SOLUTION BRIEF

Intel® Storage Builders

*Excelero NVMesh**
Intel® SSD DC P4600 Series
Distributed NVMe Server SAN*

Deploy NVMe*-Based Storage at Data Center Scale

Leverage Excelero NVMesh and Intel® SSD Data Center Family for PCIe* devices to maximize your NVMe ROI for web-scale applications.

"Excelero enables customers to leverage the full potential of NVMe at scale without giving up local performance characteristics, which lowers the storage cost dramatically."

Lior Gal, CEO Excelero

Executive Summary

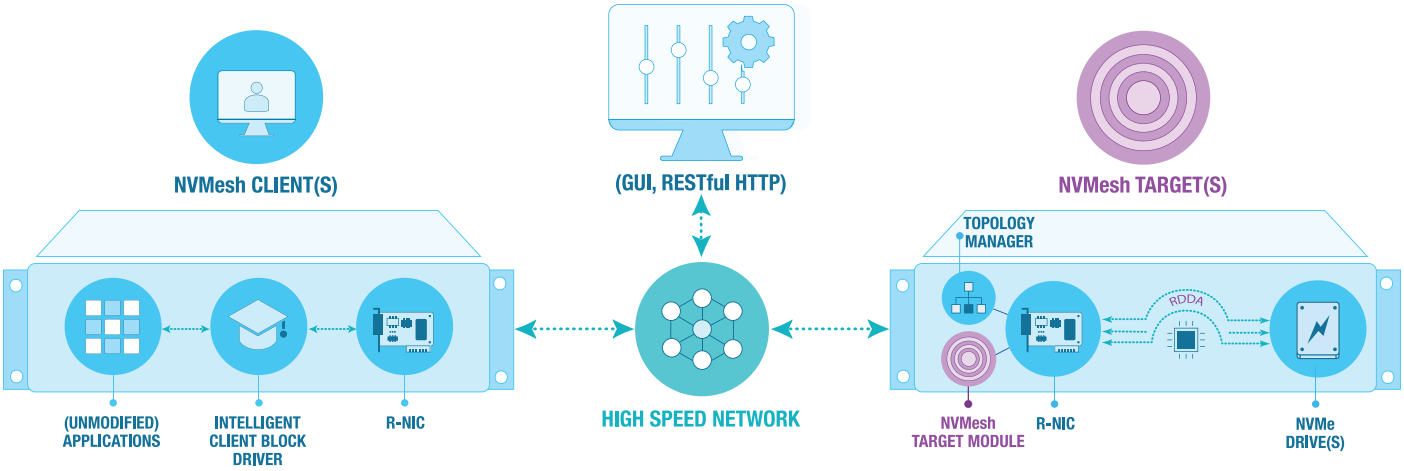
Current generations of servers are flexible systems, designed to enable Software Defined Infrastructure (SDI). They incorporate strong processing power, high-speed networking, local high-performance flash storage, and the latest-generation of memory. Advanced clustering methods enable pooling of CPU resources across multiple systems to tackle large compute jobs. However, pooling local high-performance storage media, such as Intel data center-class NVMe*-based SSDs, across the network has proven to be a challenge. IT must compromise on storage performance, use valuable CPU cycles for managing storage across the network instead of for applications, or both.

Excelero NVMesh* enables efficient pooling of NVMe-based storage, utilizing off-the-shelf components without impacting target CPU performance. By not requiring expensive proprietary hardware, it enables high-performance storage pooling and saves processor resources for their main purpose, the applications.

Excelero NVMesh – Enabling Distributed Storage with Local NVMe-Based SSD Performance

Excelero's NVMesh is a high performance, low-latency software-defined block storage solution designed to meet the performance and scalability requirements of next-generation applications. NVMesh bridges the speed and low latency of local storage with the scalability and management of distributed drives. It enables customers to deploy NVMe*-base storage devices, such as Intel® SSD Data Center Family for PCIe* devices, at massive scale—without adding typical network latency or modifying applications to manage data locality, all while using industry-standard hardware. NVMesh has been deployed for Industrial IoT, machine learning, and user behavior analytics applications.

Excelero NVMesh delivers in-server, direct-attached NVMe-based storage performance with data protection from a distributed storage infrastructure utilizing standard off-the-shelf components. It allows IT architects to leverage NVMe-based SSDs, potentially spread over many physical systems, and treat them as a unified, redundant storage pool without adding the inherent latency of distributed remote storage access over a network. Excelero NVMesh enables users to leverage the full performance of NVMe-based SSDs at massive scale—without modifying applications for data locality.



NVMesh Architecture

The NVMesh architecture features a distributed block layer that allows applications—without modification—to utilize pooled NVMe-based storage devices across a network at local speeds and latencies. Distributed resources are pooled with the ability to create arbitrary, dynamic block volumes that can be utilized by any host running the NVMesh block client. These virtual volumes can be striped, mirrored, or both, while enjoying centralized management, monitoring and administration. Applications can enjoy the latency, throughput, and IOPs of a local NVMe-based storage device, while getting the benefits of centralized, redundant storage.

