

PDSW at SC'25

DAOS on 400 Gbps Fabrics

Michael Hennecke

17-NOV-2025



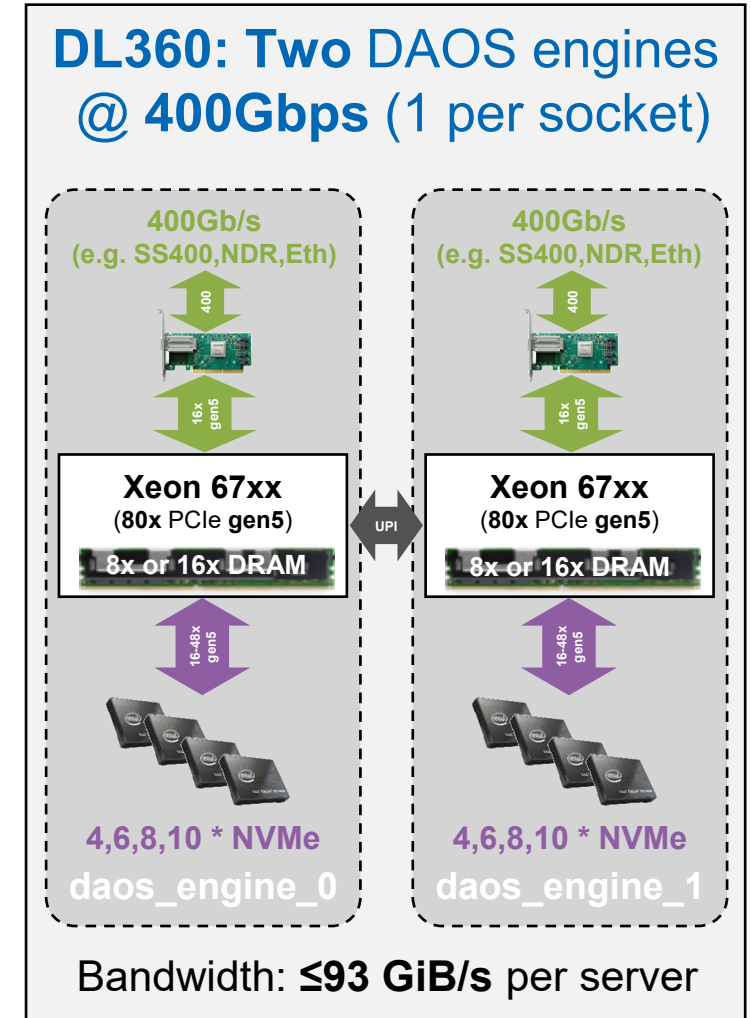
HPE Cray Supercomputing Storage K3000: DAOS Solution on DL360-Gen12

In 12/2024, DAOS engineering team moved from Intel to HPE

- Continuing to drive **open source** DAOS development
- **K3000** solution developed by HPE/Cray product team
 - Adds provisioning, configuration, monitoring, commercial support

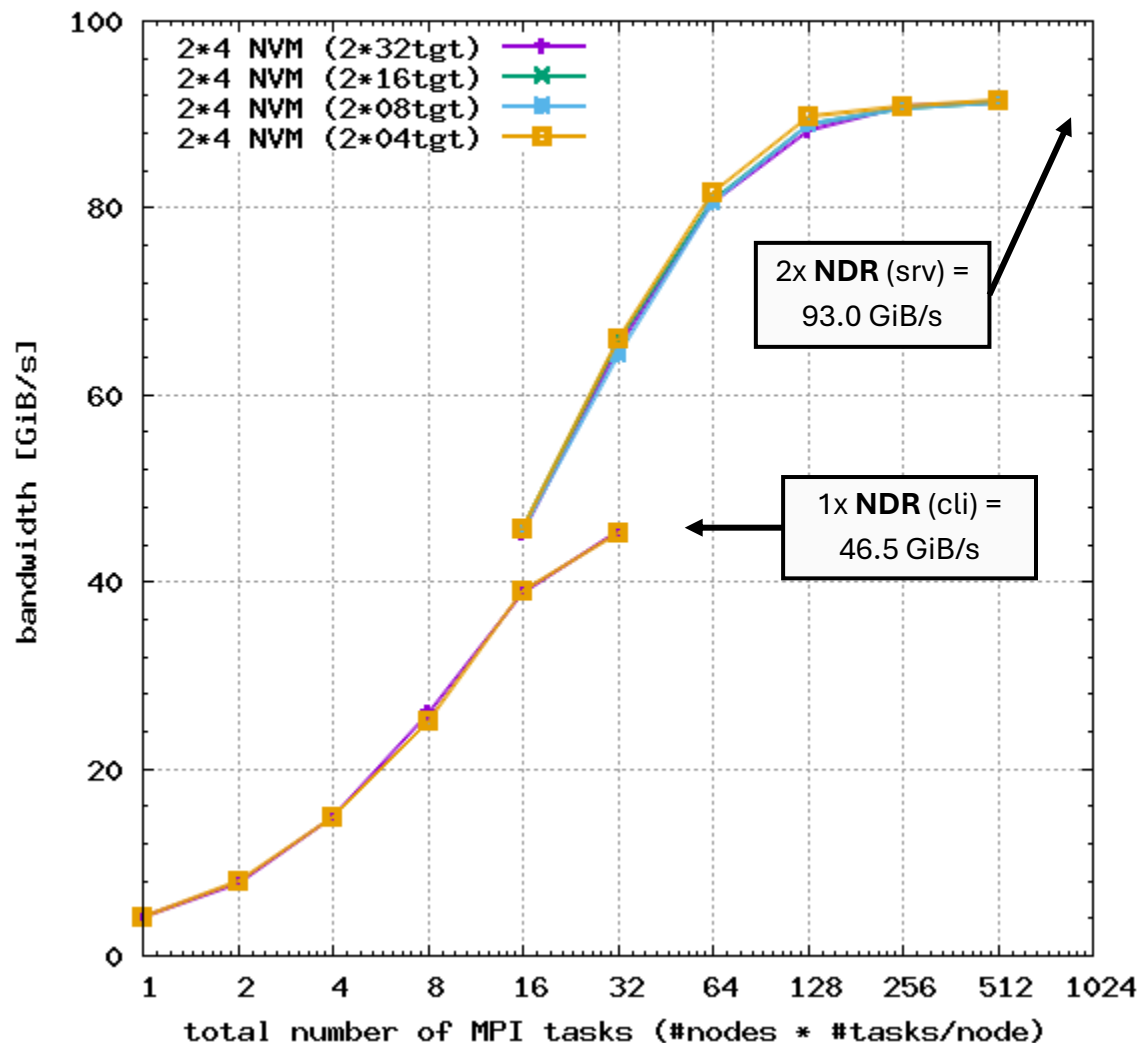
Hardware based on ProLiant **DL360** Gen12 (PCIe gen5)

