TSDB: 1 year in

Ganesh Vernekar

November, 2019

About me

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Prometheus GSoC'18 student

Prometheus Member, TSDB Maintainer

Graduated this year from IIT Hyderabad

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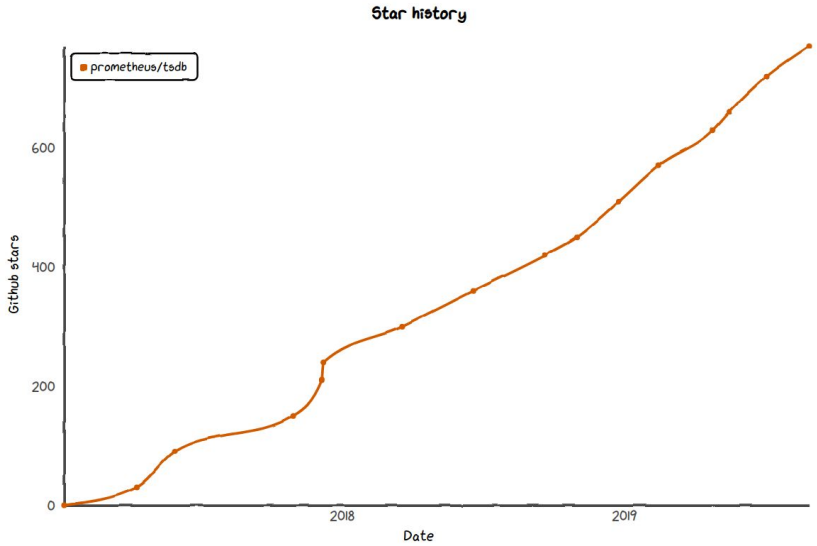
What is TSDB (Time Series DataBase)?

- Storage engine of Prometheus 2.x
- Independent repo in the past prometheus/tsdb
- Now a part of Prometheus repo, inside tsdb directory

Statistics

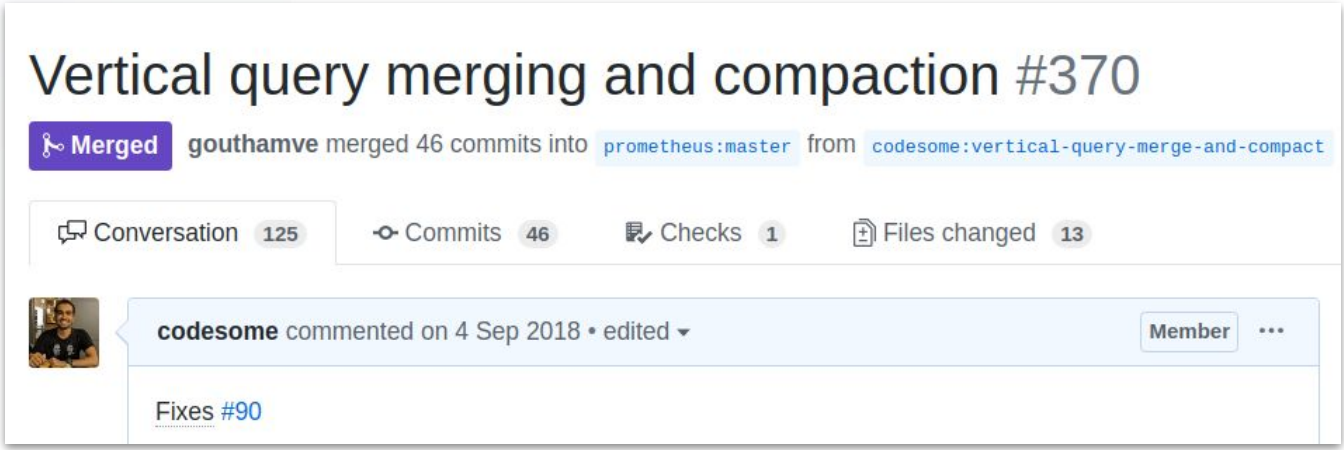
- 500+ commits since Prometheus 2.0 release
- 60+ contributors
- 771 stars before archiving



Some selected features/enhancements

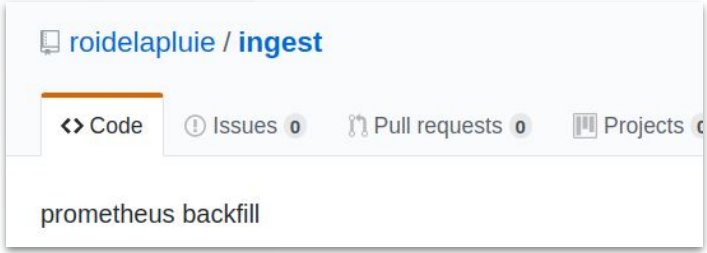
Backfilling

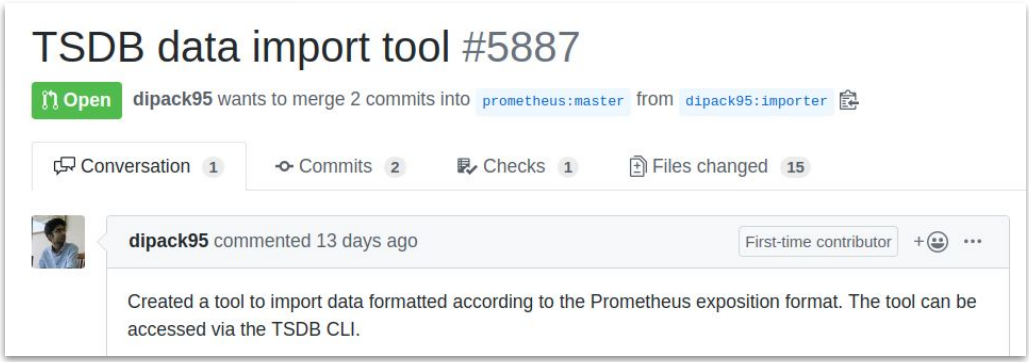
- Issue before: cannot have overlapping blocks
- Vertical query merging and compaction in Feb. 2019



