Aurora Site Update

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Aurora

Leadership Computing Facility
Exascale Supercomputer

Peak Performance
≧ 2 Exaflops DP

Intel GPU
Intel® Data Center GPU Max

Intel Xeon Processor
Intel® Xeon® CPU Max

Platform
HPE Cray-Ex

Compute Node
2 Xeon Intel® Xeon® CPU Max processors
6 Intel® Data Center GPU Max
Node Unified Memory Architecture
8 fabric endpoints

GPU Architecture
Intel XeHPC architecture
High Bandwidth Memory Stacks

Node Performance
>130 TF

System Size
>9,000 nodes

Aggregate System Memory
>10 PB aggregate System Memory

System Interconnect
HPE Slingshot 11
Dragonfly topology with adaptive routing

Network Switch
25.6 Tb/s per switch (64 200 Gb/s ports)
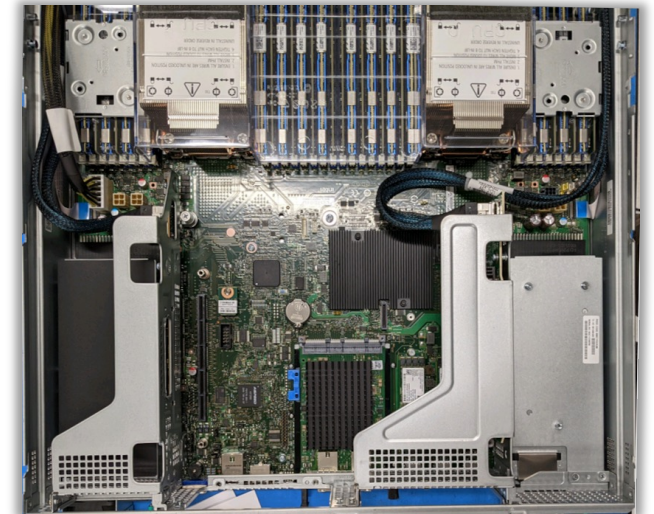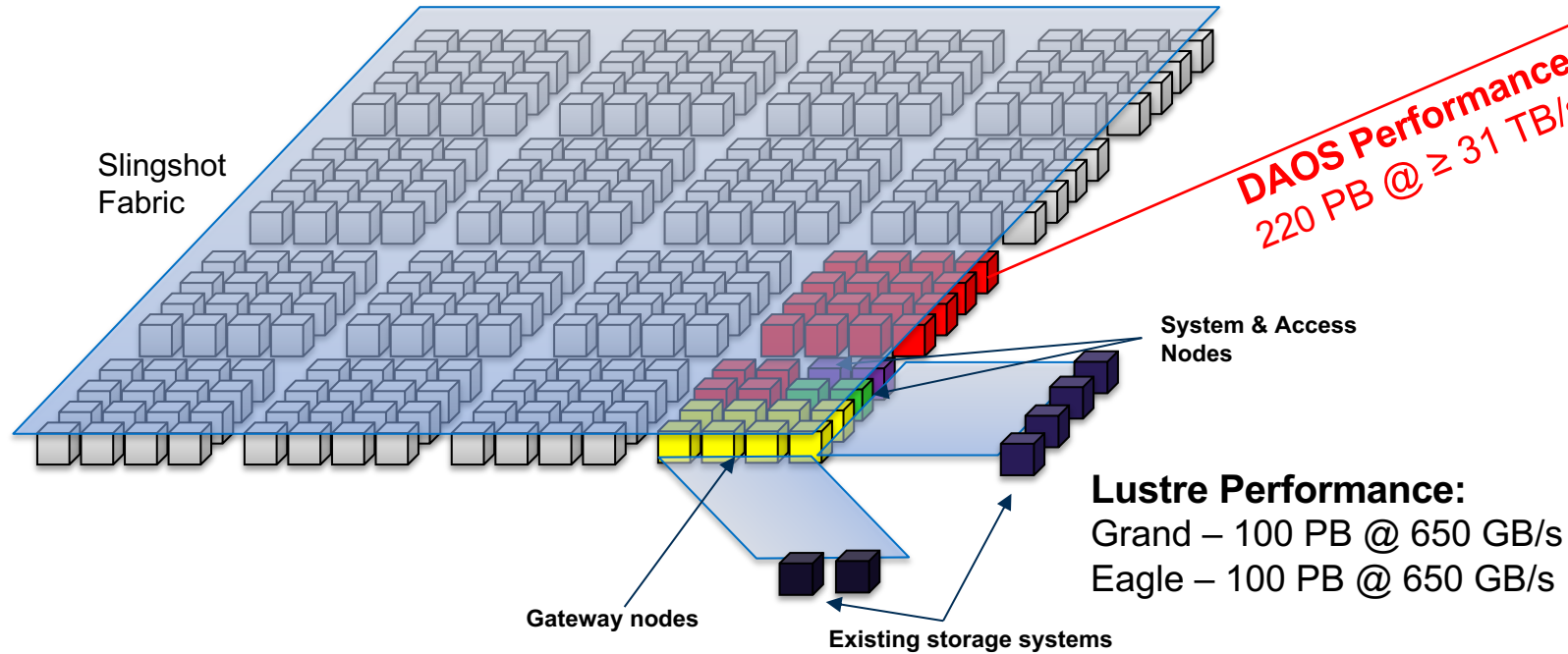Links with 25 GB/s per direction

