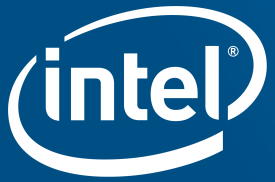

Lustre* Features In Development

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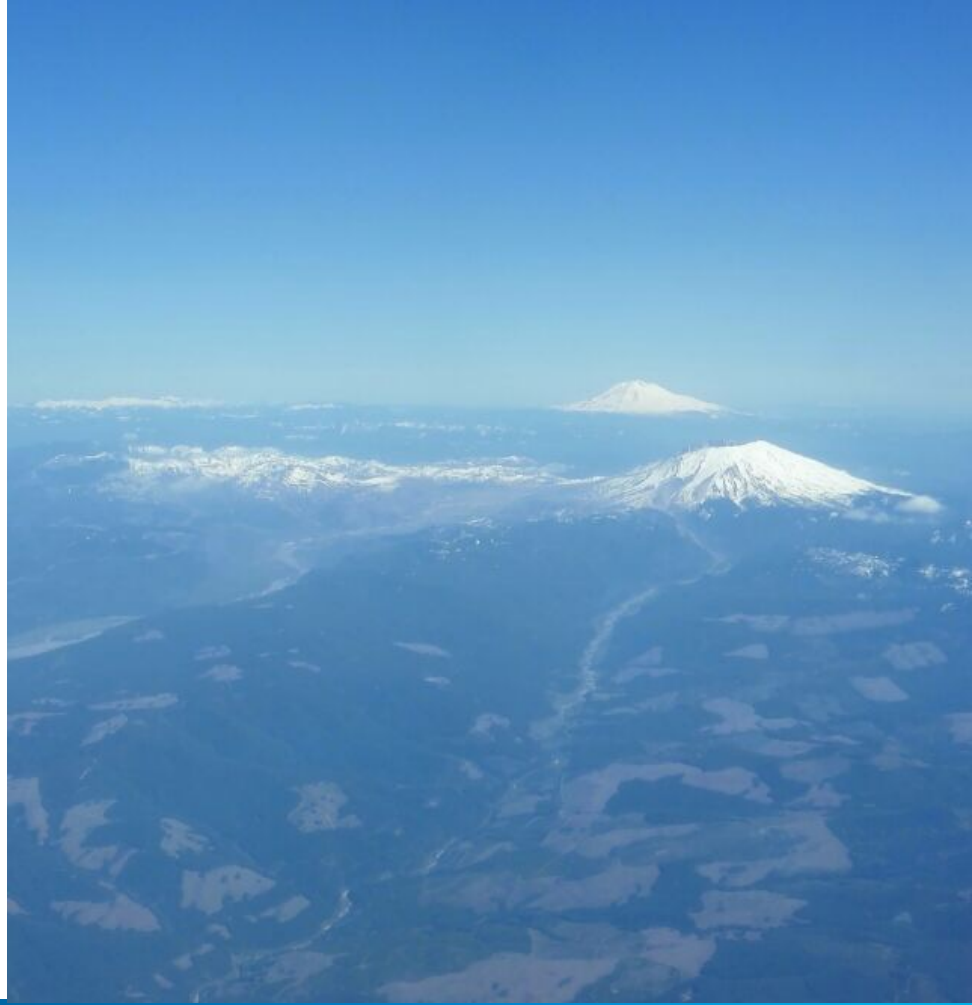
CLUG 2017 @Beijing

Outline

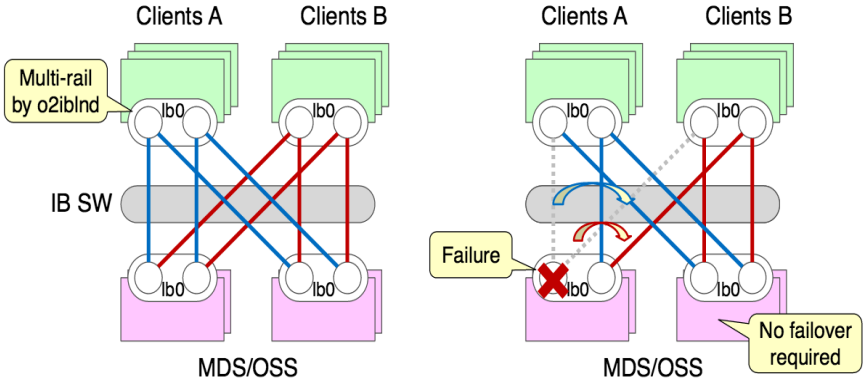
- LNet reliability
- DNE improvements
- Small file performance
- File Level Redundancy
- Miscellaneous improvements
- ZFS enhancements
- Client side data compression



LNet Network Health (LU-9120, Intel)

Builds on LNet Multi-Rail in Lustre 2.10 (Intel, HPE/SGI*)