Backfilling

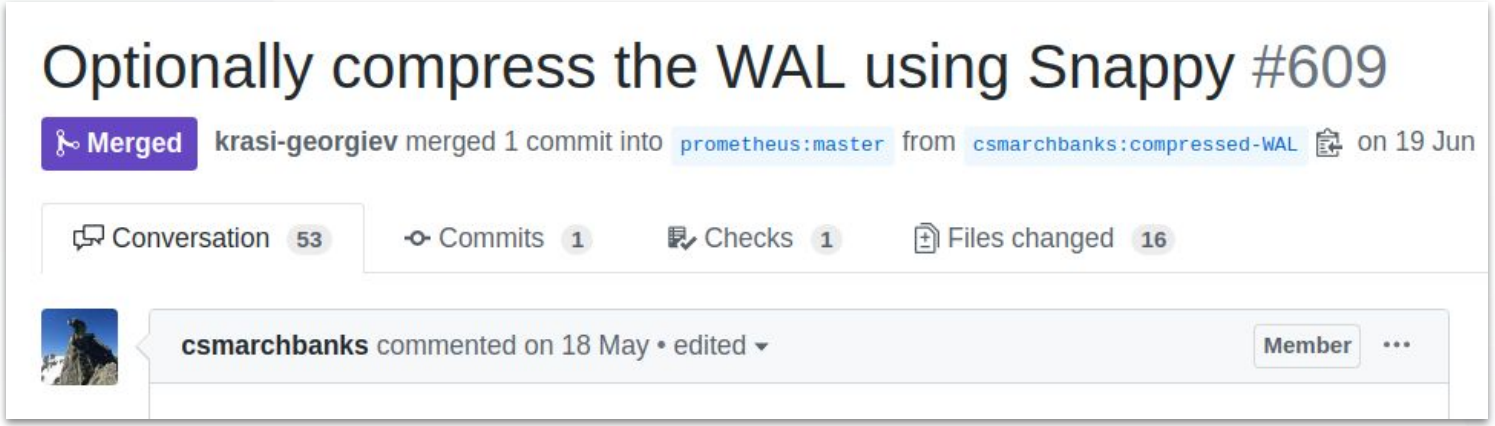
- No recommended way to backfill yet
- Community is taking it forward





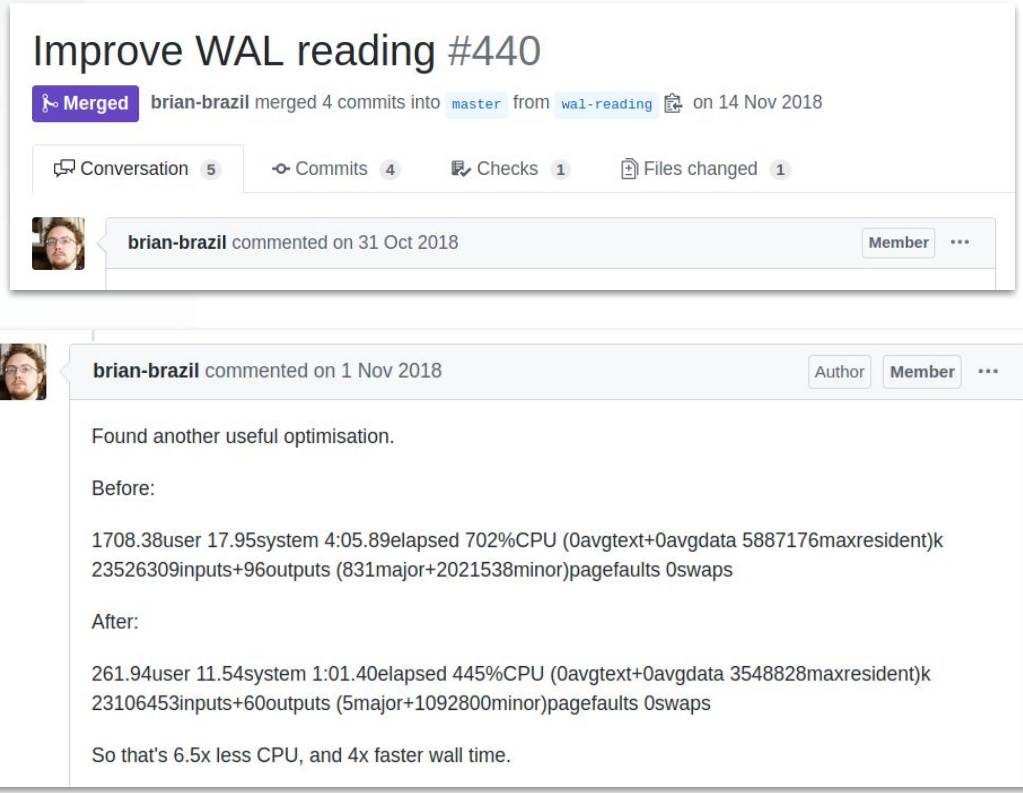
WAL compression

- Optional snappy compression for WAL



- Can save up to 50% of WAL size without compromising on performance

WAL read optimizations



Improve WAL reading #440

Merged **brian-brazil** merged 4 commits into `master` from `wal-reading` on 14 Nov 2018

Conversation 5 · Commits 4 · Checks 1 · Files changed 1

brian-brazil commented on 31 Oct 2018 — Member

brian-brazil commented on 1 Nov 2018 — Author Member

Found another useful optimisation.

Before:

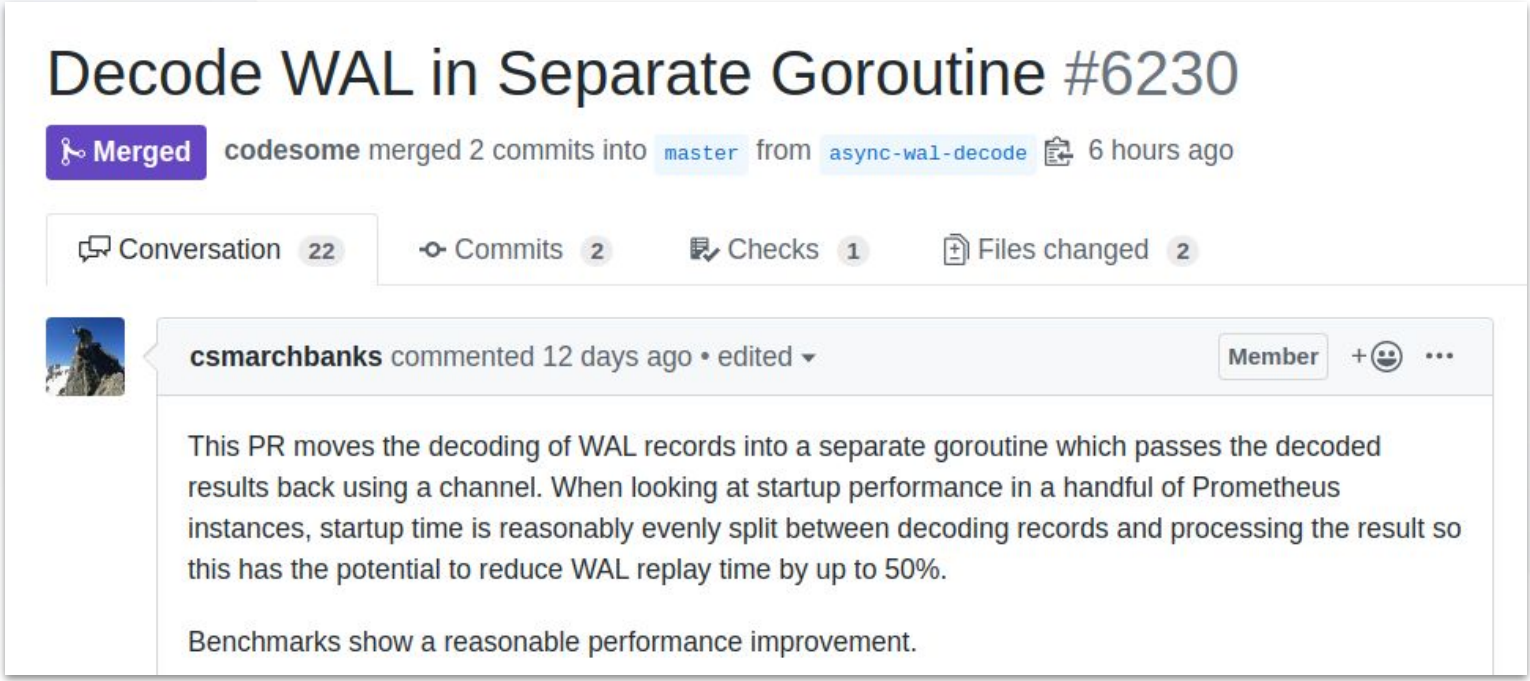
1708.38user 17.95system 4:05.89elapsed 702%CPU (0avgtext+0avgdata 5887176maxresident)k
23526309inputs+96outputs (831major+2021538minor)pagefaults 0swaps

After:

261.94user 11.54system 1:01.40elapsed 445%CPU (0avgtext+0avgdata 3548828maxresident)k
23106453inputs+60outputs (5major+1092800minor)pagefaults 0swaps

So that's 6.5x less CPU, and 4x faster wall time.

WAL read optimizations



Decode WAL in Separate Goroutine #6230

Merged **codesome** merged 2 commits into `master` from `async-wal-decode` 6 hours ago

Conversation 22 Commits 2 Checks 1 Files changed 2

csmarchbanks commented 12 days ago • edited Member

This PR moves the decoding of WAL records into a separate goroutine which passes the decoded results back using a channel. When looking at startup performance in a handful of Prometheus instances, startup time is reasonably evenly split between decoding records and processing the result so this has the potential to reduce WAL replay time by up to 50%.

Benchmarks show a reasonable performance improvement.

WAL read optimizations

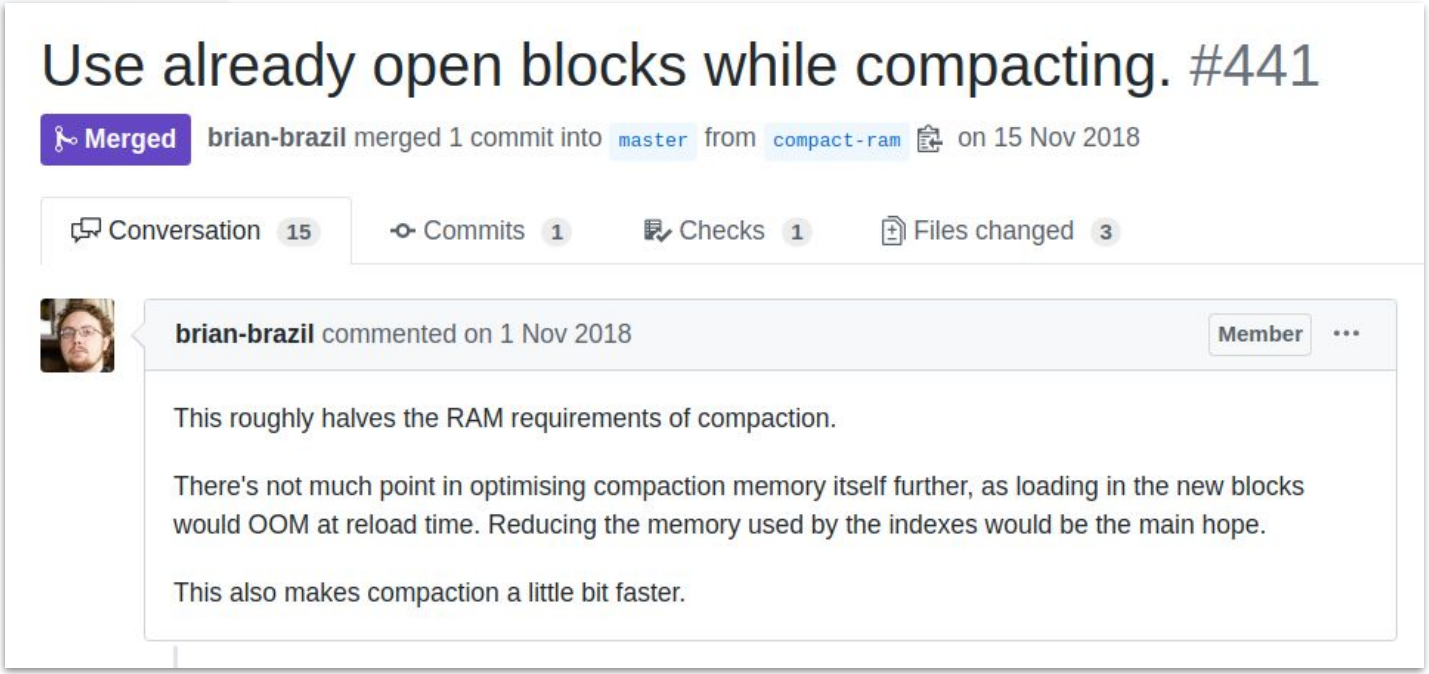
csmarchbanks commented 3 days ago • edited ▾ Author **Member** +😀 •••

