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Processor Options Stack up for Industrial Applications

By Caroline Hayes, Senior Editor

Traditionally, the reliability of the PC/104 stackable board format means they have been widely used in industrial applications. Now, this reliability is supplemented with a supportive ecosystem and more processor options.

Sundance Technology has a strategy to introduce ARM architecture to boards and has added the EMC² KU35 model to its EMC² range.

The stackable design of PC/104 makes the boards a rugged structure as well as expandable as a project evolves. Central Processing Units (CPUs) can be replaced easily, and inexpensively, compared with other rack systems, where a backplane would have to be replaced.

Flemming Christensen: Managing Director, Sundance Technology and Technical Chair, PC/104 Consortium.

Flemming Christensen, Managing Director, Sundance Technology, is also Technical Chair of the PC/104 Consortium and believes that this versatility helps address the redundancy cycle, as the boards can be retrofitted to include the latest version of a processor.

“All systems will have a CPU board. That is the one that is most likely to be upgraded, whereas the I/O interfaces, the display control and the USB control—they never change. PC/104 allows the developer to keep all the I/O boards, and just change the CPU board,” he explains. This helps with the redundancy cycles, he adds, bearing in mind that CPUs will typically have a seven-year life guarantee, whereas an embedded system, particularly in medical applications, may be in operation for 20 years. In such cases, if a compatible processor cannot be sourced, it is possible to upgrade to the latest version with minimal fuss. There are also power savings, he notes, from using the latest processor, as the user can benefit from advances in processor technology with each iteration. “The alternative is a Computer on Module (COM),” says Christensen, “where you assign a custom, bespoke carrier board, with all the I/O needed on a single board. They are stackable but limited to two stacked boards. You can add a carrier board; they are expandable, but still benefit from the same concept in that you can replace the CPU board.”

Industry Collaboration

PC/104 is designed for integration into embedded systems, as opposed to COMs, which are used in hundreds of thousands of systems each year, sums up Christensen. He estimates that PC/104 is used by developers that are designing and integrating boards into fewer than 100 systems per year.

Rodger Hosking: Vice President, Pentek.

Rodger Hosking, Vice President, Pentek, points out that other parties, other than board suppliers, have a stake in reliable, rugged industrial applications. “System integrator and enclosure vendors bear a significant share of responsibility for protecting PC/104 boards from environmental factors, such as heat, moisture, shock and vibration, which are all common adversaries of reliability and maintainability,” he says.

Part of the industry collaboration extends to the wide choice of processors used on boards. Sundance Technology has a strategy to introduce ARM architecture to boards, and has added the EMC² KU35 model to its EMC² range (Figure 1). It integrates Xilinx’s Kintex UltraScale FPGA.

“PC/104 has always been based on Intel or AMD processors,” explains Christensen, explaining the company’s decision to introduce ARM architecture. The main reason is the ARM ecosystem of hardware and software suppliers, offering support. “ARM is already in the embedded market, with its Internet of Things (IoT), which Sundance refers to as embedded. We have always done IoT,” he laughs, “but we have always called it embedded.” Although he concedes that the ARM and FPGA combination may be expensive at the moment, he justifies the use of the Zynq FPGA, saying: “Sundance picked a Xilinx Zynq FPGA, which has a dual core ARM and a lot of fabric. This makes them more expensive than a standard CPU, but we are introducing the concept of stackable boards using FPGA technology,” he says.

The pricing means that the ARM and FPGA combination will not be used for large volume applications—at the moment, he adds.

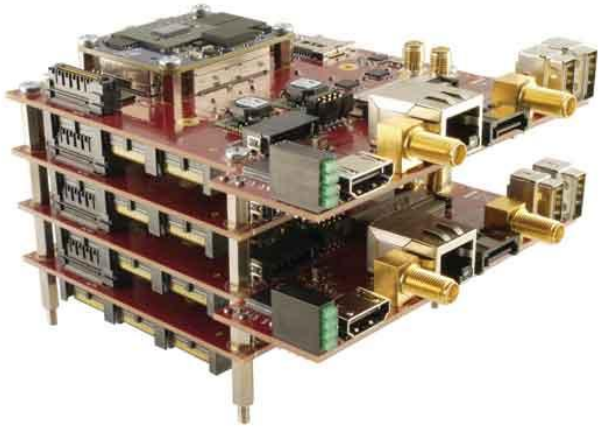

Figure 1: The EMC² KU35 adds to Sundance Technology’s EMC² family, introducing ARM architecture to embedded industrial systems.

