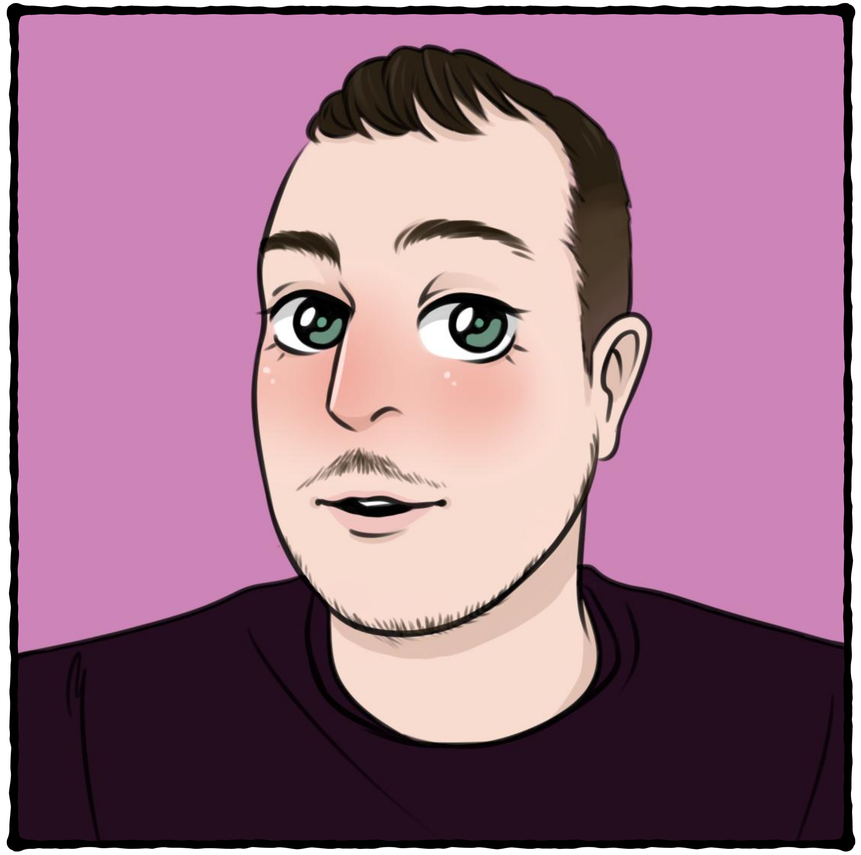

wide event analytics
@igonwhilefalse

hello!