NVMesh is deployed as a virtual, distributed, non-volatile array that supports both converged and disaggregated architectures, giving customers full freedom in their architectural design. An Excelero solution scales granularly as a single pool of high-performance block storage, and it features easy provisioning of volumes. Applications can access the block volumes directly or through a file system, which makes integration very straightforward.

NVMesh's Remote Direct Drive Access

A key component of Excelero's NVMesh is the Remote Direct Drive Access (RDDA) functionality, which bypasses the CPU. As a result, Excelero NVMesh avoids the noisy neighbors effect for the application. The shift of data services from centralized CPU-based to complete client-side distribution enables linear scalability, provides deterministic performance for applications, and enables customers to maximize the utilization of their flash drives.

Intel SSD Data Center Family for PCIe/NVMe Devices Deliver Data Center Reliability and Performance at Web Scale

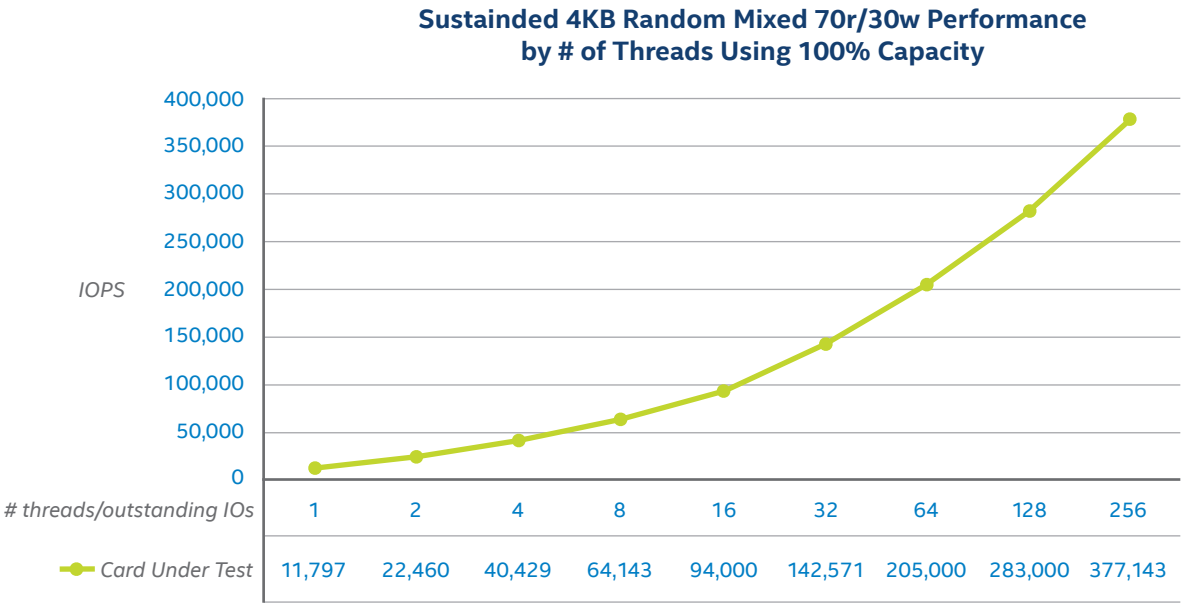
The Intel SSD Data Center Family for PCIe brings extreme data throughput directly to Intel® Xeon® processors with up to six times faster data transfer speed than 6 Gbps SAS/SATA SSDs.[1] Intel led the industry in creation of a new Non-Volatile Memory Express* (NVMe) storage interface standard. NVMe overcomes SAS/SATA SSD performance limitations by optimizing hardware and software to take full advantage of NVM SSD technology.

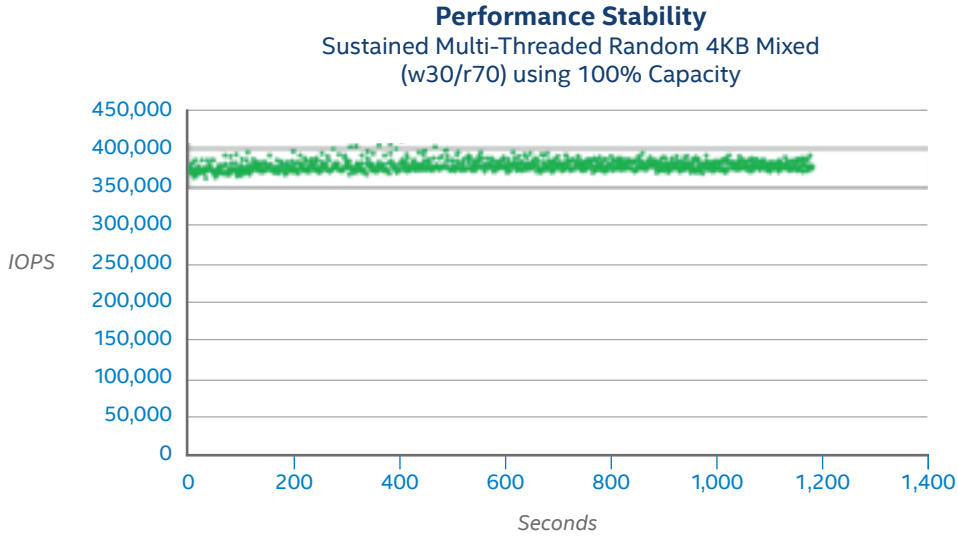
Intel SSD Data Center Family for PCIe devices are based on Intel-developed controller, firmware, and leading manufacturing process NAND flash memory. Rigorous qualification and compatibility testing ensures a highly reliable SSD. The Intel® SSD Data Center Tool provides a powerful set of management capabilities.

