

The case for a new small form factor

By Jonathan Miller

Since the beginning of the PC/104 specification 15 years ago, the choice of compute technologies and pervasiveness of embedded systems have expanded in an impressive array of applications. PC/104 has a great legacy but is strongly tied to backward compatibility. Therefore, the time is ripe for introducing a new standard that not only incorporates the key benefits of PC/104, but also responds to new technologies and market conditions.

The PC/104 specification brought two significant benefits:

- **Easy expansion:** By installing one or more I/O modules onto a CPU, designers could customize systems to meet their needs without sacrificing functionality or paying for unneeded features.
- **Interoperability:** By attracting a large number of companies that offer compatible CPU and I/O boards as well as accessories like enclosures, PC/104 gave designers a wide choice of vendors and components to choose from.

These two attraction forces created a snowball effect in the market: The relative ease of developing with PC/104 helped attract the largest number of vendors and customers to the format and ensured fast market acceptance of the standard.

But today, other forces are at work. In addition to x86 processors, many other

alternative processor architectures are available to meet varying embedded application needs. Multiple full-featured operating systems available now are not solely dependent on x86 technology. And new concepts in packaging have appeared, such as incorporating I/O connectors directly onto a board for reduced cost and increased ease of assembly.

PC/104 and its related formats (EBX, EPIC) have never exceeded more than about 7 percent of the market for embedded boards. The vast majority of PC/104 applications are small volume, deploying up to roughly 100 systems per year. More appropriate choices are now available to customers with higher-volume or higher-performance needs.

New small form factor requirements

To build on the benefits of PC/104, incorporate new technology, address higher volumes, and capture more market share, a new form factor definition should include the following features.

Support for multiple processor architectures

Compatibility with multiple processor architectures will give the new form factor the greatest chance for market penetration and success. This also allows support for a wider range of operating systems.

Ease of system configuration

The purpose of any expandable system architecture is to enable convenient

Editor's note: Readers probably recognize Jonathan Miller as past president of the PC/104 Embedded Consortium, president of Diamond Systems Corporation, and a frequent contributor to our magazine. We excerpted the following text from an article Jonathan submitted for publication. Coincidentally, we recently talked with Bob Burckle on the formation of the SFF-SIG, as shown in the sidebar. Jonathan and Diamond Systems are not (yet) affiliated with the SFF-SIG. But the timing of these events is interesting to us.

system configuration to meet each application's unique requirements. The new form factor must provide an expansion bus signaling system with multiple options for flexibility and a mechanical interconnection method of suitable ruggedness and ease.

Support for multiple I/O expansion buses

While ISA is all but obsolete, multiple I/O vehicles are available for expansion, including PCI, PCI Express, Ethernet, USB, Low Pin Count (LPC), Serial Peripheral Interface (SPI), and Serial ATA (SATA), to name a few. Limiting a new form factor to a single bus unnecessarily restricts its life cycle and appeal. Today's high-speed, high-density connectors can accommodate enough signal paths to support multiple buses on one connector. A single connector could improve ease of assembly and reduce the space needed for interconnects.

Ease of system assembly

One of the biggest problems with PC/104 is the difficulty of assembling and housing a system. Virtually all PC/104 systems require custom packaging solutions and complex cabling of questionable ruggedness. In addition, removing a board from the stack to reconfigure or repair it involves cumbersome hardware disassembly and difficult separation of boards with tight mechanical connections at one or more sides. The new form factor should be inherently easy to assemble, disassemble, and reconfigure.

Ruggedness

Embedded systems are frequently used in applications exposed to shock, vibration, humidity, corrosive elements, repeat handling, and temperature extremes. The physical format of the new form factor should address these issues suitably. It may not be possible or even desirable to address all environmental concerns in the basic solution because of cost, size, or weight issues. However, the form factor should provide an appropriate starting point to address these issues so that a customer requiring a rugged solution would consider the form factor a viable option.

Long life cycle

As the nature of embedded systems involves enabling customers to depend on a consistent platform for the life of their product, the new form factor must be designed around technologies and components expected to have long life cycles. The components selected should be available from multiple vendors whenever possible to minimize supply-chain risk.

Widest possible vendor base

The momentum created by a large number of vendors committed to a standard will propel it into a position of prominence.

Vendors will develop products to expand the range of options, making it attractive to customers needing customization capabilities or concerned about dependence on a single vendor. Support from multiple vendors creates competition, driving down prices and providing incentives to constantly improve performance. ➤



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Corporation. He held various technical positions before launching Diamond Systems in 1989. He also ran in the 2003 California gubernatorial recall election in which voters replaced incumbent Governor Gray Davis with Arnold Schwarzenegger. Jonathan has a BS in Computer Science from the Massachusetts Institute of Technology.

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SFF-SIG formed

At the Embedded Systems Conference in Boston this September, five industry leaders announced the formation of a new standards group focused on small form factors. The group, dubbed Small Form Factor Special Interest Group (SFF-SIG), has charted a course to develop, adopt, and promote circuit board specifications and related technologies that will help electronics equipment manufacturers and integrators reduce the overall size of their next-generation systems.



The group's philosophy is to embrace the latest technologies, maintain legacy compatibility, and enable transition solutions for next-generation interfaces. New technologies available to long life-cycle system and device manufacturers include highly integrated, lower-power processors, chipsets, and memory based on 90 nm and 65 nm processes, higher-density connectors with improvements for ruggedness, and high-speed serial interfaces such as PCI Express, Serial ATA (SATA), and USB 2.0, which replace slower and space-consuming parallel interfaces.

Founding members include Octagon Systems, Samtec, Tri-M Systems, VIA Technologies, and WinSystems. The group is actively seeking broader membership and aiming to provide a forum that can help manufacturers with proprietary small form factor designs gain broader support through adoption and standardization of their technologies. For more information, visit www.sff-sig.org.