/benchmark cancel

Just restarted each Prometheus. Timing numbers are from the log line for starting to replay the WAL to the last segment loaded.

```
master:      7m59s
pr:          5m52s
improvement: 23.3%
```

Allocation/memory optimization for compaction



Use already open blocks while compacting. #441

Merged **brian-brazil** merged 1 commit into `master` from `compact-ram` on 15 Nov 2018

Conversation 15 Commits 1 Checks 1 Files changed 3

brian-brazil commented on 1 Nov 2018 Member

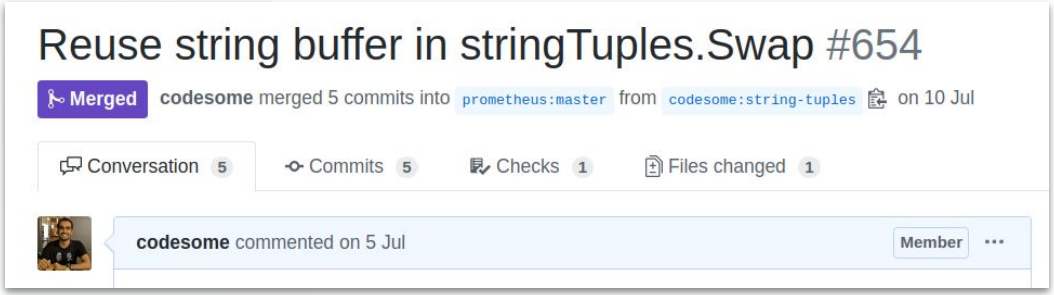
This roughly halves the RAM requirements of compaction.

There's not much point in optimising compaction memory itself further, as loading in the new blocks would OOM at reload time. Reducing the memory used by the indexes would be the main hope.

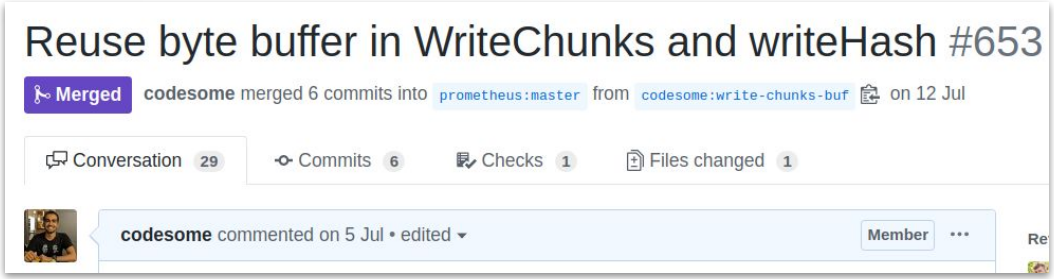
This also makes compaction a little bit faster.

Allocation/memory optimization for compaction

35% allocations

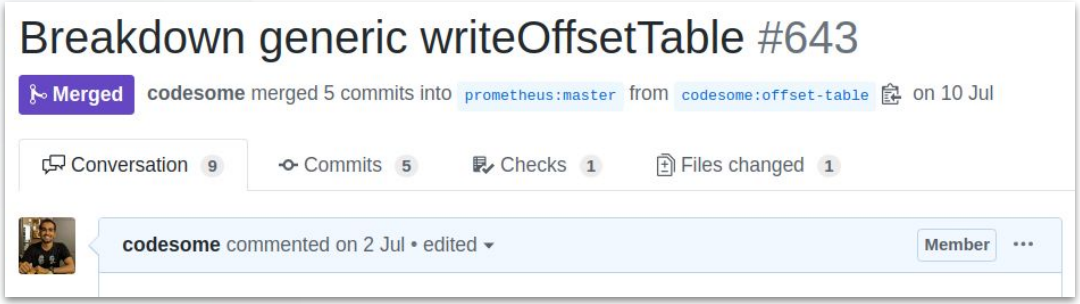


19% allocations

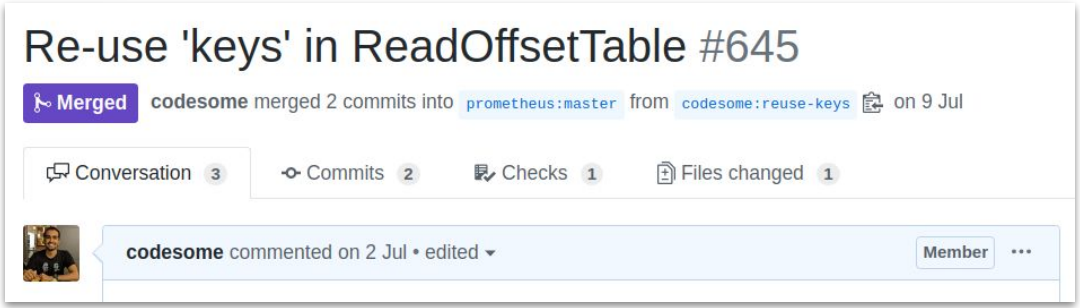


Allocation/memory optimization for compaction

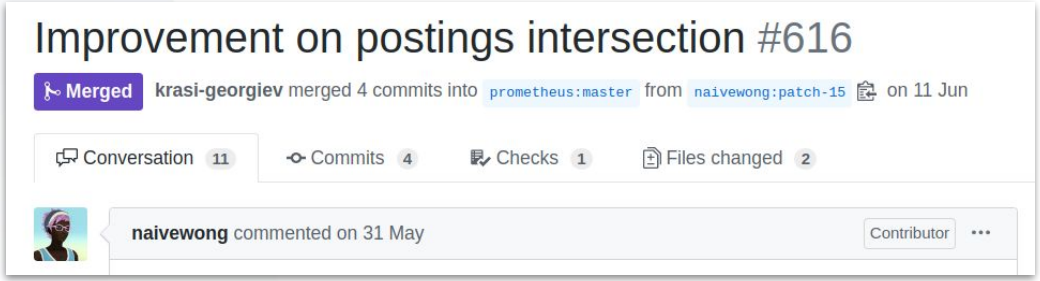
6.5% allocations



(Don’t have the numbers)



