Installing & Configuring Lustre on KVMs

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Goals

Our mission was to find a scalable filesystem for our HPC environment.

We decided to create a small, proof of concept cluster on some kernel-based virtual machines.

Our goals were as follows:

- Investigate Lustre
- Create a miniature lustre cluster utilizing three kvms
- Investigate and install a backend filesystem for lustre (zfs vs ldiskfs).
- Run some benchmark tests

Lustre

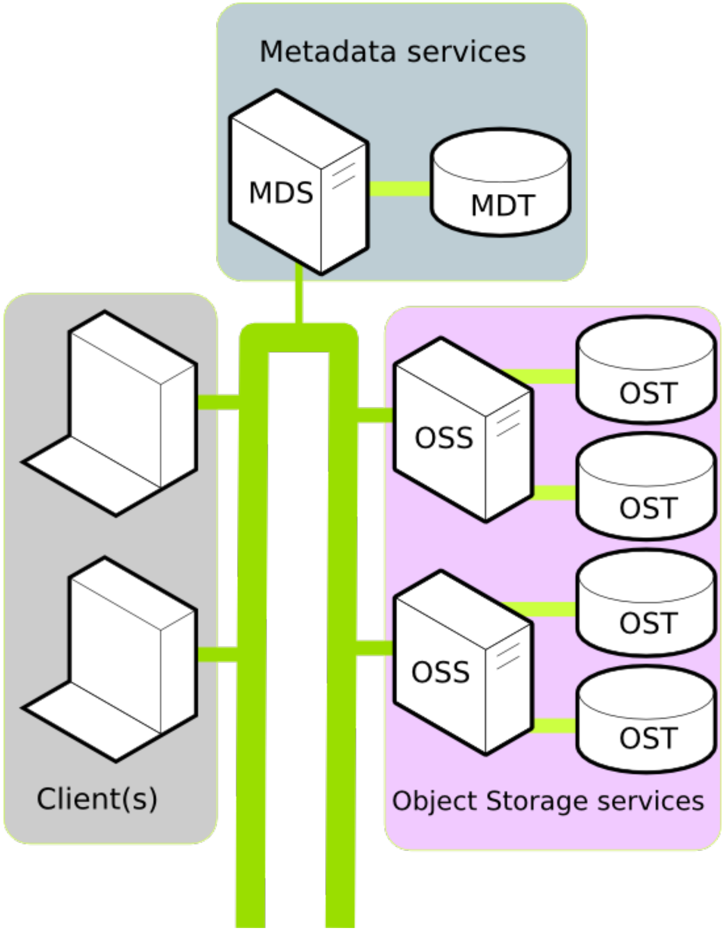
- Why use Lustre in HPC?

  Lustre has…

  - Exascale Capacities
    - Lustre uses distributed, object-based storage managed by servers.
      - Very large files can be distributed amongst different data objects and amongst several servers.
  - Data Integrity (only ZFS)
    - Data is written frequently in the event of a node crashing
  - Massive Scalability
    - Object Storage is low cost and efficient
    - I/O thoroughput and capacity are easily scaled by dynamically adding servers
  - POSIX-compliant on a Linux-based OS

The Lustre Architecture

- Components of a Cluster
  - MGS: Management Server, stores configuration information.
  - MDS: Metadata Server, manages MDTs.
  - MDT: Metadata target that stores file information/ location.
  - OSS: Object Storage Server, manages OSTs.
  - OST: Object Storage Target, storage device, hosts files.
  - Client(s): Access and use the data.



Why ZFS over LDISKFS?

- Larger Capacities
- Integrated Data Integrity

Feature	LDISKFS	ZFS
Max Volume Size	32PB	512PB
Maximum Lustre File Size	512PB	8EB
Native Data Protection	None	Mirror, RAIDZ{1,2,3}, DRAID (Future)
Detect/ repair silent data corruption	None	Yes
File system repair	Offline: FSCK	Online: ZFS Scrub

What we accomplished

In the end, our setup consisted of:

- 3 Centos 7 Kernel-based virtual machines
- A single MGS/MDS/MDT and OSS/OST setup with one client
- A small Lustre cluster built from source utilizing a ZFS backend filesystem

- What was not accomplished:

- Benchmark tests
  - Lustre utilizing local storage
  - Lustre utilizing JBODs

Challenges

- Outdated resources
  - Tutorials written for an older RHEL version
  - More niche technology with few public discussions
  - Poor documentation (Except Lustre manual)
    - Documentation used old methods and syntax
- Installing Lustre
  - Lustre packages hard to find/ Don’t support ZFS
  - Setting up the development environment
    - LNET
    - Mounting Lustre Devices

Possible Future Goals

- High Availability
  - Utilize pacemaker to maintain high availability in the event of server failure
- Explore Hierarchical Storage Management (HSM)
  - Integrate Cheap Long-term Storage Solutions
  - Automatically move old data to/ from a cheaper/ slower storage medium
  - Invisible to end client
- Explore Clustered Trivial Database (CTDB)
  - Interface for the Server Message Block protocol (Windows protocol)
  - Extend filesystem support for different clients and operating systems

Sources

- https://wiki.lustre.org/
- https://wiki.whamcloud.com/
- https://en.wikipedia.org/wiki/Lustre_(file_system)
- https://wiki.lustre.org/images/6/64/LustreArchitecture-v4.pdf
- https://www.netapp.com/data-storage/storagegrid/what-is-object-storage/

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