LGTM stack

Or: philosophy of Observability

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Why this matters to you

Or: Who is that person?

My Background

- Director of Community @ Grafana Labs
- Prometheus team member
  - PromCon lead, Prometheus dev summit chair
- Founded OpenMetrics, goal is IETF RFC
- CNCF SIG Observability chair
- snmp_exporter & modbus_exporter
- Built Europe's most modern datacenter, monitored through SNMP and Modbus/TCP only
- Extensive paid and pro bono consulting on how to instrument existing and new applications

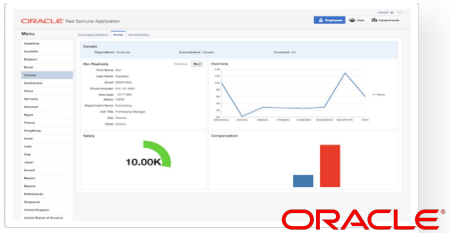
My Background

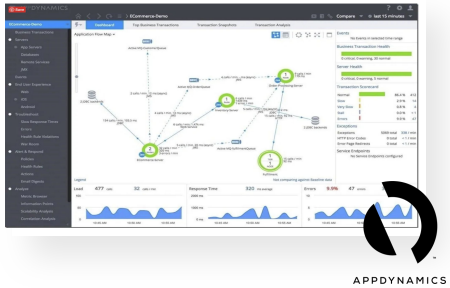
- Ran the backbone of an ISP for eleven years
  - Was the only person on call
  - My life & sanity depended on on-point monitoring & alerting
- Active in RIPE, IETF, DENOG, #networker etc
  - RFC to my name, changed RIPE NCC's IPv4 PI policies, etc.
- Prometheus transition for Germany's oldest ISP, ~5k devices
- Staffed world's largest IRC network for more than a decade
- Run conferences & monitoring from 100s to 18k attendees
  - DENOG, DebConf, FOSDEM, CCC, GrafanaCon, PromCon

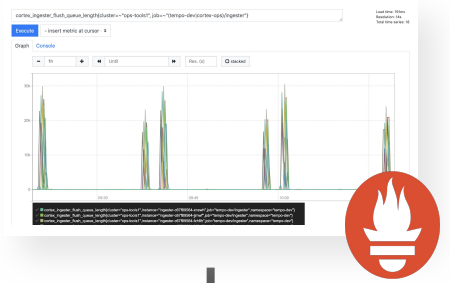
I come from the trenches of tech

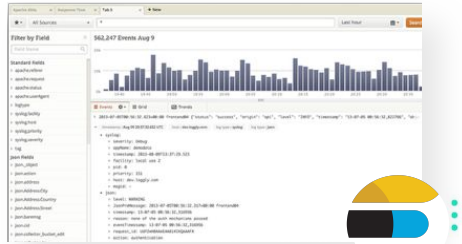
I know your pains and want to help

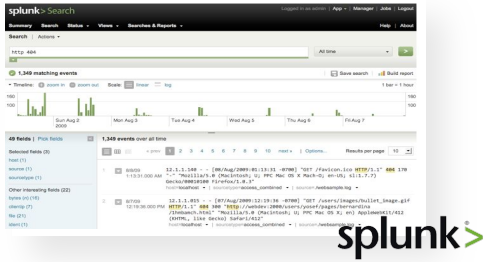
Today’s reality: Disparate systems. Disparate data.











