Quo vadis, Prometheus?

Monitoring. At scale.

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‘whoami‘

- Richard ”RichiH” Hartmann
- Swiss army chainsaw at SpaceNet
  - Currently responsible for building one of the most modern datacenters in Europe
  - ...and always looking for nice co-workers in the Munich area
- FOSDEM, DebConf, DENOGx, PromCon staff
- Author of `https://github.com/RichiH/vcsh`
- Debian Developer
- Prometheus team member

Show of hands

- Who has heard of Prometheus?
- Who is considering using Prometheus?
- Who is POCing Prometheus?
- Who uses Prometheus in production?

Prometheus 101

- Inspired by Google's Borgmon
- Time series database
- int64 timestamp, float64 value
- Ecosystem of instrumentation & exporters
- Not for events
  - Logging
  - Tracing (more on that later)
  - etc.
- 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

Cloudy with a chance of buzzwords

- So it's built with highly dynamic environments in mind
- It's the second project to ever join CNCF and the de facto standard in cloud-native monitoring
- Kubelets, sidecars, microservices, ALL the cloud-native
- But it's a monolithic application
- ...why?

Resilience, resilience, and also resilience

- What do you need for operations?
  - Power and cooling
  - Network connectivity
  - Observability, a.k.a. Monitoring
- The rest you can fix

Three main features

- Storage backend
  - Caveat: Prometheus 2.0 comes with storage v3
- Staleness handling
- Remote read & write API is now stable-ish
- Links to in-depth talks about these features are at the end

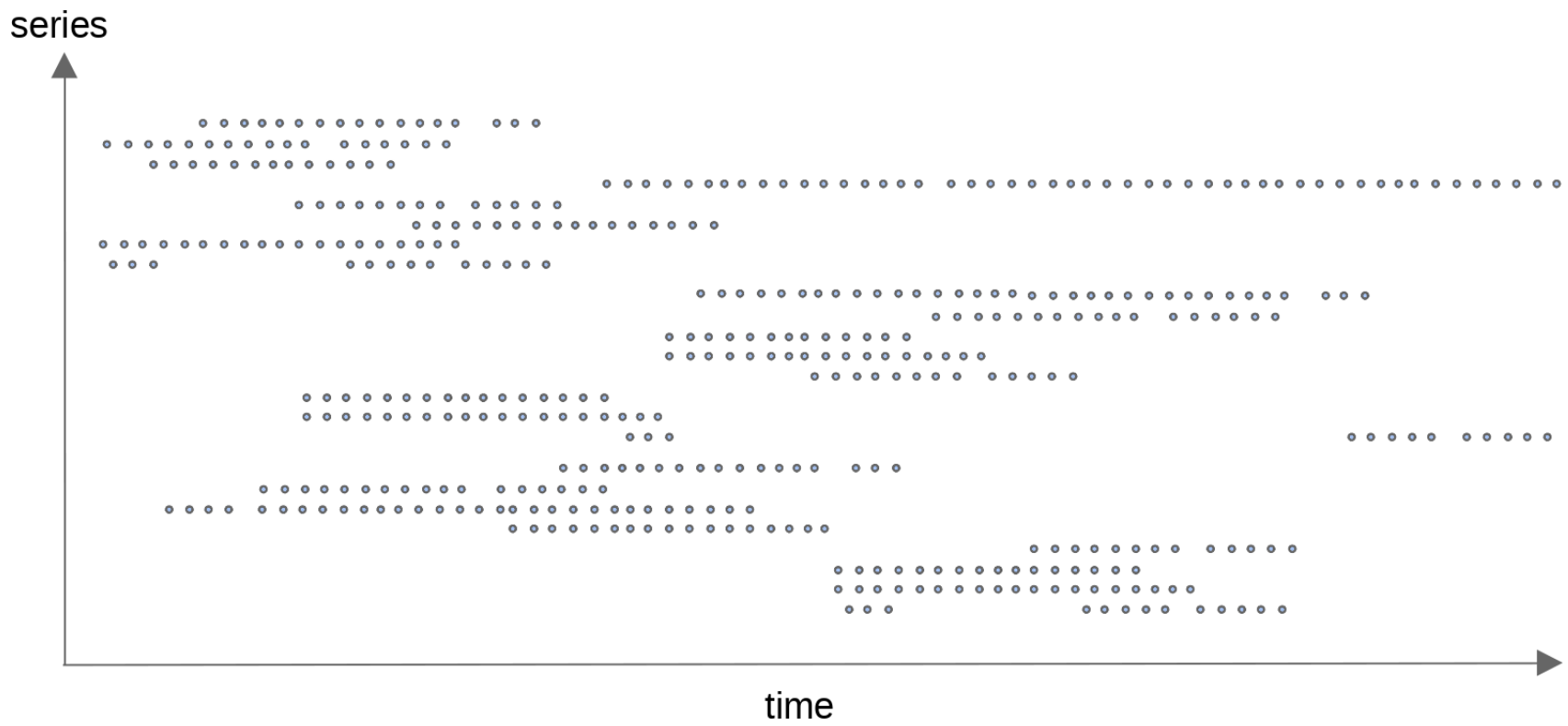
Prometheus 1.x

- We used to have one file per time series
- Relatively easy to implement
- Pretty efficient
- Why change?

