Quantcast

Hot Swap Your Datastore:

A practical approach and lessons learned

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Hello, my name is

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About Quantcast

Radically simplify advertising and privacy for publishers and brands on the open internet.

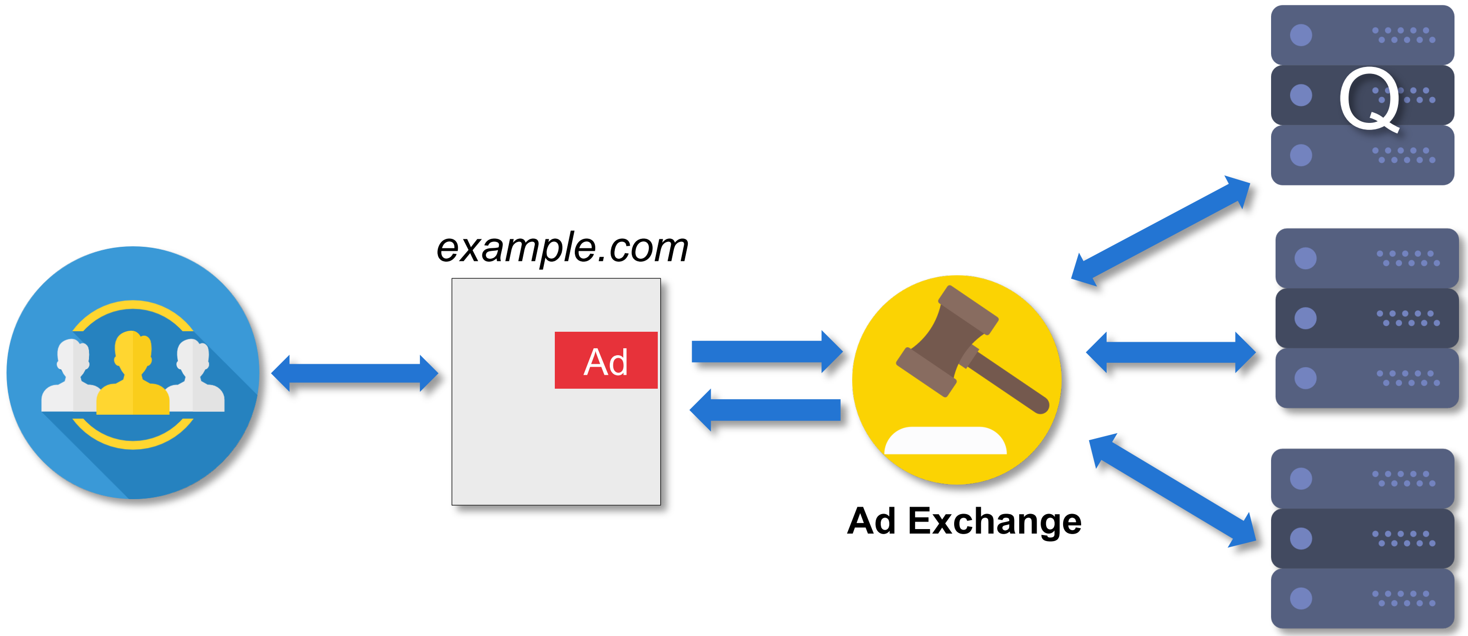
Quantcast Measure

Quantcast Advertise

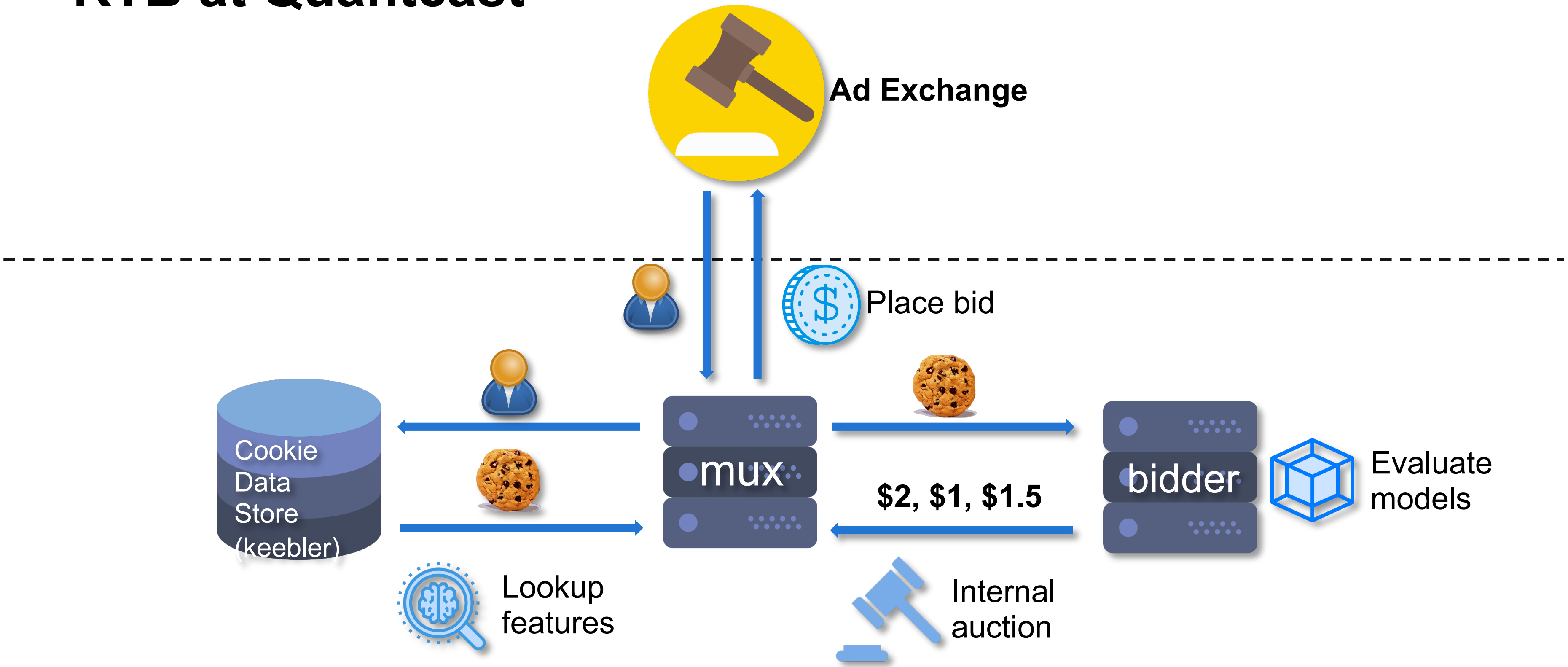
Quantcast Choice

Real Time Bidding (RTB)

Buying and selling of online ad impressions through real time auctions



RTB at Quantcast



Some Numbers

1.8 Million

Number of bid requests per sec we receive in largest region

3.3 Million

Number of bid requests per sec we receive in all regions

700 Million

Models evaluated by bidders per sec

<80 msec

Total time we have to respond to a bid request

Keebler

- Quancast's distributed cookie data store since 2010
- A Keebler cluster in every AWS region