@igorwhilefalse

gentle constructive rant

debugging large scale systems using events

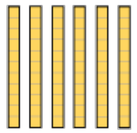
understanding system behaviour

app

events

{ k: v }

column store



analytical queries

SELECT ...
GROUP BY

users

😊

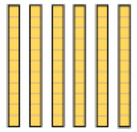
app

you are here

events

{ k: v }

column store

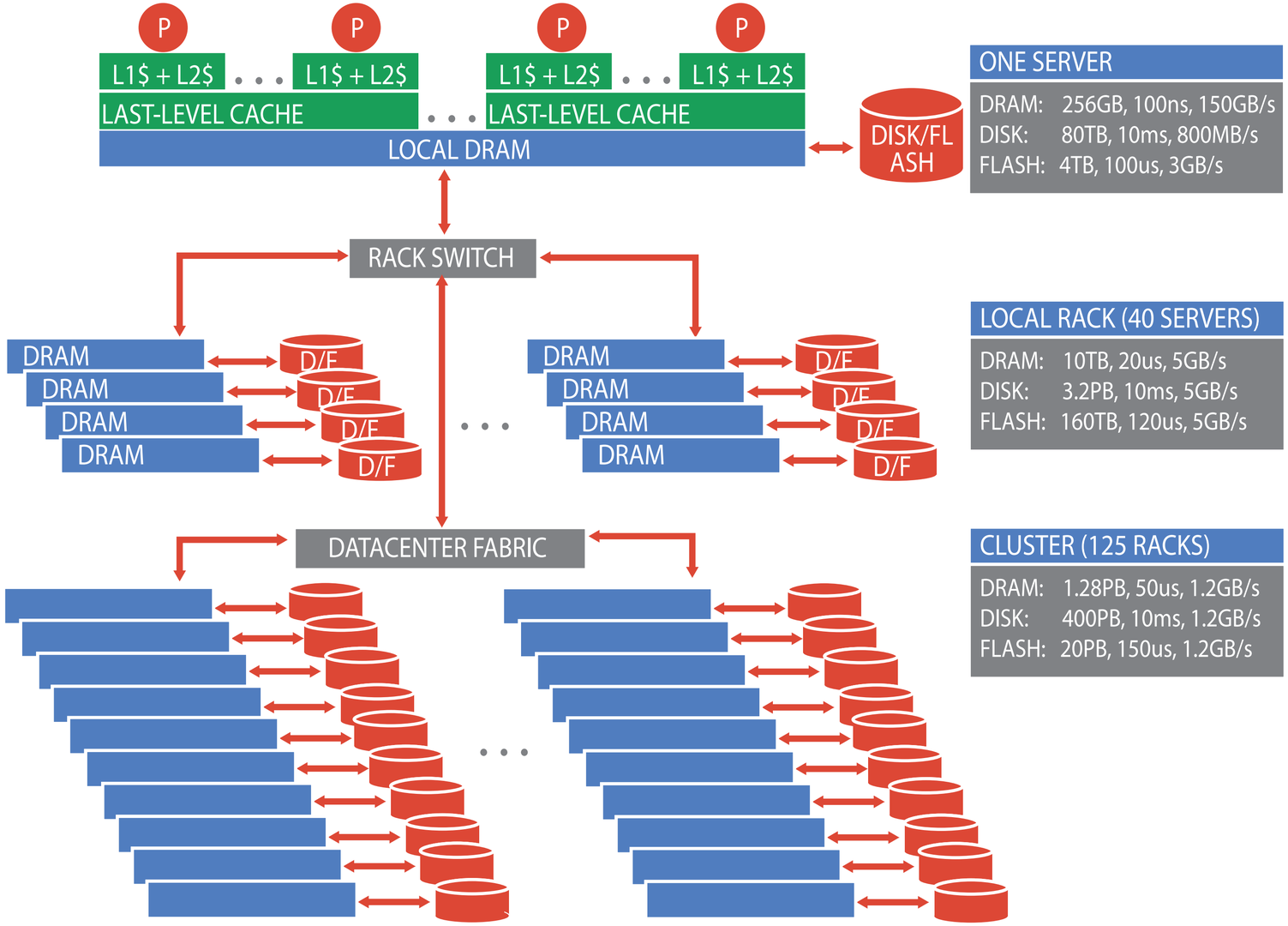


analytical queries

SELECT ...
GROUP BY

users

software is becoming
increasingly complex



ONE SERVER

DRAM: 256GB, 100ns, 150GB/s
DISK: 80TB, 10ms, 800MB/s
FLASH: 4TB, 100us, 3GB/s

LOCAL RACK (40 SERVERS)

DRAM: 10TB, 20us, 5GB/s
DISK: 3.2PB, 10ms, 5GB/s
FLASH: 160TB, 120us, 5GB/s

CLUSTER (125 RACKS)

DRAM: 1.28PB, 50us, 1.2GB/s
DISK: 400PB, 10ms, 1.2GB/s
FLASH: 20PB, 150us, 1.2GB/s

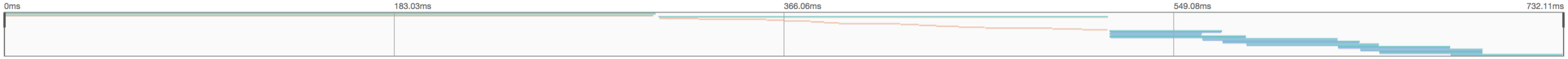
The Datacenter as a Computer, Barroso et al

Jaeger UI | Lookup by Trace ID... | Search | Dependencies | About Jaeger

frontend: HTTP GET /dispatch

Search... | View Options

Trace Start: **July 20, 2018 2:48 PM** | Duration: **732.11ms** | Services: **6** | Depth: **5** | Total Spans: **51**



Service & Operation	Duration
frontend HTTP GET /dispatch	
frontend HTTP GET: /customer	305.89ms
frontend HTTP GET	305.88ms
customer HTTP GET /customer	304.46ms
mysql SQL SELECT	304ms
frontend Driver::findNearest	211.15ms
driver Driver::findNearest	210.78ms
redis FindDriverIDs	18.23ms
redis GetDriver	32ms
redis GetDriver	8.17ms
redis GetDriver	12.34ms
redis GetDriver	6.24ms
redis GetDriver	6.96ms
redis GetDriver	28.81ms
redis GetDriver	8.77ms
redis GetDriver	8.12ms
redis GetDriver	10.49ms
redis GetDriver	12.4ms
redis GetDriver	31.63ms
redis GetDriver	14.02ms
redis GetDriver	11.72ms
frontend HTTP GET: /route	52.92ms
frontend HTTP GET	52.89ms
route HTTP GET /route	52.08ms
frontend HTTP GET: /route	43.45ms
frontend HTTP GET	43.44ms
route HTTP GET /route	42.48ms
frontend HTTP GET: /route	64.18ms
frontend HTTP GET	64.15ms
route HTTP GET /route	63.48ms
frontend HTTP GET: /route	63.67ms
frontend HTTP GET	63.65ms
route HTTP GET /route	63.36ms