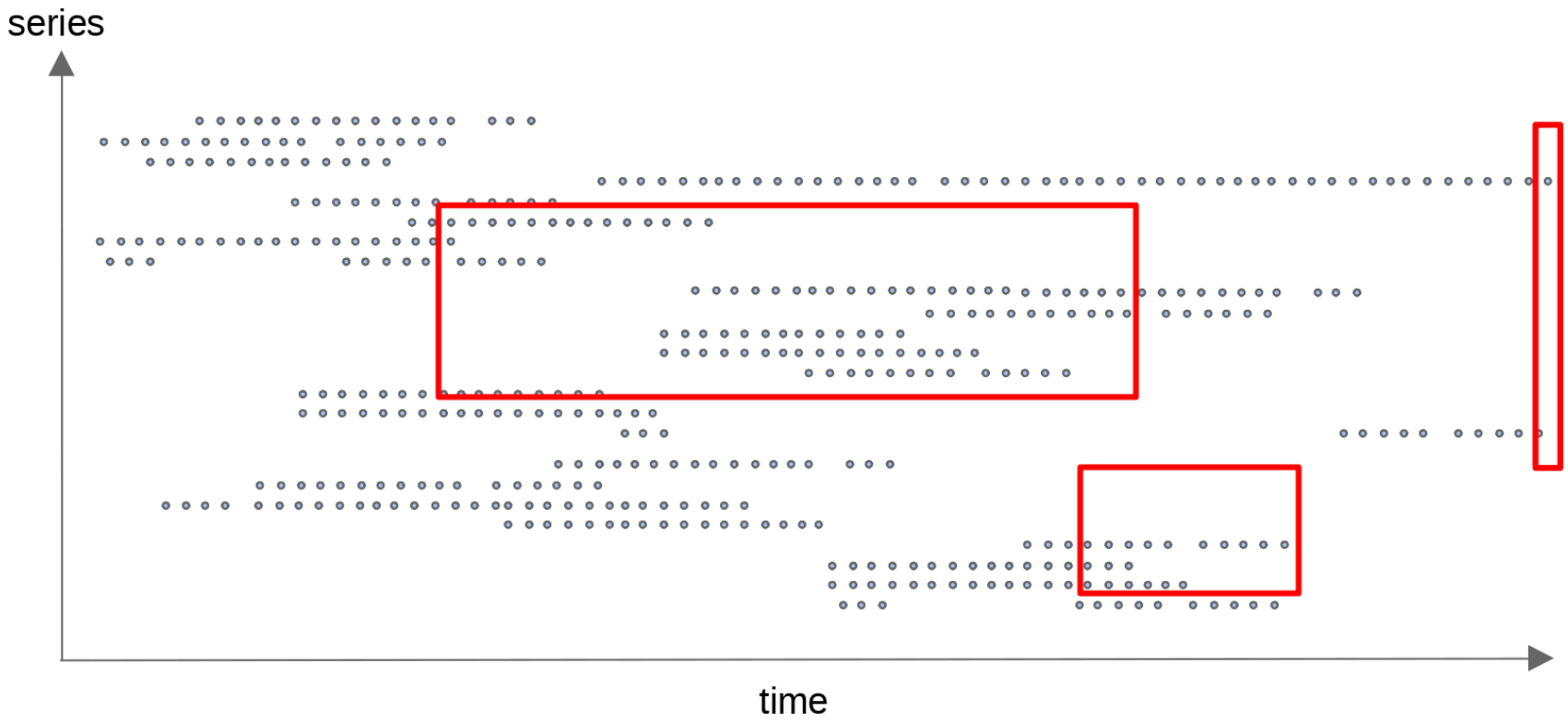
Churn

- Churn was becoming more and more of a problem
- There's a company with a 15 minute maximum lifetime for their containers
- If you have a lot of files which might contain data for any given time frame, you need to look at all of them