GeoIP

Frequency capping

Features

Bid lockout

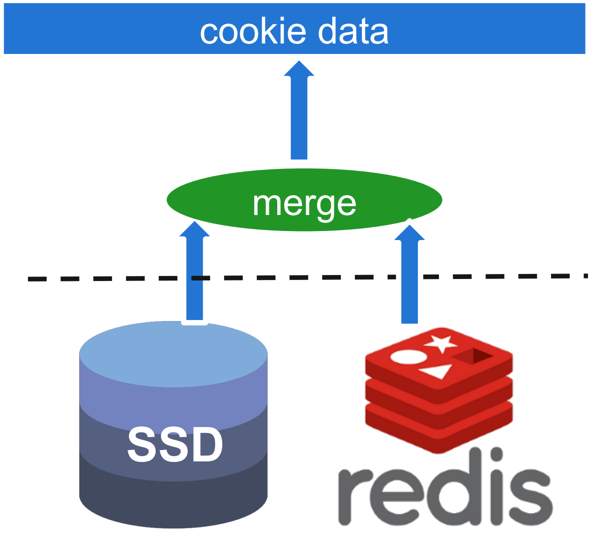
Segments

Cookie maps

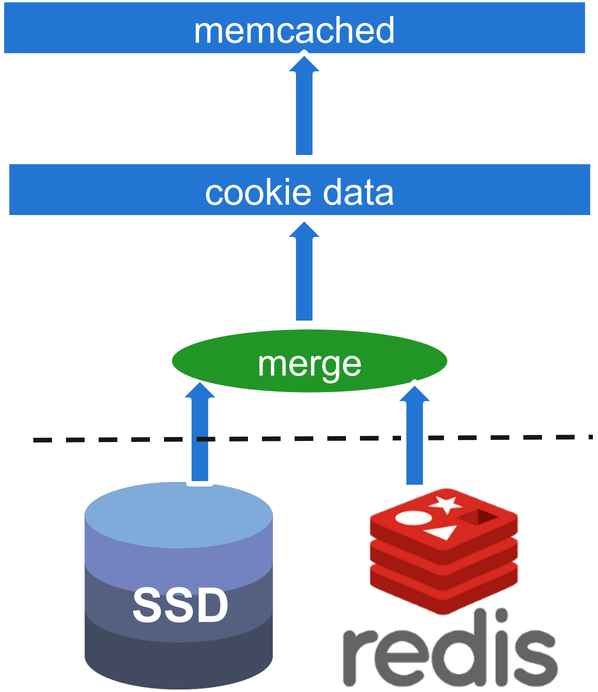
Fraud filtering

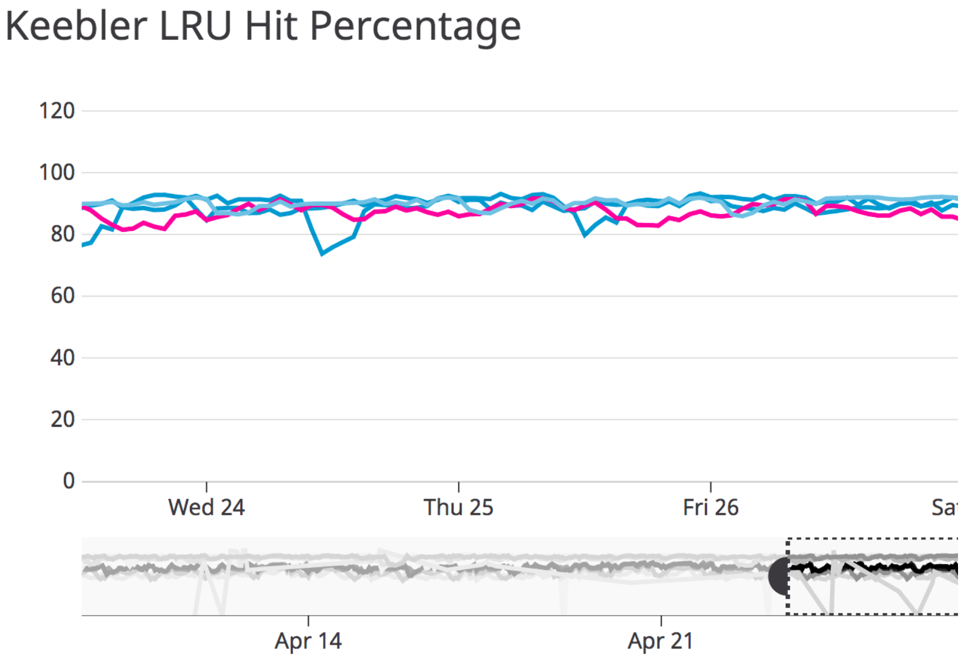
A single Keebler node

- Sharded
- SSD:
  - Re-computed every day
  - Immutable
- Redis:
  - Realtime updates



Keebler uses caching





Why replace Keebler?