- Dual-socket 1U servers (Xeon 67xx)
- NVMe configs: {8, 12, 16, 20} E3.S @ {3.84, 7.68, 15.36} TB
- K3000 v1 **Fabric Support:**
 - Slingshot 200 and 400
 - NDR InfiniBand
 - 400 Gbps Ethernet (with ConnectX-7 NICs)
- Working with Cornelis on CN5000 validation
 - DAOS community effort, unrelated to K3000 HPE product
 - TCP provider only at this time (opx provider still has gaps)

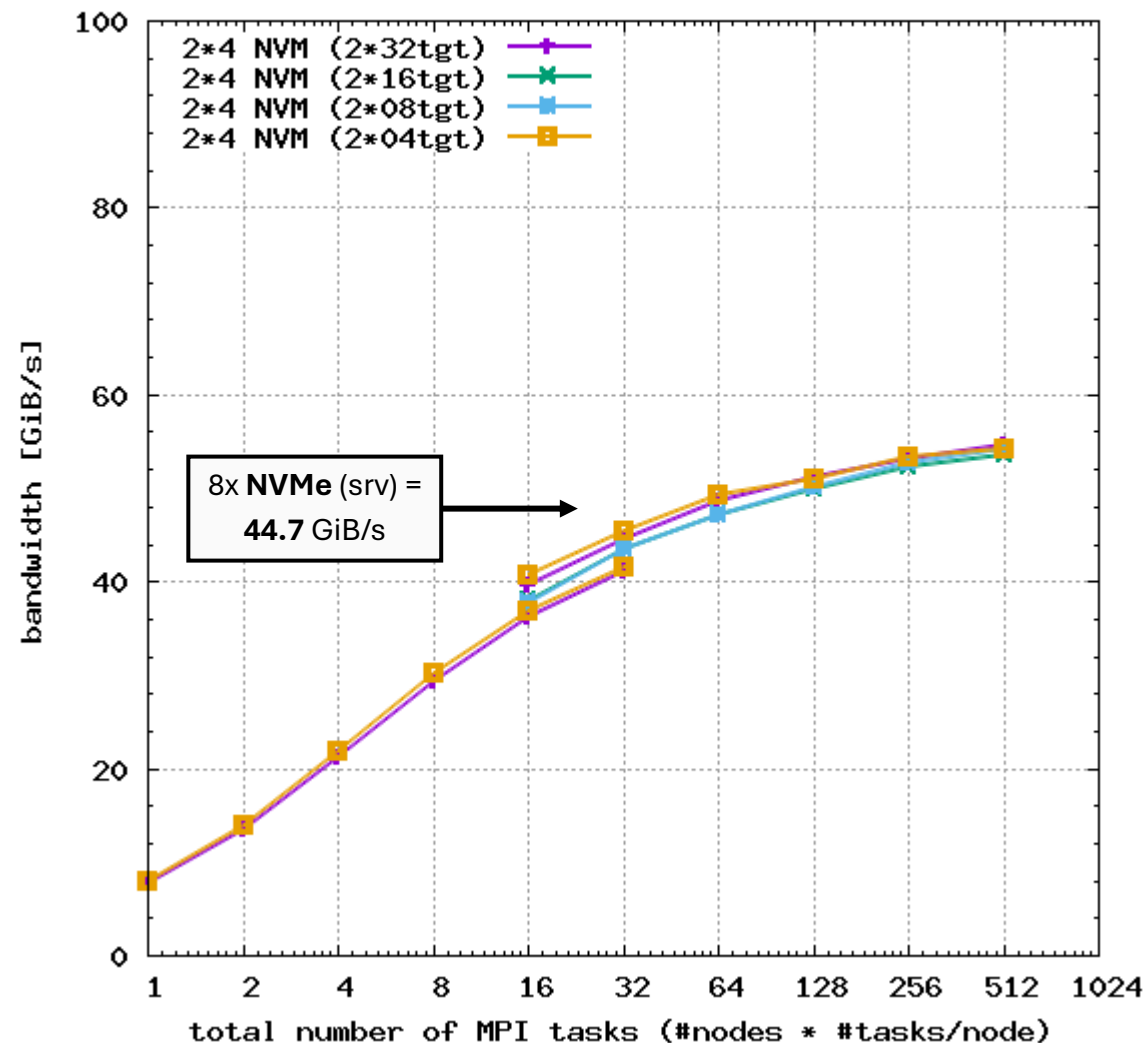


DAOS on DL360-Gen12 with NDR: `ior-easy-{read,write}` using 8x NVMe

1x DL360-Gen12 Server - I0500 Scaling - IOR-easy-read
(2x Xeon 6740P, 8x PM1743 15.36TB NVMe, 2x CX-7 NDR)