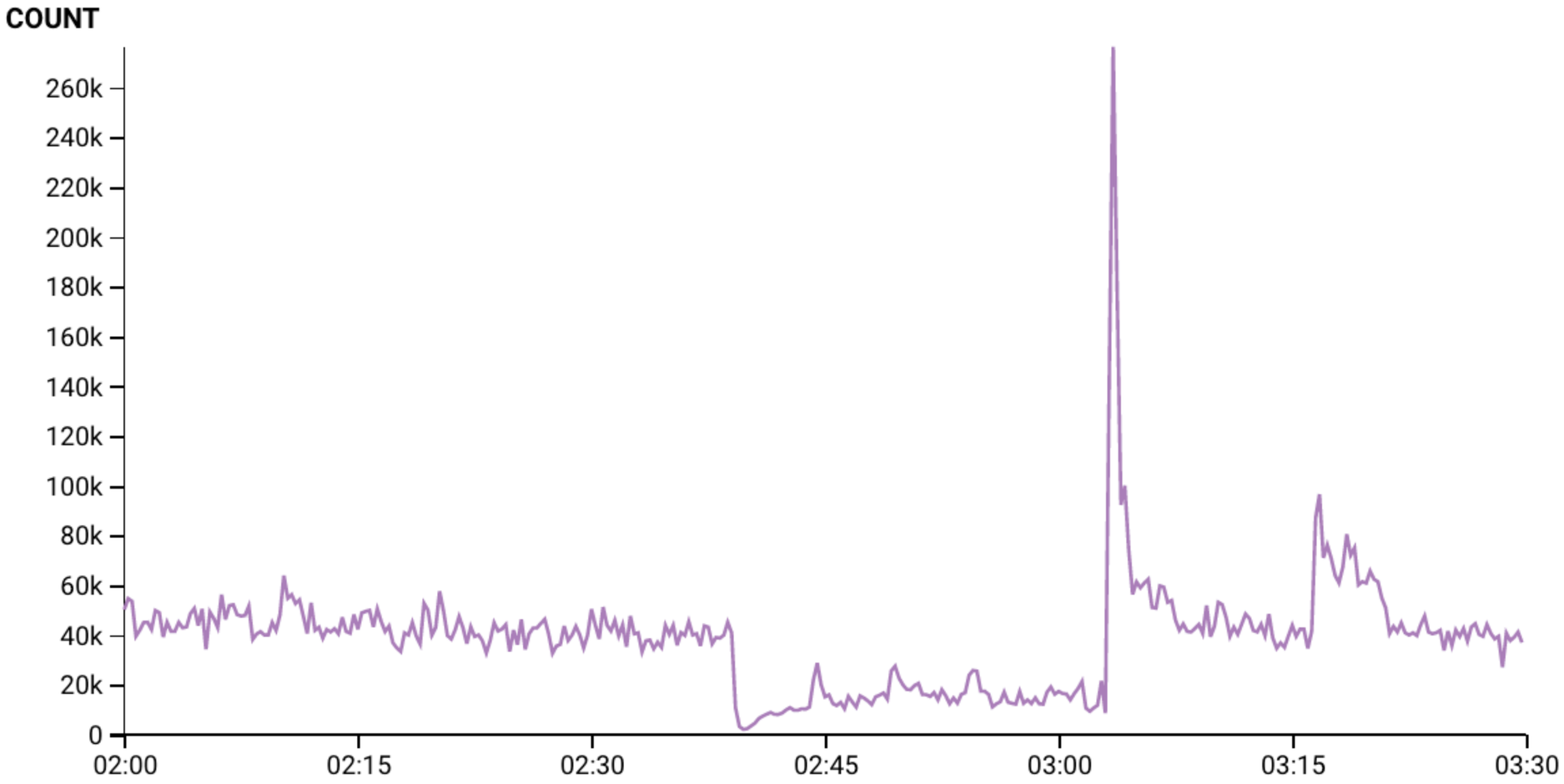
Jaeger, Uber


PREPARE TO STOP
NO DANGEROUS GOODS IN TUNNEL
LOW CLEARANCE 4.4 m
CAHILL TUNNEL
NO DANGEROUS GOODS IN TUNNEL
LOW TUNNEL CLEARANCE 4.4m
DETOUR
GRESHAM
Philippe M Desveaux

Alexandre Baron

logs vs metrics: a false dichotomy

```
10.2.3.4 - - [1/Jan/1970:18:32:20
+0000] "GET / HTTP/1.1" 200 5324
"-" "curl/7.54.0" "-"
```


COUNT
260k
240k
220k
200k
180k
160k
140k
120k
100k
80k
60k
40k
20k
0
02:00
02:15
02:30
02:45
03:00
03:15
03:30

we can derive metrics
from log streams

```
$ cat access.log
    | grep ... | awk ...
    | sort | uniq -c
```

```
{
  time            = "1970-01-01T18:32:20"

  status          = 200
  method          = "GET"
  path            = ...
  host            = "i-123456af"
  client_ip       = "10.2.3.4"
  user_agent      = "curl/7.54.0"

  request_dur_ms = 325
  request_bytes  = 2456
  response_bytes = 5324
}
```