High-Performance Storage
220 PB
≧25 TB/s DAOS bandwidth

Software Environment
- C/C++
- Fortran
- SYCL/DPC++
- OpenMP offload
- Kokkos
- RAJA
- Intel Performance Tools

Aurora Storage Architecture

Slingshot Fabric

DAOS Performance:
220 PB @ ≥ 31 TB/s

System & Access Nodes

Lustre Performance:
Grand – 100 PB @ 650 GB/s
Eagle – 100 PB @ 650 GB/s

Gateway nodes

Existing storage systems

The Aurora open-source storage strategy strongly favors cooperation:

- DAOS: object storage system for in-fabric high-performance platform storage (the first of its kind on a DOE leadership system!)
- Lustre: parallel file systems for facility-wide access and data sharing

Namespace integration will make it easier for users to manage data.

- 1024 DAOS server nodes, each with:
  — 16 x 512GB persistent memory
  — 16 x 15.3TB NVMe drives
  — 2 x HPE Slingshot NICs
  — Dual CPU with 512 GB RAM

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Aurora DAOS Status

- Aurora compute nodes available for testing by ALCF, Intel and ECP users

- Intel team testing with Aurora compute nodes now
  - Looking at application scaling
  - Performance analysis
  - Io500 testing (more later)

- Lots of 2.4 release testing

- Planning on DAOS partition with 20-40 DAOS nodes
  - Available and run in production like fashion
  - Setup to have DAOS available on job execution via parameters provided to scheduler
  - Evaluate DAOS as /home and /soft file systems
    - /home is our traditional home file system for building and basic work
    - /soft is a volume for locally built and installed software, supported by the wider ALCF staff

