ATCA and CompactPCI Take Post-Acceptance Victory Laps

Embedded Computer Building Blocks Serve High-Bandwidth Military Needs

Form factors such as CompactPCI, VME and VPX provide solutions for today's ever growing demands for high-bandwidth data movement in military systems. PCI Express and Ethernet provide the fabric interconnects that bring it all together.

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The need for advanced connectivity and bandwidth is continually evolving to support the modern battlefield. This is mainly due to the availability, and thus demands, for higher image resolution technologies along with the ability to support multiple types of data and sensor sources for radar, sonar and surveillance applications. Military systems designers have begun to incorporate Ethernet and other high bandwidth protocols for more than pure networking. A growing number of military applications that require immense data processing are able to realize the benefits of using Ethernet and PCI Express for advanced switch deployments or as an interconnect fabric.

Designers of new and tech refresh programs looking for high bandwidth building blocks are turning to a variety of high-performance embedded computing platforms, including VME, CompactPCI and VPX. The sidebar on p. 48, "CompactPCI Builds Legacy of Success in Mil/Aero Programs," describes some example program wins for CompactPCI. For instance, VPX is able to utilize Gigabit Ethernet (GbE) on the backplane to implement high-speed serial link point-to-point connections between boards that enable significantly improved performance compared to parallel bus architectures. With VPX connectors and backplanes, the full data plane bandwidth does not have to be shared between boards. The result is that each board can have one or more dedicated 10 Gigabit connections via Ethernet or PCI Express, which is a tenfold increase in I/O bandwidth.

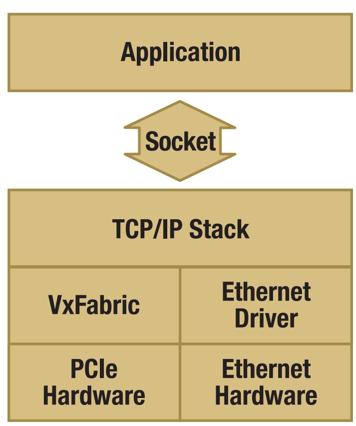

Figure 1

APIs provide a thin layer of software that helps simplify application development for IP-based transport over PCI Express

Fabric Choices Matter

But design challenges are far from over, even when the hardware platform is set. Additional analysis to determine the optimum communication protocol for the application is needed. Current standards, such as PCI Express, GbE and Serial RapidIO, offer different advantages that must be weighed. For example, PCI Express uses point-to-point serial links to provide an interface between I/Os and processor units, as well as a native communications link in a multiprocessor environment.

APIs Simplify Development

Application Program Interfaces (APIs) are becoming an essential development and data flow management tool to speed high bandwidth designs. APIs provide a thin layer of software that helps simplify application development for IP-based transport over PCI Express. Leveraging PCI Express' high bandwidth through an API allows designers to implement efficient inter-board communication at hardware processing speeds. From a software perspective, an API acts the same as the Ethernet network infrastructure, allowing applications written for TCP/IP sockets to use PCI Express for increased communications performance.

Addressing those needs, Kontron offers its VXFabric (Figure 1), which is an API for its PCI Express switch fabric technology for VPX High Performance Embed-

CompactPCI Builds Legacy of Success in Mil/Aero Programs

CompactPCI took a number of years to become an overnight success for military applications. Typical of the defense industry, acceptance of new embedded computer form factors takes time. But with two decades under its belt, CompactPCI is no longer the new kid on the block and has become an established option in a number of military and aerospace programs. There are numerous examples of CompactPCI providing the right solution.

The CompactPCI computers aboard the Navy's Stiletto boat manage the onboard integrated systems, such as situational awareness sensors and navigation, communications and networking, and craft control.

One example was a system developed in 2007 by QinetiQ as a defense project funded by the UK Ministry of Defence (MOD). The system gives unmanned aircraft an advanced level of independence and intelligence. A series of successful flight trials were flown using a Tornado as the command and control aircraft and QinetiQ's BAC 1-11 trials aircraft acting as a "surrogate" unmanned air vehicle (UAV). The Tornado pilot also had the responsibility of commanding three other simulated UAVs. For the flight trials, the control of the BAC 1-11 and the three simulated UAVs was handled by QinetiQ software running on Kontron components in four server racks—one rack for controlling each of the UAVs. Each rack contained multiple VMP2 3U Power PC processor boards and CP306 3U processor boards with processors based on Intel Centrino technology.

In a space-based example of CompactPCI in action, a cPCI board is part of a research module aboard the International Space Station. Built by EADS Space Transportation, the research module called DECLIC is dedicated to fluid and material research under microgravity. Using the system, scientists study the behavior of near ambient temperature-critical fluids. Depending on which experiment container is currently installed and operated, a control library and a hardware description relevant to that experiment are loaded. A CP303 CompactPCI based on a socketless low voltage 933 MHz Mobile Pentium III-M processor manages the following three tasks: it controls the temperature for each of the various experiment containers; it operates as the command interface for the scientific scripts which run on the data management computer, also based on a CompactPCI board; and finally, it collects the data from the five to eight microcontroller boards on which the specific intelligence for the individual experiment is implemented.

There are numerous Navy application examples of CompactPCI use. Among them was the Navy's Stiletto program. For the Stiletto boat, an embedded computing platform was needed that could perform flawlessly within the carbon fiber material used in Stiletto's hull (Sidebar Figure 1), which has been known to put special demands on electronics. The embedded computing runs Azimuth's CIES software to manage all of the boat's integrated systems—situational awareness sensors and navigation, communications and networking, craft control and integrated video capabilities.

Azimuth chose a Kontron CP6012, a 6U CompactPCI CPU board with an Intel Core Duo processor. This high performance, PCI Express-based computing blade enabled the Azimuth system to handle data throughput like a server. The CompactPCI-based solution also provided easy expansion capabilities for Azimuth, allowing 14 blades per chassis.

ded Computing (HPEC) environments. It allows military designers to develop extremely high-performance 6U OpenVPX technologies with greater than 10 Gbit/s board-to-board connectivity. This HPEC platform can facilitate the design of high-speed, socket-based communication between blades by using multiple switched fabric interconnects within the backplane. Another benefit of PCI Express is that it is a native data bus in all of today's processor chipsets with broad support from an existing and growing software ecosystem.

Compute-intensive military applications will continue to progress with the help of advanced fabric interconnect technologies, such as PCI Express and 10 Gigabit Ethernet, that can deliver the high bandwidth needed. Modern APIs accelerate the software development, allowing these technologies to be leveraged even under aggressive deployment schedules.

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