SCALABLE CHANGELOGS DISTRIBUTION WITH CLAP

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MDS changelogs as a notification mechanism
- The metadata servers can provide us with a stream of changelogs records
- Used as an asynchronous notification facility
- Interested parties must subscribe (register/deregister) and poll for records

Unbalanced situations may occur…
- One MDS/Numerous subscribers
- One reader/Numerous MDS
typically: robinhood facing DNE

As well as clearly suboptimal ones
- Ephemeral readers constantly registering/deregistering
- Ephemeral readers going away for a long time before re-appearing
- Readers filtering out most records
  …but getting the whole stream anyway
Based on the existing changelogs API

- Broadcast the stream (publish/subscribe) to numerous unregistered clients
- Distribute stream processing
- Re-order the records to optimize final processing
  - Can drop records that cancel out each other (create/unlink patterns)
  - Can group records by target FID or parent FID
  - Offload this work from reader applications (e.g.: Robinhood Policy Engine)

More generally

- Stream pre-processing
- Versatile distribution scheme
- Relaxed constraints on the MDS
CLAP PROXY
Stands for *changelogs Aggregate & Publish*

- Client/Server architecture
  - libclapclient
  - clapd
  - processing modules

- Essentially a Lustre changelogs proxy
  - Seen as a single changelogs reader by Lustre
  - Lives in userland
  - Re-ordering and distribution schemes implemented as loadable modules

- Official CEA project
  - Freely distributed ([https://github.com/cea-hpc/clap.git](https://github.com/cea-hpc/clap.git))
As close as possible from liblustreapi

- **Proxified channel (default)**
  - `clap_changelog_start()`
  - `clap_changelog_receive()`
  - `clap_changelog_clear()`
  - `clap_changelog_fini()`
  - `clap_changelog_setopt()`

- **NULL-channel**
  - `CLAP_CL_DIRECT` flag to `clap_changelog_start()`
  - Other flags mapped to their `lustreapi` equivalents
  - Functions then directly call their `lustreapi` siblings

- Client only needs the server URI (taken from env)
**Implements all the logic**

- All communications based on the (excellent) Zeromq message passing library
- Purpose-specific policies
Transactionnal aspect remains preserved (or not, you choose)

- Reader applications acknowledge records up to a given index
- Policy gets informed
- Policy instructs clapd what/when to acknowledge to the MDS
- Examples:
  - Can use \( \min(\text{acknowledgements}) \)
  - Can decide to acknowledge unread records if there are no readers (broadcast)
Lightweight message passing library

Adaptive patterns (REQ/REP, PUB/SUB, PUSH/PULL…)

Asynchronous I/O

Familiar API (close to BSD sockets)

Excellent documentation

Used for internodes and interthread communications

The lockless monster isn’t a monster anymore!

Free and actively developed software (see http://zeromq.org)
Aggregation and distribution modules

- Policies implemented as modules
  - executed server-side

- Distributed as shared libraries

- Expose a pre-defined API
  - Enqueue records (allow re-ordering)
  - Dequeue records (allow distribution strategies)
  - Indicate up to which record # to clear server-side
N collaborative threads

- One changelogs reader thread per MDS
- Requests push/pulled to policy worker threads
- Can share nothing or operate a common data structure
UNDER THE HOOD: BATCHING

Aggregation

- Policies can internally re-order records as they want
- Records are batch sent to the client
- Policies can decide how to deliver stream to a given client
  - Can group by target FID
  - Can group by source MDS
  - Can rely on simple time windowing
DISTRIBUTION STRATEGIES
Distribute stream processing between two instances of robinhood

- Round-robin between end readers

Diagram:
- MDS
- clapd
- Subscribers
Replicate stream to many ephemeral readers

Publish/Subscribe mechanism

MDS

clapd

Subscribers
Replicate partial stream (filter out records)

- Publish/Subscribe mechanism, records not matching client filters aren’t delivered
CONCLUSION
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Interesting prospectives
- Already proven easy to extend/experiment with
- Ongoing
  - Write more elaborated policies
  - Make clap able to stack them
  - Implement adaptive batching

Stabilize and mature the project
- Not yet used in production
- Improve resiliency
  - Clients currently can’t recover from a server (clapd) crash
- Profile and optimize using at scale deployments
WANT TO TRY IT?

Disclaimer: clap is still under heavy work 😊

- Implemented in C (kernel style, minus tabs)
- Limited dependencies (lustreapi/pthread/zmq)
- LGPLv3

https://github.com/cea-hpc/clap.git (soon)
THANK YOU!

ANY QUESTION?