

VME Still Dominates Defense Market

The characteristics, development history, and deployed market potential of Compact PCI and VME are compared and contrasted. The author concludes that the defense sector's recent interest in CPCI will wane unless the long-term viability of PCI can be assured by significant support from the industrial and telecommunications sectors and a commitment to backwards compatibility.

Compact PCI (CPCI) is a new bus standard positioned against VMEbus with promises of lower cost, higher performance, and quicker access to technology advances. Not surprisingly, while there is some truth to the story, the choice between them is not simple, especially in the context of the military market. As an early adopter of Futurebus, the military learned a hard lesson in the early 90's as this technology never gained wider market acceptance. At that same time the VME standard was beginning to thrive in the commercial and industrial segments. Is this process repeating itself as outsourcing hits the telecommunications market and CPCI sees early interest by some integrators?

Depending on the application, selection of VME or CPCI is usually a question of trade-offs (Table 1). The following examination of several key attributes will highlight the strengths and weaknesses of these respective technologies.

FUNCTIONAL CHARACTERISTICS

Many modern VMEbus designs include on-board PCI. In these systems the VME bus does little more than indirectly interconnect these PCIs. In contrast, CPCI

directly connects the PCIs, eliminating the cost of a VME interface chip set. When applied to defense challenges, CPCI's benefits become foggy. This is because defense applications typically leverage fewer commodity PCI chips than commercial applications. Defense applications are thus less likely to already incorporate a PCI bus on every board and if a design does not already have a PCI bus, addition of a PCI bus is comparable to a VME bus. In this very common situation, selection between CPCI and VME requires a detailed analysis.

BANDWIDTH

On paper, the 32-bit version of CPCI offers users almost double the bandwidth of 64-bit VMEbus (132 Mbytes/sec versus 80 Mbytes/sec). In reality, PCI chips vary widely in quality. Poor PCI implementation in only a few chips affects an entire CPCI system. The best PCI chips that we have seen sustain DMA writes at 70 to 89 Mbytes/sec. This is only a little better than the best VME interfaces at 73 Mbytes/sec sustained. Though, it is expected that PCI implementations will improve over time.

Both the VMEbus and PCI communities have formal

PARAMETERS	VME	CPCI
Form Factor	6U 233mmX160mm	same
Air cooled	IEEE 1101.10	IEEE 1101.10
Conduction cooled	IEEE 1101.2	N/A
Bus width	8/16/32/64-bit	32 or 64bit
Addressing	Flexible add. modifiers	Fixed
Data types	Single cycle or burst	Burst optimized
Data rate- real/today	60MB/s	100MB/s
Data rate- theory future	320 - 520MB/s	264MB/s
Interrupts	7 levels- vectored	4 levels- polled
Multi-master	Yes, all slots	Master slot 1
# of slots	21	6-8 (bridge to extend)
I/O Pin count	205 (VME64x)	340

Table 1. CPCI and VMEbus Comparison

plans for significant bandwidth improvements, however, the VME world will implement its plans more gradually than the CPCI world.

BASIC ARCHITECTURE

CPCI is an I/O bus-one host interacting with multiple slaves. In contrast, VMEbus is a full-featured bus that supports peer multiprocessing. Many military systems take advantage of this extra functionality. For example, it is common to leverage VME's features to provide a communications backbone between multiple SBCs pressed into a single VMEbus. CPCI cannot easily duplicate VME's support for multiple SBCs. This is because commodity PCI bridge silicon, which expects a flat address space, does not include necessary address translation hardware. Also, off-the-shelf Wintel software does not understand how to initialize a multi-processor PCI configuration.

The maximum number of slots also differs. VME supports 21 slots, CPCI supports 9. Further complicating matters, the single CPCI slot designated for "hosts" differs from the eight slots available for I/O boards. Expanding beyond eight I/O slots is possible, but expansion requires active bridging technology that introduces cost, latency, and special packaging.

PMC on CPCI does have a potential "slot" advantage over PMC on VME. This is because a 6U VME slot physically supports only two PMC daughtercards. Thus

VME configurations must incorporate special expansion hardware when designers require more than two PMC daughtercards hanging off one SBC. Such expansion is simple if your SBC vendor embraced the problem and included that hardware. However, most SBCs do not include this hardware. To address this lack VMETRO created the Midas PMC I/O Subsystem for VMEbus and RACEway. Midas enables PMC expansion in VME with any PMC or RACEway SBC.

CPCI does not share this expansion challenge. PMC daughtercards in a CPCI system always share a single PCI bus, making an expensive Midas-like subsystem unnecessary in CPCI.

Some companies mix CPCI with VMEbus, attempting to combine Compact PCI's advantages with VME's large inventory of existing designs. A formal standard exists for doing this. The CPCI bus looks to VME like a single board computer with an unusually large number of PMC cards. To realize these cost savings, CPCI boards must someday cost less than PMC daughtercards (today CPCI boards cost about the same as VME boards-significantly more than PMC daughter cards generally cost). One final architecture note, VMEbus does not provide parity protection while CPCI does.

