects, for example, both of which top out at about 1 Mbps, or in some limited cases at 10/100 Ethernet links on existing platforms. These relatively slow interconnects create a bottleneck, slowing delivery of critical battlefield information needed for situational awareness. Additionally, these different interconnect technologies do not provide the common standardized methods of data transport needed for interoperability between battlefield systems and applications.

By bringing GbE interconnectivity to rugged Line Replaceable Modules (LRMs) such as 3U VPX boards, it is possible to effectively reduce rich data transfer times from minutes to subsections within internal switching context times as low as a few microseconds – and drastically reduce response time. This brings the battlefield network closer to the ultimate goal of real-time delivery of much richer data (video, signal processing, enemy tracking) for actionable intelligence.

By bringing GbE to the intervehicle network, network modules provide significant performance improvement, from 1 Mbps to 1,000 Mbps, over legacy data communications architectures such as CANbus or MIL-STD-1553. Even better, these modules are being designed to support next-generation 10 GbE, which can deliver a 100x increase in bandwidth and intravehicle data communications capacity.

Security becomes reality with VPX

The battlefield network can be a dangerous place. Security has become an increasingly critical concern for embedded system integrators in light of rising dangers of reverse engineering when technology falls into enemy hands. In FY2007, foreign military sales exceeded \$19 billion, reflecting the sheer volume of U.S. technology out of direct control. The use of VITA 48 covers on a 3U VPX Line Replaceable Module lends itself nicely to creating an opaque security boundary that can conceal the underlying electronics. By extending top and bottom VITA 48 covers to completely cover all components on a PWB and enabling it with an active mesh, a secure electronic boundary can be implemented at the module level. Should a tamper event occur where an attacker tries to penetrate the electronic boundary on a 3U VPX board, a penalty can be enforced that can erase a security key or destroy the electronics underneath, protecting sensitive data or Intellectual Property.

Networking at the battlefield's edge

Today's new open-standards-based 3U VPX is an emerging platform that can be used to address the needs of a new breed of computers at the networks' edge. It will improve the operational effectiveness of the net-centric model with its performance vs. power benefits, superior backplane and serial fabric connectivity, and security-facilitating capabilities. These secure 3U VPX rugged computers will help extend the reach of the network into places it couldn't reach before.

Figure 2 depicts Curtiss-Wright's VPX3-1100 ATOMIC SBC, which combines the benefits of low-power, high-performance processing, network connectivity, and advanced security. The SBC provides a 1.1 GHz Intel Atom processor and up to 512 MB DDR2 SDRAM, 1 GB NAND flash, a BIOS Firmware Hub (FWH), and a Trusted Platform Module for trusted boot. The ATOMIC card additionally features 2-Level Maintenance Secure Computing perimeter defense technology. **CS**

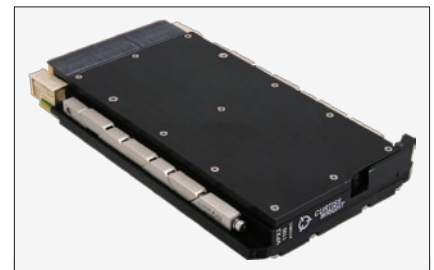


Figure 2: Curtiss-Wright's new 3U VPX3-1100 ATOMIC is an example of an SBC that combines the benefits of low-power, high-performance processing with network connectivity and advanced security.



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