Optimizing EXAScaler for AI workloads and AI infrastructure.
DDN is the World’s Largest Privately Held Storage Company

Market Leader With Global Presence

- 10,000 Customers
- 1,000 Employees
- 20 Years of Industry Leadership
- 10 Technology Centers Around the World
- 150+ Patents
Powering the World’s Data Intensive Workflows In All Industries

AI & Analytics
Optimized Turnkey End-to-End AI Solutions Engineered for All Your Use Cases at Any Scale

Web and Cloud
Enhancing Your On Prem and Private Clouds With the Most Versatile Public Cloud Storage

Enterprise
Combining Reliability and Business Continuity with Enterprise Analytics and Management Tools

Enterprise at Scale
Bringing Massive Scale and True Flexibility to the World of Enterprise Data Storage

Govt/Academia
20 Years of Delivering the Most Powerful At Scale Data Solutions For All Your HPC Infrastructures
# EXAScaler Platforms and Specifications

<table>
<thead>
<tr>
<th></th>
<th>NVMe All-Flash</th>
<th>All NVMe/Hybrid</th>
<th>Mid Range Hybrid</th>
<th>EXAScale Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ES200NVX</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 GB/s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5M IOP/s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 NVME Slots</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDR/HDR100 IB (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Or 40/100GbE (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ES400NVX</strong></td>
<td>50 GB/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3M IOP/s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 NVME Slots</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDR/HDR100 IB (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Or 40/100GbE (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ES7990X</strong></td>
<td>24 GB/s</td>
<td>50 GB/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800K IOP/s</td>
<td>3M IOP/s</td>
<td></td>
<td></td>
<td>76 GB/s</td>
</tr>
<tr>
<td>Up to 360 SAS Slots</td>
<td></td>
<td></td>
<td></td>
<td>48 NVMe Slots</td>
</tr>
<tr>
<td>Up to 450 SAS Slots</td>
<td></td>
<td></td>
<td></td>
<td>Up to 1872 SAS Slots</td>
</tr>
<tr>
<td><strong>ES18KX</strong></td>
<td>76 GB/s</td>
<td></td>
<td>24 NVMe Slots</td>
<td></td>
</tr>
<tr>
<td>3M IOP/s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDR/HDR100 IB (16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Or 40/100GbE (16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performance Simplified with EXAScaler Appliances

Consolidated, Simplified Componentry with no compromise on performance
The Fastest Data Solution for Trading

DDN Tested Platform

- 72% less footprint
- 1/3 of the power consumption
- 1/4 of the Operation Cost

www.STACresearch.com/KDB200915
The Fastest Cloud Data Platform

Available on GCP, AZURE, and AWS*
## Cloud Performance

400TB EXAScaler filesystem with 32 clients shows aggregated throughput of over 50GB/s

### Performance with Multiple Clients (16 threads per client)

### Node Configuration

<table>
<thead>
<tr>
<th>Node</th>
<th>Count</th>
<th>Type</th>
<th>Disk</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS</td>
<td>1</td>
<td>Skylake n1-stan</td>
<td>dPaDr-dS-S4D</td>
<td>1TB</td>
</tr>
<tr>
<td>OSS</td>
<td>40</td>
<td>Skylake n1-stan</td>
<td>dPaDr-dS-T1D6</td>
<td>10TB</td>
</tr>
<tr>
<td>Client</td>
<td>40</td>
<td>Skylake n1-standard-8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
High Performance Kubernetes Support

A³I Performance Direct to Containers

- Kubernetes (K8s) automates deployment, scaling, and management of containerized applications.

**cnvrg.io** uses K8s to easily orchestrate AI workflows. EXAScaler would be seen as a tile
DDN Insight Aggregator for Customers with Many EXAScaler Filesystems

Insight Aggregator Dashboard

- Choose which filesystem(s) performance to view: Throughput or IOPs, Read, Write or Both
- Breakdown of throughput/IOPs for each filesystem
- Capacity Consumed Status for each Filesystem
- Predict Future Capacity Needs
Dashboard View

- Performance Overview
- Capacity Available and Used (Data and Inodes)
- Workload Analyzer Widget
- SFA Health Summary
EXAScaler Performance

View Aggregate or Average

Select and De-Select Storage Servers

View throughput or IOPs

Adjust time view

Read and Write Time Series view
EXAScaler Performance

Select all, or a subset of MDS

Absolute Value and Change Shown

View Metadata Activity

Read and Write Time Series view

Shadow shows performance for the prior time period
Workload Analyzer

User can re-order by Throughput, IOPS or Metadata activity

Running Jobs

Aggregate Performance of Selected Jobs

IO Size (read, Write, or Both)
EXAScaler Data Services

- Scale-Out Data Services deliver multiprotocol access to EXAScaler Namespace
- Management REST API for system admin
Two single port NICs (cluster) and two GPUs per PCIe switch, up to 24 GB/s per NIC, optimal path for GPUDirect Storage.

Dual port NICs (storage) close to CPU, up to 28 GB/s per NIC.

Eight GPUs interconnected within the system through NVSwitches (NVIDIA proprietary interconnect, 10x higher bandwidth than PCIe Gen4, 600 GB/s GPU-to-GPU).