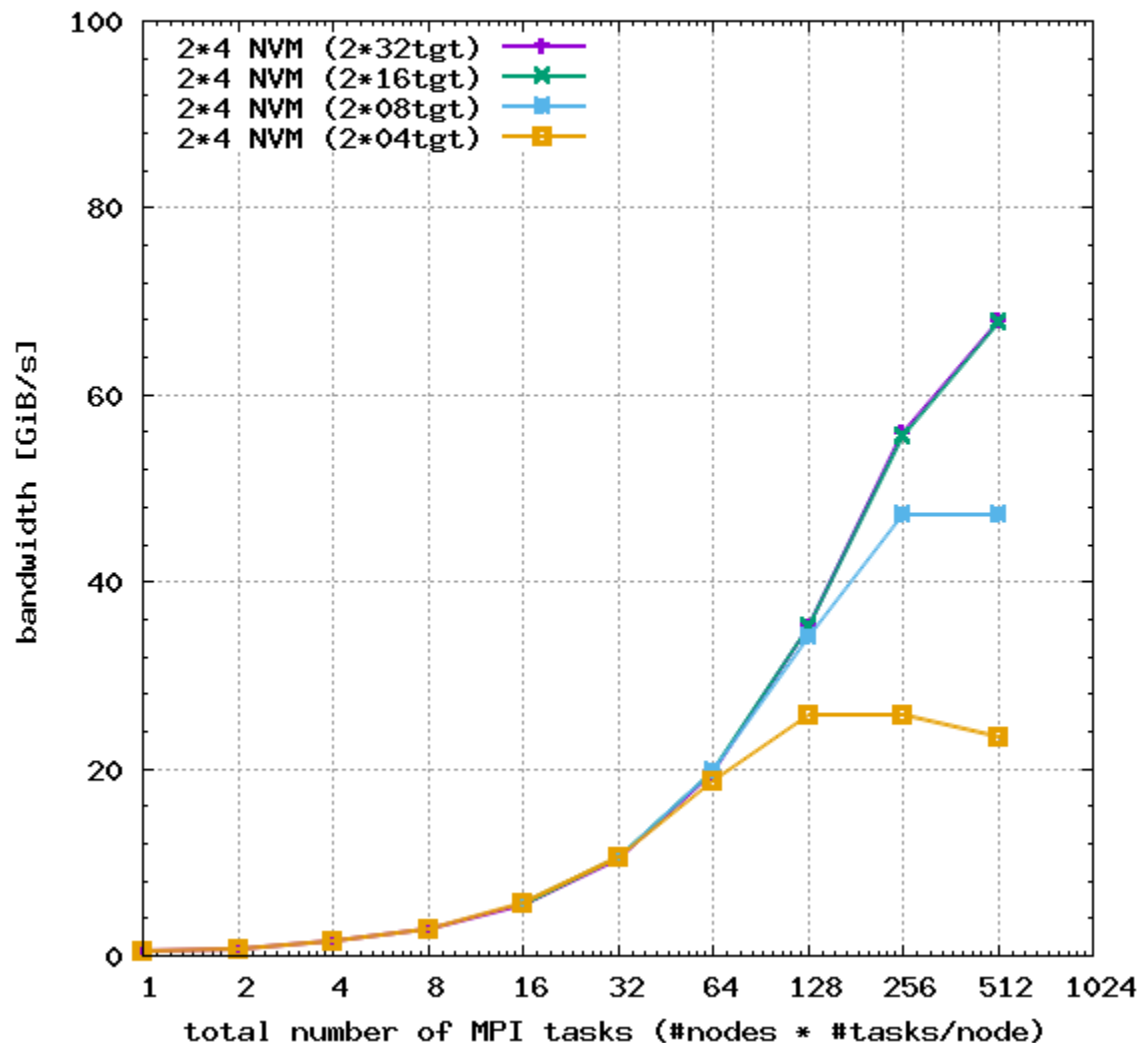


1x DL360-Gen12 Server - I0500 Scaling - IOR-easy-write
(2x Xeon 6740P, 8x PM1743 15.36TB NVMe, 2x CX-7 NDR)