Various optimizations for the queries

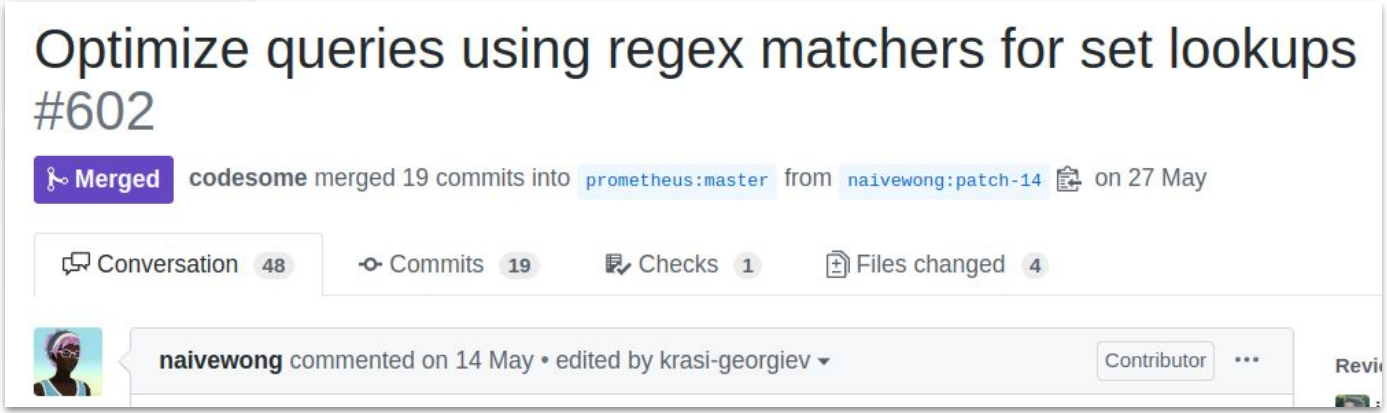



```
benchmark                          old ns/op     new ns/op     delta
BenchmarkIntersect/ManyPostings-8  18495452      649025        -96.49%
BenchmarkIntersect/LongPostings2-8 422           136           -67.77%
BenchmarkIntersect/LongPostings1-8 341           125           -63.34%

benchmark                          old allocs     new allocs     delta
BenchmarkIntersect/ManyPostings-8  99999          1              -100.00%
BenchmarkIntersect/LongPostings1-8 4              2              -50.00%
BenchmarkIntersect/LongPostings2-8 4              2              -50.00%

benchmark                          old bytes     new bytes     delta
BenchmarkIntersect/ManyPostings-8  4799963       32            -100.00%
BenchmarkIntersect/LongPostings2-8 216           98            -54.63%
BenchmarkIntersect/LongPostings1-8 208           96            -53.85%
```