- Sheer number of machines

Region	Keebler Machines
US East	172
US West	129
Europe	173
Asia	130

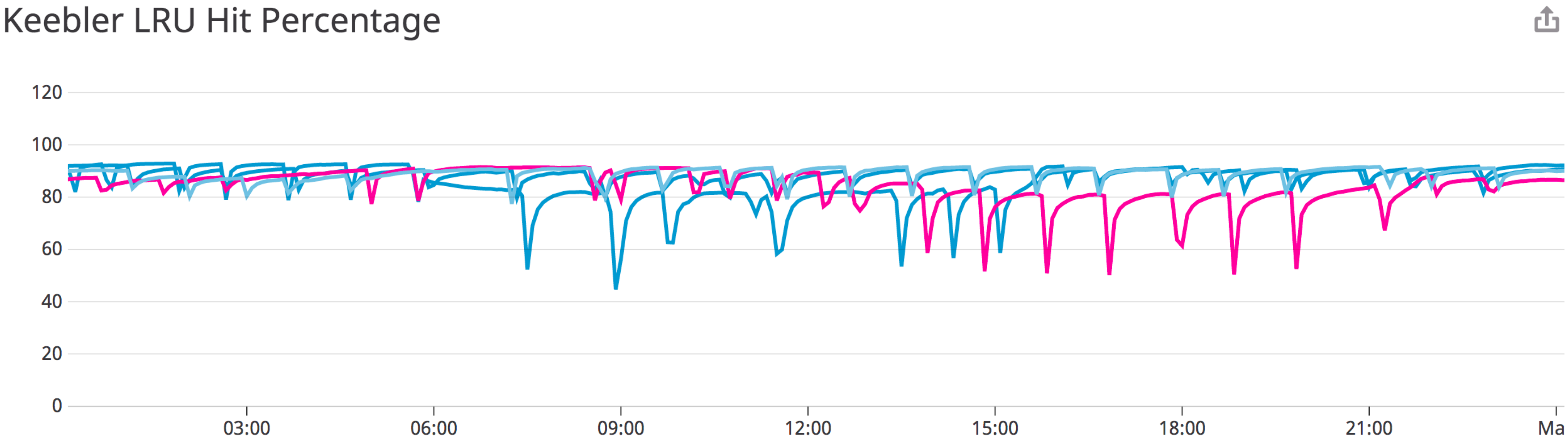
$1.8 Million

Infrastructure costs just to run the hardware

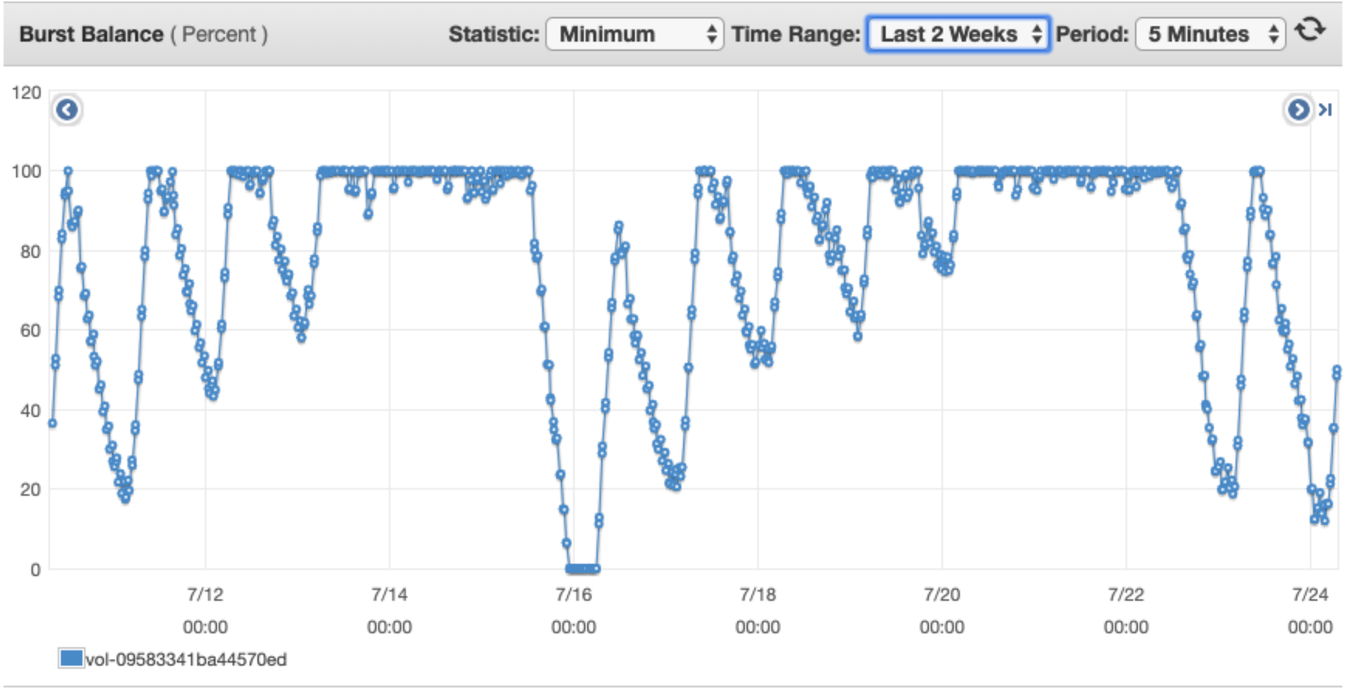
Why replace Keebler?