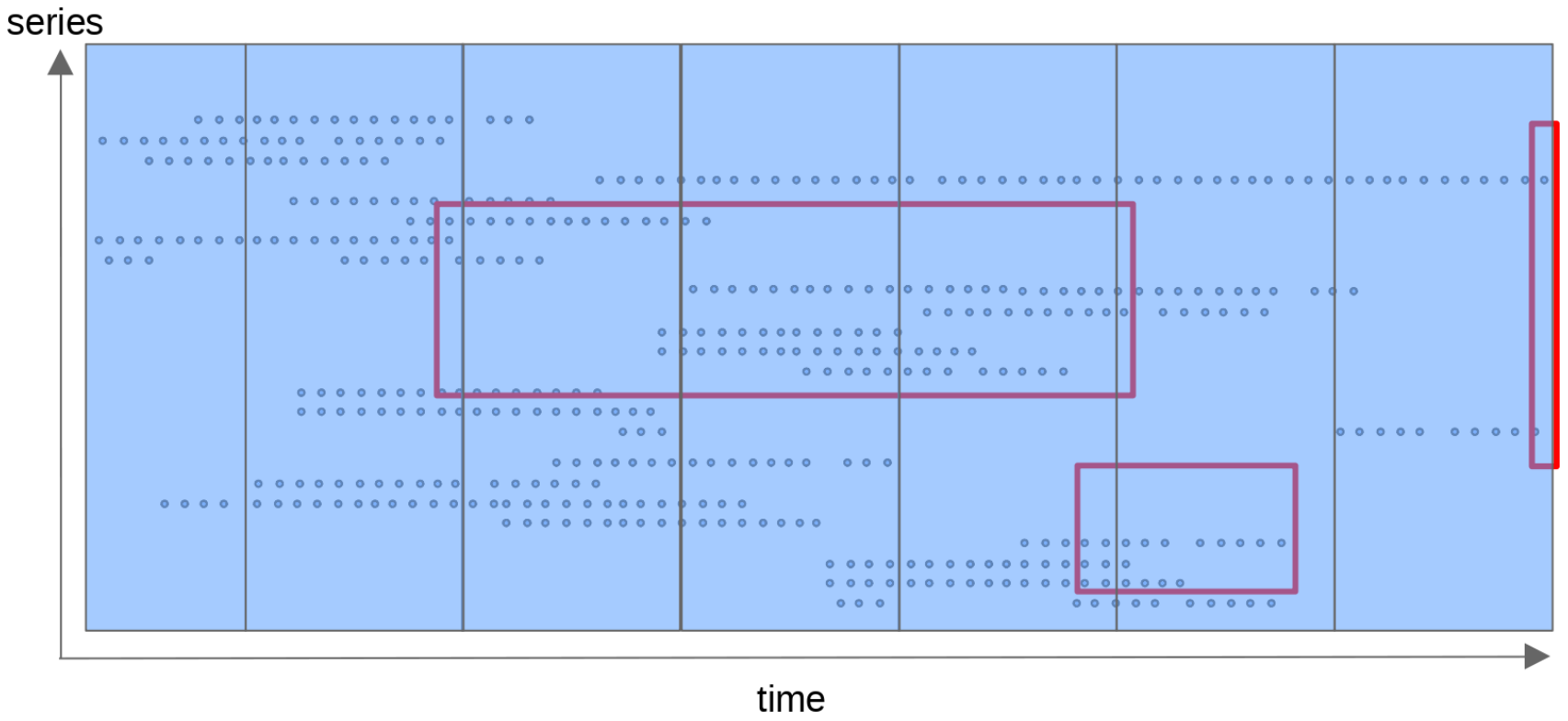
One file per series



Selection



Blocks



Test setup

- Kubernetes cluster with dedicated Prometheus nodes
- 800 microservice instances and Kubernetes components
- 120k samples/sec
- 300k active time series
- Swap out 50% of all pods every 10 minutes

Results

- 15x reduction in memory usage
- 6x reduction in CPU usage
- 80-100x reduction in disk writes
- 5x reduction in on-disk size
- 4x reduction in query latency on expensive queries
- Want to reproduce?
  `https://github.com/prometheus/prombench`

Downside of handling churn

- So now we can handle extreme churn
- ...and suddenly, five minutes staleness timeouts seem awfully long
  - Down alerts continue to fire
  - Double counting
  - Other icky corner cases

Results

- When a target goes away, all its time series are considered stale
- When a target no longer returns any specific time series, this time seires is considered stale
- It's a lot more complicated than that under the hood

Playing nicely with others

- We now have a stable-ish remote read/write API
- Which we're already using ourselves; it's the recommended upgrade path from 1.x
  - You need to upgrade to 1.8.2 or later for this to work

So, about backfill and explicit timestamps...

