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TECH BRIEF

OpenFlex™ Data24 as a SAS JBOF Replacement

The Opportunity

As the SSD market moves from SAS to NVMe™ for higher performance, increased IOPs, and lower latency, at lower cost per GB, this is the ideal opportunity to future-proof your investment and transition away from SAS-based JBOF infrastructure to an NVMe-oF™-based solution for sharing NVMe storage.

OpenFlex™ Data24 NVMe-oF Storage Platform

SAS Limitations

- **Silo'ed Storage Inefficiencies:** Putting SSDs in a dedicated server results in silos of independent storage volumes throughout your data center that are not easily shared or optimized.
- **Increasing Demands:** I/O-intensive workloads benefit from the performance available in NVMe SSDs, but NVMe has been limited to direct-attach storage bound by the PCIe interface within servers.
- **Limited Development:** Technology has transitioned to NVMe as a memory-like, low-overhead interface, while SAS with its electro-mechanical heritage will not be able to keep up even at similar clock speeds.
- **Physical Limitations:** Where the SAS interface roadmap shows 24Gbps in the future, PCIe® — the basis of NVMe — has seen first releases of 5th-generation products clocking at 32GHz, while Ethernet has offered 4x 25Gbps per port for a couple of years already, going to 4x 50Gbps with the next release.
- **Management Difficulties:** Inflexible legacy solutions can't keep pace with data growth, resulting in silos of data that are complex, expensive, often under-utilized, and costly to service or manage.

NVMe Benefits

- **Enterprise-Class Reliability:** The OpenFlex™ Data24 is architected to provide redundant paths to your data, similar to a SAS-attached JBOF, but with the additional advantage of flexible routing capabilities over switched Ethernet networks.
- **NVMe Accelerates Your Most Challenging Applications:** NVMe is used in servers to address the most latency-affected applications in your data center. Enterprise-class NVMe SSDs can improve efficiency in the workloads that stress those servers to the limit, which in turn enables your business to thrive. Once the size of the data set grows beyond what a single server can accommodate, scaling-out requires additional SSDs that have previously been accessed via SAS external cables and JBOFs.
- **Disaggregated NVMe SSD Storage:** NVMe-oF infrastructure is quickly replacing traditional SAS HBAs, cables, and JBOFs. Economies of scale make Ethernet a clear choice for the fabric on which to run your most performance-sensitive applications. Ethernet fabrics don't need to be complicated! OpenFlex Data24 can be cabled directly to an Ethernet NIC in your server without the complexity of a switch, making the simplest implementation comparable to SAS. Up to six ports can be directly connected to servers, or just one port per I/O module for the most cost-sensitive deployments.
- **Technology of the Future:** NVMe SSDs and Ethernet fabrics are out-pacing SAS in both performance and capacity.
- **Improved Performance:** NVME-oF enables more bandwidth and lower latency than current SAS JBOF offerings.

SAS vs NVMe Feature Comparison

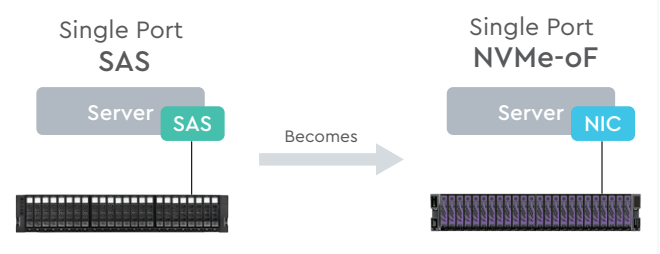
Element	SAS	NVMe-oF
Cable Cost	High	Low
Distance	Restricted	Full Network Coverage
Bandwidth	24Gbps	100Gbps+
Availability	Siloed to Servers	Flexible/Available to all
Performance	Medium	High
Management	Per Server	Single API
Latency	Good	Excellent

The Solution

The OpenFlex Data24 NVMe-oF utilizing industry-leading 100GbE connections provides the simplicity of direct-attached storage, higher performance than SAS, and efficiencies of disaggregating storage needed in many servers into a single JBOF. The OpenFlex Data24 can be directly attached to up to six hosts, or to an Ethernet switch for larger topologies.