structured logs

summary events

canonical log lines

arbitrarily wide data blobs

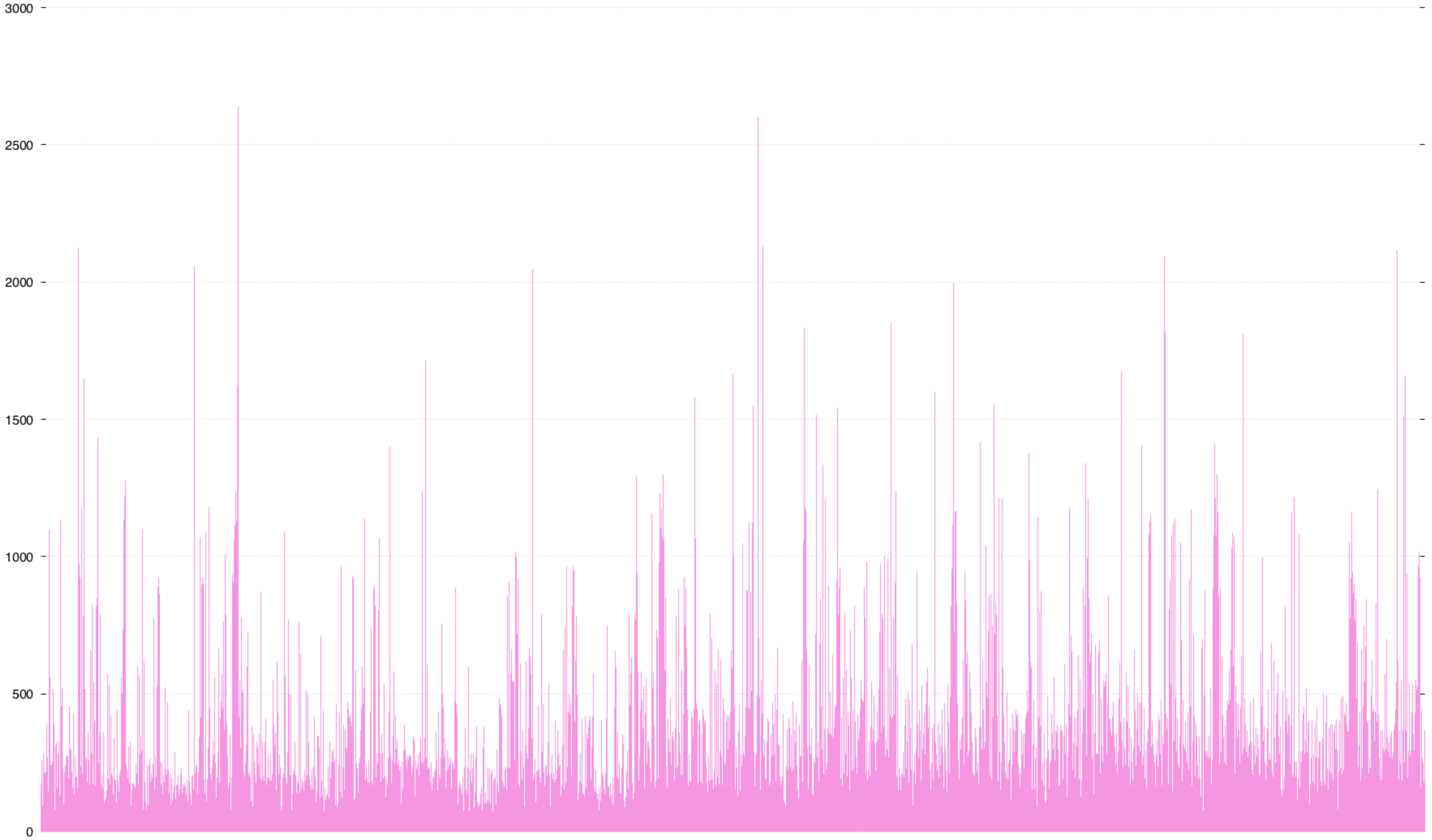
events

a metric is an aggregation
of events

why do we aggregate?

1. Python

```
38.113.234.181 - - [20/May/2010:11:27:36 +0100] "GET /post/274953/ HTTP/1.1" 404 15 "-" "Voyager/1.0"
67.195.114.50 - - [20/May/2010:11:31:16 +0100] "GET /sources/14/ HTTP/1.0" 200 14262 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
61.135.216.104 - - [20/May/2010:11:32:56 +0100] "GET /feeds/latest/ HTTP/1.1" 200 48364 "-" "Mozilla/5.0 (compatible;YoudaoFeedFetcher/1.0;http://www.youdao.com/help/reader/faq/topic006/;1 subscribers;)"
125.22.2.42 - - [20/May/2010:11:33:09 +0100] "GET /feeds/latest/ HTTP/1.1" 200 48364 "-" "Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; .NET CLR 1.1.4322; .NET CLR 2.0.50727; MS-RTC LM 8; .NET CLR 3.0.04506.648; .NET CLR 3.5.21022; MSOffice 12)"
77.88.26.26 - - [20/May/2010:11:33:50 +0100] "GET /posts/2234/ HTTP/1.1" 200 33674 "-" "Yandex/1.01.001 (compatible; Win16; I)"
24.62.152.212 - - [20/May/2010:11:34:07 +0100] "GET /media/style.css HTTP/1.1" 200 4847 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
24.62.152.212 - - [20/May/2010:11:34:07 +0100] "GET /media/exmpl.png HTTP/1.1" 200 28479 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
24.62.152.212 - - [20/May/2010:11:34:05 +0100] "GET / HTTP/1.1" 200 110836 "-" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
24.62.152.212 - - [20/May/2010:11:34:08 +0100] "GET /media/img/m-inact.gif HTTP/1.1" 200 2571 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
24.62.152.212 - - [20/May/2010:11:34:08 +0100] "GET /media/img/side-container.gif HTTP/1.1" 200 1415 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
24.62.152.212 - - [20/May/2010:11:34:08 +0100] "GET /media/img/m-act.gif HTTP/1.1" 200 143 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_6_3; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
166.205.4.62 - - [20/May/2010:10:39:16 +0000] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
166.205.4.62 - - [20/May/2010:11:39:16 +0100] "GET /media/exmpl.png HTTP/1.1" 304 - "http://example.com/" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
166.205.4.62 - - [20/May/2010:11:39:13 +0100] "GET / HTTP/1.1" 200 26130 "-" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
166.205.4.62 - - [20/May/2010:10:39:17 +0000] "GET /media/img/m-act.gif HTTP/1.1" 304 - "http://example.com/" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
166.205.4.62 - - [20/May/2010:11:39:18 +0100] "GET /media/img/m-inact.gif HTTP/1.1" 304 - "http://example.com/" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
166.205.4.62 - - [20/May/2010:10:39:20 +0000] "GET /media/img/side-container.gif HTTP/1.1" 304 - "http://example.com/" "Mozilla/5.0 (iPad; U; CPU OS 3_2 like Mac OS X; en-us) AppleWebKit/531.21.10 (KHTML, like Gecko) Version/4.0.4 Mobile/7B367 Safari/531.21.10"
67.195.114.50 - - [20/May/2010:11:40:09 +0100] "GET /post/249681/ HTTP/1.0" 404 15 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
67.195.114.50 - - [20/May/2010:11:40:15 +0100] "GET /post/256414/ HTTP/1.0" 404 15 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
220.181.7.76 - - [20/May/2010:11:42:35 +0100] "GET / HTTP/1.1" 200 26130 "-" "Baiduspider+(+http://www.baidu.com/search/spider.htm)"
67.195.114.50 - - [20/May/2010:11:42:58 +0100] "GET /post/274910/ HTTP/1.0" 404 15 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
68.59.242.134 - - [20/May/2010:10:43:14 +0000] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:43:14 +0100] "GET / HTTP/1.1" 200 26130 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:10:43:16 +0000] "GET /media/img/favicon.ico HTTP/1.1" 200 1406 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:10:44:14 +0000] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/posts/2/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:44:12 +0100] "GET /posts/2/ HTTP/1.1" 200 34408 "http://example.com/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