- Detect network failures
  - Local interface, remote interface, router
- Handle related faults in LNet
  - Resend across different type(s) of interface(s)
  - Mitigate & simplify upper layer error handling
- Restore connection when available
  - Avoid upper layer complex recovery



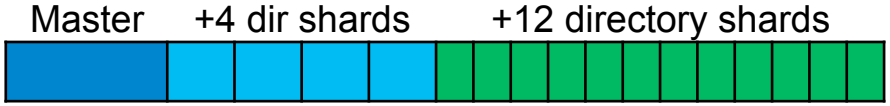
DNE Improvements (LU-4684, Intel)

Directory migration from single to striped/sharded directories

- Rebalance space usage, improve large directory performance
- Inodes are also migrated along with directory entries

Automatic directory restriping to reduce/avoid need for explicit striping at create

- Start with single-stripe directory for low overhead in common use cases
- Add extra shards when master directory grows large enough (e.g. 32k entries)
- Some policies for the restriping
  - Existing *dir entries* stay in master, or are migrated to shards asynchronously
  - New created entries in new shards to distribute load, or rebalance globally
- Performance scales as directory grows



Data-on-MDT for Small File Perf (LU-3285, Intel)

Avoid OST overhead (data, lock RPCs)

Pre-fetch file data with metadata

Size on MDT for small files

High-IOPS MDTs (mirrored SSD vs. RAID-6 HDD)

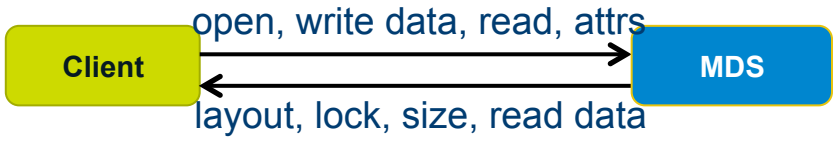
Avoid contention with streaming IO to OSTs

Integrates with PFL to simplify usage

- Start file on MDT, grow onto OSTs if larger

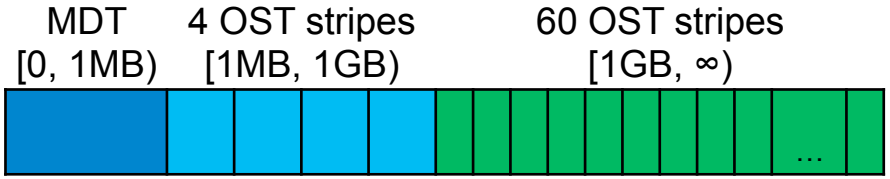
Complementary with DNE 2 striped directories

- Scale small file IOPS with multiple MDTs



Small file IO directly to MDS

Example DoM/PFL File Layout

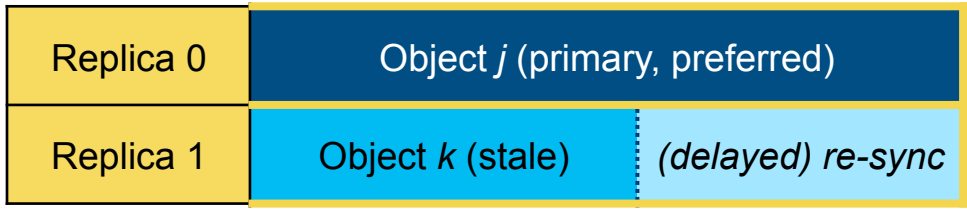


File Level Redundancy (LU-9771, Intel)

Based on Progressive File Layout (PFL) feature in Lustre 2.10 (Intel, ORNL)

Significant value and functionality added for HPC and other environments

- Optionally set on a per-file/dir basis (e.g. mirror input files and one daily checkpoint)
- Higher availability for server/network failure – finally better than HA failover
- Robustness against data loss/corruption – mirror (and later M+N erasure coding)
- Increased read speed for widely shared input files – N-way mirror over many OSTs
- Mirror/migrate files over multiple storage classes – NVRAM->SSD->HDD (e.g. Burst Buffer)
- Local vs. remote replicas (WAN)
- Partial HSM file restore
- File versioning (no re-sync replica)
- Many more possibilities …



Miscellaneous Improvements

Client asynchronous `ladvise` Lock Ahead (LU-6179, Cray*)

- Client (MPI-IO) to request read/write DLM locks before IO to avoid latency/contention
- MPI-I/O integration so applications can benefit from this without modification

Token Bucket Filter (NRS-TBF) improvements

- Real-time priorities for TBF rules if server is overloaded (LU-9228, DDN*)
- Support UID/GID for TBF policies, compound policy specification (LU-9658)

File access and modification auditing with ChangeLogs (LU-9727, DDN)

- Record UID/GID/NID in ChangeLog for `open()` (success or fail), other operations