- DAOS Foundation

The DAOS Foundation
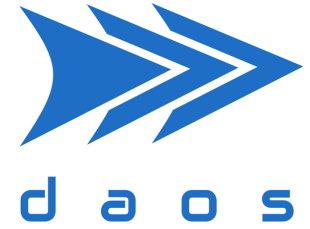
- **Intel**, in partnership with **Argonne National Lab**, **Enakta Labs**, **Google**, and **HPE** have launched the DAOS Foundation
  - Democratizing and accelerating DAOS for HPC and AI/ML applications
  - Together, members drive future DAOS development, pooling resources and knowledge
  - Independent and future-proof of any single company, product, or technology
  - Intel remains committed to DAOS
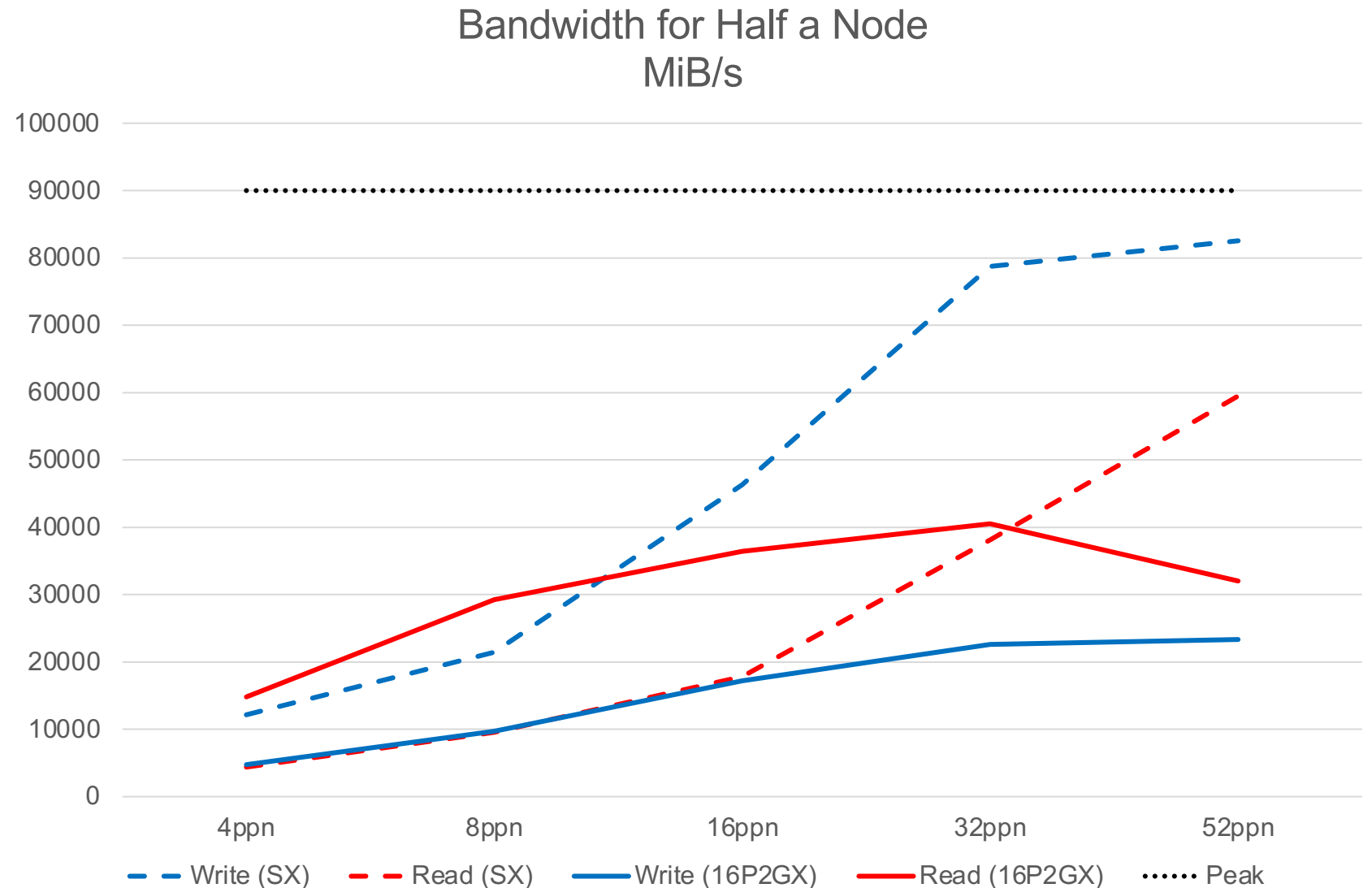
Sunspot

- ALCF's Test and Development system
  - Think of it as a baby Aurora
- Two compute racks / groups
  - 128 compute nodes
- DAOS deployment
  - 20 DAOS nodes
  - Identical server configuration to Aurora
  - Allows running EC16+2 – 18 nodes with 2 nodes for failover
- Production environment for DAOS at ALCF
  - Follow pool and container usage plan for Aurora
  - 1 pool per project
    - ACL limits pool to project members
    - Users create containers
  - Suggested default data protection of EC16+2 on containers
  - Running DAOS v2.2

