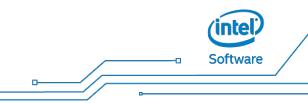


## Lustre\* HSM in the Cloud

Robert Read, Intel HPDD





Lustre in the Cloud

HSM for Cloud

- Importing from Amazon Simple Storage Service\* (S3)
- General archive with S3
- Crazy snapshot idea

□ Software

Lustre is not intended to be used for long-term storage in AWS

• (though HA support makes this possible)

S3 is more cost effective than Lustre (in AWS) for long term storage

Data needs to be managed outside the filesystem

- Data outlives filesystems
- Datasets can be shared

\_\_\_\_\_ Software

Could HSM help with cloud data management?

- Supports "on demand" use case
- Existing tools don't support S3
- Other challenges?

Much of the rest of this is speculative and "what iffy" Not a Roadmap Works fine for initial import in an empty filesystem (no FID clashes)

But importing into a live file system requires remapping FIDs

- No rename in S3
- Don't want to force a database

Don't use FIDs when archive will outlast the filesystem

\_\_\_\_\_ Software

GUID can be stored in file's extended attributes

- Database lookup not required
- Could support multiple archives with different identifiers

Disadvantage: Mapping is lost when file is deleted

- Include xattr in changelog entry?
- Retain unlinked, archived inodes?

□\_\_\_\_\_□ Software

How about a URL?

hsm-url=s3://my-bucket/my/big/file.log

□ Software

Import data from an S3 bucket on demand.

- Provide POSIX access to large dataset stored on S3
- Allow processing to begin before data has been imported
- Retrieve data from S3 as it is needed
- Remains in Lustre\* until released

© Software

S3 Import Tool

- Scan keys in S3 and create "stub" files in Lustre
- Save the object URL as extended attribute
- Create other metadata based on defaults (uid, gid)

S3 Copy Tool

• Copy file data from S3 links

[root@test1]# lhsm mirror --url s3://my-bucket/tools --dest /mnt/lustre/tools --uid 500 --gid 500

```
[root@test1]# tree /mnt/lustre
/mnt/lustre
    tools
    emacs-21.4
    aclocal.m4
    AUTHORS
    BUGS
    ChangeLog
    config.bat
    config.guess
    config.sub
```

• • •

[root@test1]# lhsm status -r /mnt/lustre/tools 100 released /mnt/lustre/tools/emacs-21.4/vpath.sed 100 released /mnt/lustre/tools/emacs-21.4/aclocal.m4 100 released /mnt/lustre/tools/emacs-21.4/install-sh 100 released /mnt/lustre/tools/emacs-21.4/configure 100 released /mnt/lustre/tools/emacs-21.4/config.sub

[root@test1]# lhsm status -r -l /mnt/lustre/tools 100 released (s3://my-bucket/tools/emacs-21.4/vpath.sed) /mnt/lustre/tools/emacs-21.4/vpath.sed 100 released (s3://my-bucket/tools/emacs-21.4/aclocal.m4) /mnt/lustre/tools/emacs-21.4/aclocal.m4 100 released (s3://my-bucket/tools/emacs-21.4/install-sh) /mnt/lustre/tools/emacs-21.4/install-sh 100 released (s3://my-bucket/tools/emacs-21.4/configure) /mnt/lustre/tools/emacs-21.4/configure 100 released (s3://my-bucket/tools/emacs-21.4/config.sub) /mnt/lustre/tools/emacs-21.4/config.sub

[root@test1]# lhsm restore /mnt/lustre/tools/emacs-21.4/vpath.sed
restore: /mnt/lustre/tools/emacs-21.4/vpath.sed

[root@test1t]# lhsm status /mnt/lustre/tools/emacs-21.4/vpath.sed 100 archived /mnt/lustre/tools/emacs-21.4/vpath.sed

[root@test1]# file /mnt/lustre/tools/emacs-21.4/aclocal.m4
/mnt/lustre/tools/emacs-21.4/aclocal.m4: ASCII English text

[root@test1]# lhsm status /mnt/lustre/tools/emacs-21.4/vpath.sed 100 archived /mnt/lustre/tools/emacs-21.4/vpath.sed

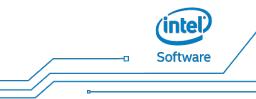
## D Software

## Archive

- Generate GUID and save in xattrs
- Store data in <u>s3://archive-bucket/objects/GUID</u>
- Supports hardlinks and transparent to renames

Restore

- Retrieve GUID from xattrs
- Fetch data by GUID



Store Metadata in S3

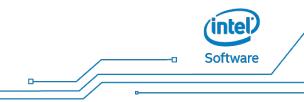
- JSON format
- Include special files
- Store entire directory in one key
  - Single fetch for complete directory
  - Updates are expensive
- One key per directory entry
  - Fetch per key
  - Updates easy

```
"name": "work/important.txt",
"xattr": {
  "user.hsm_guid": "e819d8fe-e969-40a5-af8a-0956da5c2e8c"
"stat": {
  "ino": 180144002274692600,
  "mode": 33188.
  "gid": 0
  "uid": 0
  "nlink": 1
  "mtime": 1427217574
  "atime": 1427217756
  "size": 38
  "ctime": 1427217756
  "rdev": 0
  "dev": 743766374
"type": "reg"
```



Create stub file in .hsmsnap/ referencing the GUID in archive

- Generate a new GUID every time file is archived
- Multiple "snapshots" available directly to the user
- Could be created by copytool or based on policy



Create a "snapshot" of a file when archived

[root@test1]# lhsm archive -a 2 important.txt

[root@test1]# lhsm status -1 important.txt
2 archived (66b2d482-7d1d-462a-b76e-bdd2c50891f8) important.txt

[root@test1]# tree .hsmsnap/ .hsmsnap/ \_\_\_\_\_ important.txt^2015-03-24T10:19:34-07:00

[root@test1]# lhsm status -1 .hsmsnap/
2 released (66b2d482-7d1d-462a-b76e-bdd2c50891f8) .hsmsnap/important.txt^2015-03-24T15:12:41-07:00

© Software

Create a new snapshot when file is archived again

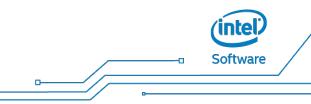
[root@test1 work]# lhsm status -1 important.txt
2 dirty (66b2d482-7d1d-462a-b76e-bdd2c50891f8) important.txt

[root@test1 work]# lhsm archive -a 2 important.txt
archive: important.txt

[root@test1 work]# lhsm status -1 important.txt
2 archived (a326deae-2024-4ce1-9999-817a78fd51be) important.txt

[root@test1 work]# lhsm status -1 .hsmsnap/ 2 released (66b2d482-7d1d-462a-b76e-bdd2c50891f8) .hsmsnap/important.txt^2015-03-24T15:12:41-07:00 2 released (a326deae-2024-4ce1-9999-817a78fd51be) .hsmsnap/important.txt^2015-03-24T15:14:18-07:00





- Lustre is being used on the cloud
- Need to manage datasets that outlive the filesystem
- Using extended attributes adds flexibility without a database
  - Importing existing S3 data straightforward
  - General archive to S3 needs metadata storage decision
  - Creating approximate snapshots on HSM (CASH)





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