QuickSilver: A Distributed Policy Engine for Lustre

Chris Brumgard
brumgardcd@ornl.gov
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Problem

• At ORNL, filesystems are becoming increasingly complex to accommodate the needs for faster storage as well as larger storage.
  – Tiers

• Beyond just tiering, admins want an easy and reliable way to implement different policies for different users/groups.
  – Purging
  – Telemetry and querying
Problem

• Users need both fast storage and large capacity storage.
  – Solution: We’ll give them two storage stores: SSDs and hard drives.

• Oh wait!!! Users are terrible at managing multiple data stores.
  – Solution: Okay fine, well just put the different pools under Lustre and let Lustre be the unified namespace.

• Oh wait!!! Users will have to set their stripe data to use the correct pools.
  – Solution: We’ll just set the default pools to be NVMe.

• Oh wait!!! Users will have to remember to migrate and purge their data using lfs_migrate and such tools.
  – Solution: ???
Enter QuickSilver

• A Distributed Policy Engine for Lustre.

• Purposes:
  - Tiering writeback
  - Purging
  - Data collection and telemetry

• What do we mean by distributed?
  - Actor model
  - Message passing
  - State-lite
QuickSilver

• Actor model
  – Private state (no shared memory) and light-weight
  – Each actor type does only one particular task.
  – Communicate via messages and process one message at a time.
  – Asynchronous to each other (respond to messages they receive)

• Fault Tolerance & Scalability
  – Passing much of the burden to the messaging system and Lustre.
  – Supervisors to launch and monitor actors.
  – Numerous instances of each actor type (scalable).
  – Raft Protocol for leader election within certain actor types.
  – Designed so that tasks can be lost without affecting the overall system.
Quick Silver diagram

- Scan Agent
- Scan Agent
- Scan Agent
- Scan Agent
How is QuickSilver different?

• No database, the file system is our database
• No replicated state (except for some key data items like leader election)
• Best effort
  – If tasks fail, that’s okay. We’ll get them next time.
  – Actors aren’t tracking the progress of other actors and waiting on results.
• Highly scalable
  – Need more performance, add more agents of the corresponding type.
Future work

• Still in active development.
  – Reducing the scan work.
  – Productionizing.
  – Deploying to systems this Summer.

• More tiering capabilities.
  – Moving data back to the performance tier

• More complex policies.
  – Decomposing complex actions into simpler rules.

• Non-Lustre agents.
  – HPSS
  – Edge
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