67.195.114.50 - - [20/May/2010:11:45:37 +0100] "GET /post/259342/ HTTP/1.0" 404 15 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
209.85.228.82 - - [20/May/2010:11:46:18 +0100] "GET /feeds/latest/ HTTP/1.1" 200 48364 "-" "FeedBurner/1.0 (http://www.FeedBurner.com)"
209.85.228.82 - - [20/May/2010:11:46:23 +0100] "GET /feeds/latest/ HTTP/1.1" 200 48364 "-" "FeedBurner/1.0 (http://www.FeedBurner.com)"
72.14.199.102 - - [20/May/2010:11:46:33 +0100] "GET /feeds/latest/ HTTP/1.1" 200 48364 "-" "Feedfetcher-Google; (+http://www.google.com/feedfetcher.html; 9 subscribers; feed-id=18260778798542229819)"
196.203.53.144 - - [20/May/2010:11:46:37 +0100] "GET /feeds/latest/ HTTP/1.0" 200 48364 "-" "Mozilla/5.0 (Windows; U; Windows NT 5.0; fr; rv:1.9.2.3) Gecko/20100401 Firefox/3.6.3"
68.59.242.134 - - [20/May/2010:10:46:43 +0000] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/posts/3/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:46:41 +0100] "GET /posts/3/ HTTP/1.1" 200 25865 "http://example.com/posts/2/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:48:13 +0100] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/posts/4/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:48:12 +0100] "GET /posts/4/ HTTP/1.1" 200 25930 "http://example.com/posts/3/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
66.249.65.42 - - [20/May/2010:11:48:14 +0100] "GET /posts/4/ HTTP/1.1" 200 25930 "-" "Mediapartners-Google"
66.249.65.40 - - [20/May/2010:11:48:37 +0100] "GET /post/274703/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
66.249.65.40 - - [20/May/2010:11:49:13 +0100] "GET /post/274704/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
68.59.242.134 - - [20/May/2010:10:49:54 +0000] "GET /media/style.css HTTP/1.1" 304 - "http://example.com/posts/5/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
68.59.242.134 - - [20/May/2010:11:49:52 +0100] "GET /posts/5/ HTTP/1.1" 200 29611 "http://example.com/posts/4/" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; InfoPath.2)"
66.249.65.42 - - [20/May/2010:11:49:54 +0100] "GET /posts/5/ HTTP/1.1" 200 29611 "-" "Mediapartners-Google"
66.249.65.40 - - [20/May/2010:11:50:18 +0100] "GET /post/274687/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
66.249.65.40 - - [20/May/2010:11:51:23 +0100] "GET /post/274716/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
66.249.65.40 - - [20/May/2010:11:52:29 +0100] "GET /post/274712/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
75.57.176.28 - - [20/May/2010:11:52:42 +0100] "GET /media/style.css HTTP/1.1" 200 4847 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
75.57.176.28 - - [20/May/2010:11:52:42 +0100] "GET / HTTP/1.1" 200 26130 "-" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
75.57.176.28 - - [20/May/2010:11:52:43 +0100] "GET /media/img/m-inact.gif HTTP/1.1" 200 2571 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
75.57.176.28 - - [20/May/2010:11:52:43 +0100] "GET /media/img/side-container.gif HTTP/1.1" 200 1415 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
75.57.176.28 - - [20/May/2010:10:52:42 +0000] "GET /media/exmpl.png HTTP/1.1" 200 28479 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
75.57.176.28 - - [20/May/2010:11:52:43 +0100] "GET /media/img/m-act.gif HTTP/1.1" 200 143 "http://www.example.com/" "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_8; en-us) AppleWebKit/531.22.7 (KHTML, like Gecko) Version/4.0.5 Safari/531.22.7"
66.249.65.40 - - [20/May/2010:11:53:34 +0100] "GET /post/274702/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
67.195.114.50 - - [20/May/2010:11:54:36 +0100] "GET /post/256204/ HTTP/1.0" 404 15 "-" "Mozilla/5.0 (compatible; Yahoo! Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)"
66.249.65.40 - - [20/May/2010:11:54:39 +0100] "GET /post/274873/ HTTP/1.1" 404 15 "-" "Mozilla/5.0 (compatible; Googlebot/2.1; +http://www.google.com/bot.html)"
```