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Back to the basics

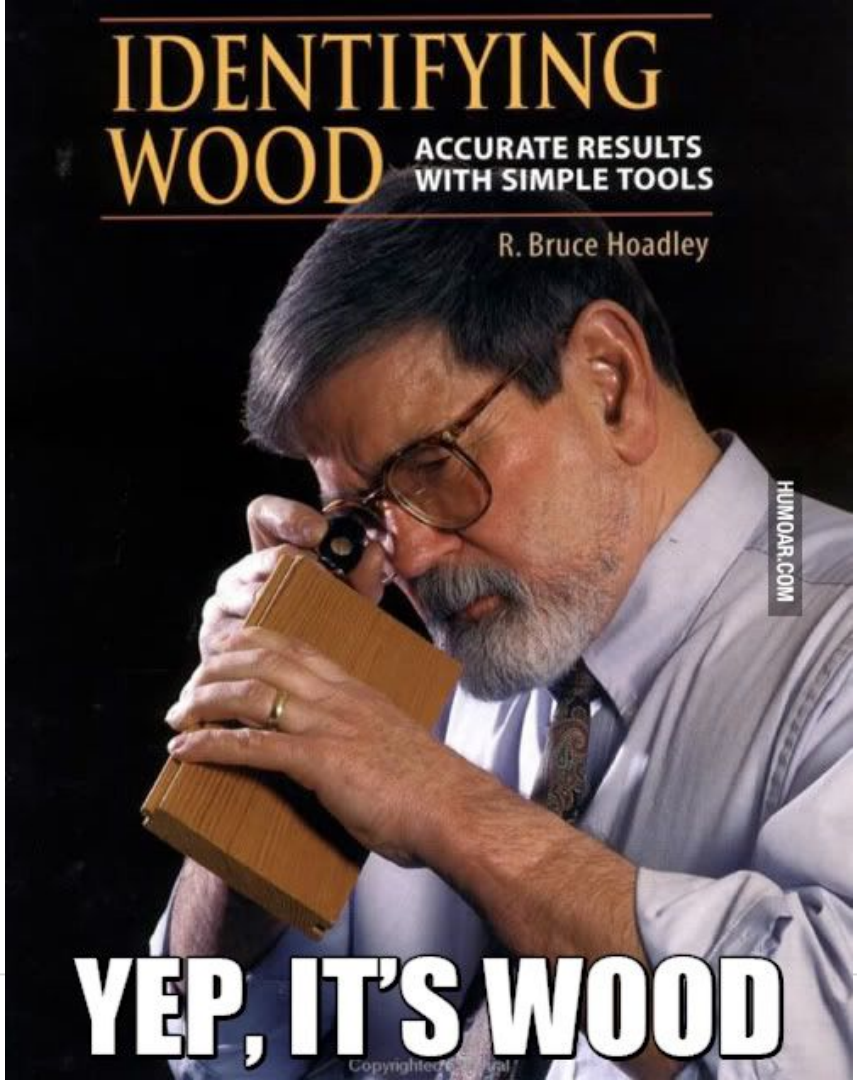
Let’s rethink this

Observability & SRE

Or: Buzzwords, and their useful parts

Buzzword alert!

- Cool new term, almost meaningless by now, what does it mean?
  - Pitfall alert: Cargo culting
  - It's about changing the behaviour, not about changing the name
- "Monitoring" has taken on a meaning of collecting, not using data
  - One extreme: Full text indexing
  - Other extreme: Data lake
- "Observability" is about enabling humans to understand complex systems
  - Ask **why** it's not working instead of just knowing that it's not


IDENTIFYING WOOD
ACCURATE RESULTS WITH SIMPLE TOOLS
R. Bruce Hoadley
HUMOAR.COM
YEP, IT'S WOOD

Complexity

- Fake complexity, a.k.a. bad design
  - Can be **reduced**
- Real, system-inherent complexity
  - Can be **moved** (monolith vs client-server vs microservices)
  - Must be **compartmentalized** (service boundaries)
  - Should be **distilled meaningfully**

SRE

- Another buzzword ;)
- At its core: Align incentives across the org
  - Easier said than done
- SLI, SLO, SLA
  - Error budgets allow devs, ops, PMs, etc. to optimize for shared benefits

SRE

- Everyone uses the same tools & dashboards
  - Shared incentive to invest into tooling
  - Pooling of institutional system knowledge
  - Shared language & understanding of services
- Service?
  - Compartmentalized complexity, with an interface
  - Different owners/teams
  - Contracts define interfaces

Services

- Why “contract”: Shared agreement which MUST NOT be broken
  - Internal and external customers rely on what you build and maintain
- Other common term: layer
  - The Internet would not exist without network layering
  - Enables innovation, parallelizes human engineering
- Other examples: CPUs, harddisk, compute nodes, your lunch

Services

- Customers care about services being up, not about individual components
- Discern between different SLIs
  - Primary: service-relevant, for alerting
  - Secondary: informational, debugging, might be underlying's primary

Anything currently or imminently impacting customer service must be alerted upon

But nothing(!) else

Prometheus

Prometheus 101

- Inspired by Google's Borgmon
- Time series database
- unit64 millisecond timestamp, float64 value
- Instrumentation & exporters
- Not for event logging
- Dashboarding via Grafana

Main selling points

- Highly dynamic, built-in service discovery
- No hierarchical model, n-dimensional label set
- PromQL: for processing, graphing, alerting, and export
- Simple operation
- Highly efficient

Main selling points

- Prometheus is a pull-based system
- Black-box monitoring: Looking at a service from the outside (Does the server answer to HTTP requests?)
- White-box monitoring: Instrumenting code from the inside (How much time does this subroutine take?)
- Every service should have its own metrics endpoint
- Hard API commitments within major versions

Time series

- Time series are recorded values which change over time
- Individual events are usually merged into counters and/or histograms
- Changing values are recorded as gauges
- Typical examples
  - Access rates to a webserver (counter)
  - Temperatures in a datacenter (gauge)
  - Service latency (histograms)

Super easy to emit, parse & read

```
http_requests_total{env="prod",method="post",code="200"} 1027
http_requests_total{env="prod",method="post",code="400"} 3
http_requests_total{env="prod",method="post",code="500"} 12
http_requests_total{env="prod",method="get",code="200"} 20
http_requests_total{env="test",method="post",code="200"} 372
http_requests_total{env="test",method="post",code="400"} 75
```

Scale

- Kubernetes is Borg
- Prometheus is Borgmon
- Google couldn't have run Borg without Borgmon (plus Omega and Monarch)
- Kubernetes & Prometheus are designed and written with each other in mind

Prometheus scale

- 1,000,000+ samples/second no problem on current hardware
- ~200,000 samples/second/core
- 16 bytes/sample compressed to 1.36 bytes/sample

The highest we saw in production on a single Prometheus instance were 15 million active times series at once!

