Achieve High-Performance Computing in Three Easy Steps

Solve Your Big Data Computing Challenges with Micron® Advanced Computing Solutions

Overview

Start solving some of big data’s biggest computing challenges — from the edge to the data center to the desktop and the cloud — with the industry’s leading technology for high-performance computing (HPC) systems: Advanced Computing Solutions (ACS). Our modular and massively scalable architecture, built upon advanced memory and field-programmable gate array (FPGA) technologies, brings industry-leading performance, high-compute density, energy efficiency and simplified application design to a whole new level. And, by virtue of our flexible architecture and complete development framework, we make accelerated computing technology easy to use.

Easy Expansion or Upgrade

Snap our interchangeable modules into a PCI Express® (PCIe®) board (or backplane), and get a x16 PCIe connection from the host and a x8 PCIe bus to the modules. This allows the host to directly address the many FPGAs on the board (up to six per board and up to 48 FPGA clusters in a single 4U chassis). Our unique architecture is truly plug and play, making your system expansions or upgrades as simple as snapping in new or additional modules into our PCIe backplanes or adding more fully populated backplanes to a chassis.

Powerful Development Framework

Our PicoFramework brings a true system-design perspective to HPC and embedded computing. We’ve done all the interface and configuration automation work so you don’t have to.
Our firmware, API and other tools let you get started right away on the work that really matters. We even provide a complete suite of analytics tools. In short, we save you time and thousands of dollars in development work, yielding a low total cost of ownership — and a much more satisfying design experience.

Let's get started designing your HPC solution by first choosing your module.

1. Choose Your Module(s)

No bigger than a business card, Micron’s modules are the foundational building blocks for creating massively scalable HPC systems based on PCIe. Integrating advanced FPGA and memory technologies, including Micron’s Hybrid Memory Cube (HMC), these versatile computing modules bring state-of-the-art solutions to HPC applications spanning machine learning to high-speed trading.

You can simply snap any combination of the below modules onto PCIe backplanes, yielding massively parallel and easily scalable HPC solutions:

**AC-510 With HMC + Xilinx® UltraScale™ FPGA**

The business card-sized AC-510 advances our unique modular architecture with Micron’s high-bandwidth HMC and a Xilinx UltraScale FPGA. Snap up to six AC-510 modules onto full-length PCIe backplanes (up to eight backplanes in a 4U chassis). You've just filled a single PCIe slot with a groundbreaking level of parallel processing density for compute-intensive, memory-bound applications. Equally important, the AC-510 includes the HMC controller (an IP core within the FPGA), which provides an inexpensive entry point for HMC, making evaluation easy and straightforward. And with support for OpenCL®, any software developer can exploit this transformative combination of technologies to accelerate the most demanding workloads with the most efficient and cost-effective performance/watt profile available.

**AC-505 With DDR3**

The powerful AC-505 module is comprised of FPGA logic, a local memory subsystem (8GB DDR3 + 128MB NOR configuration flash), and a fully switched PCIe x8 communication structure. Based on the Xilinx Kintex®-7 K325T FPGA, the AC-505 is designed for both maximum and economical processing bandwidth. Snap up to six AC-505 modules onto full-length PCIe backplanes to offload compute-intensive applications from the host. The module features a PCIe x8 Gen2 connection to the host and high-performance, high-density SODIMM memory with an independent memory controller local to the FPGA.
AC-506 With DDR3
The AC-506 module is a variant of the AC-505, featuring an Intel® (formerly Altera) Stratix® V 5SGXMA3 FPGA. Like the AC-510 and AC-505, the business card-sized AC-506 is a powerful computing element composed of FPGA logic, a local memory subsystem (2GB, 4GB and 8GB DDR3 + 256MB quad-serial configuration flash), and a fully switched PCIe x8 communication structure. You can snap up to six AC-506 modules onto full-length PCIe backplanes to accelerate your compute-intensive applications. The module features a x8 PCIe Gen3 connection to the host and high-performance, high-density SODIMM memory with an independent memory controller local to the FPGA.

Figure 4: AC-506 module

AC-520 With HMC + Intel® Arria® 10 FPGA
The AC-520 module advances our unique modular architecture with Micron’s high-bandwidth HMC and an Intel Arria® 10 FPGA. Snap up to three AC-520 modules onto full-length PCIe backplanes (with up to eight backplanes in a 4U chassis), and fill a single PCIe slot with a tremendous amount of parallel processing density for compute-intensive, memory-bound applications. The AC-520 also includes OpenCL support.

Figure 5: AC-520 module

Figure 6: Any combination of modules simply snaps onto PCIe backplanes, yielding massively parallel and easily scalable HPC solutions
2a. Choose Your Backplane/Blade Server

Micron offers a variety of PCIe Gen3 backplanes designed to yield the highest-performance compute density available, while simultaneously making HPC easy to design and deploy. These include full-height, full-length PCIe boards, GPU-height-and-length PCIe boards and single-board computers (as shown in step 2b). You can use a single backplane as a blade server or workstation accelerator card, or scale up multiple backplanes in a SC6 cluster for massively parallel computing performance.

**EX-700**

The full-height, full-length EX-700 backplane is based on a fully-switched, 8 GB/s, PCIe x16 Gen3 bus from the host. It also provides independent x8 PCIe Gen3 buses to each module mounted on the backplane. The EX-700 accommodates up to six single-wide modules and forms the foundation of Micron’s scalable and upgradeable architecture.