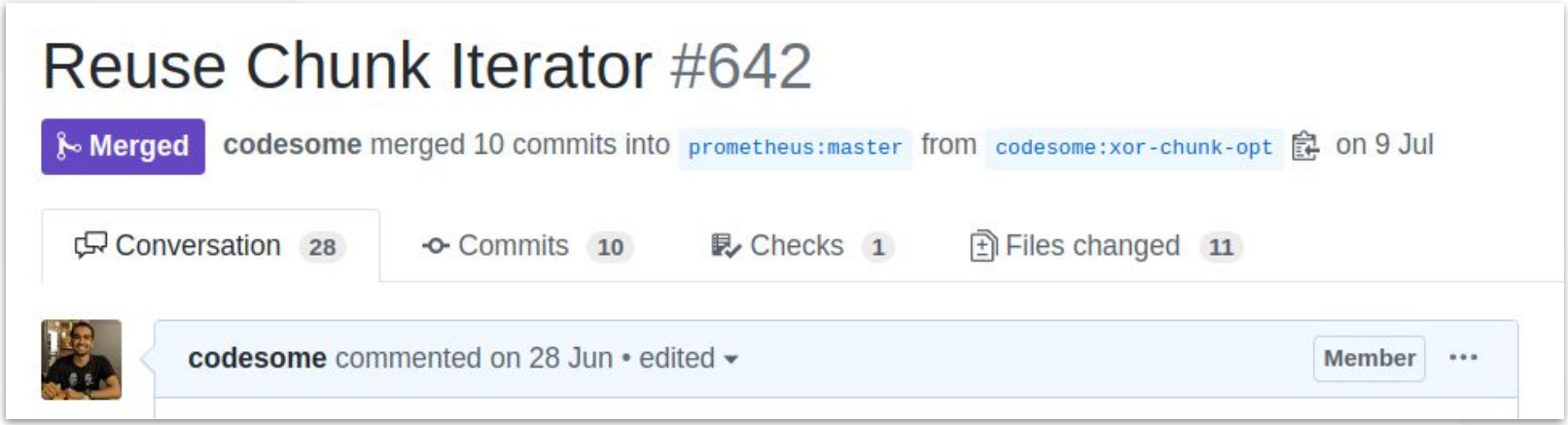
Various optimizations for the queries



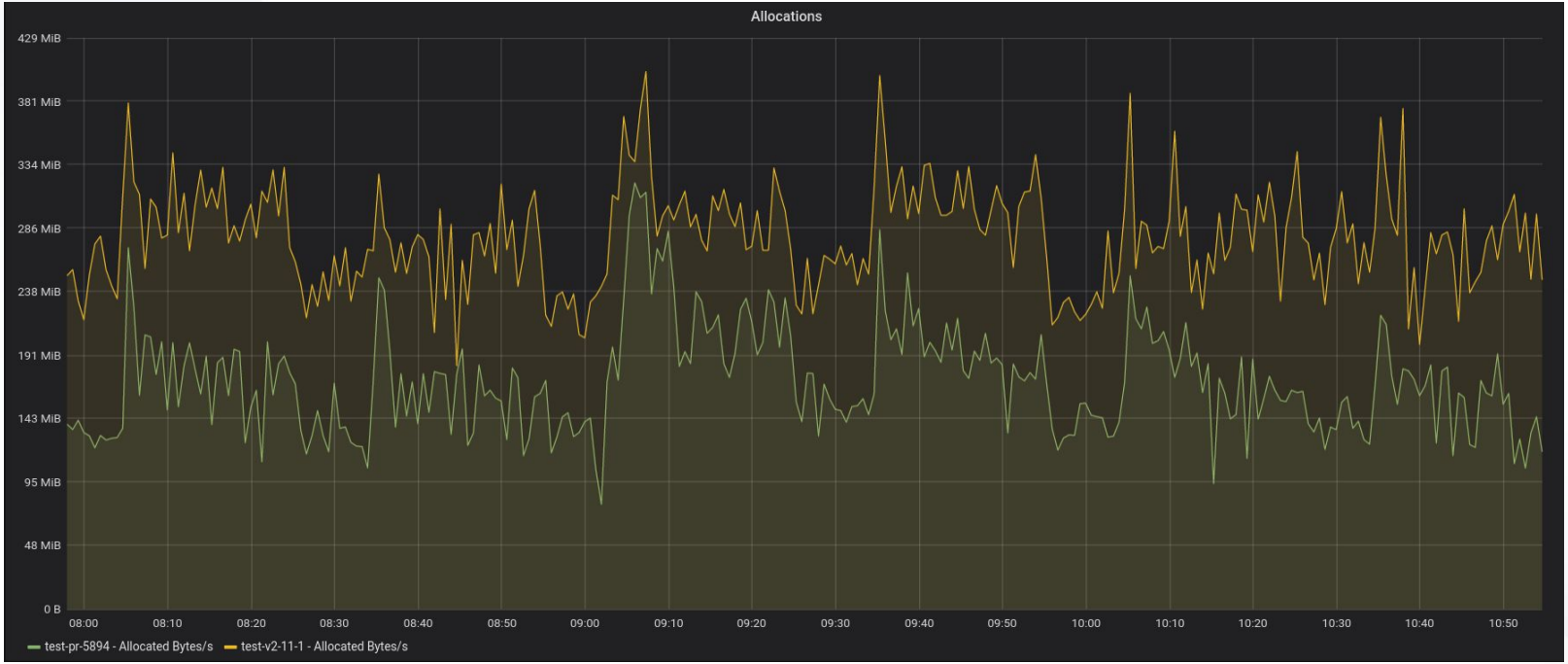

```
{foo=~"bar|baz"} => {foo="bar"} or {foo="baz"}
```