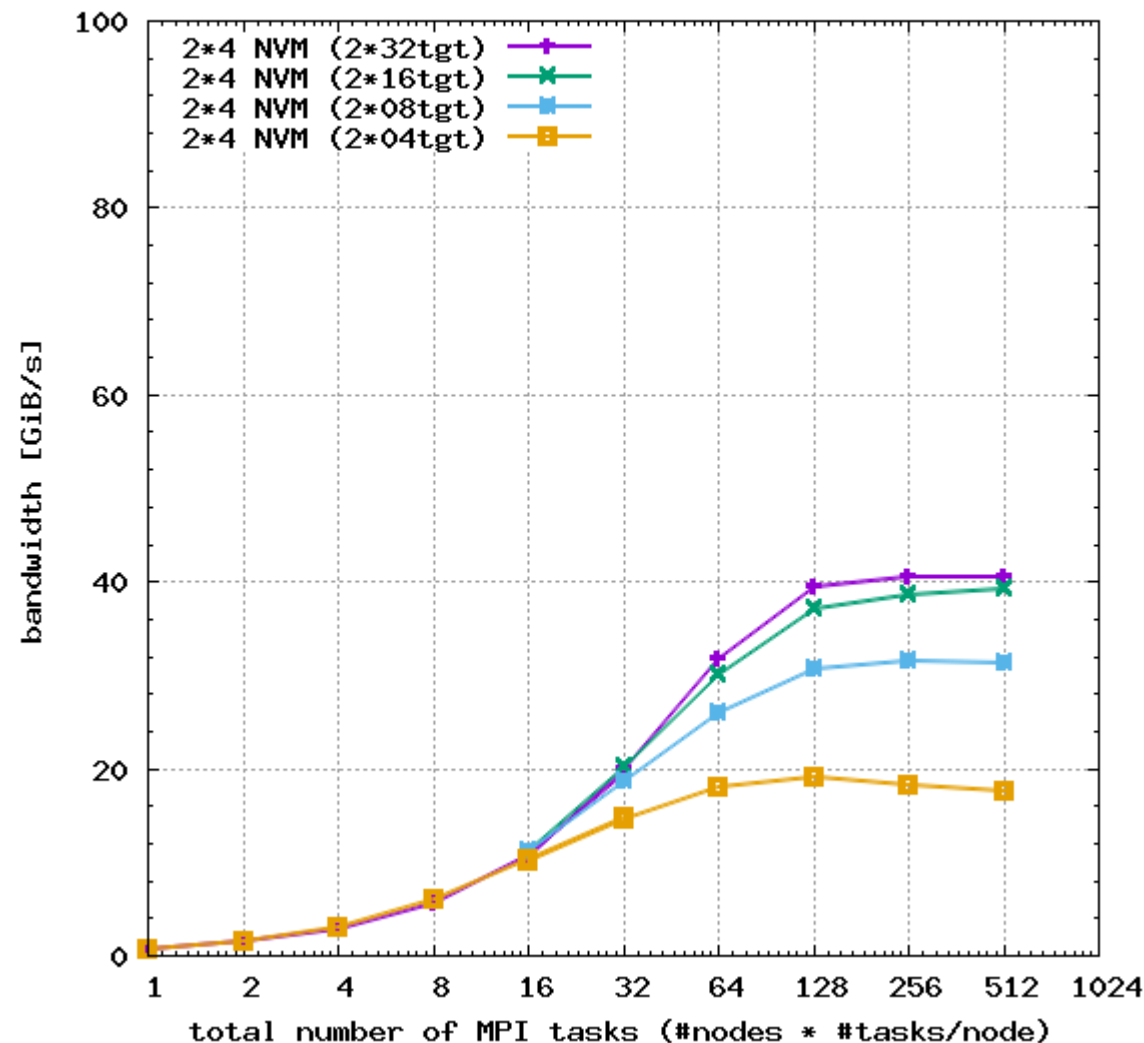


DAOS on DL360-Gen12 with NDR: `ior-hard-{read,write}` using 8x NVMe

1x DL360-Gen12 Server - I0500 Scaling - IOR-hard-read
(2x Xeon 6740P, 8x PM1743 15.36TB NVMe, 2x CX-7 NDR)