The EMC²-KU35 stackable module has Gen2 PCI Express interfaces compatible with the OneBank, 16-lane connector. The Kintex UltraScale KU35 FPGA has a dual-core ARM-A9 processor and controls the VITA

57.1 FMC FPGA Mezzanine Card (FMC) I/O slot to meet Commercial-Off-The-Shelf (COTS) or bespoke I/O modules for custom expansion.

The industrial-grade PC/104 board has two banks of 16-bit Double Data Rate fourth generation (DDR4) memory, with just under 2Gbyte per sec bandwidth per bank. It measures 90 x 96mm. Board-to-board bandwidth is typically above 500Mbyte per sec using the module's OneBank connectors. It is also possible to achieve a bandwidth of over 6GByte per sec using the FMC I/O module.

Design support is offered with the Xilinx Vivado tools. The module can be combined with x86-based Single Board Computers (SBCs) to integrate into embedded systems, according to function and capability needs, as well as interconnection and computing requirements.

Figure 2: The Jade family uses Xilinx Kintex UltraScale FPGAs.

Although not PC/104, the Jade XMC modules from Pentek also use Xilinx's Kintex UltraScale FPGAs. They are designed for industrial applications that require acquisition and processing of wideband sensor signals for process monitoring, explains Hosking. "Many industrial systems require very fast feedback control loops to maintain manufacturing tolerances," he says, "and Jade products, equipped with fast ADC and DAC front ends and a powerful, real-time processing engine, can execute complex, high-speed algorithms much faster than any CPU, and still maintain extremely low latency." He addresses the cost associated with FPGAs. "The unit cost of critical resources, such as logic cells and DSP engines is not only lower than previous generation FPGAs, but also lower than other members of the UltraScale family," he points out. "Secondly, the power dissipation per function is significantly less than previous families. . . .and, for the first time, the DSP and logic resource density of

Kintex devices exceeds those of the traditionally highest Virtex members of the UltraScale family," he reasons. "Jade offers significant advantages in boosting DSP horsepower, while reducing cost, heat and size," he says, describing the combination as a "powerful incentive for system designers of virtually all high-performance acquisition and signal processing applications."

Altera Arria FPGAs

Although Xilinx FPGAs are the choice of both Sundance Technology and Pentek, Altera FPGAs are the logic of choice for companies like Colorado Engineering. It has introduced the PCIe/104-A10 module, for video and image processing applications. It is built using Altera's Arria 10 FPGA, with 1,150K Logic Elements (KLEs) and core fabric clock speed of up to 800MHz.

The module can be used for video capture, recording and downlinking, image processing and machine vision in factory applications, as well as robotics and industrial inspection. It can be used for Cost, Size, Weight and Power (C-SWaP) applications or as part of large systems with one, four, eight, 16 or more video input channels.

Connector Plans

To meet the need of CPUs with an integrated graphics processor, becoming popular as more functionality is required in embedded systems, the PC/104 Consortium adopted the Samtec Gen2 PCIe Express connector, which offers 16 lanes, covering CPU to graphics I/O. However, a further development for PC/104 is being planned. Christensen reveals that plans are underway for a smaller, faster connector design, offering an increased number of signals, up to 200 pins and taking up less real estate, possibly as much as 20 percent less, than the OneBank connector. Further details will be released when the concept is announced, in around 18 months, assures Christensen.

Caroline Hayes has been a journalist covering the electronics sector for more than 20 years. She has worked on several European titles, reporting on a variety of industries, including communications, broadcast and automotive.

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