



Creating Breakthrough Storage Performance With Enhanced Data Center Efficiencies

With the tremendous growth of data, enterprises across the globe know that processing and analyzing large amounts of data in real-time is a key differentiator. To garner more performance in servers (measured in I/O per second or IOPS), faster SSDs are now quickly replacing traditional spinning media HDDs.

Gains are even more dramatic with SSDs connected directly to the server's PCIe® bus via NVMe Express® (NVMe™), which replaces legacy SATA and SAS. The NVMe protocol aims to bring storage I/O closer to the system processor for both faster IOPS performance and lower average latency. Today, PCIe Gen3 supports ~1 GB/s of bandwidth for each lane, and a given peripheral can use up to 16 lanes at a time. NVMe SSDs currently use four lanes, with plans to use eight lanes in the future.¹

NVMe brings significant performance benefits to applications and workloads, and now NVMe over Fabric (NVMe-oF) can extend those benefits beyond the local application server and into the data center. The specification provides a common architecture to transmit the NVMe protocol across networks, connecting applications to distributed storage nodes for improved delivery and performance. As applications evolve and data continues to grow exponentially, the underlying storage and networking infrastructure supporting them must also evolve.

Integrating Server-Local Storage and Centralized Storage

Micron's forthcoming next-generation IT platform connects a cluster of server nodes (with Micron NVMe SSDs inside) using Mellanox's end-to-end high-speed and low-latency RDMA over Converged Ethernet (RoCE) networking solution. The Micron platform includes low-latency software that provides a crafted set of data services. This combination results in an extremely high-performance pooled storage solution. If you deploy distributed storage infrastructure, the platform can perform similarly to local direct-attached storage. The platform also enables a compute-centric deployment to build application servers connected to NVMe storage pools and still run local applications

Benefits of Sharing NVMe Over High-Bandwidth, Low-Latency Fabrics

Performance

Traditional shared and local storage has been meeting growing application demands with a performance evolution culminating in NVMe. Now that NVMe is easily shared, you can broaden its use and bring its benefit to more applications, more workloads and more users

Scaling

Shared NVMe-oF can enable a building-block approach that wasn't possible with server-local NVMe. You can scale storage independently from the compute resources. Simply add nodes to the NVMe-oF cluster when additional storage resources are required or add application servers as needed to meet the workload demand.

Storage Efficiency

By leveraging shared NVMe, you can use an optimized, storage-centric pool or extra capabilities within application servers (housing local, shareable storage) to improve NVMe utilization for each server, tuning the associated pool to the application running only on that server.

Simplified Administration

Shared NVMe can be easily managed from a single pane of glass. With modern, high-bandwidth networks you can do this without concern over latency.

Scalable Performance: Micron NVMe SSDs and Mellanox Fabric

[Preliminary benchmark results](#) show that when running over three 2U storage nodes, which are connected over Mellanox 100 Gb/s RoCE links, the solution achieves more than 10.9M IOPS.² This is within 4% of an equivalent server-local deployment and is achieved while only adding an average of 10µs to the overall I/O (100% random reads in 4K blocks). This is also less than 1% of an equivalent server-local deployment. These results validate again the efficiency of the solution.

The results show that combining Micron NVMe SSDs with high-bandwidth Mellanox fabric delivers scalable performance comparable to a local in-server NVMe. This solution is designed to take the data center to new record levels of efficiency.

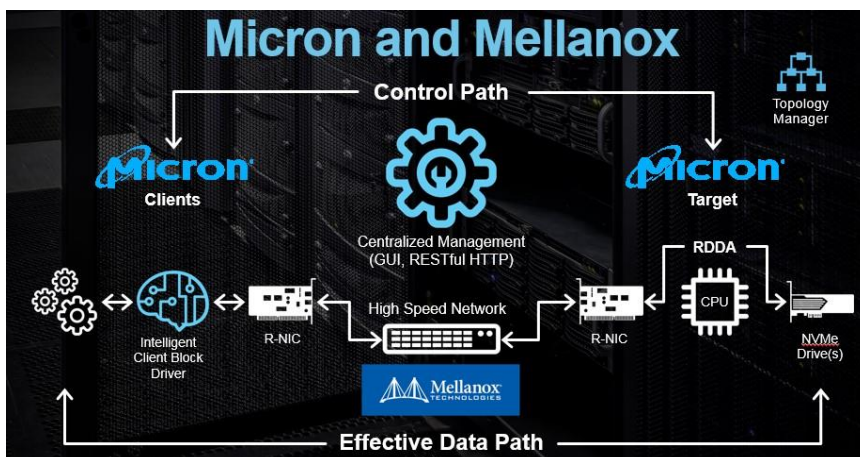


Figure 1: Platform Architecture for a Shared, Scale-Out NVMe Storage Solution

Powering High-Performance Business Workloads

NVMe storage enabled by NVMe-oF is particularly targeted for applications that use highly distributed, scalable architectures. Shared accelerated storage solutions are particularly effective for use cases where large bandwidth, high IOPS and low-latency requirements are critical to the bottom line of the enterprise

Micron is bringing this new innovative solution to market with its SolidScale™ platform architecture. Micron's SolidScale platform is a scale-out, shared NVMe storage solution that unleashes performance, capacity, and CPU efficiency, resulting in faster time to business value, while simultaneously driving down data center costs. SolidScale architecture addresses today's near-real-time, performance-sensitive workloads such as big data and real-time analytics, transaction and stream processing, and machine learning and the IoT. Its integrated platform architecture simplifies construction of fast, scalable, next-generation IT infrastructure that delivers low-latency, high-performance access to compute and storage. It lets innovative organizations store and share data at the speed of NVMe. Discover more at micron.com/solidscale.

About Mellanox

Mellanox Technologies (NASDAQ: MLNX) is a leading supplier of end-to-end InfiniBand and Ethernet interconnect solutions and services for servers and storage. Mellanox interconnect solutions increase data center efficiency by providing the highest throughput and lowest latency, delivering data faster to applications and unlocking system performance capability. Mellanox offers a choice of fast interconnect products: adapters, switches, software and silicon that accelerate application runtime and maximize business results for a wide range of markets including high performance computing, enterprise datacenters, Web 2.0, cloud, storage and financial services. More information is available at www.mellanox.com.

About Micron

Micron (NASDAQ: MU) is a world leader in innovative memory solutions. Through our global brands — Micron, Crucial® and Ballistix® — our broad portfolio of high-performance memory technologies, including DRAM, NAND, NOR Flash and 3D XPoint™ memory, is transforming how the world uses information. Backed by more than 35 years of technology leadership, Micron's memory solutions enable the world's most innovative computing, consumer, enterprise storage, data center, mobile, embedded, and automotive applications. More information is available at www.micron.com.

1. NVMe Express 1.3 Specifications: http://www.nvmexpress.org/wp-content/uploads/NVM_Express_Revision_1.3.pdf

2. All testing was completed on early beta releases of all SolidScale hardware and software. Actual product performance will be finalized and communicated later. Results reflect FIO 4K random reads using a single Micron 2.4TB 9100 MAX installed in a server versus installed in a remote SolidScale node. All network connections were 100Gb RoCE interfaces.

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