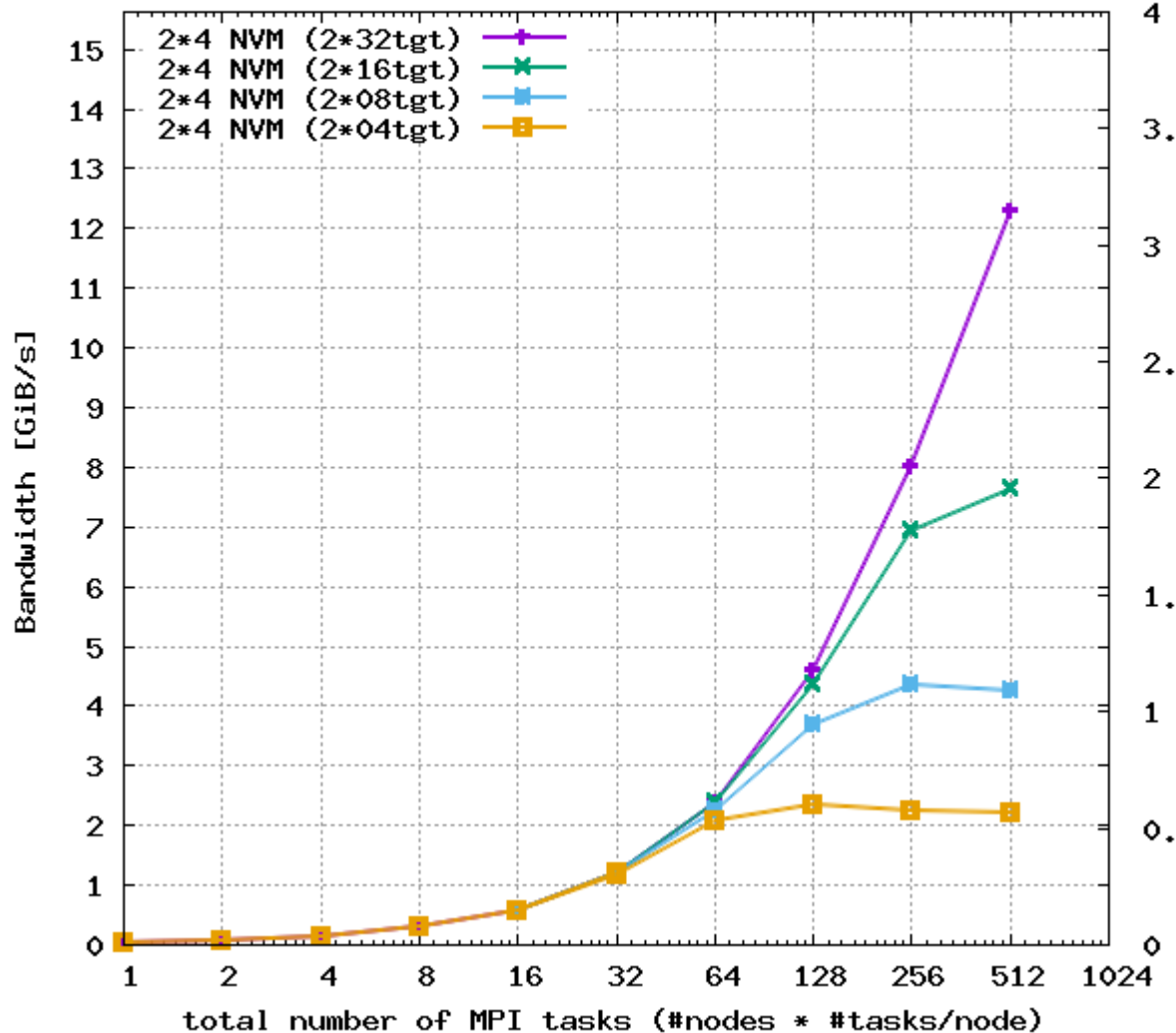


1x DL360-Gen12 Server - I0500 Scaling - IOR-hard-write
(2x Xeon 6740P, 8x PM1743 15.36TB NVMe, 2x CX-7 NDR)

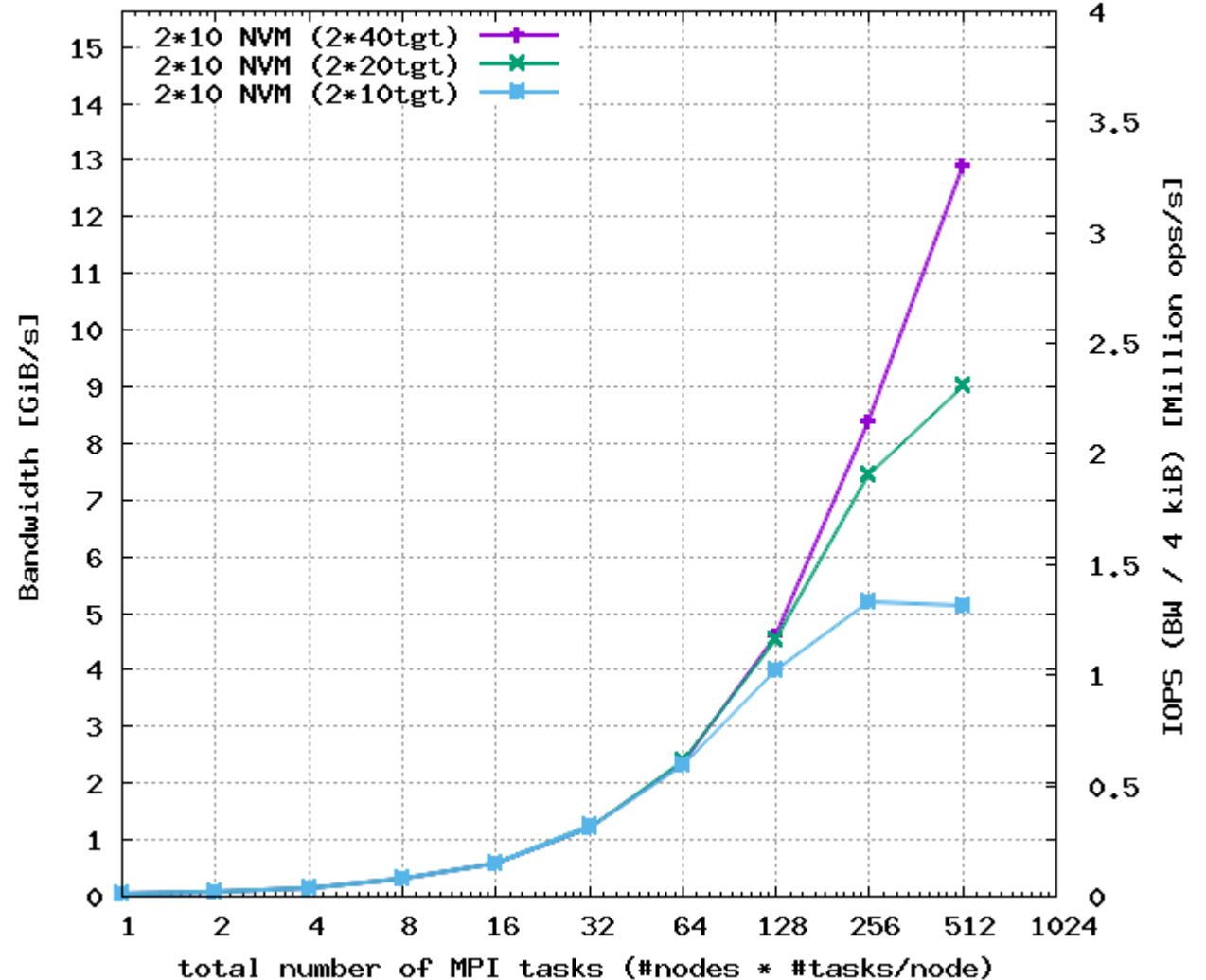


DAOS on DL360-Gen12 with NDR: ior-rnd4K-read using 8x (left) and 20x (right) NVMe