3000
2500
2000
1500
1000
500
0

count

p50

p99

max

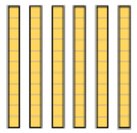
histogram

app

events

{ k: v }

column store



analytical queries

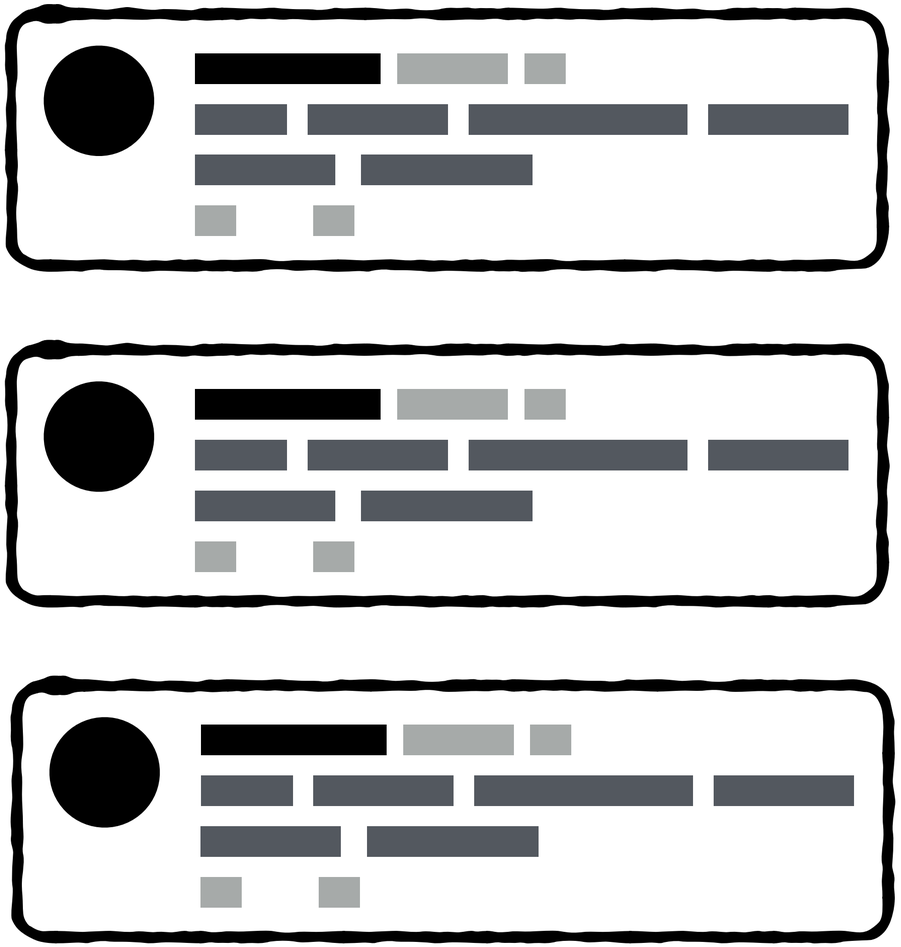
you are here

SELECT ...
GROUP BY

users

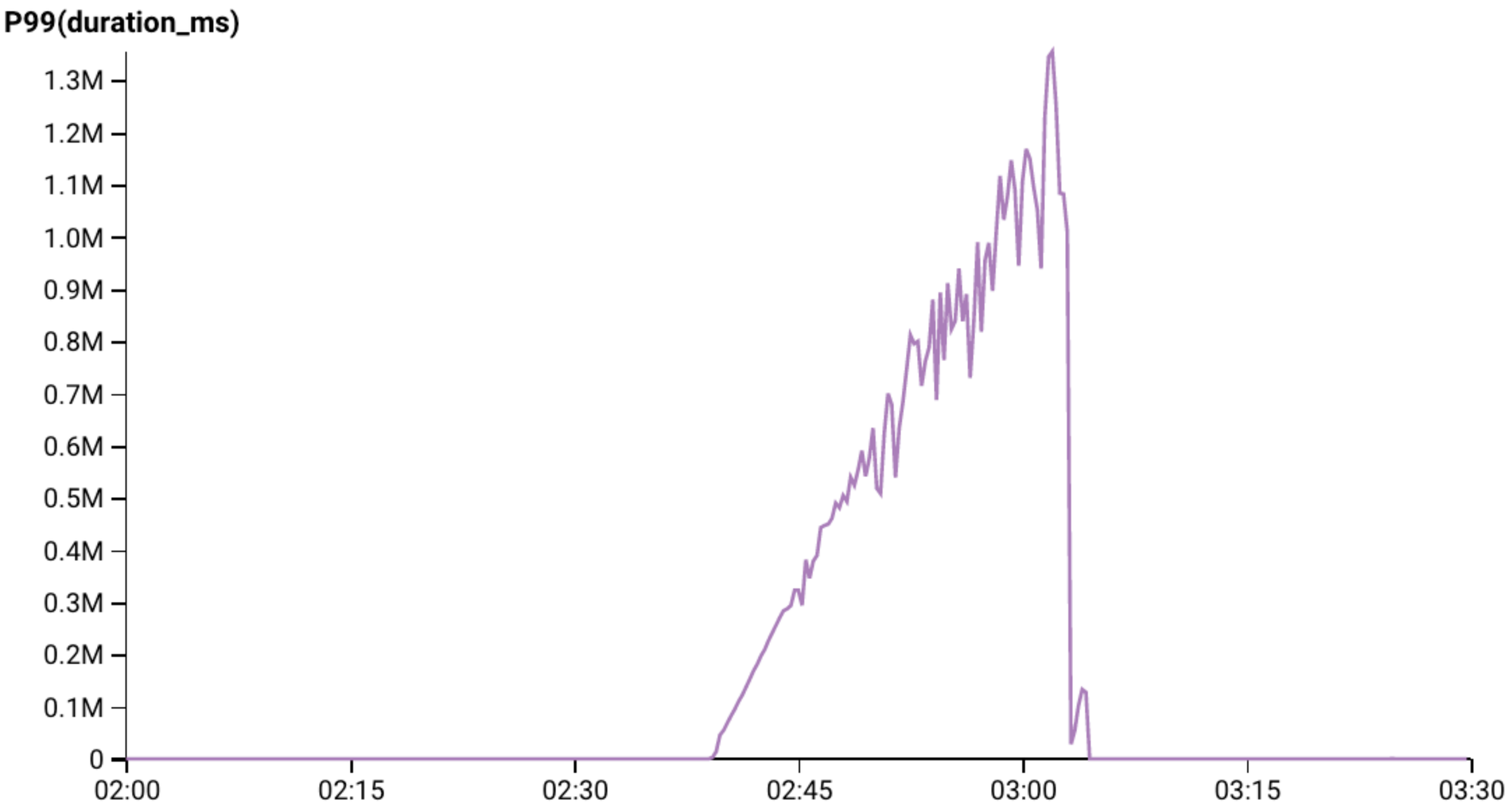
😊

prometheus and the problem with metrics



domaso

"it's slow"


P99(duration_ms)
1.3M
1.2M
1.1M
1.0M
0.9M
0.8M
0.7M
0.6M
0.5M
0.4M
0.3M
0.2M
0.1M
0
02:00
02:15
02:30
02:45
03:00
03:15
03:30

p99(request_latency)
> 1000ms

300 requests were slow

... which ones?!