Recent testing by Excelero revealed incredible performance using an NVMesh client reading and writing a remote Intel® SSD DC P4600 drive using the Excelero RDDA protocol. The transactions did not use CPU cycles on the target storage server.

The following graphs show the mixed read/write performance and performance stability results from testing using the following configuration.

Component	Specification
System Chassis	Supermicro* SYS-2028BT-HNR+
Processor(s)	2X Intel® Xeon® Processor E5-2620 v4 @ 2.10 GHz
Memory	64 GB
Operating System	CenOS* Linux* 7.3.1611, kernel 3.10.0-514.16.1.el7.x86_64
Network	Dual-port Mellanox* CX-5 @ 50 Gbps
Testing Software	Excelero* NVMesh ver. 1.2.0; FIO ver. 3.0.5-g168b





Average IOPs: 378,275 Coefficient of Variation (%STDDEV): 1.7%

NVMesh Benefits

NVMesh offers the following benefits.

Choice – NVMesh is a software-only solution, giving users a choice of any standard servers to meet all their storage requirements.

Use applications natively – NVMesh allows applications to utilize pooled NVMe-based storage—without modification—across a network at local speeds and latencies.

Simplicity – A unified pool of NVMe-based devices enables customers to maximize storage utilization and avoids data locality issues for the application.

Full convergence – NVMesh enables 100 percent converged infrastructure by full logical disaggregation of storage and compute.

More CPU cycles for applications – The patented Remote Direct Drive Access (RDDA) bypasses the CPU and avoids the noisy neighbors effect for the application. Applications can leverage the full capability of CPU.

Enables NVMe-based SSD virtual SAN – NVMesh is a highly flexible deployment model for server SAN. It is deployed as a virtual, distributed non-volatile array and supports both converged and disaggregated architectures—and even mixed environments—giving customers full freedom in their architectural design.

Highly Scalable – NVMesh delivers a sharing technology that scales performance linearly at near 100% efficiency. The shift of data services from centralized CPU to complete client-side distribution provides deterministic performance for applications and enables customers to maximize the utilization of their flash drives.

IT Benefits

Data Management & Protection	
Multiple Transports	Patented RDDA, NVMf-ready
Logical Volumes	Concatenated, RAID 0, RAID 1, RAID 10
Multiple Drive Types	NVMe, NVMf, SATA, SAS
Failure Domains	Host, rack, and row aware
Management & Monitoring	
Interactive Interfaces	Web GUI and CLI commands
Automated Provisioning	RESTful API, Docker Persistent Volumes
Next Gen Data Center	
Flexible Topologies	Physically converged, disaggregated, or mixed
High Performance	Limitlessly scalable at near 100% linear performance
Scale-Out Architecture	Client, target, and management scale independently
Intelligent Clients	Clients utilize multiple hosts, drives, network-paths, and racks
Advanced Networking	Ethernet (RoCE v2), InfiniBand*

About Excelero

Excelero enables enterprises and service providers to design scale-out storage infrastructures leveraging standard servers and high-performance flash storage. Founded in 2014 by a team of storage veterans and inspired by the tech giants' shared-nothing architectures for web-scale applications, the company has designed a software-defined block storage solution that meets performance and scalability requirements of the largest web-scale and enterprise applications.

With Excelero's NVMesh, customers can build distributed, high-performance server SAN for mixed application workloads. Customers benefit from the performance of local flash, with the convenience of centralized storage while avoiding proprietary hardware lock-in and reducing the overall storage TCO. The solution has been deployed for hyper-scale Industrial IoT services, machine learning applications and massive-scale simulation visualization.

Learn more about Excelero NVMesh at www.excelor.com

Learn more about Intel storage solutions at www.intel.com/storage

Intel® Xeon® Scalable processors: intel.com/xeonscalable

Intel® Builders: http://builders.intel.com

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[1] Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Configurations: Performance claims obtained from data sheet, sequential read/write at 128k block size for NVMe and SATA, 64k for SAS. Intel® SSD DC P3700 Series 2 TB, SAS Ultrastar® SSD1600MM, Intel® SSD DC S3700 Series SATA 6 Gbps. Intel® Core™ i7-3770K processor @ 3.50 GHz, 8 GB of system memory, Windows* Server 2012, IOMeter. Random performance is collected with 4 workers each with 32 QD.

Intel does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

Cost reduction scenarios described are intended as examples of how a given Intel- based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

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