1x DL360-Gen12 Server - I0500 Scaling - ior-rnd4K-read
(2x Xeon 6740P, 8x PM1743 15.36TB NVMe, 2x CX-7 NDR)



1x DL360-Gen12 Server - I0500 Scaling - ior-rnd4K-read
(2x Xeon 6740P, 20x PM1743 15.36TB NVMe, 2x CX-7 NDR)



DAOS Performance on Slingshot

1. CUG 2025 paper : *Enhancing RPC on Slingshot for Aurora's DAOS Storage System*

- <https://doi.org/10.1145/3757348.3757350> →

2. Slingshot 400 Early Performance Evaluation

- 8x DAOS servers: ProLiant **DL320** Gen11
 - 1x Intel Xeon 6448H (32 cores → targets=24, nr_xs_helpers=6)
 - 512 GiB DRAM
 - 4x Samsung PM1743 3.84TB **NVMe**
 - 1x **Slingshot 400**
- daos-2.6.4-7.50.g10f82ab3, mercury-2.4.1~rc4-1
- libfabric-2.2.0rc1-SHS13.0.0 (**pre-GA**, build 20250827055305_8c2efcafddeb)
- Results submitted to IO500-SC25 Ten Node List

Enhancing RPC on Slingshot for Aurora's DAOS Storage System

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Abstract

DAOS is an open-source software-defined high-performance storage solution designed for massively distributed solid-state drives and non-volatile memory. It is a key component of the Aurora exascale system that aims to deliver high storage throughput and low latency to application users. Utilizing the Slingshot interconnect, DAOS leverages Remote Procedure Call (RPC) to communicate between compute and storage nodes. While the preexisting RPC mechanism used by DAOS was already designed for high-performance computing fabrics, it required a number of scalability, performance, and security enhancements in order to be successfully deployed on Aurora.

We present and discuss in this paper the improvements that were made to address this set of challenges in each of the components that DAOS relies on: the Collective and RPC Transport (CaRT) layer, the Mercury RPC library, and the libfabric Slingshot (cxi) provider. While some of these enhancements were tailored to the DAOS storage system specifically, they also serve as a broader reference for implementing scalable high-performance data services over RDMA fabrics. This paper focuses on the design and implementation of each functionality that was improved, enabling DAOS to provide both high throughput and low latency to Aurora users.

CCS Concepts

• **Networks** → Application layer protocols; Programming interfaces; • **Software and its engineering** → Software design engineering; Client-server architectures; • **Information systems** → Application servers; Storage network architectures.

Keywords

Remote Procedure Call, Data Services, High-Performance Computing, Slingshot, DAOS, Mercury, RDMA, libfabric

ACM Reference Format:

Jerome Soumagne, Alexander Oganezov, Ian Ziemba, Steve Welch, Philip Carns, Kevin Harms, John Carrier, Johann Lombardi, Mohamad Chaarawi, Zhen Liang, and Scott Peirce. 2025. Enhancing RPC on Slingshot for Aurora's DAOS Storage System. In *Cray User Group (CUG '25)*, May 04–08, 2025, Jersey City, NJ, USA. ACM, New York, NY, USA, 12 pages. <https://doi.org/10.1145/3757348.3757350>

