



Bravera™ SC5 SSD Controller Launch Q&A

Industry's First PCIe Gen5.0 Flash Storage Controllers for Data Center Infrastructure

What are you announcing and why are you announcing it?

Marvell is announcing the industry's first PCIe Gen 5.0 SSD controllers under the family name Bravera SC5. As the market leader in merchant and custom SSD controllers, Marvell once again takes a leadership position to be the first to enable SSD manufacturers, storage system OEMs and cloud service providers (CSPs) to build state-of-the-art SSDs that are specifically optimized for workloads that run on Cloud infrastructure. With COVID-19 accelerating the transition of latency sensitive and critical applications to Cloud infrastructure, and with the announcement of Gen 5.0 server platforms expected to start in the back half of 2022 and into 2023, we are leading the market enablement with optimized SSD controller solutions that provide best-in-class performance, flexibility, security and data protection.

Bravera SC5 represents the first SSD controllers in the industry with:

- PCIe 5.0 support
- 16 NAND channels enabled on an E1.S form factor
- The ability to support multiple usage models without HW changes
- Hardware-based Elastic Service-Level-Agreement Enforcement for multi-tenant environments

Please tell me more about the Bravera brand name and what products it includes.

As Marvell introduces new storage controllers that target the data center and cloud market, we will use the newly introduced Bravera brand name. Bravera refers to a "Brave New Era" in storage semiconductor solutions, and Marvell is leading this era with disruptive new technologies. It is important for the industry to easily recognize Marvell's leadership storage products as we collaborate with the entire ecosystem to bring these solutions to market.

The first Bravera product family announced is the Bravera SC5 family that includes the world's first PCIe 5.0 SSD controllers sampling today. The family includes the MV-SS1331 and MV-SS1333, which support 8 and 16 NAND channels, respectively. These devices include Marvell's core 5th generation NANDEdge™ technology which provides industry-leading LDPC error correction.

What are the market drivers for PCIe Gen 5.0 for storage and SSDs?

PCIe 5.0 offers twice the performance of PCIe Gen 4.0, enables lower latency across a higher throughput interface and delivers ~40% better power/performance efficiency. Given increasing market demand for AI and ML workloads to process and ingest ever-increasing data set sizes, we are seeing the cadence for higher performing SSDs speed up, especially in Cloud infrastructure environments. We are also seeing that with the transition to WFH/LFH (work/learn from home) and hybrid approaches that this will continue as we pull out of the pandemic. The demands on multi-tenant cloud and hybrid cloud infrastructure will only continue to increase storage performance requirements. This is why we are already working with the entire ecosystem to enable PCIe Gen 5.0 infrastructure.

How is Bravera SC5 positioned vs. other SSD controller offerings?

As we can only comment on what we've seen publicly announced, we believe we are in an advantageous position to enable SSD manufacturers, storage system OEMs and CSPs to build Gen 5.0 SSD solutions as



Bravera SC5 is the first announced solution. As the market leader, we believe that it is critical to invest in strong relationships and have technical depth with the entire ecosystem to successfully bring these advanced solutions to market. This includes working directly with CSPs, storage system OEMs, NAND vendors, system component and manufacturing suppliers, SSD component partners, and many others. As you see can with a prestigious list of supporting companies, Bravera SC5 has been well-received by the industry and is poised for success.

Other than the silicon, does Marvell provide anything else as part of the Bravera SC5 solution?

While it is critical to provide a state-of-the-art silicon solution that is reliable and low power, it is important to enable our customers with significantly more to mutually be successful. This includes providing customers with a feature-complete firmware solution that meets the Open Compute Project Cloud SSD Specification. We also provide a complete reference design for the latest E1.S form factor that we expect several leading CSPs to adopt.

Other than PCI Gen 5.0 support, what other features are required to be optimized for cloud and hyperscaler environments?

SSD cloud workloads can be generally categorized into two main categories: Compute workloads where high IOPS and low-latency are critical and storage workloads where high capacity, reliability and security are valued. Bravera SC5 was designed to be optimally used in both of these environments.

For compute workloads, we have ensured that end-to-end latency through the chip has been minimized with the innovative use of hardware accelerated engines for key data path processing functions. We have also built in the ability to easily isolate many different types of traffic and provide quality-of-service, making this solution ideal to handle multiple workloads at the same time. Bravera SC5 is the first to feature multiple physical functions, hardware queue management, and a granular hardware arbiter which have been architected to enable CSPs with the ultimate in Service Level Agreement enforcement while maximizing performance.

For storage workloads, we support the most advanced QLC NAND technologies for the lowest \$/GB without sacrificing reliability. Bravera SC5 offers the flexibility to support different Flash management architectures including Kioxia's Software-Enabled Flash (SEF) and Zoned Name Space (ZNS) specifications. We have advanced security features including AES-256 line rate encryption, root-of-trust and firmware versioning protection that also differentiate our offering.

What NAND devices and SSD form factors do you expect the Bravera SC5 will be built with?

Marvell has made it a priority to work with all the NAND vendors in the industry as well as their latest state-of-the-art solutions including low latency SLC to TLC and QLC and beyond.

We are seeing a transition from traditional M.2 (7W) to E1.S (12W to 25W) to optimize data center infrastructure performance. Bravera SC5 supports the mainstream industry-standard form factors for data center infrastructure: E1.L, U.2, E3, etc.

Our flexibility to work with any NAND vendor and to optimally fit into any of the mainstream cloud and data center form factors is why Tier-1 CSPs are interested to either work directly with Marvell to build their own SSDs, or to work with other SSD manufacturers.

What customers are you announcing as part of the Bravera SC5 launch?

While Marvell has several existing customers and partners that we have been jointly architecting and developing the solution with today, we are not at liberty to make comments for them about their products. We expect they will announce their products and solutions as we get closer to PCIe Gen 5.0 platforms being deployed into the market starting in the back half of 2022 and into 2023.