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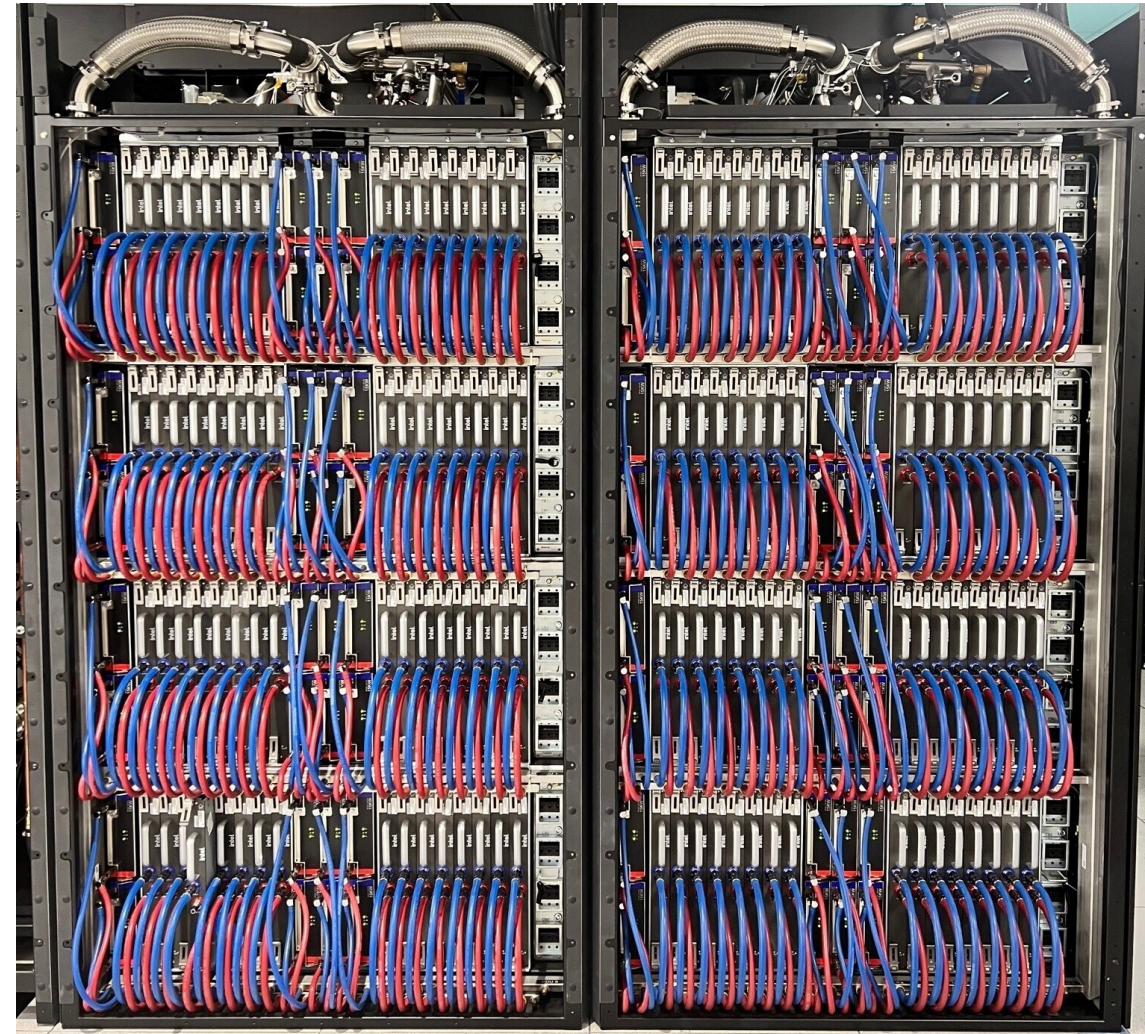
IOR Scaling per Process

