MicroTCA Heeds the Call for 40GbE

August 28th, 2017

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Where and how to implement 40GbE in MicroTCA is a process seemingly out of step with the body that specifies the open communications system standard. By anticipating customer needs, VadaTech is moving ahead and 40GbE is gaining traction.

Back in 2014, developers were grappling with wired and wireless communication systems that needed a boost. The scalable and modular Micro Telecommunications Computing Architecture (MicroTCA) standard was stuck at 10GbE, yet developers needed a performance boost to meet the complexity, speeds, and power demands of military, commercial, and industrial communications.

At Embedded World, in Nuremberg, Germany, VadaTech introduced the industry's first 40G MicroTCA chassis platform, designed for 40GbE signals. The VT866 (Figure 1) proved to be ground-breaking and was certainly ahead of its time; the PCI Manufacturer's Industrial Computer Group (PICMG) was deliberating on the draft specification for 40GbE at the time.

Figure 1: The VT866 was the first 40G MicroTCA chassis available in 2014.

Ian Shearer, Managing Director, VadaTech UK, recalls the reaction to the launch: "Market sectors—telecommunications, application specific integrated circuit [ASIC] emulation, optical communications —were all looking for high bandwidth on the backplane. It was a little esoteric then, now there are several products to support 40GbE at the front, but none at the back."

Defining Specifications

As recently as April this year, PICMG reported that it is still deliberating on ways to incorporate 40GbE into MicroTCA systems. It currently runs at 10GbE for 10GBASE-KX and 10GBASE-KR. The Higher Speed Ethernet Fabrics for MicroTCA and AMC.2 group is focused on incorporating 10GBASE-KX4, 10GBASE-KR and 40GBASE-KR4, and to make them backward-compatible with existing MicroTCA and Advanced Mezzanine Cards (AMC) connectors. It is also important that the 40G MicroTCA products are interoperable at 40GbE speeds and that there is guidance for third parties to develop products that are able to operate effectively at the increased rates.

Ian Shearer, Managing Director, VadaTech UK

One of the stumbling blocks is signal integrity at the higher speeds. Signal integrity testing is needed to make sure that the MicroTCA construction is robust and interoperable. The PICMG group assessed AMCs, MicroTCA Carrier Hubs (MCHs), and backplanes or chassis for 10GBASE-KR compliance testing, testing differential insertion loss, skew, differential return loss, crosstalk ratio to insertion loss, and jitter tolerance. (The VadaTech VT866 is designed for 40GbE 10GBASE-KR signals.) It reported "a good solid baseline for 40G signal integrity efforts."

The results will be used to update the MicroTCA specification, which will be submitted for review and approval.

Upgrade Program

At VadaTech, Shearer reports that the company is already upgrading all chassis that ship in bulk to 40G. He breezes over what needs to be done to upgrade: "The backplane connector supports 40G, it is simply a question of getting the signal integrity on the backplane, making sure the layout is appropriate and using the correct material," he says. "When you go to higher speeds, you get better performance if you go to low loss material on the backplane," he reveals. "We use Meg6 [Megatron 6], although you can continue to use RB4 Printed Circuit Board (PCB) material, but we see issues with that at higher speeds," he counsels. "To get the best signal integrity, we do signal integrity design work and [use Meg6]. It is a slightly more expensive material but it gives better performance on the system," he says.

This approach is possible as the company is unusual in that it designs and produces every part of the system, chassis, processor card, Field Programmable Gate Array (FPGA) card as well as the switch and management software. As the company covers construction and software, it can carry out system level tests to reassure the customer.

Figure 2: The UTC004 MCH introduced Layer 3 switches.

The introduction of the VT866 was in response to customer requests for a 40GbE level of performance, reveals Shearer. "As VT866 took off, the need for an MCH with a Layer 3 switch gained traction, as a lot of people are looking for that level of performance," he continues. This led to the introduction of the UTC004, a third generation, 40Gbe/PCIe Gen3 MCH, with Layer 3 managed Ethernet switches (Figure 2).

FPGA Capability

The next step is to enhance MicroTCA's capability, says Shearer. It is clear that 40GbE on the backplane is gaining traction. The next step is to address point-to-point connectivity for ASIC emulation and high data rates. The company's progress is driven, observes Shearer, by its strong relationship with Xilinx. It is using Xilinx UltraScale Plus FPGAs to double bandwidth, says Shearer and is still looking at ways to enhance capability and support without moving up to the size, and expense, of AdvancedTCA (ATCA).

Adding standard fabrics in the MCH space to support PCIe Gen3 and RIO is the next step, Shearer believes, together with adding an FPGA option to replace the fabric switch and thus increase the flexibility of the architecture. This motivation has also led to the introduction of the UTC006 double module MCH (Figure 3) which has PCIe Gen3, 10/40GbE, Xilinx Virtex-7 FPGA, Cross Bar Switch (CBS), and Serial Rapid Input Output (SRIO) fabric options.

Figure 3: The UTC006 is a double module MCH with fabric options.

A recent application of this was at Oak Ridge National Laboratory , where the research team needed a low latency system in the Spallation Neutron Source particle accelerator. The accelerator covers a wide area and uses a Machine Protection System to monitor over 1,000 sensors.

The power generated by the accelerator was high but also subject to uncontrolled energy release and power flow. In the event of any hazards, the accelerator has to be shut down before any damage occurs. Commenting on the use of the UTC006 in this project, Shearer says that the MicroTCA 4 standard provides the additional precision timing and clock distribution across the backplane and allows signal conditioning in the rear.

Although this illustrates the options and flexibility available, there is also a case to be made that development work has to continue for commercial customers who want interoperability and to work within standards. The industry and PICMG have to reach agreement on a timetable for this to come about.

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