- Operational complexities: manual sharding/resharding
- Unreliable performance
  - Service restart upon new SSD files
  - EBS volumes running out of IOPS credits

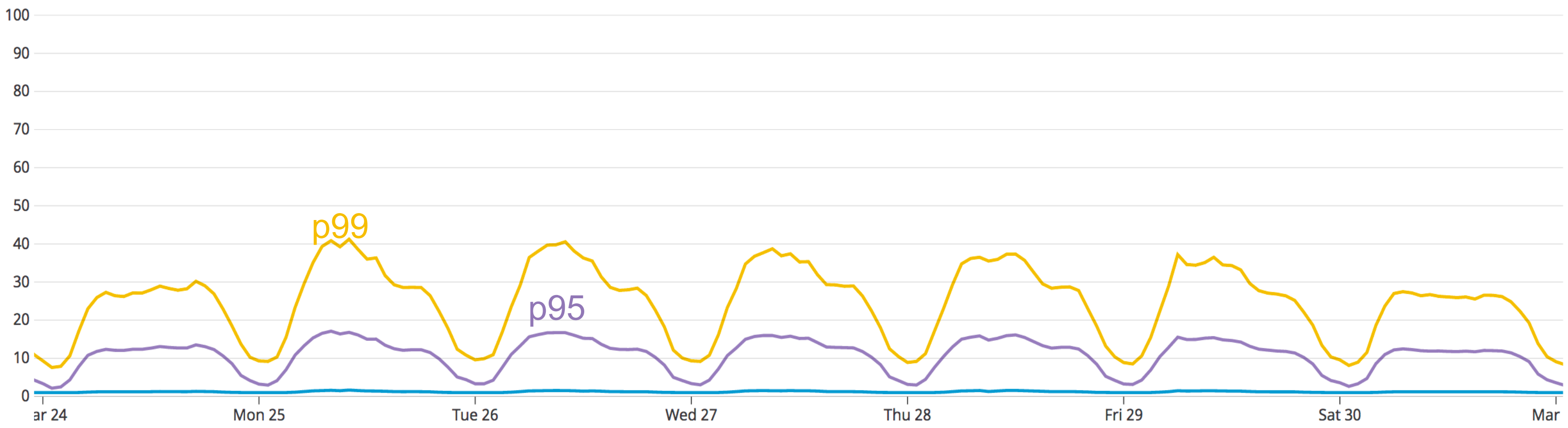
LRU Hit Percentage Fluctuation



EBS Volumes running out of IOPS credits