- If explicit timestamps were icky before, this has now become worse
- You can not ingest data older than the age of the current storage block, nor data much newer
- Staleness vs timestamps is non-trivial

ACID databases...

- **A**tomicity - since 1.x
- **C**onsistency - since 1.x
- **I**solation - will happen within 2.x
- **D**urability - since 2.0

Isolation

- Each append action gets a write ID (64 bit monotonic counter)
- Every sample's write ID is noted along with value and timestamp
- Any append action which has not yet been committed, or has been rolled back, is ignored at query time
- We keep write IDs in memory; if we restart or crash, the atomicity of the write ahead log will protect us

Quick is not quick enough

- Brian Brazil is currently working on optimizing PromQL
- 5x faster for time vector functions
- 100x reduction in garbage to collect
- `github.com/prometheus/prometheus/pull/3966`

Release stability

- Every single release since 2.0.0 has had issues
- Some bugs and some human mistakes in the release process
- 2.2.1 is clean and stable
- Always running latest is the cloud-native approach, but this is still not acceptable
- We put in more checks and balances to ensure cleaner releases going forward

Security & quality

- CNCF is sponsoring external code review by Cure53
- Focussed on security, but this always means looking at stability as well
- Keep in mind that Prometheus willfully ignores most security considerations
- Encryption, authentication, and authorization should be handled via reverse proxies
- Review starts next Monday; actually had the kick-off call before this talk

Problem statement

- Long-term storage is the last remaining major feature left untackled
- Fundamentally, Prometheus operates as distinct data islands
- As there's no backfill, data dies along with its instance by default

Solutions

- Storage v3 supports backups efficiently and effectively
- Remote read-write allows you to integrate with a growing list of projects and products, e.g. Cortex
- On storage level, there are object storage backends for Prometheus, e.g. Thanos

- We deliberately do no endorse any particular approach or solution; this might change over time

Humble aspirations

- When we say that we want to change how the world does monitoring, we mean it
- One of our most powerful features are labels
- Labels are encoded in our exposition format
- Some third-party projects and vendors have an issue with supporting a ”competing” project

What do?

- We are spinning out Prometheus' exposition format
- Face-to-face kick-off last August at Google London
- Independent CNCF member project, IETF RFC, test suite, etc
- We finished our technical discussions last week and I am currently writing the Internet Draft
- `https://github.com/RichiH/OpenMetrics`

Beyond metrics

- OpenMetrics supports more than just metrics
- Every single data point in a time series can point to one single event
- Especially useful if you emit one trace id per histogram bucket
- Some integrations already support this concept, e.g. OpenCensus
- Ingestors are free to discard this optional data, e.g. Prometheus

Bringing observability together

- OpenTracing already on board with this effort
- Will hammer out more details and have a face-to-face during KubeCon Seattle this December
- Will most likely have a three-day side track called Observacon
- Long-term goal is one common, modular, well-engineered standard under a new name

First committers to adopt, too many to list all

- Cloudflare
- CNCF at large
- GitLab
- Google
- Grafana
- InfluxData
- Kausal.co
- Oath.com / Yahoo / Verizon
- RobustPerception
- SpaceNet
- Uber

PromCon 2018

- August 09 & 10
- Held at Google office in Munich
- Organized by the Prometheus community, mainly be me
- Sponsorship still open
- CfP still open for two weeks
- Diversity funding available; from just the ticket to travel & accomodation
- `promcon.io`

Generally speaking...

- Yes, we want to change the world
- Simple and resilient operation of Prometheus remains a core goal
- The path from raw data to reliable alerts is the single most important user contract we have
- More project and software integrations... and we're talking to hardware vendors as well
- Supporting tomorrow's 10x scale today

Relevant talks

- Storing 16 Bytes at Scale: `https://promcon.io/2017-munich/talks/staleness-in-prometheus-2-0/`
- Staleness and Isolation in Prometheus 2.0: `https://promcon.io/2017-munich/talks/staleness-in-prometheus-2-0/`
- Social aspects of change: `https://promcon.io/2017-munich/talks/social-aspects-of-change/`

Further reading

- Prometheus 2017 Dev Summit:
  `https://docs.google.com/document/d/1DaHFao0saZ3MDt9yuuxLaCQg8WGad08s44i3cxSARcM/edit`
- OpenMetrics: `https://github.com/RichiH/OpenMetrics`
- This and other talks:
  `https://github.com/RichiH/talks/`

Thanks!

Thanks for listening!

Questions?

Email me if you want a job in Munich.

See slide footer for contact info.