GPUs from multiple systems can communicate through a cluster network, ideally via single port NICs on same PCIe Switch as GPU (ports 1-8).
Multi-Rail Networking

Multi-Rail Networking

Fast, Secure, Resilient Networking Made Easy

- Multi-Rail automatically detects and manages multiple network interfaces on a single network.
- Load-balancing across network links
- Link fault detection, dynamic failover and recovery
- Improved peak performance with single mount point on client nodes with multiple network interfaces
- Runs over Infiniband and/or Ethernet

DDN A³I MultiRail greatly simplifies DGX deployments.
UNIVERSAL ACCELERATOR FOR CONTAINERS

DDN A³I enables seamless fastest file access to shared storage directly from containerized applications at runtime, with full performance.

Parallel client capability is inserted at runtime with a universal wrapper and does not require any modification to application or container.

Easy to deploy and manage compartmentalized data access and secure multi-tenancy with trusted levels of segregation using containerized applications.
## DDN AI400X with NVIDIA DGX A100
### Validated Performance Results Summary – Dual Ported NICs

<table>
<thead>
<tr>
<th>Two Dual-Port NICs, IB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AI400X Configuration</strong></td>
</tr>
<tr>
<td><strong>DGX A100 Configuration</strong></td>
</tr>
<tr>
<td><strong>GDS Enabled?</strong></td>
</tr>
<tr>
<td><strong>Max Read Performance</strong></td>
</tr>
<tr>
<td><strong>Max Write Performance</strong></td>
</tr>
<tr>
<td><strong>Comments</strong></td>
</tr>
</tbody>
</table>
DDN AI400X with NVIDIA DGX A100
Validated Performance Results Summary – Single Ported NICs

<table>
<thead>
<tr>
<th>Eight Single Port NIC, IB</th>
</tr>
</thead>
</table>
| Al400X Configuration | 4x AI400X  
| DGX A100 Configuration | 8 x HDR200 IB
| Ports 1, 2, 3, 4, 5, 6 ,7, 8  
| GDS Enabled? | No | Yes  
| Max Read Performance | 108 GB/s – 4.8M IOPS | 178 GB/s  
| Max Write Performance | 95 GB/s | 154 GB/s |
Accelerating The AI-Enabled Drug Discovery Revolution
Recursion Boldly Reimagines Pharmaceutical R&D With AI

- Leveraging AI to rapidly identify compounds for new treatments.

- DDN and NVIDIA solution based on the DGX SuperPOD architecture, fully integrated and optimized for the Recursion pipeline.

- End-to-end workflow managed; data capture, AI data preparation, all phases of deep learning workloads, and complete data governance, security and migration from the cloud.

- Up to 20X cost savings and introduces new levels of pipeline acceleration.
Empowering GPU-accelerated Clinical and Research Genomics
St-Jude Children’s Research Hospital

Leading the Way for The World to Understand, Treat and Defeat Childhood Cancer With AI

- DDN selected to design, implement and optimize the data infrastructure and end-to-end workflow integration.

- Successful and rapid implementation using pre-defined DDN A³I solutions reference architecture enabled quick deployment to researchers with full performance and immediate acceleration for science efforts.

“DDN A³I solutions give us full performance out-of-the-box.

With other storage vendors, our applications run 20X slower and GPUs waste 90% of cycles waiting for data to be delivered.”

Wei Guo
Computational Engineer
St Jude Children’s Research Hospital
Accelerating Swedish AI Research across Industry and Academia

Wallenberg Artificial Intelligence, Autonomous Systems and Software Program

• Artificial intelligence and autonomous systems acting in collaboration with humans, adapting to and learning from their environment through sensors, information and knowledge, forming intelligent systems-of-systems.

• DDN A³I All Flash Solutions supports the supercomputer, a NVIDIA DGX SuperPOD, which will deliver a processing speed of 300 petaFLOPS for AI.
The World’s Fastest AI Supercomputer in Academia.

Transforming our Society and Tools with AI

- From religion to agriculture, and liberal arts to engineering, every student will have worked with the AI curriculum and will be able to apply that knowledge to advance the field they are studying in. With performance of an astounding .70 petaflops

- Tightly integrated and tested A³l and SuperPOD architecture will strengthen UF research potential through unmatched access to AI training and tools, ultimately addressing some of the most challenging global plights, like rising sea ocean levels, food insecurity, aging populations and more.

“We have a history of success with DDN storage systems powering our HPC computing and anticipate similar high productivity for our AI workloads.”
AI Case Study: **NVIDIA SELENE**

**DDN Delivered:**

- A dramatic increase in AI workload performance demonstrates how organizations can iterate faster and boost data science productivity.
- A modular platform that ensures AI infrastructure scalability with greater speed and cost efficiency.
- From delivery dock to fully installed in 4 hours.
- A long-term technical collaboration for AI excellence.

“Having a partner who stands shoulder-to-shoulder with our engineers to solve the big challenges is where the true value comes from. We’re definitely pushing the boundaries of what’s possible today while exploring new frontiers for the future.”
Throughput on NVIDIA Selene

- Proven Scaling to Reach Max Performance of DDN AI400X systems to 128 NVIDIA DGX100
- MultiRail across both DGX100 systems and DDN AI400X systems
Increased Efficiency, Higher Acceleration, Lower Cost at Any Scale

Proven with thousands of successful deployments

- Wide set of Functionality to bring the right feature set and capabilities to new AI customers, bring easier deployment and monitoring
- Proven at larger scale than any other storage system with the only SuperPOD reference architecture based on EXAScaler
- More to come around simplification and features for our growing customer base.