CONDUCTION COOLING

The CPCI standards group (PICMG) has not defined a

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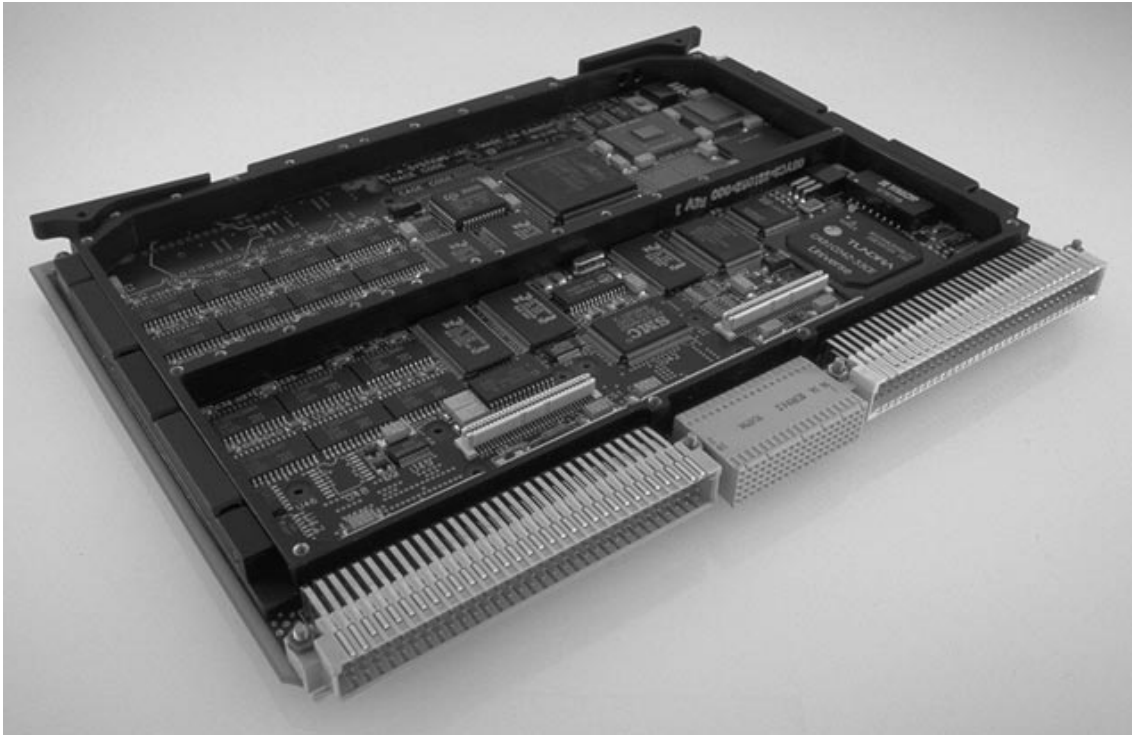


Figure 1. Rugged VME PowerPC SBC

conduction-cooled variant. Fortunately, mapping the VMEbus conduction-cooling standard (IEEE 1101.2) into CPCI is reasonable. There is no reason, however, to expect CPCI to offer significant savings here.

TECHNOLOGY ROADMAP

The Microsoft Windows™/Intel™ (Wintel) world is evolving faster than the VMEbus world. CPCI allows users to quickly leverage new technology. For example, Wintel initiatives such as hot swapping, PnP, VIA, and I2O should become available to CPCI users long before equivalent standards evolve within VME. However, new Wintel technologies primarily benefit users of Microsoft operating systems and Intel microprocessors. These users are not significant players in today's defense market for embedded computers because Wintel systems are not optimized for real-time, floating point performance, or low-power consumption.

MARKET

The VMEbus market is mature and of significant size. CPCI is new but it has benefited from some of VME's momentum thanks to their physical similarities. It is not clear that CPCI will become the harsh environment PCI standard as there are alternative industrial/telecommunications PCI solutions, such as PCI-ISA, that may prevail. While not rugged, PCI-ISA and other industrial PCI standards efforts could steal many of CPCI's commercial volume opportunities. Without volume boosts beyond VME, the CPCI industry cannot significantly undercut VME costs.

LIFE CYCLE

Ideally, a backplane standard should prosper throughout the 10 to 20 year life cycles of the military. The military paradigm of 'technology insertion' only offers value

if the backplane standard outlives the board technology by orders of magnitude. A living standard does permit affordable "model year upgrades." VME has demonstrated that it can sustain military life cycles by delivering new technology with backward compatibility.

In contrast, Intel invented PCI for use within the fast-moving desktop PC world. Unfortunately for the chip vendors, the life span of PCI at Intel is limited. A movement exists within the PC community to replace PCI slots with high-speed serial connectors in a form factor called "Device Bay".

Furthermore, Intel recently announced plans to replace PCI internally on the desktop. Although details are sketchy, Intel indicated that a new unnamed bus using ultra fast gigabit serial bus technology is under development. It remains unclear how these plans will impact the chip community, and as a result, how these developments will affect the life span of CPCI

SUMMARY

Today, compared to VMEbus, CPCI is a risky alternative for defense, especially for deployment. Early defense adopters of CPCI will demand significant advantages to offset that risk. If CPCI wins in the industrial and telecommunications markets (i.e. there is broad industry sourcing of competitive off the shelf products) conservative decision-makers may find CPCI palatable for defense applications. ■

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