Long term storage

- Two long term storage solutions have Prometheus-team members working on them
  - Thanos
    - Historically easier to run, but slower
    - Scales storage horizontally
  - Cortex
    - Easy to run these days
    - Scales both storage, ingester, and querier horizontally
- Both converge on tech again; have annoyed people with “Corthanos” for years

Cortex @ Grafana Labs

- 700+ million metrics

OpenMetrics

OpenMetrics

- Prometheus is the de-facto standard in cloud-native metric monitoring and beyond
  - Same is true for Prometheus exposition format
- Ease of exposing data has lead to an explosion in compatible metrics endpoints
  - Thousands of exporters and integrations
- Standard exporters and libraries make integrating this easy

OpenMetrics

- Some other projects & vendors are torn about adopting something from a competing product or project
- Especially traditional vendors prefer to support official standards
- Re-use installed base of Prometheus
  - Ease of adoption
  - No kitchen sink, do one thing well, remain focused and opinionated
- Many competing companies collaborated on OpenMetrics and helped shape
- The result is an actually neutral standard
  - Official IETF RFC process

Three pillars

- The “three pillars”
  - Metrics: Alerting, dashboarding, AI/ML
  - Logs: Due diligence, debugging, incident response
  - Traces: Debugging, performance tuning
- Plan since ‘15 was to have a label-based logging format
- Google shared scaling information about traces in ‘16, it was clear that exemplars were the only way
  - First-class support for exemplars in OpenMetrics

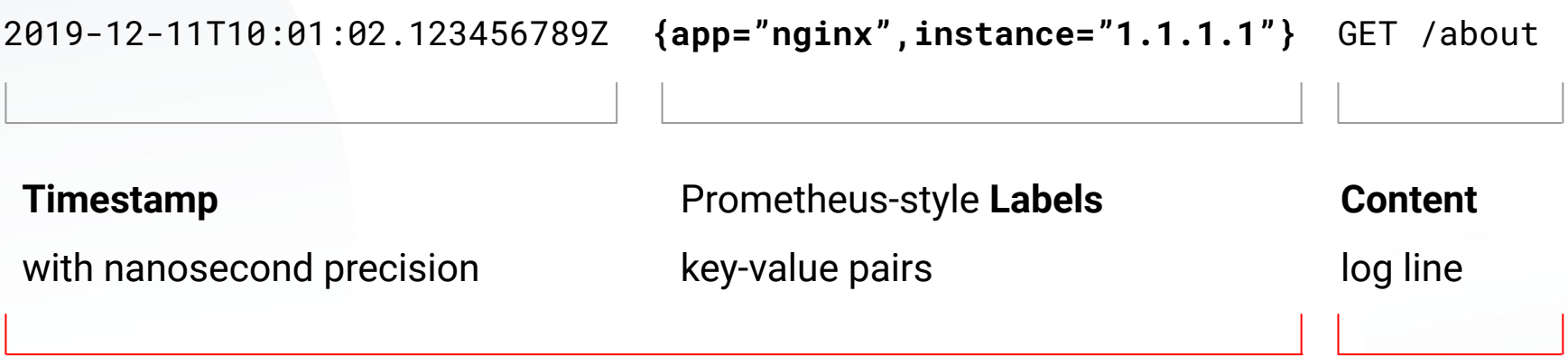
Prometheus changed how the world did metric-based monitoring. I started OpenMetrics to change how the world does Observability.

(Not joking.)

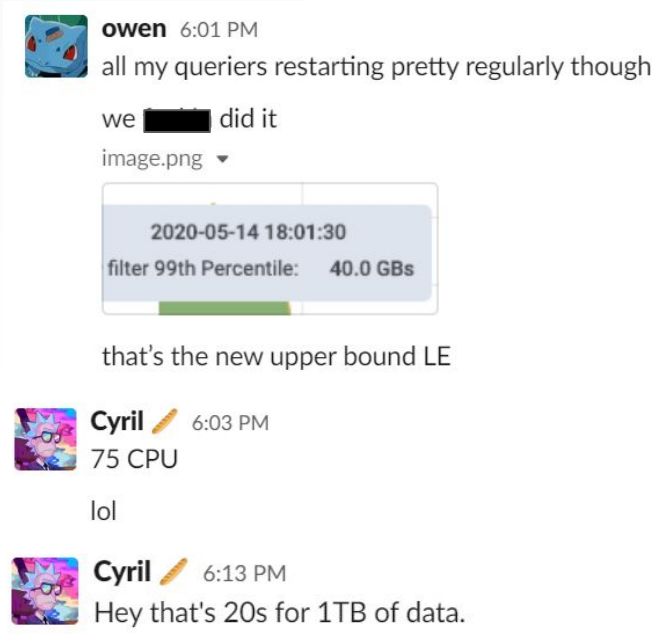
Loki

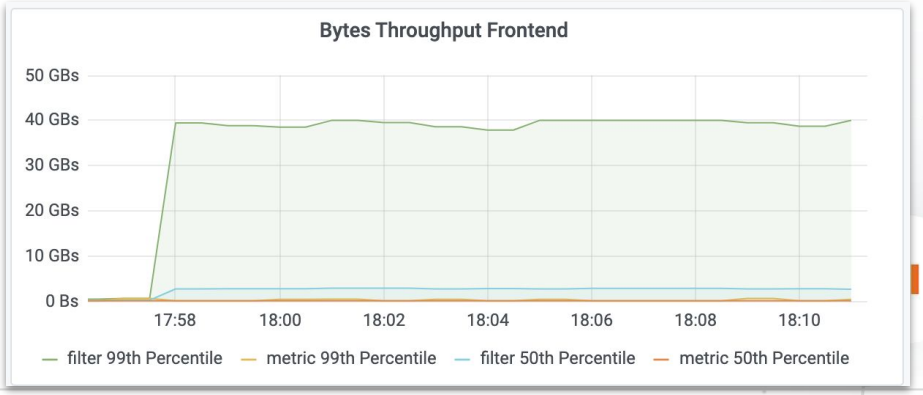
Loki 101

- Following the same label-based system like Prometheus
- No full text index needed, incredible speed
- Work with logs at scale, without the massive cost
- Access logs with the same label sets as metrics
- Turn logs into metrics, to make it easier to work with them
- Make direct use of syslog data, via promtail