Bad long tail of latencies

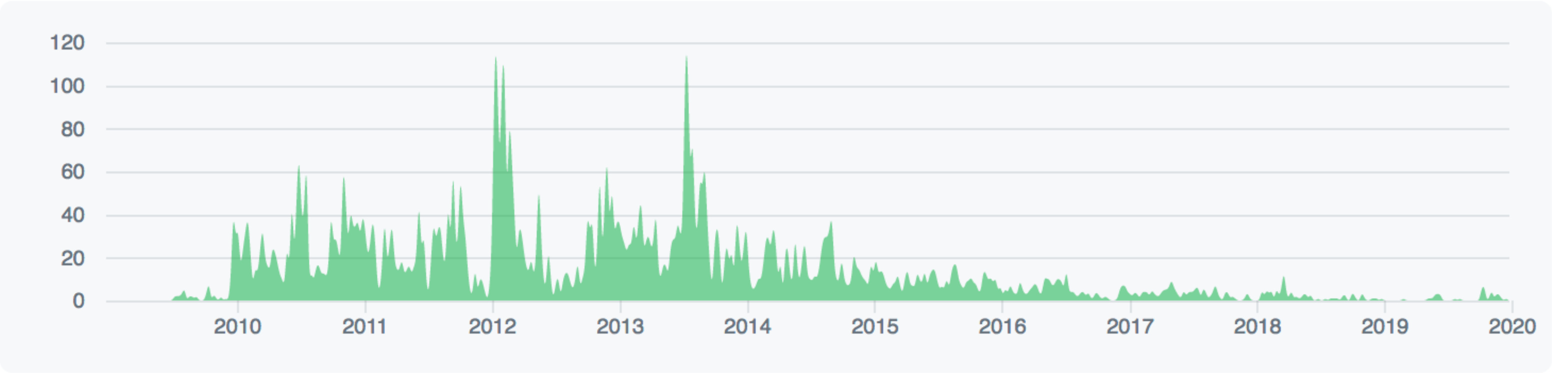


Loss of institutional knowledge

Feb 22, 2009 – Feb 25, 2020

Contributions: **Commits**

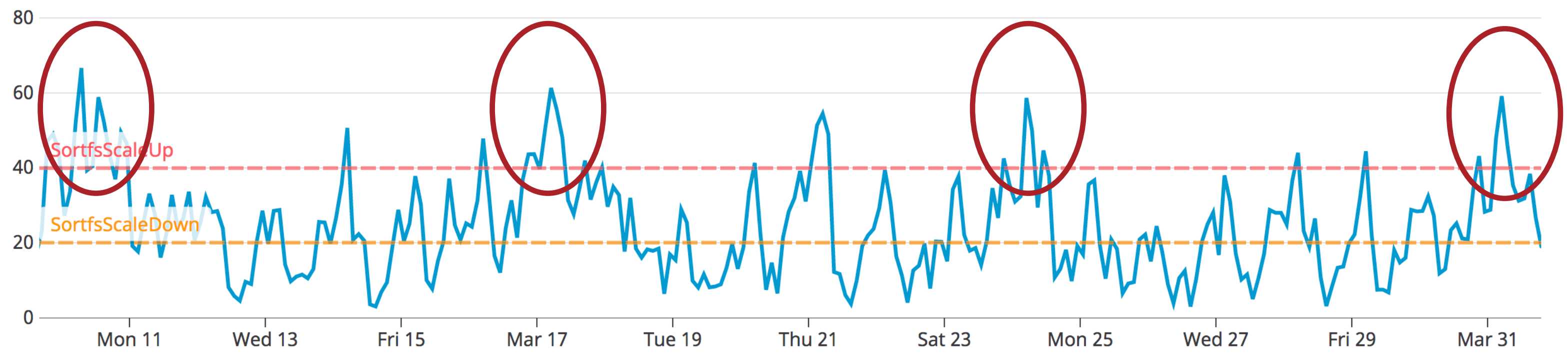
Contributions to master, excluding merge commits