**Note:** While Figure 7 shows the EX-700 populated with AC-510 modules, the backplane is compatible with all interchangeable Micron modules.

**EX-750**

The GPU-height-and-length EX-750 backplane is based on a fully switched, 8 GB/s, PCIe x16 Gen3 bus from the host. It too provides independent PCIe x8 Gen3 buses to each module mounted on the backplane. The EX-750 accommodates up to four single-wide modules.
2b. Or, Choose a Single-Board HPC Solution

SB-851 Xilinx UltraScale-Based Blade Server With Two QSFP28 Cages

Our half-height, half-length SB-851 PCIe Gen3 board is based on a Xilinx UltraScale VU9P/VU7P FPGA. It also features up to 72MB of Micron DIMMs and 512Mb of flash memory. The SB-851 has two QSFP28 cages (four transceivers to each). It has a USB-to-JTAG programming solution and a temperature and voltage system-monitoring mechanism. We offer development kits with examples for FPGA build, programming, monitoring/control and cable loopback verification.

3. Choose Your Chassis

Micron’s systems are the highest-density air-cooled, FPGA-accelerated computing machines in the world. These supercomputing clusters use the system’s processor and Linux to control the applications that run on the FPGA modules, with all elements working together under our PicoFramework. You can configure or customize the systems via the mixing and matching of the various modules, and you can upgrade or expand at any time with different, additional or newer modules and/or backplanes.

HPC Data Center Systems: SC6-4U Supercluster

Accommodating up to eight EX-700 PCIe backplanes (or single-board computers) with up to six modules per backplane, the SC6-4U can host a total of 48 FPGAs. The SC6 is a complete, stand-alone rack-mounted system aimed at HPC applications. The SC6 is orders of magnitude faster than conventional servers, while maintaining a small physical footprint and consuming a fraction of their energy. System migration is seamless using Micron’s revolutionary PicoFramework, letting you maintain a familiar Linux work environment. All SC6 systems are PCIe Gen3 and fully plug and play with the various modules and backplanes.

HPC Desktop Systems: SC6-Mini

The small-form-factor SC6-Mini is a Linux-based desktop PC configured with up to six FPGA modules (Intel or Xilinx variants) or single-board computers featuring HMC. It delivers an unprecedented level of desktop performance. Being orders of magnitude faster than a conventional CPU-based computer, the SC6-Mini is the ideal desktop solution for HPC applications that span bioinformatics to cryptography, deep learning to signal processing. What’s more, it uses only a fraction of the energy of conventional processor-based systems.
Integrating and Deploying HMC With Ease

Micron’s configurable HMC controller IP provides tremendous benefits to memory-bound applications — particularly those that require high bandwidth and fast random access. The HMC’s 15 Gb/s interface yields bidirectional bandwidth of up to 240 GB/s. When integrated into Micron HPC platforms, you get exceptionally high bandwidth and outstanding performance/watt in a small but modular and highly scalable package (HMC devices operate at least 15 times faster than DDR3 and consume up to 70% less energy). Micron’s HMC controller is highly parameterized to yield truly optimized system configurations to meet your specific design objectives. You can “dial in” the number of HMC links addressed, the number and width of internal ports, clock speeds, power, performance, area and other parameters to yield precise characteristics.

HMC Controller IP Deliverables and Support

Micron offers a complete solution for integrating the HMC Controller, including:

- Complete HMC Controller 1.1 specification in IP, ready for implementation
- Register-transfer level (RTL)
- Built-in analysis features that allow evaluation, test and characterization of the HMC in the context of the system
- Integration with the PicoFramework (PCIe, DMA engine, APIs, etc.)
- Test bench with simulation model
- Documentation, training and application support

Comprehensive Design Framework

Implementing the HMC controller is easy thanks to our PicoFramework — an innovative Linux-based design utility and runtime environment that provides the vital link between your application software running on a host computer and the hardware algorithm or firmware implemented in the FPGA. PicoFramework is a powerful but invisible and active intelligence that runs and governs the board-level implementation of FPGA designs — as well as data flow, memory management, system communication, monitoring, debugging and more. It makes it easy for the FPGA design engineer using vendor tool flows.
In short, our PicoFramework has everything you need to get up and running right away:

- Enables automatic loading of the HMC controller and other FPGA bitfiles over PCIe
- Includes all drivers (including host-side), API (C++) and integrated firmware test suite
- (Linux) interface to host (PCIe)
- Automates all reading and writing to the FPGAs' off-chip memory (firmware memory interfaces automate all memory systems arbitration)
- Actively monitors FPGA(s) temperature, current and voltage to enhance system performance and reliability

Full Support of OpenCL

OpenCL enables significantly faster time to market by facilitating a higher level of design abstraction (versus conventional FPGA design flows), which also yields end designs with higher performance and greater power efficiency. Not only do all Micron FPGA-based products support OpenCL, but Micron offers a complete, easy-to-use, turnkey OpenCL workstation (fully integrated within the SC6-Mini chassis) for FPGA-based development (in both Xilinx and Intel configurations), making our platforms ideal for OpenCL developers and a myriad of high-performance applications.

The Bottom Line

It's easy to meet your HPC performance needs of today and tomorrow in just three easy steps with Micron's solutions. Whether you need higher performance, better power efficiency, flexibility to scale or all three, Micron has the right solution to meet your specific situation. Visit micron.com/acs to discover more.