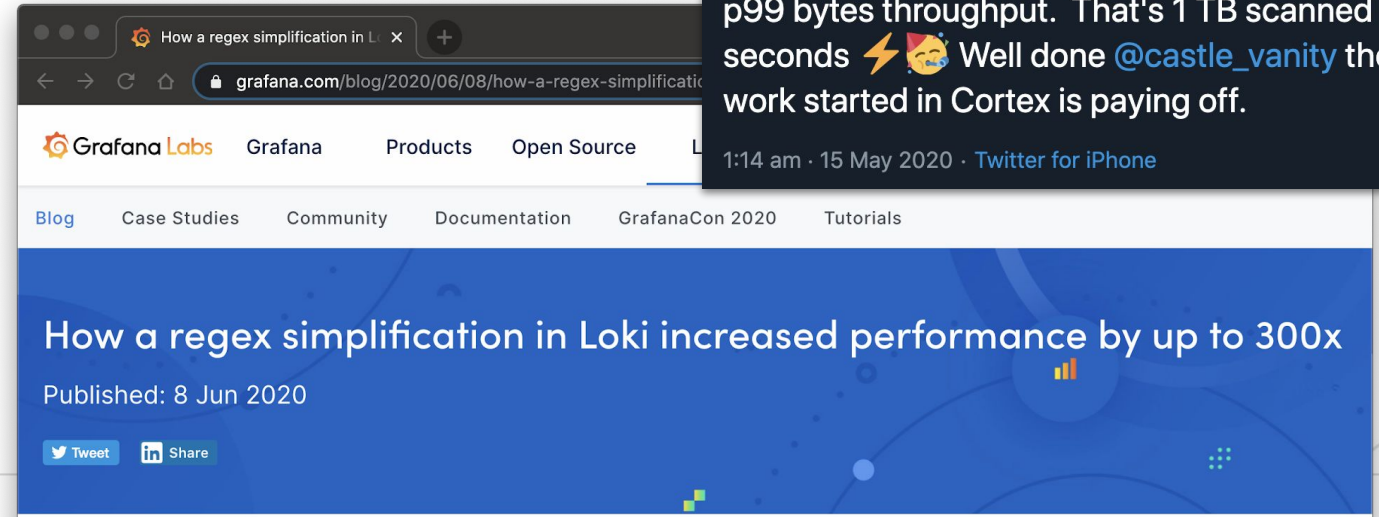

2019-12-11T10:01:02.123456789Z
{app="nginx",instance="1.1.1.1"}
GET /about
Timestamp
with nanosecond precision
Prometheus-style Labels
key-value pairs
Content
log line
indexed
unindexed