Indirect costs

- Running a map-reduce job with 300TB sort every Sunday

Sort filesystem space usage



Requirements for the new system

- Read/write volumes at peak traffic
  - 900K reads, 100K writes

- Reads must be fast (1-2 msec)
  - slow writes are more tolerable

- Cost ($$$)
  - must scale vertically

- No manual intervention for sharding
- Connectors with data frameworks
- Observability, support, …

AEROSPIKE

Proof of Concept

- Aerospike cluster: 20 c5d.18xlarges, 10 billion records, 16TB data
- Client setup: 864 clients (on idle m4.xlarges) using sync API

594 Million

cookies written

6 Billion

cookies read

0

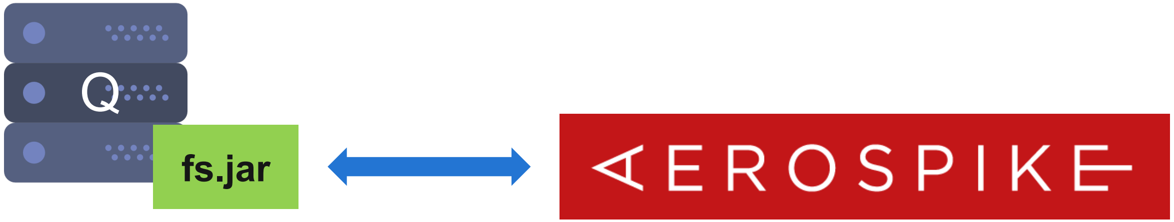
number of failures

%99.9

of reads/writes less than 5 msec

Design Choices

- Implement the new system as a library



- Benefits:
  - Single network hop
  - Less number of machines
  - Think twice before adding yet another use case

Design Choices

- Stay away from cryptic representations as much as possible

- Abandon *edge cookie file* format
    - Only Keebler can understand

- Use standard data structures for storing key value

02 | Requirements when performing the migration

01

At any point switch back to legacy system

02

Ability to run the system in hybrid mode

03

Keep the costs down when running two systems in parallel

04

Verify the correctness of the data in Aerospike against Keebler

05

Get equal or better latency performance from Aerospike

06

No downtime in our bidding service

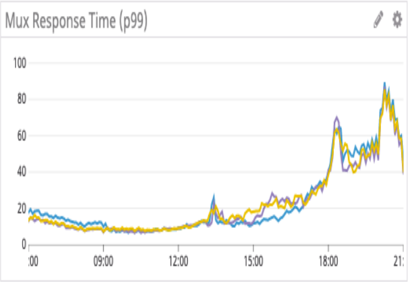
03 How we met the requirements

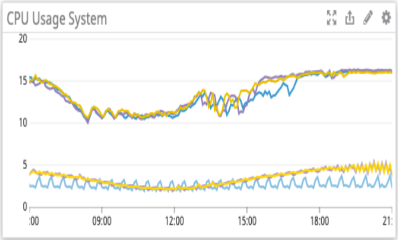
Step 1

Clear go/no-go metrics and gradual deployment process

Latency 01

99th percentile latency for the datastore lookup, as well as the bidder service



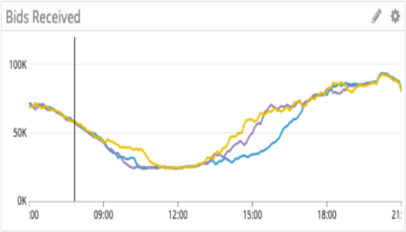


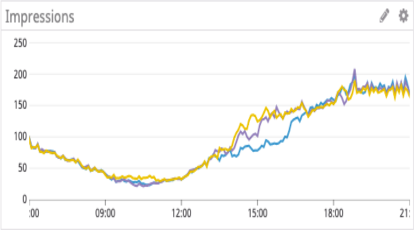
03 **CPU**

Any changes (+/-) in CPU usage

Throughput 02

Number of bids processed





04 **Performance**

Impressions, auction spend

Requirement 1

Ability to quickly switch back to keebler. Rollbacks were our best safety net

```
$unifiedfeaturestore_enable_optout = extlookup("mux_unifiedfeaturestore_enable_optout", "false")
$unifiedfeaturestore_lookups_enabled = extlookup("mux_unifiedfeaturestore_lookups_enabled", "false")
$unifiedfeaturestore_use_features_for_bidding = extlookup("mux_unifiedfeaturestore_use_features_for_biddi
$unifiedfeaturestore_use_filter_segments = extlookup("mux_unifiedfeaturestore_use_filter_segments", "fals
```