Disconnect idle clients from servers (LU-7236, Intel)

- Reduce memory usage on client and server for large systems
- Reduce network pings and recovery times
- Aggregate `statfs()` RPCs on the MDS (LU-10018)

ZFS Enhancements Related to Lustre*

Lustre `osd-zfs` updates to use zfs-0.7.x

- Use ZFS native object accounting (Intel)
  - More accurate object quota
- OI Scrub for ZFS (LU-7585, Intel)
  - Server side file-level backup/restore
  - Migration from ldiskfs to ZFS
- File create performance (Intel)
  - Parallel lock/alloc
  - New APIs

ZFS backend new features

- Dynamic dnode size (0.7.x, LLNL)
  - Better xattr performance/space
- Optimized parallel dnode allocation (0.7.x, Delphix, LLNL, Intel)
- Multi-mount protection (#6279, 0.7.x, LLNL)
  - MMP, improve HA safety
- Native encryption for ZoL (#5769, 0.8.x, Datto)
- Project quota on ZFS (#6290, 0.8.x, Intel)
- Declustered RAID (dRAID) (0.8.x, Intel)

Client Side Data Compression (LU-10026, Uni Hamburg)

Piecewise compression

- Compressed in 32KB chunks
- Allows sub-block read/write

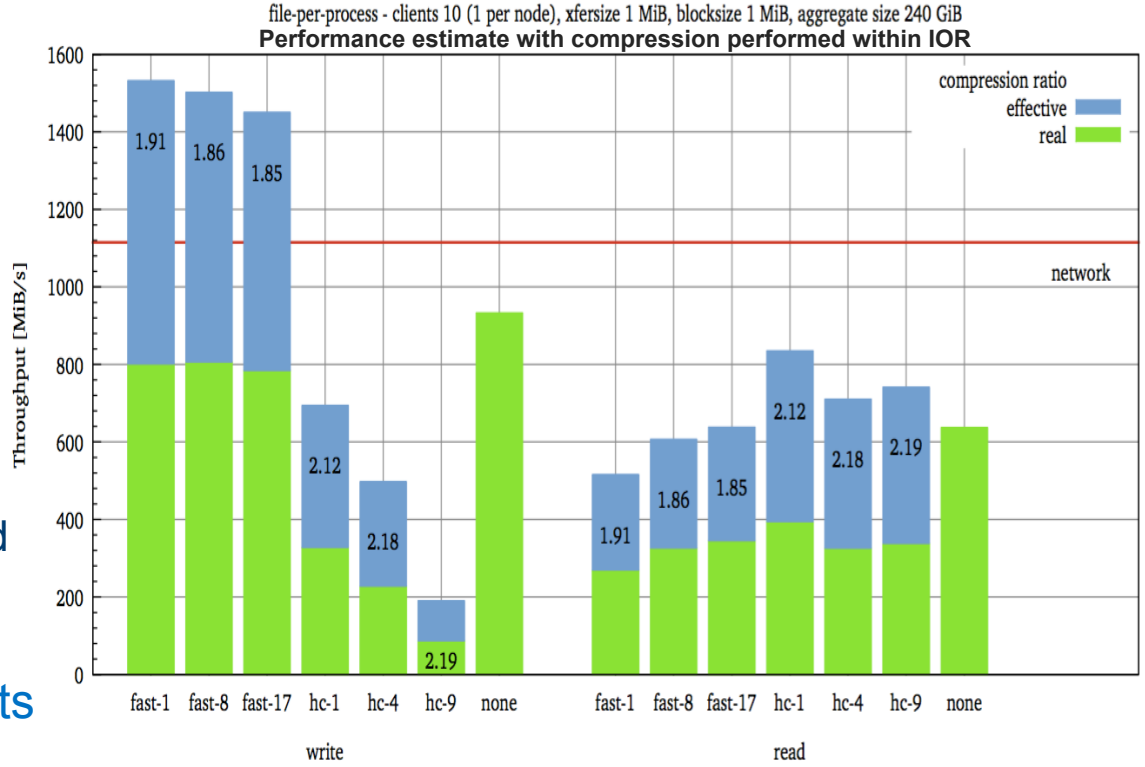
Integrated with ZFS data blocks

- Leverage per-block type/size
- Code/disk format changes needed

Avoid de-/re-compressing data

Good performance/space benefits

- Graph courtesy Uni Hamburg



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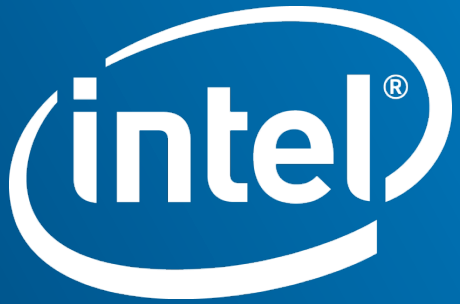
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