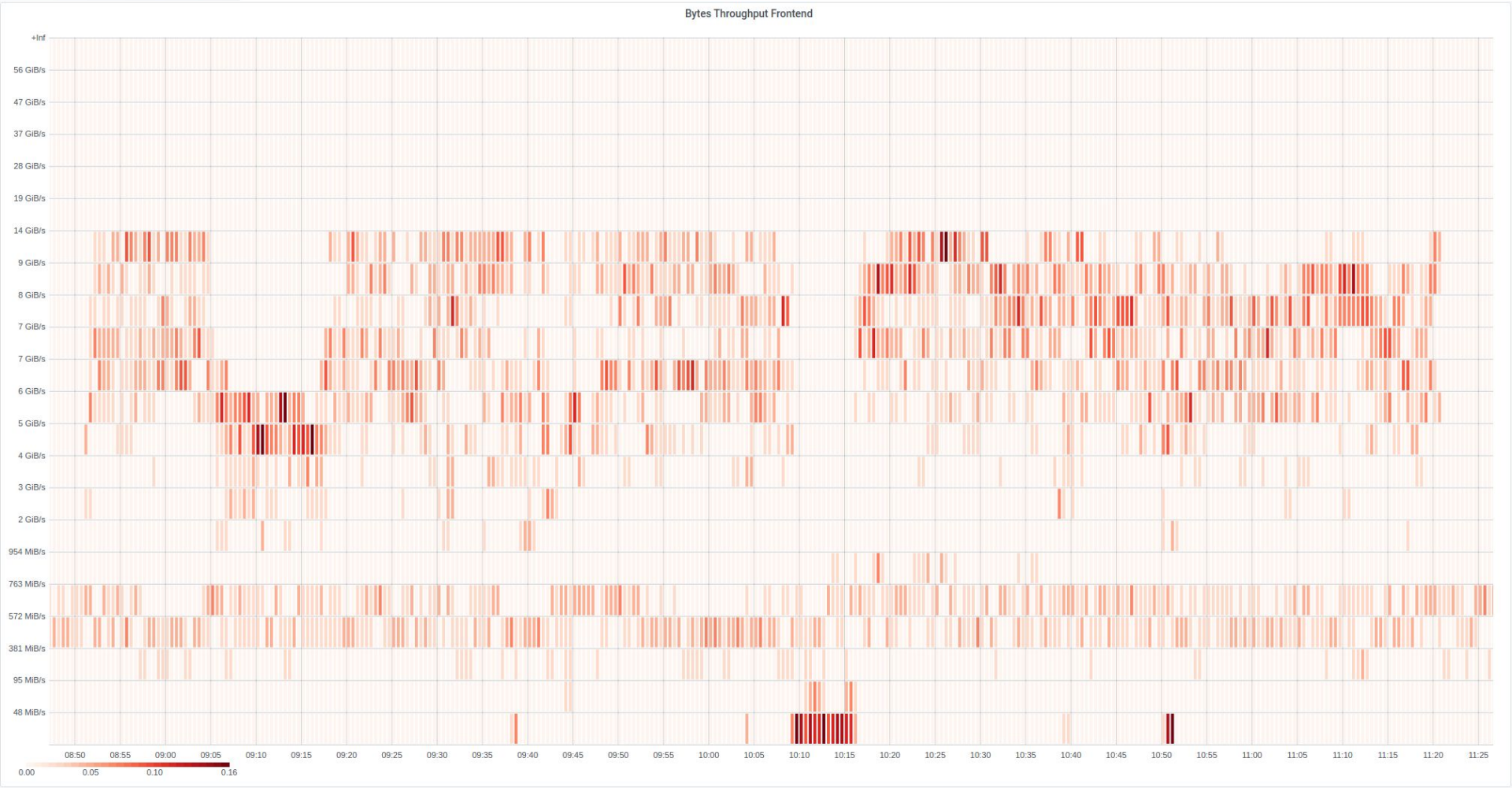
Query Frontend → Sharding





Grafana Loki: Blazin' Fast LogQL




Bytes Throughput Frontend
+Inf
56 GiB/s
47 GiB/s
37 GiB/s
28 GiB/s
19 GiB/s
14 GiB/s
9 GiB/s
8 GiB/s
7 GiB/s
7 GiB/s
6 GiB/s
5 GiB/s
4 GiB/s
3 GiB/s
2 GiB/s
954 MiB/s
763 MiB/s
572 MiB/s
381 MiB/s
95 MiB/s
48 MiB/s
08:50 08:55 09:00 09:05 09:10 09:15 09:20 09:25 09:30 09:35 09:40 09:45 09:50 09:55 10:00 10:05 10:10 10:15 10:20 10:25 10:30 10:35 10:40 10:45 10:50 10:55 11:00 11:05 11:10 11:15 11:20 11:25
0.00 0.05 0.10 0.16

Tempo

Tempo

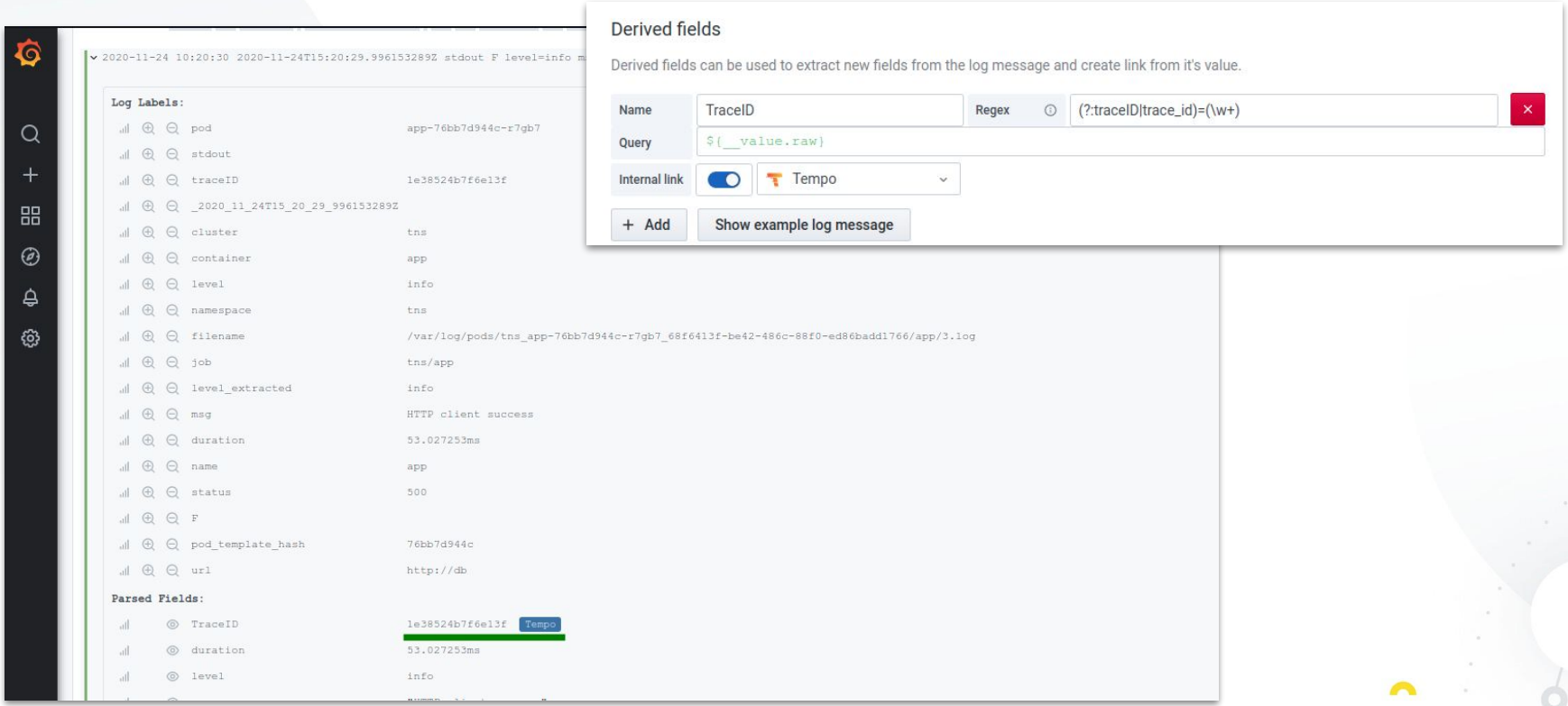
- Exemplar-based: Jump from relevant logs & metrics
  - Native to Prometheus, Cortex, Thanos, and Loki, but works with all
  - Exemplars work at Google scale, with the ease of Grafana
- Object store only: No Cassandra, Elastic, etc.
- 100% compatible with OpenTelemetry Tracing, Zipkin, Jaeger
- 100% of your traces, no sampling