1 Introduction

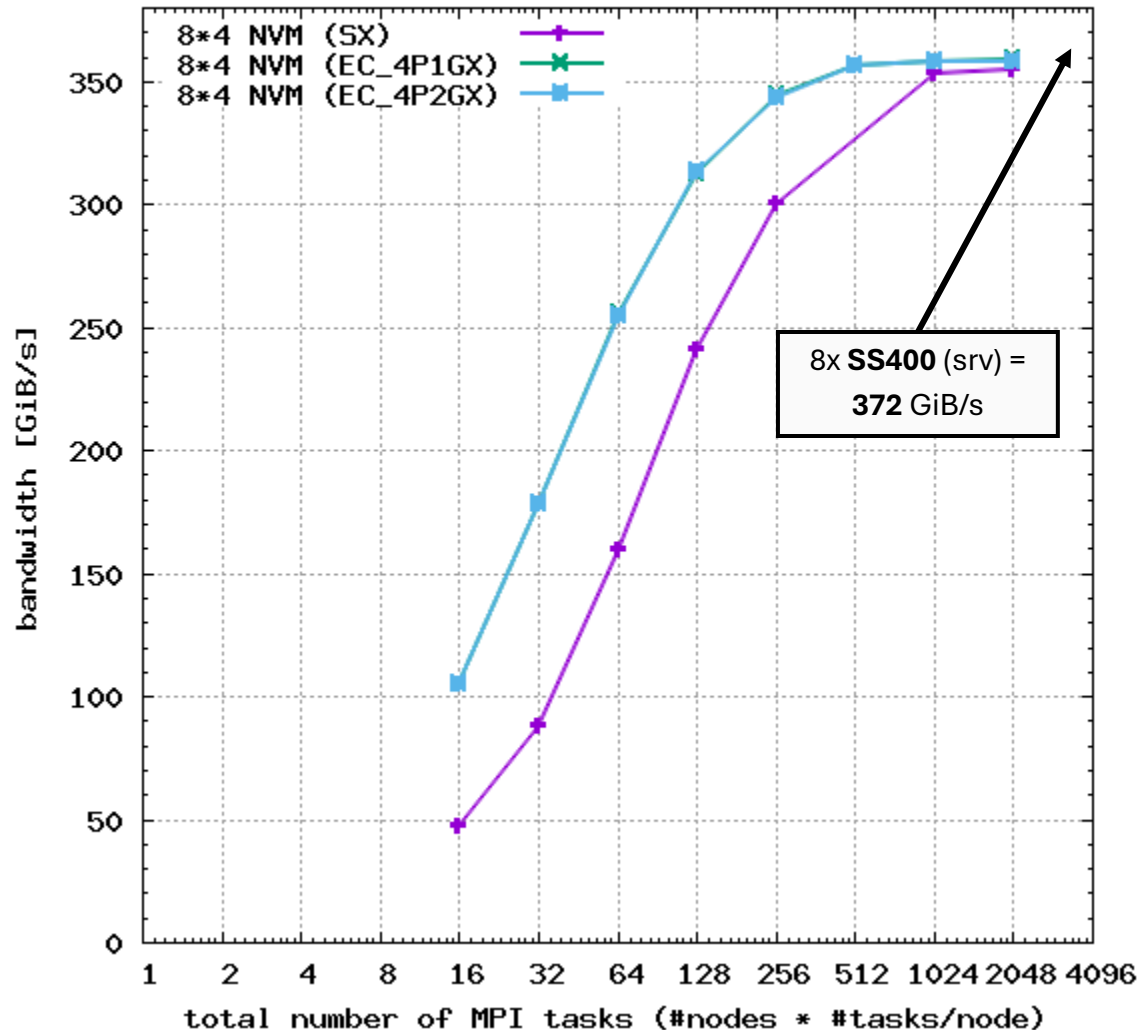
The design and deployment of distributed data services in high-performance computing (HPC) was once the exclusive domain of monolithic parallel file systems. However, the emergence of new storage technologies and the increasing complexity of HPC applications has prompted exploration of new data service architectures that not only take advantage of platform capabilities but are also more closely tailored to application needs [3, 10]. These HPC data services must achieve high bandwidth and low latency while also providing ease of deployment, scalability, and fault tolerance; and as such they rely heavily on the underlying network infrastructure. However, most network infrastructures are designed with an emphasis on application-level message-passing interface (MPI) first and foremost. They do not necessarily support or expose the set of features that are required for implementing data services at



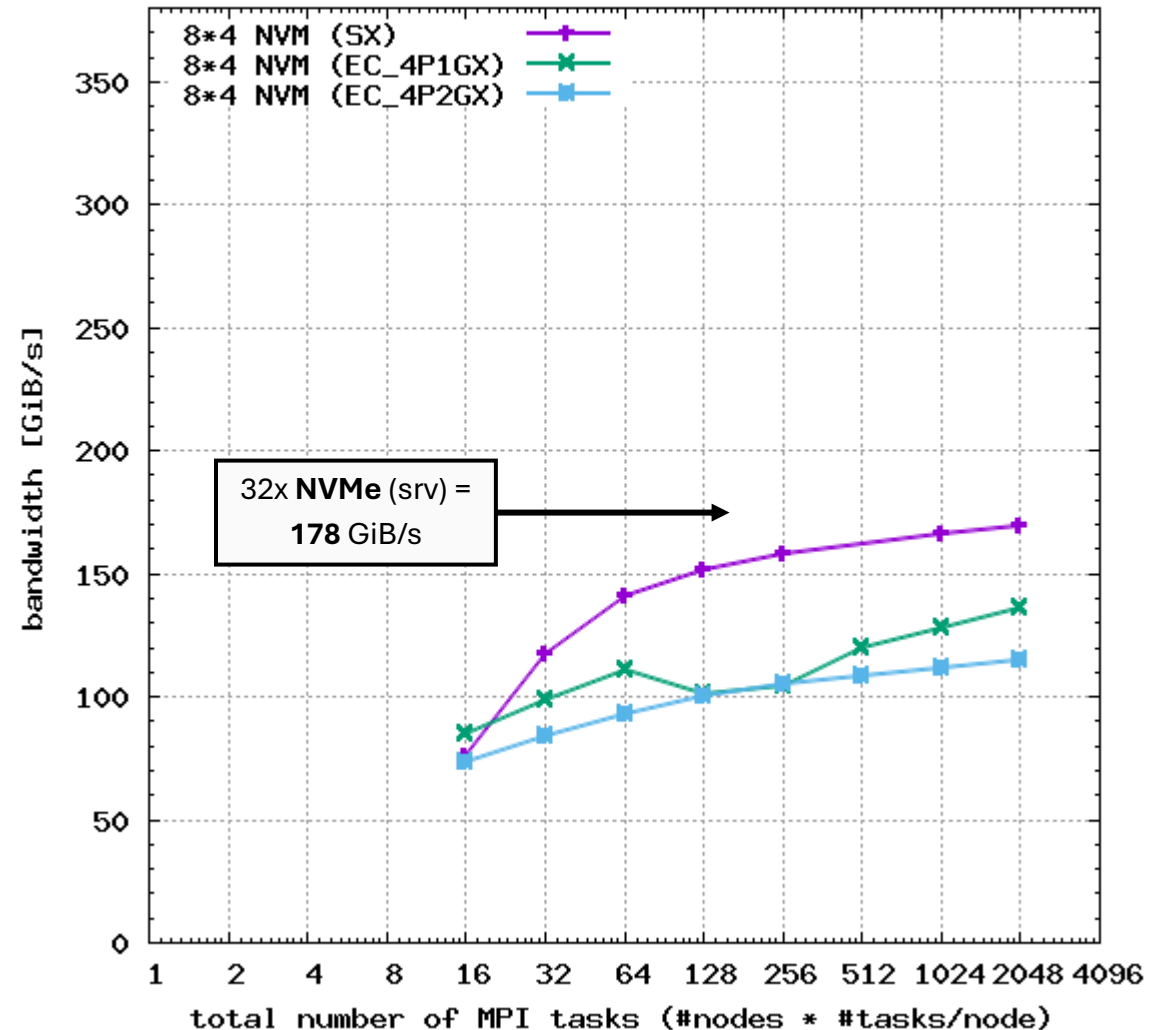
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DAOS on 8x DL320-Gen11 with Slingshot 400: `ior-easy-{read, write}`