group by

most monitoring questions are

✨ top-k 🥇

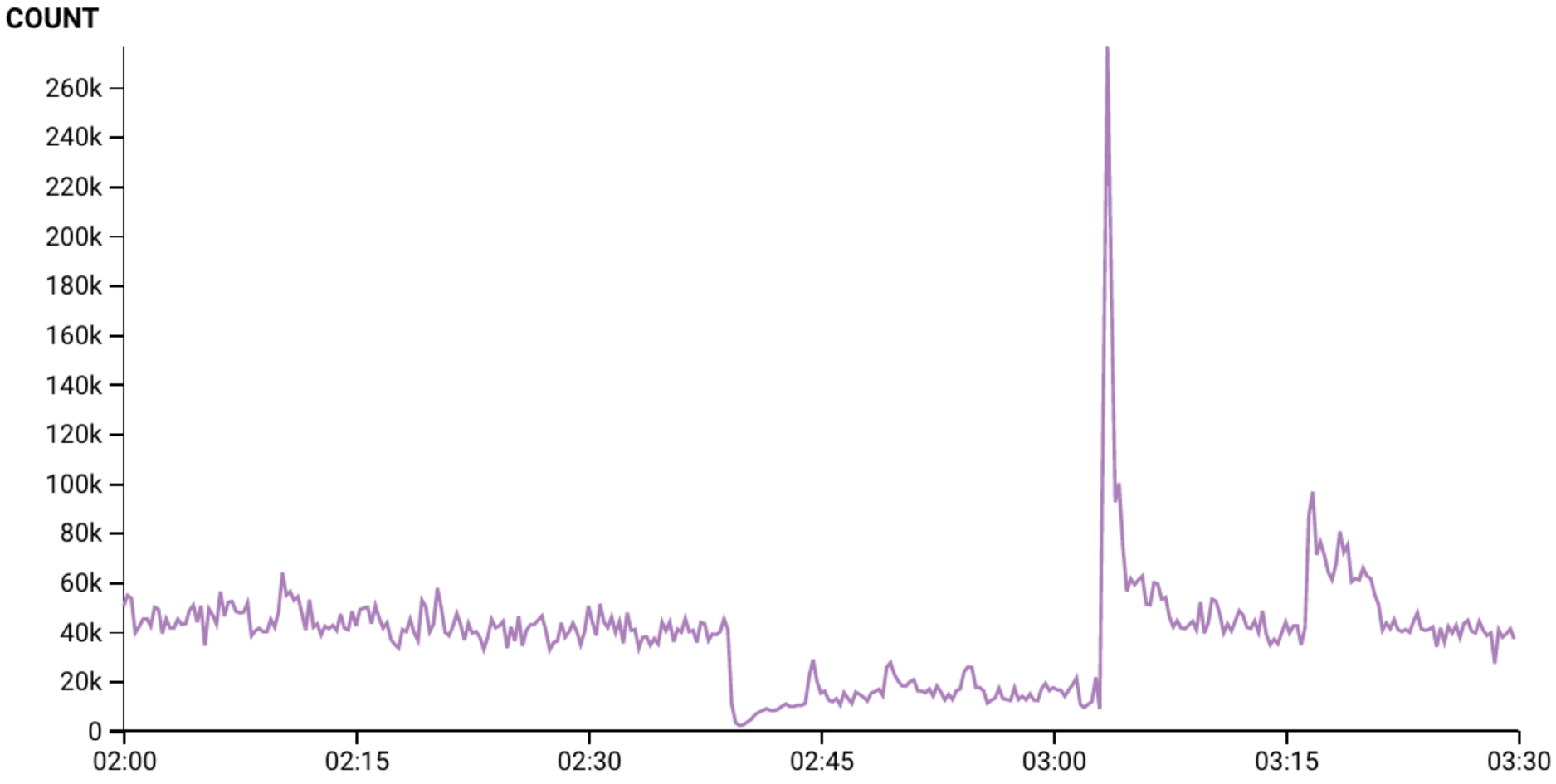
- 🏆 top traffic by IP address
- 🏆 top resource usage by customer
- 🏆 top latency by country
- 🏆 top error count by host
- 🏆 top request size by client