Tempo @ Grafana Labs (2021-07)

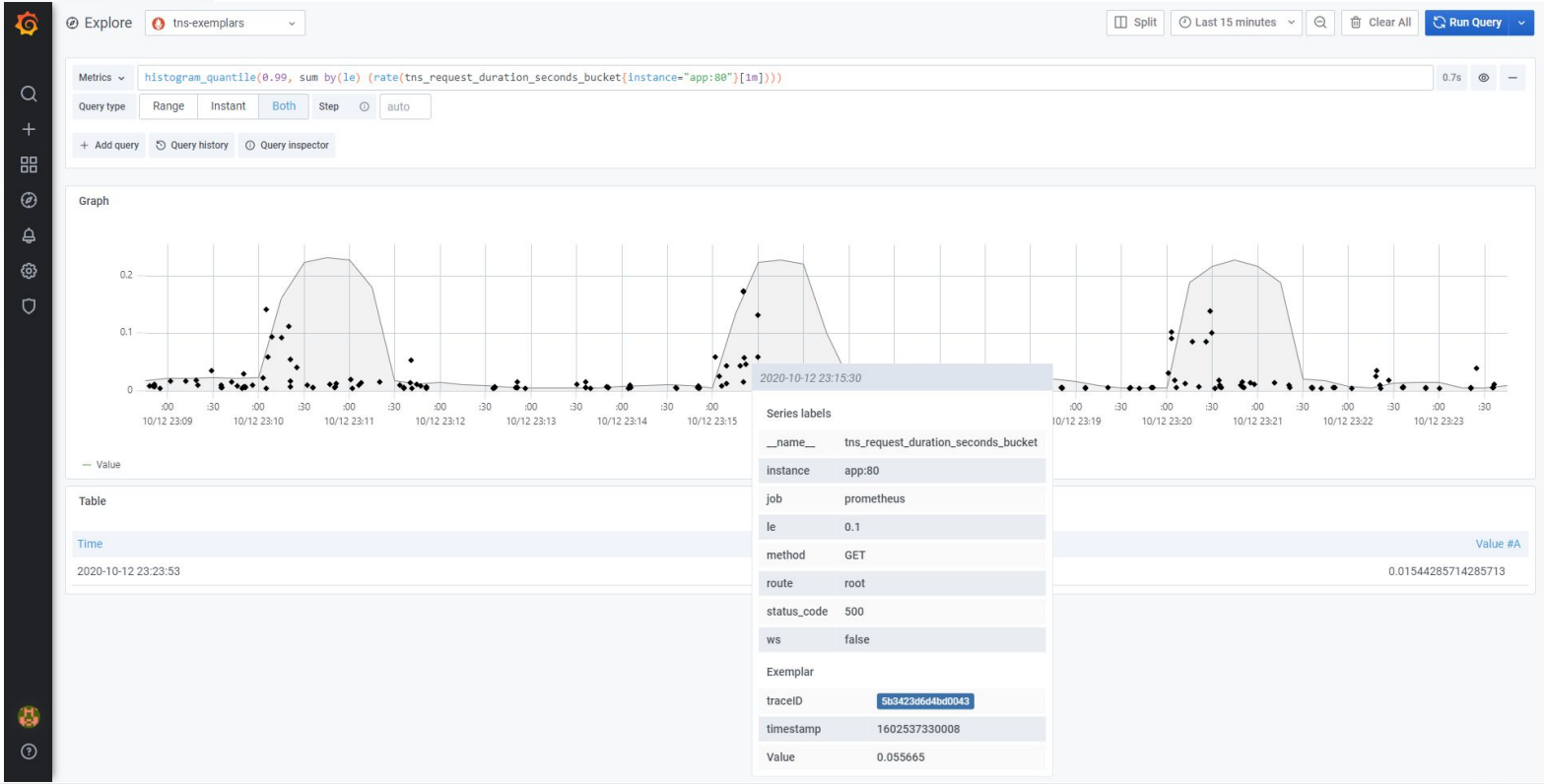
- 2,200,000 samples per second @ 350 MiB/s
- 14-day retention @ 3 copies stored
- ~240 CPU cores (includes compression cost)
- ~450 GiB RAM
- 132 TiB object storage
- Latencies:
  - p99 - 2.5s
  - p90 - 2.3s
  - p50 - 1.6s

