# Analyzing Parallel I/O

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Motivation

- An ability to understand parallel I/O performance is critical to ensuring efficient use of HPC resources
  - However, users, system admins, and I/O researchers are often ill-equipped for understanding an increasingly complex HPC I/O ecosystem

- Complex systems
  - Diverse application I/O workloads
  - Deep storage hierarchies utilizing emerging storage hardware
  - I/O middleware to bridge the gap

- In this BoF, we attempt to form a broad community of parallel I/O stakeholders to discuss state-of-the-art in analyzing parallel I/O, with the following goals:
  - Inform community of recent advances in tools/techniques for I/O monitoring
  - Discuss experience/limitations of current approaches
  - Derive a roadmap for future I/O tools to capture, analyze, predict, and tune I/O
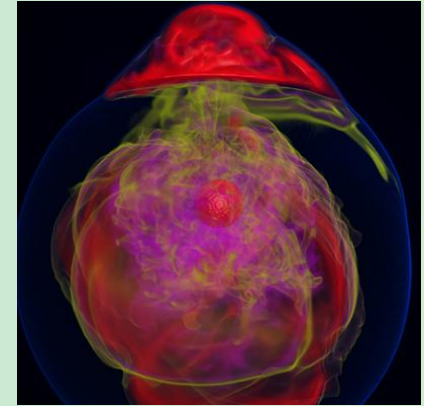
Visualization of entropy in Terascale Supernova Initiative application. Image from Kwan-Liu Ma's visualization team at UC Davis.

HPE/Cray Aurora system at the ALCF

Agenda

- Talks
    - "The Network Testing Mode in elbencho v3.0", Sven Breuner (VAST)
    - "The HPC IOAnalysis Repository", André Brinkmann (JGU Mainz)
    - "MangoIO", Radita Liem (RWTH Aachen)
    - "Understanding Storage Performance using Benchmarking - Experiences at GWDG", Hendrik Nolte (GWDG)
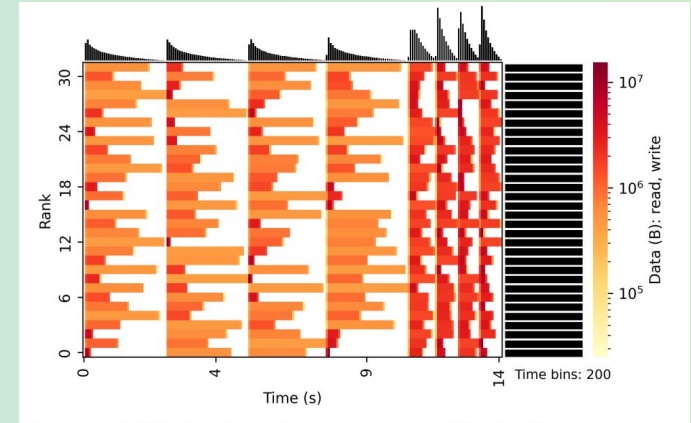- (Audience-driven discussion)

Recent Darshan developments

- New *heatmap module* offers tradeoff between Darshan's traditional condensed data capture and fine-grained tracing with DXT
    - Now available for POSIX, MPI-IO, and STDIO interfaces

- *PyDarshan framework* enables extraction of Darshan log data in popular Python formats (e.g., pandas dataframes) and forms foundation of a newly developed Darshan job summary tool
    - Available via PyPI: `pip install darshan`

- (In progress) New *DAOS modules* providing in-depth characterization of various DAOS APIs
    - DAOS file system (DFS) as well as native object APIs (key-val, array)

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Heatmaps showcase I/O intensity across time (x-axis) and ranks (y-axis). Comparing across interfaces can offer insights into I/O behavior (e.g., collective I/O)

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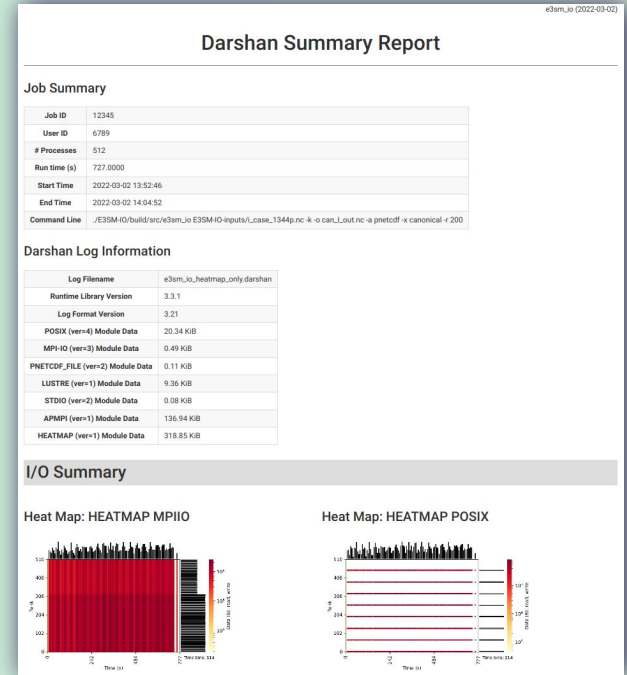
New PyDarshan-based job summary tool generates detailed HTML reports of job I/O behavior

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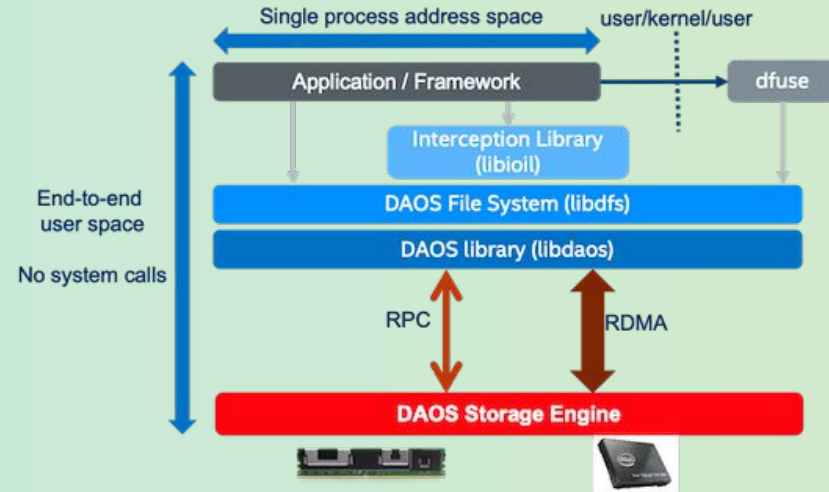
Various access methods for DAOS users.

Figure courtesy of Intel

Thanks to all for attending!

BoF website will be updated with speaker materials, notes, etc.:

https://hps.vi4io.org/events/2023/sc-analyzing-io