Towards Total Knowledge of I/O at NERSC through Holistic Monitoring

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Total Knowledge of I/O with holistic analysis

- Our vision: augment expert knowledge using existing tools
- Index and normalize all available data
- Provide a holistic view through a single pane (UMAMI)
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IO Nodes, BB Nodes
Storage Servers

• Compress
• Process
• Analyze
• Index
• Normalization
• Holistic view

Total Knowledge of I/O (TOKIO)
UMAMI: variation due to contending bandwidth

Group job performance by I/O motif (similar transaction size, file/process ratio, client count, etc)
UMAMI: variation due to contending bandwidth

- Most jobs get exclusive access to Lustre bandwidth ($CF_{bw} \approx 1.0$)
UMAMI: variation due to contending bandwidth

Performance variation caused by bandwidth contention
Variation due to metadata contention (GPFS)

- Bandwidth was uncontended
- IOPS contended by high readdir rates
- Effected by ALCF's GPFS architecture
Variation due to extremely full file system (Lustre)

- Moderate negative correlation: Perf vs. OSS CPU load
- Strong negative correlation: fs fullness
- Result of Lustre block allocation at >90% fullness
TOKIO Project—come join the party!

- Implemented in the pytokio Python package: https://github.com/nersc/pytokio/
  - Jupyter notebooks: demonstrate useful analyses
  - CLI tools: interact with component-level data
  - Unit tests (and integration tests, smoke tests, etc): basic usage examples and sample input data sets
- 1000% open-source (BSD)
  - pytokio is open source and open development
  - REST API allows researchers to take data with them
- Supported by DOE SC (DE-AC02-05CH11231 and DE-AC02-06CH11357; A Framework for Holistic I/O Workload Characterization; program manager: Dr. Lucy Nowell)

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