Bringing it together

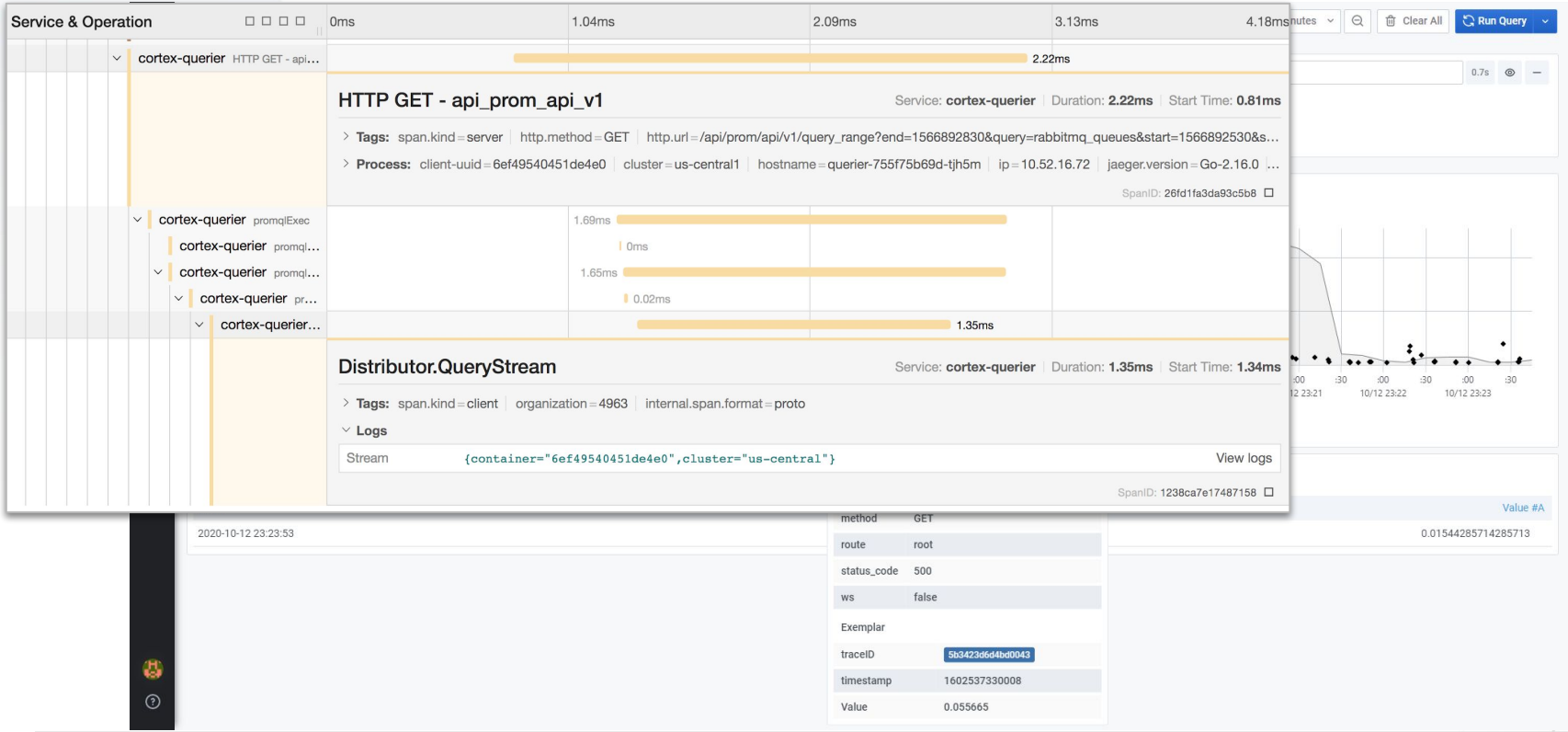
From logs to traces



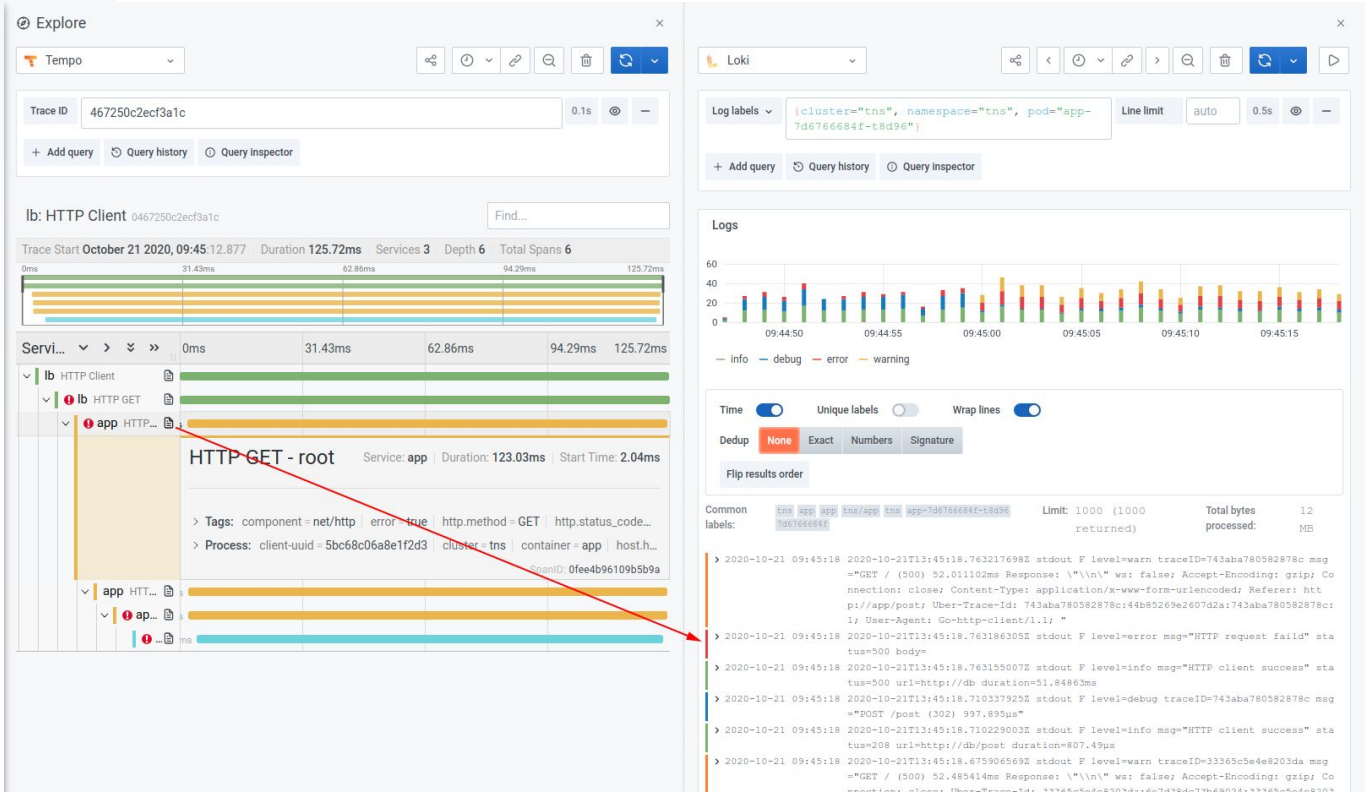
From metrics to traces



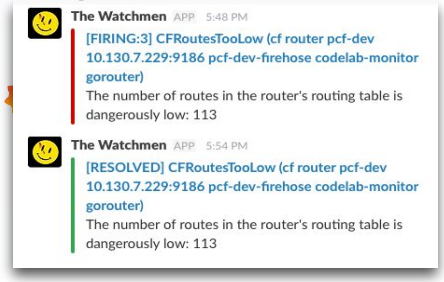
From metrics to traces

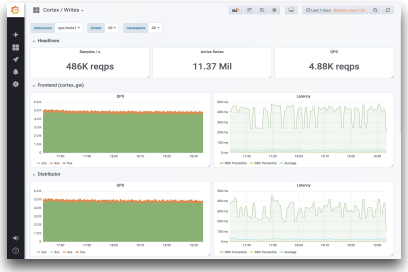


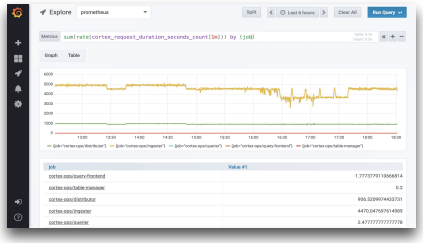
...and from traces to logs

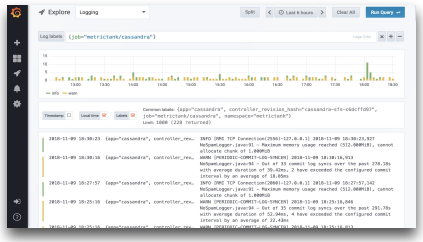


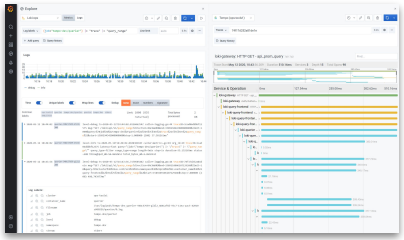
All of this is Open Source and you can run it yourself

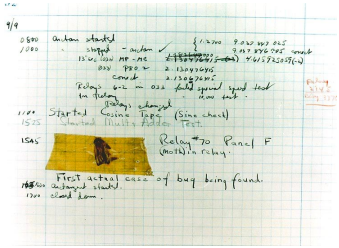

The Watchmen APP 5:48 PM
[FIRING:3] CFRoutesTooLow (cf router pcf-dev 10.130.7.229:9186 pcf-dev-firehose codelab-monitor gorouter)
The number of routes in the router's routing table is dangerously low: 113
The Watchmen APP 5:54 PM
[RESOLVED] CFRoutesTooLow (cf router pcf-dev 10.130.7.229:9186 pcf-dev-firehose codelab-monitor gorouter)
The number of routes in the router's routing table is dangerously low: 113


Cortex / Writes
486K reqps
11.37 Mil
4.88K reqps


Explore
prometheus


Explore
Logging




First actual case of bug being found.

Thank You!

richih@richih.org
twitter.com/TwitchiH
github.com/RichiH/talks