Make Grafana dashboard queries faster

Various optimizations for the queries



Reuse Chunk Iterators



Reuse Chunk Iterators

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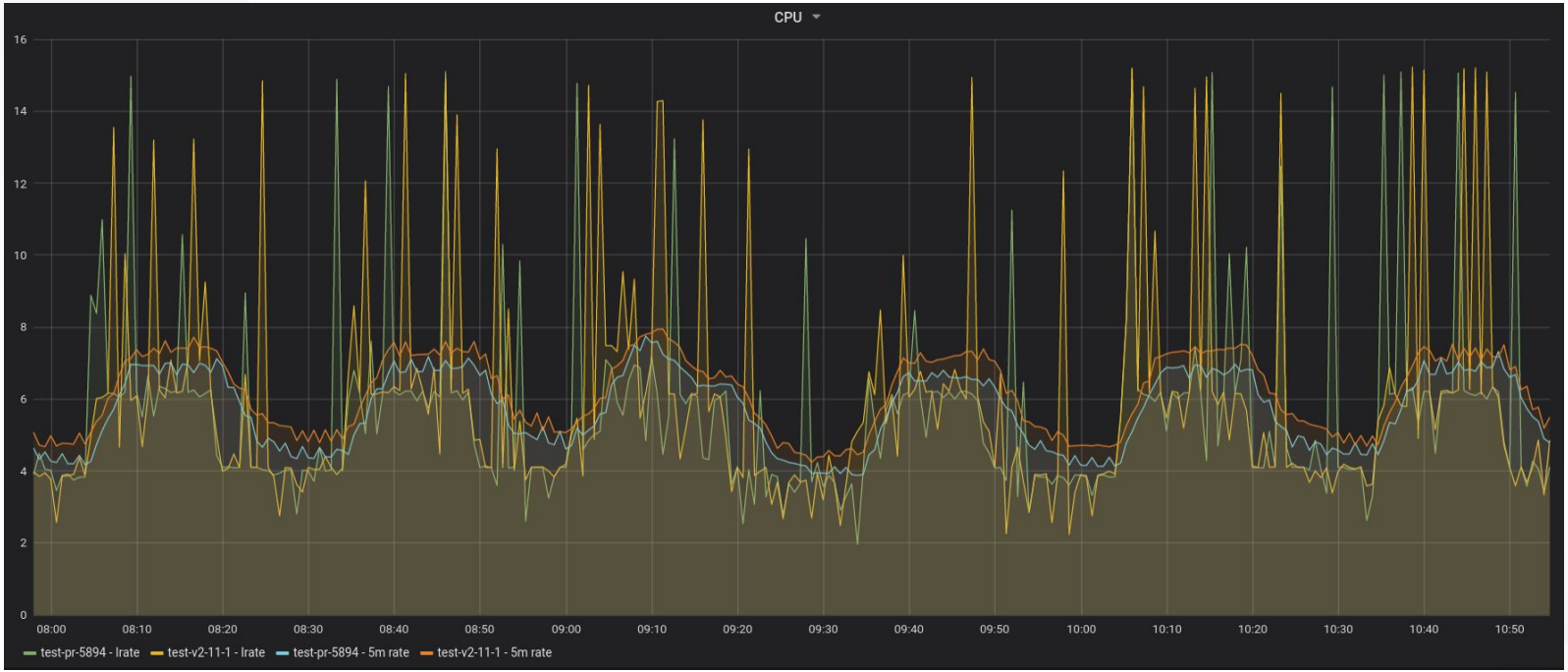
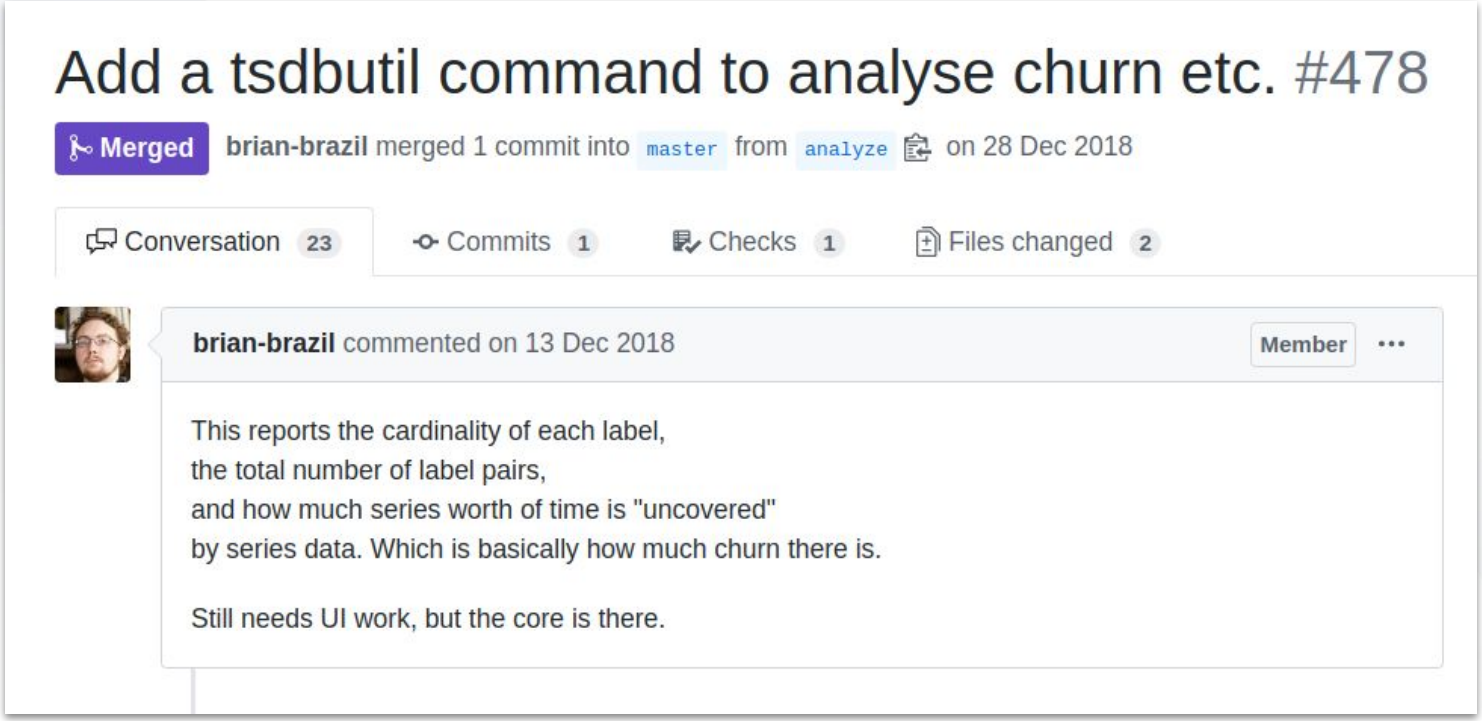
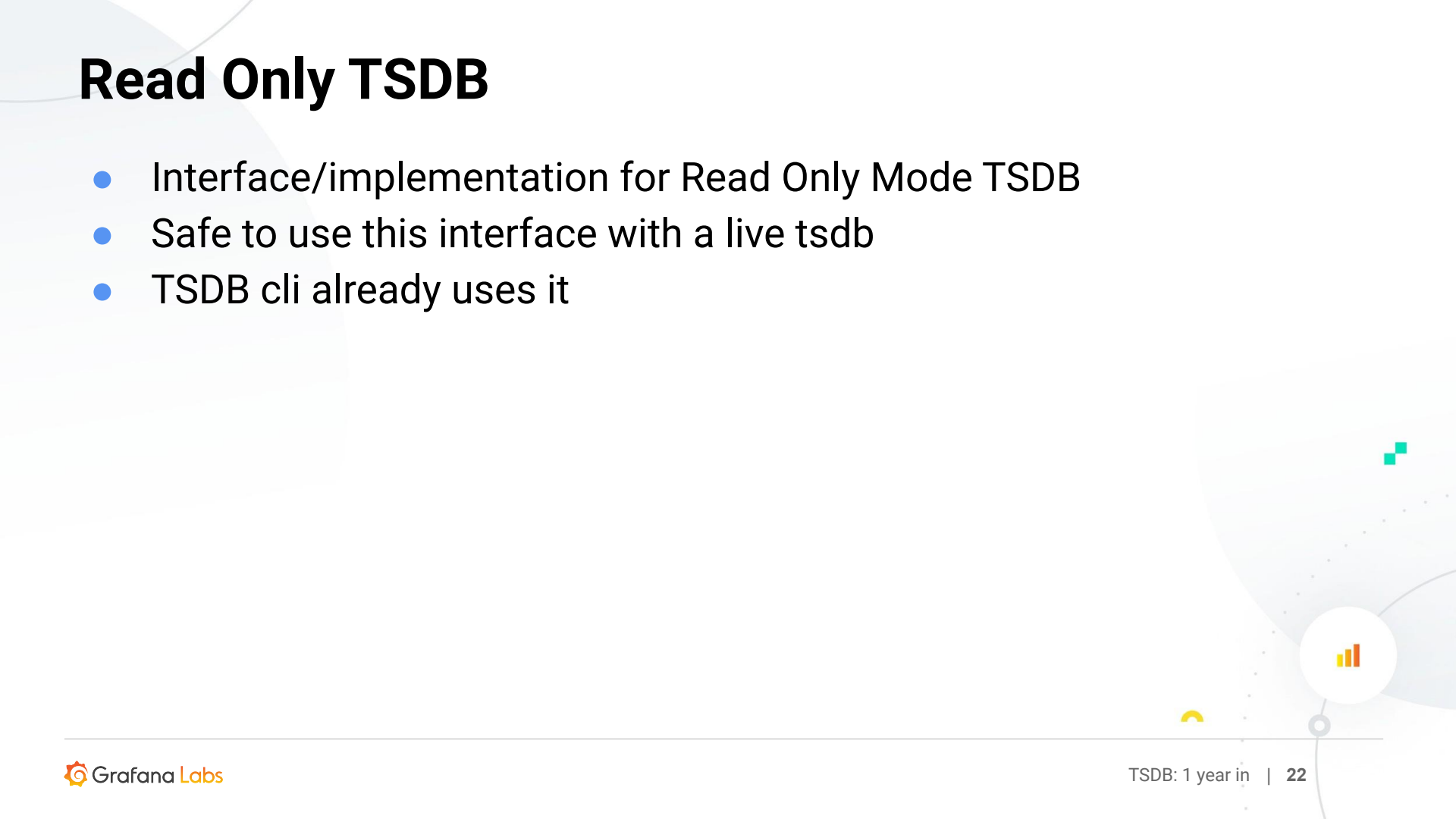