8x DL320-Gen11 Server - I0500 Scaling - IOR-easy-read
(1x Xeon 6448H, 4x PM1743 3.84 TB NVMe, 1x SS400)

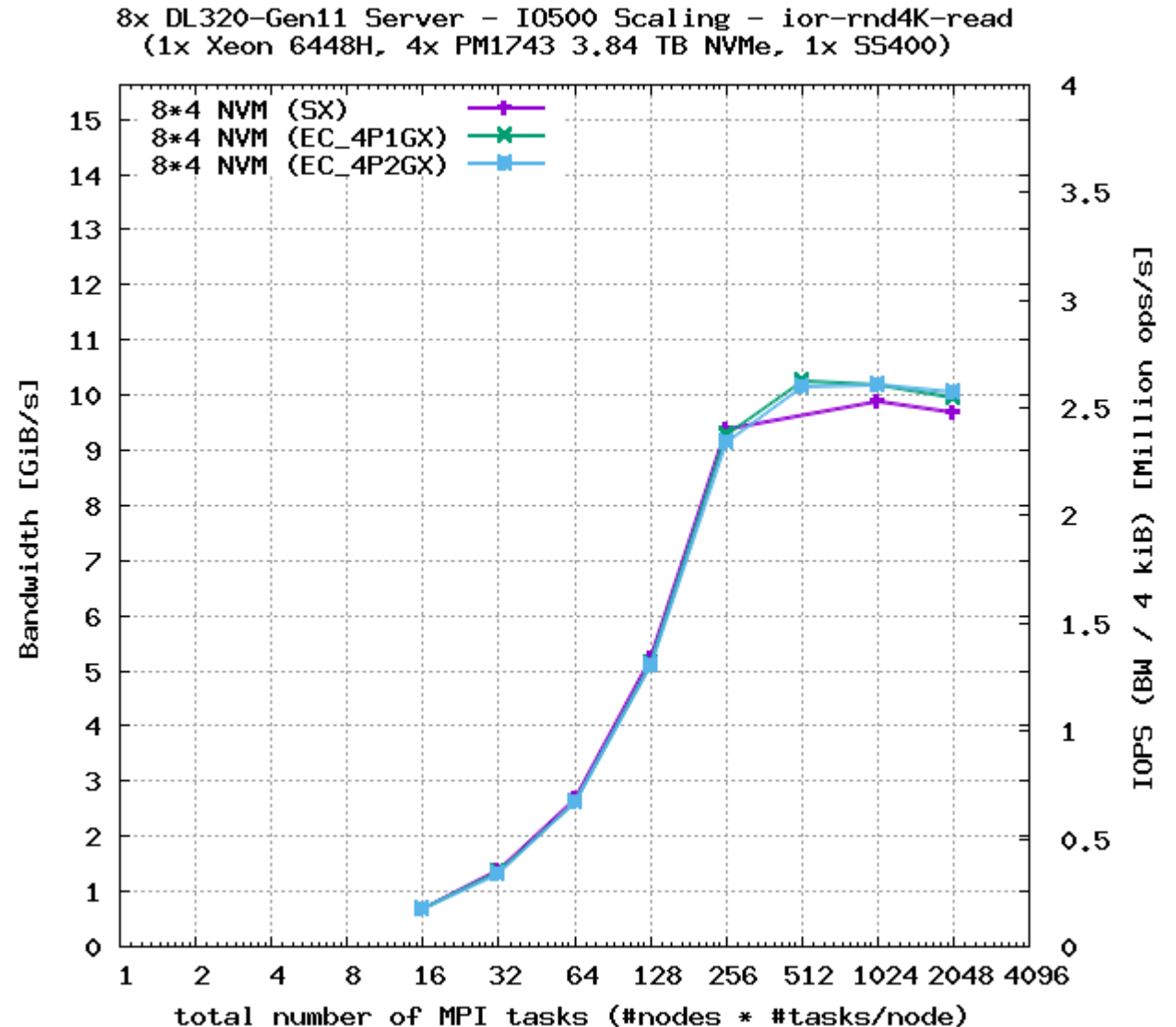


8x DL320-Gen11 Server - I0500 Scaling - IOR-easy-write
(1x Xeon 6448H, 4x PM1743 3.84 TB NVMe, 1x SS400)



DAOS on 8x DL320-Gen11 with Slingshot 400: ior-rnd4K-read

- IO500-ISC25 introduced 4kiB random read test
 - not included in ranking yet
 - Requires to run IOR-Easy with file-per-proc...
- Getting 2.5 Million IOPS with 32x NVMe
 - Same results with/without data protection, as expected for a read workload.



Thank you