Feature Flags

Feature flags

The datastore to be used is controlled through config files. The config files are managed by puppet

Code enabled using feature flags

At startup, read the config file and decide what to use

Requirement 2

Run system in hybrid mode. Have consistent response no matter which datastore the clients connected to

Keep both datastores running

- We kept the data across both the datastores
- We maintained the data pipelines that update both datastores simultaneously
- We provided on-call support for both the datastore systems (no second-class citizens)

Benefits of being able to run in hybrid mode

- Allowed us to not care which datastore was used by bidding systems – we knew upstream bidding client will have cookie features
- Migrate multiple regions sequentially, instead of trying to parallelize. Reduced complexity load

Requirement 3

Verify the correctness of the data in Aerospike against keebler. We wanted to track key lookup bugs or missing data

Parallel lookups for all, log a sample

- During this phase, lookup from both datastores and log 1% of responses. Have an offline job to compare response
- We found bugs in our data pipeline, key lookups and verified data consistency

Requirement 4

Keep the costs down when running two systems in parallel

Keep costs down

- Opportunistically kill Aerospike clusters. Terminate cluster during codefreeze and over weekends. **Bonus**: we refined our complete restore process
- Reclaim instances from keebler cluster. As we increased aerospike cluster size, we reduced keebler cluster.

Requirement 5

Get equal or better latency performance as keebler.

Equal or better latency performance

Verify capacity

Non-blocking dark reads from Aerospike in one region (while using Keebler)

Track p99 latency

Datastore lookup latency, as well as full bidding stack latency

Verification

Monitor go/no-go dashboard during release

Release at peak

Any latency bottlenecks would show up during release, instead of waiting a day

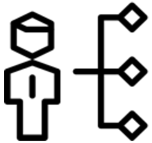
Requirement 6

No downtime in services using the datastore

No downtime in dependent services

01

Gradual changes: host, canary rack, region



02

Keep operational support for legacy, as well as new datastore

03

Well tested rollback runbooks

04

What went well

Reduced infrastructure footprint

- From 500 to 90 hosts: lower operational load
- Reclaimed reserved instances quota from reducing cluster size
- Hard to trace latency spikes due to iops slowness are gone

More deployments and experiments

- Better documented APIs
- Better integration with Jupyter notebooks and spark
    - New models from data scientists
    - New features using UFS

Retire keebler data pipeline

- Killed off 300Tb sort job, no more spikes over weekends
- Scaled down cluster supporting keebler

05

Unpleasant surprises

Extended deadlines

- Higher latency when using the non-blocking aerospike api. During prototype, we had used sync api.
- Teams were using keebler to store multi-region data
    - Hard to discover small use cases
    - Had to re-discover why some data was being used through keebler

Latency spikes due to too fast cluster reduction

Teams had been using keebler as a multi-region store. We found this when we would reduce cluster size and there would be reports latency spikes

06

Audience Takeaways

Audience takeaways

Replacing a major component of your distributed system is feasible. However, there is no out-of-box solution. Be prepared for a cycle of deploy, find a bug, rollback, fix

Avoid synthetic benchmarks

For proof of concept, use production software under production loads

Have safety nets

Reliable rollbacks, controlled changes, feature flags

Support hybrid mode

Clients running in hybrid mode helps to smooth the migration

Plan rollbacks first

Before big infrastructure changes, plan how to rollback and resurrect

Thank you

- Q&A – on Twitter: @ilunatech
- https://www.quantcast.com/blog/category/engineering/