- Each step uses 1 process per NIC across 4 NICs
  — 1 MiB I/O request

- No redundancy
  — dfs.oclass=SX

- Redundancy
  — dir.oclass=EC_16P2GX

Bandwidth for Half a Node
MiB/s

IOR per Node Scaling

- Running up to 64 nodes
  - Using 8 NICs per node

- No redundancy
  - 1 MiB I/O size
  - dfs.chunk_size=128k
  - dfs.oclass=SX

- Redundancy
  - 2 MiB I/O size
  - dfs.chunk_size=2M
  - dir.oclass=EC_16P2GX

Aggregate BW MiB/s

Legend: Write (SX), Read (SX), Write (16P2GX), Read (16P2GX), Peak
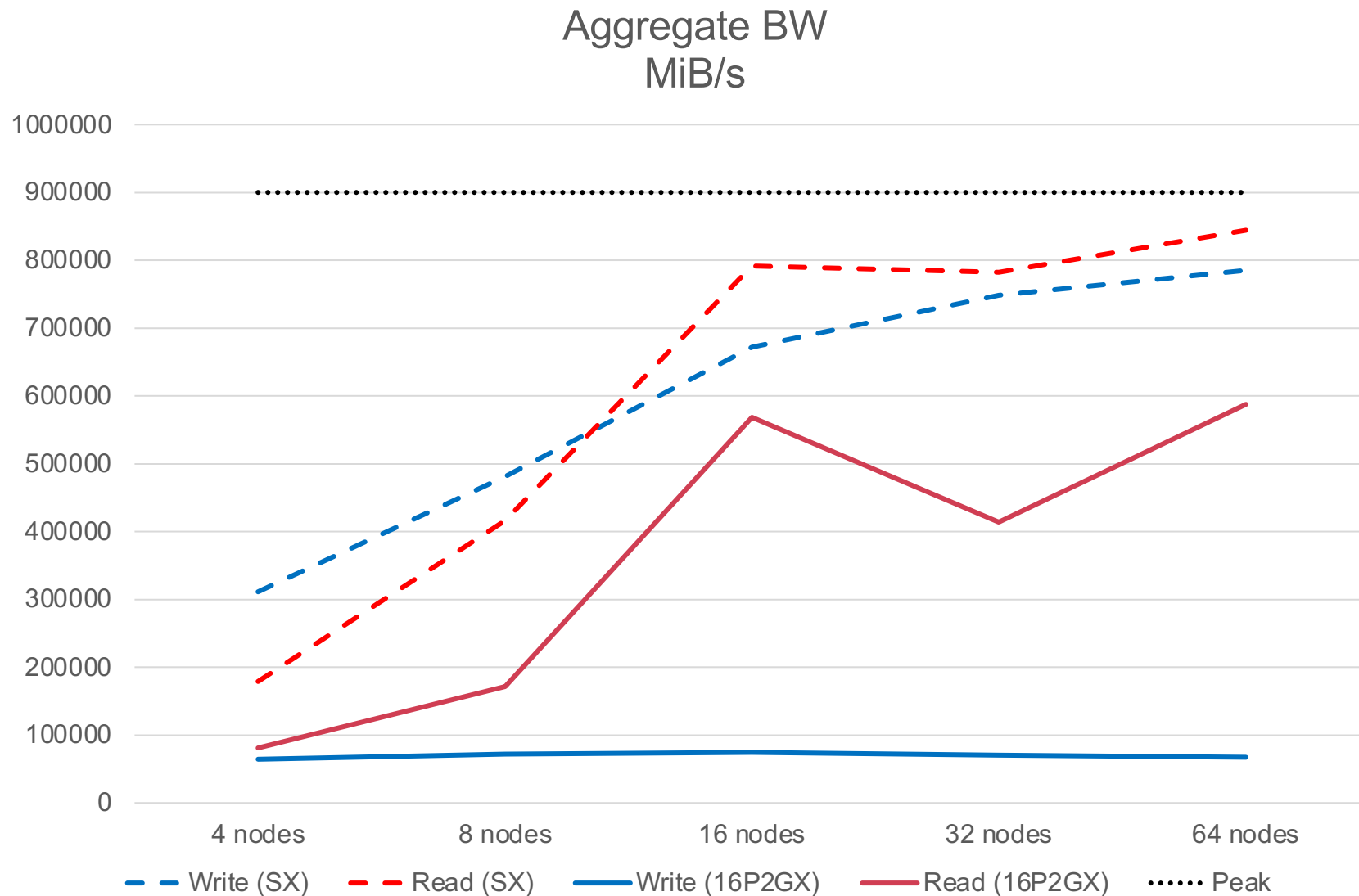
Sunspot Results and Issues

- Sunspot is running DAOS v2.2
    - We would like to upgrade but blocked by other issues unrelated to DAOS or storage
- Sunspot performance within expectations
    - Issues with redundant performance (fixed in v2.4)
- Sunspot had several science users testing
    - Mostly using POSIX dfuse
    - A few with MPI-IO test cases
    - Some successes, some failures

- Rebuild would enter infinite rebuild loop when EC data was present
    - Known fixed in 2.4
- Servers would start reporting ENOMEM for internal operations
    - Need to evaluate on 2.4
    - DAOS test team doesn't see this
- Determined the need for a dedicated DAOS management node
    - Simplifies management scheme to use centralized management point that isn't central admin node
    - Don't perform management operations on the server node itself

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IO-500 Results

IO⁵⁰⁰

https://io500.org

- New IO-500 SC23 BoF submission
  - https://io500.org
  - First production submission for Aurora!
    - Tolerate 1 server failure
    - Using 16+1 and replication
  - Still only using a portion of the available Aurora resources
    - 300 clients
    - 642 servers

- **IO500: The High-Performance Storage Community**
  - **Wednesday, November 15, 2023**
  - **12:15 – 1:15pm MST**
  - **Room 607**

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Acknowledgements

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