Analyse churn



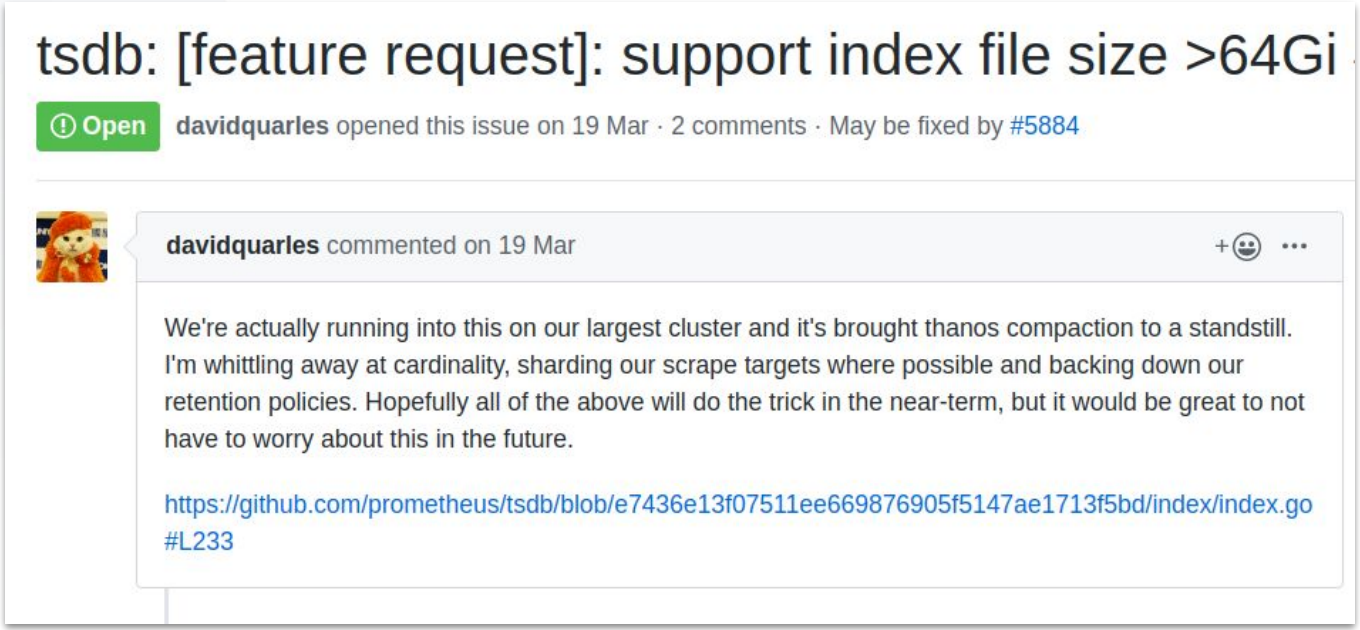
Read Only TSDB

- Interface/implementation for Read Only Mode TSDB
- Safe to use this interface with a live tsdb
- TSDB cli already uses it



Upcoming features/enhancements

Lifting index size limit



Lifting index size limit

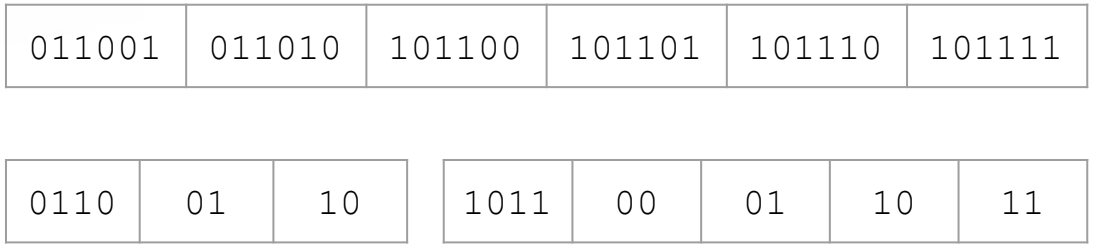
- 32 bit postings currently (reference of series in index)
  - Index size is limited to 64 GiB
- Not difficult to hit the limit
  - 8M series with block spanning 9 days - 20 GiB

https://grafana.com/blog/2019/10/31/lifting-the-index-size-limit-of-prometheus-with-postings-compression/

64 bit postings

GSoC 2019 work by Alec Wang (GH: naivewong)

- 64 bit postings - practically unlimited index size
- Use prefix compression to store postings (48 bit prefix)
- Same performance and no increase in index size



https://grafana.com/blog/2019/10/31/lifting-the-index-size-limit-of-prometheus-with-postings-compression/

Isolation

- TSDB has A C and D from ACID, but not I
  - Some progress in the past by Brian and Goutham
- Temporarily abandoned after that
- Plan is to add it this year
  - Rebase the work of Brian and Goutham :P

Improved checkpointing of WAL

Potential speedup of WAL replay by a big factor

Thanks! Questions?

 @_codesome