Migrating from SAS to NVMe-oF – Hardware:

1. Replace your traditional SAS HBA in your next server configuration with an RDMA-capable Ethernet NIC.
2. Replace your SAS cable with an Ethernet cable.
3. Replace your SAS JBOF with OpenFlex Data24.
4. Load the "in-box" RDMA driver for your NIC, connect the cables, and discover NVMe devices in your OpenFlex Data24.



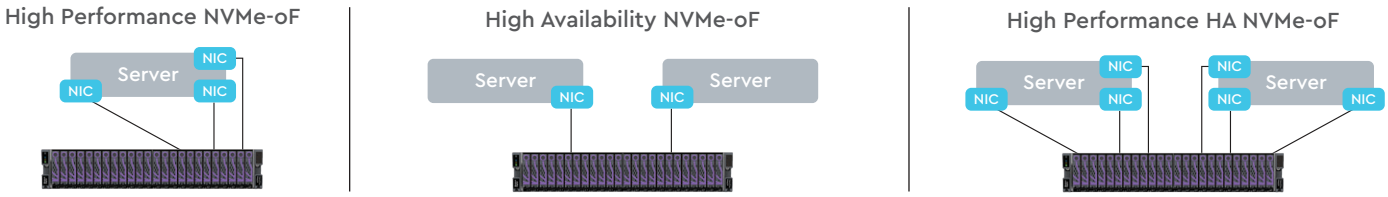
Key Interconnect Components Validated by Western Digital

Western Digital has evaluated several NIC, cable, switch, and operating system combinations supporting NVMe-oF and OpenFlex Data24. The initial list is below and is continuously growing as we look at additional vendors and models.[1] Please request the OpenFlex Data24 Compatibility Matrix for the latest additions.

- **NIC:** Mellanox® ConnectX®-4 ENMCX416A-CCAT, Mellanox ConnectX-5 ENMCX516A-CCAT
- **Switch:** Mellanox MSN2700-CS2F, Mellanox MSN2410-CB2F, Mellanox MSN2100-CB2F
- **Cables:** Amphenol NDAAFF-0001, Mellanox MCP1600-C003E30L, Mellanox MCP1600-C005E26L

A Wide Range of Connectivity Solutions to Meet Your Requirements

Starting with a simple, single host / single port connection to disaggregate your NVMe storage, OpenFlex Data24 can be configured to match your most demanding application performance and reliability. Three 100GbE ports in each of two I/O modules provide both high performance and high availability access.



Migrating from SAS to NVMe-oF – Software:

Simply install the NVMe-oF OFED drivers and assign storage in your application.

1. Install your chosen NIC and drivers, including Open Fabrics Enterprise Distribution if desired.
2. Use simple REST-based commands to discover OpenFlex Data24 information including assigned IP numbers.
3. Use the industry standard *nvme discover* command to discover NVMe devices behind each IP number.
4. Use the industry standard *nvme connect* command to assign NVMe Qualified Names.
5. Point your desired application to the assigned NQNs.

When listing the linux device table, SAS devices will appear as /dev/sda1, /dev/sdb1, etc. while NVMe-oF devices will appear as /dev/nvme0n1, /dev/nvme1n1, etc.

Conclusion

While SAS continues to be the industry standard for enterprise HDD and JBOD applications, NVMe and NVMe-oF is proving to be a better choice for enterprise SSD. NVMe SSDs are well known for improving performance of latency-sensitive applications such as database transaction processing. Until recently, that performance improvement was limited to SSDs you could house within a server. Western Digital's OpenFlex Data24 utilizes NVMe-oF running on 100Gb Ethernet to provide the same throughput and IOPs available in direct-attach storage and just slightly higher latency. OpenFlex Data24 allows you to reap the benefits of NVMe and the benefits of disaggregating and sharing those high-performing NVMe SSDs.

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[1] Western Digital tested compatibility and operation. This is not an endorsement of these products by Western Digital, and no warranty of the products is either expressed or implied.