PC/104 Outlook: How will PCI impact PC/104?

By Jim Blazer

Will PCI's transition into the embedded market follow the path blazed by PC/104 when it brought the ISA bus to embedded designs? Will PCI enjoy the success of PC/104 – or become an "also ran" like so many others? Will PCI signal the end of PC/104? Before looking ahead and trying to predict how PCI will affect PC/104, we need to remember the evolution of the embedded PC that was popularized by PC/104.

PC/104 History

When Ampro Computers, Real Time Devices, and Enclosure Technologies first sat down together in 1991 to form the PC/104 Consortium, they could only imagine the impact that meeting would have on the future of embedded computing. The initial release of the PC/104 specification in March of 1992 provided an open platform with the power and flexibility of an IBM compatible personal computer in a size suited for embedded systems. The specification was eagerly accepted by the embedded market, and membership in the PC/104 Consortium has since grown to over 160 companies worldwide.

Over the course of the next four years, PC/104 has evolved into the darling of the embedded control market. PC/104 CPUs running Microsoft's MS-DOS are easy to program and include standard peripherals that are difficult to provide on embedded microcomputers. I/O interfaces for video mass storage, keyboards, networking, serial communications, parallel I/O and data acquisition are common peripherals in an embedded system. Special adaptations for embedded control such as watchdog timers, non-volatile configuration and on-board solid state disks are provided by many vendors. The mechanical, rugged design is well-suited to the high shock and vibration that characterize many embedded applications.

Due to its elegantly simple concept, PC/104 is attracting rapidly growing interest in the embedded systems world – a phenomenon which has contributed to the explosion of the PC/104 market. PC/104 is being utilized in many applications that were previously reserved for microcontrollers, such as:

- ❏ distributed data acquisition
- ❏ industrial control
- ❏ communications nodes

The use of PC/104 as a mezzanine bus to allow simple system upgrades of CPU and/or peripherals mounted on a larger PC board serve to further enhance PC/104's popularity. This market is still emerging and will continue to grow as more developers realize the time and cost savings in such key areas as:

- ❏ system design
- ❏ software development
- ❏ time-to-market

While PC/104 CPUs have evolved from simple XTs with limited functionality to fully integrated 586 single board computers, the mainstay of the market is still in the lower-end PC modules. Intel 80386 class CPUs dominate sales in the embedded arena. Why? Because an 80386SX product runs circles around what embedded system designers have been using, the price is attractive, and a large selection of peripheral interfaces with software drivers is available. Lower software development costs, better software tools and simple upgrades make PC/104 an easy choice for embedded system designers.

Introducing PC/104-*Plus*

PC/104 has closely followed the lead of the desktop PC market, albeit a few years behind. It has taken advantage of commercially available, highly integrated CPUs and chipsets. It was only natural to expect PC/104 to continue following the desktop PC market, but an obstacle emerged. Desktop PCs were quickly moving to the PCI bus in order to support faster video cards and hard drives, while PC/104 remained tied to the IEEE P996 (ISA bus) specification.

To address this situation, the PC/104 Consortium's Board of Directors commissioned a committee to develop a specification that would bring the PCI bus to PC/104, electing me to serve as Chair. The committee represented about 30 companies worldwide and reviewed ideas from all contributors. A specification submitted by Ampro Computers was selected as a starting point, since it offered the most detail and was backed by thorough bus simulations and an existing product.

Defining the specification

It seemed that everyone had some concept of how PC/104-*Plus* (as it was dubbed) should look. Connector type and location, bus signals and compatibility with other PCI implementations were discussed. However, the greatest point of departure was board size and shape. The consensus of the group was to define a specification that was a consistent form factor with PC/104 to prevent confusion in the marketplace. PC/104-*Plus*, as the name was intended to imply, is an *addition* to the PC/104 – not a *replacement*.

There was a very real concern about the proposed 3.6" x 3.8" form factor, since this small footprint with two connectors leaves very little room for components. To allow larger size boards, the specification covers both "Compliant" and "Bus Compatible" conformance levels. Compliant modules use the 3.6" x 3.8" board with options to have only the PC/104-*Plus* connector, or both the PC/104-*Plus* and the PC/104 connectors. Bus Compatible boards can be any other form factor that conforms to all specifications *except* mechanical size.

After refinement of the specification and concurrence by all members of the working group, the PC/104-*Plus* specification was formalized in February of 1997 by the voting members of the PC/104 Consortium. With a specification in hand, developers were free to produce high-end embedded PCs and peripherals. System designers enjoyed the flexibility of another choice for embedded designs, since PC/104-*Plus* is compatible with PC/104. It is important to remember that PC/104-*Plus* was never intended to

replace PC/104 – only to provide an expansion path for systems requiring higher processing power or faster data throughput.

Market acceptance

Industrial control applications are just starting to convert from microcontroller based systems to the embedded PC. Keep in mind that a 386SX product is much faster than most microcontrollers used by embedded system designers. When you consider the factors of lower software development costs and easy upgrades, it is little wonder that stackable PC/104 modules have enjoyed such wide industry acceptance. Many of these applications have limited financial, size and/or power budgets. Smaller, low-power, inexpensive CPUs and peripherals will undoubtedly dominate this market. As such, initial investments in PC/104-*Plus* will only capture a small segment of the total PC104 market – most likely the top of the market pyramid.

Real Time Devices USA has concerns over market misconceptions about the links between PC/104 and PC/104-*Plus*. Customers might erroneously assume that PC/104 is an inferior product, when nothing could be further from the truth. While PC/104-*Plus* provides an upgrade path for future growth, in the words of our President Bob Haris, "Classic PC/104 modules will remain the mainstay of the embedded control industry for some time to come."

Conclusion

The Desktop PC market is driven to provide the ever-higher processing power that is required by multimedia, communications. and mass storage applications. In contrast, the embedded system designers are looking for a small size and low-power embedded PC that is software compatible with their desktop PC. For these reasons, the embedded market does not move to higher-power architectures at the same rate as the desktop market. PC/104 has proven to be the ideal answer for many embedded applications. We must continue to emphasize the merits of PC/104 as we incorporate the benefits of the PCI bus.

As chair of the PC/104 Consortium's PCI working group, I support the PC/104-*Plus* specification. The committee forged the specification with the intent to advance the PC/104 market without creating any confusion. The specification not only allows a blend of PC/104 and PC/104-*Plus* modules, it reveals PC/104-*Plus* to be an application-specific *enhancement* to the PC/104, not a *replacement*.

Jim Blazer, BSEE, the Director of Engineering at Real Time Devices USA, is responsible for managing a multinational engineering team dedicated to the design of intelligent data acquisition hardware and software and embedded DOS based computers. He also serves as Director of PC/104 Consortium, Co-chair of the PC/104 Consortium Technical Committee, and Chair of the PC/104-*Plus* Committee. You can reach him at jblazer@rtdusa.com.

For more information:

Real Time Devices USA, Inc.
200 Innovation Boulevard
State College, PA 16804
Tel: 814-234-8087
Fax: 814-234-5218
Email: sales@rtdusa.com