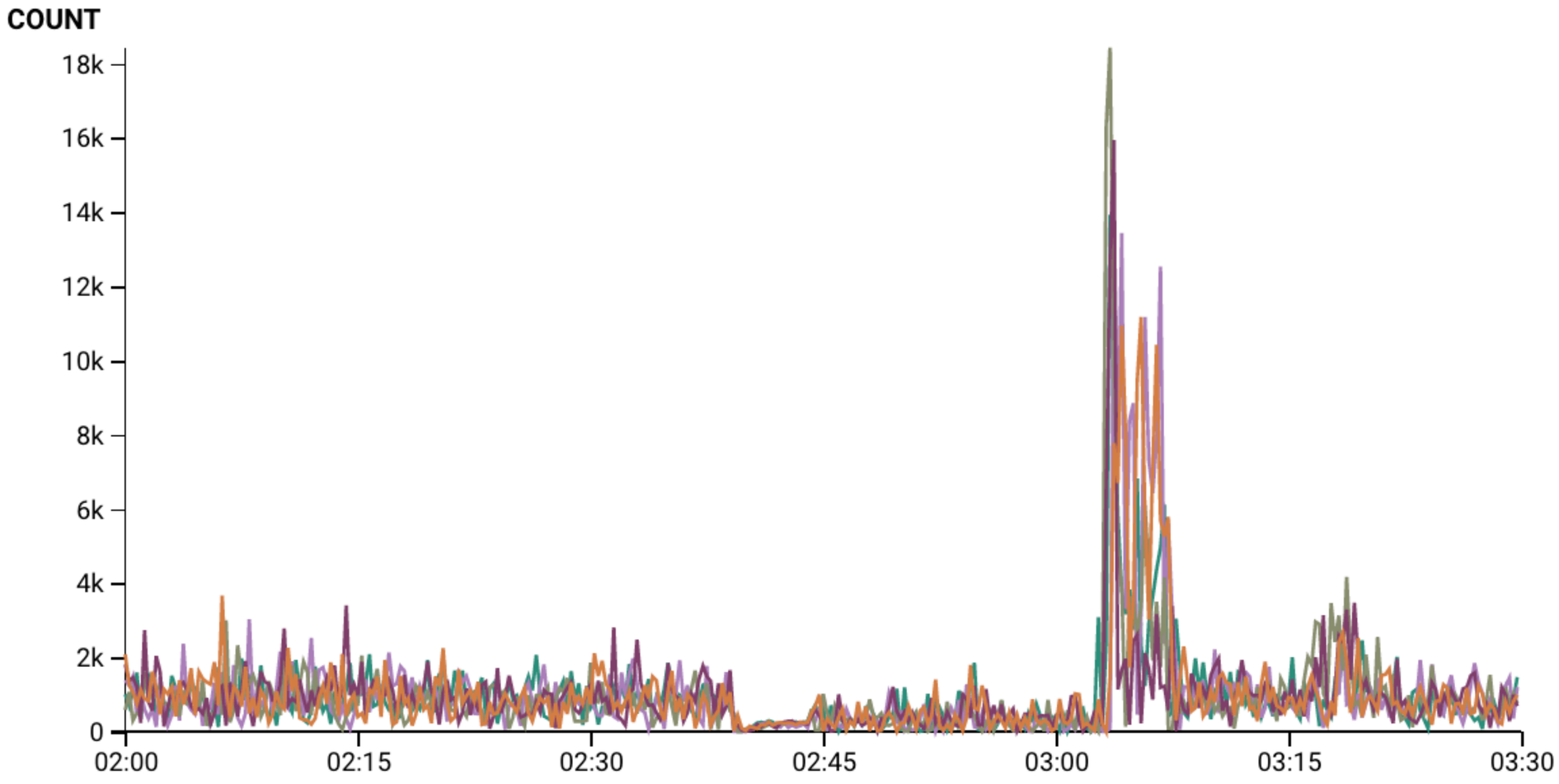
how many users
are impacted?

```
SELECT user_id, COUNT(*)
  FROM requests
 WHERE request_latency >= 1000
GROUP BY user_id
```

metrics will not
tell you this

✨ cardinality 🌙


COUNT
260k
240k
220k
200k
180k
160k
140k
120k
100k
80k
60k
40k
20k
0
02:00
02:15
02:30
02:45
03:00
03:15
03:30


COUNT
18k
16k
14k
12k
10k
8k
6k
4k
2k
0
02:00
02:15
02:30
02:45
03:00
03:15
03:30

```
http_requests_total{status=200}

http_requests_total{status=201}

http_requests_total{status=301}

http_requests_total{status=304}

...

http_requests_total{status=503}
```

10

`user_id` **10k**

100k

ip address space = 2^32

4 billion possible values

`kubectl get pods` **100**

build_id 100

the curse of dimensionality

```
{
  status         = 200
  method         = "GET"
  path           = ...
  host           = "i-123456af"
  zone           = "eu-central-1a"
  client_ip      = "10.2.3.4"
  user_agent     = "curl/7.54.0"
  client_country = "de"

  user_id        = 30032
  partition_id   = 31
  build_id       = "9045e1"
  customer_plan  = "platinum"
  endpoint       = "tweet_detail"
}
```

```
{
  status          = 200          10
  method          = "GET"        5
  path            = ...          300
  host            = "i-123456    20
  zone            = "eu-centr    5   a"
  client_ip       = "10.2.3.4    1k
  user_agent      = "curl/7.5    300 "
  client_country  = "de"         20

  user_id         = 30032        1k
  partition_id    = 31           32
  build_id        = "9045e1"     10
  customer_plan   = "platinum    3
  endpoint        = "tweet_de    20  "
}
```

10 × 5 × 300 × 20 × 5 ×

1k × 300 × 20 × 1k × 32 ×

10 × 3 × 20

= 172’800’000’000

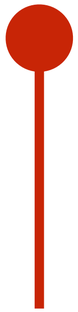
000’000’000 💥


TheUjulala

app

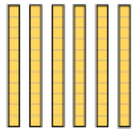
events

{ k: v }



you are here

column store



analytical queries

SELECT ...
GROUP BY

users

😊

recording events

Liz Fong-Jones (方禮真)
@lizthegrey

```
void do_rpc() {
  ...
  record_event({
    x: x,
    y:y,
    status: status,
    user: user,
    version: version,
    ...
  })
}
```

```
{
  time           = "1970-01-01T18:32:20"

  status         = 200
  method         = "GET"
  path           = ...
  host           = "i-123456af"
  region         = "eu-central-1"
  zone           = "eu-central-1a"
  client_ip      = "10.2.3.4"
  user_agent     = "curl/7.54.0"
  client_country = "de"
  kernel         = "5.0.0-1018-aws"

  user_id        = 30032
  tweet_id       = 2297111098
  partition_id   = 31
  build_id       = "9045e1"
  request_id     = "f2a3bdc4"
  customer_plan  = "platinum"
  feature_blub   = true
  cache          = "miss"
  endpoint       = "tweet_detail"

  request_dur_ms = 325
  db_dur_ms      = 5
  db_pool_dur_ms = 3
  db_query_count = 63
  cache_dur_ms   = 2
  svc_a_dur_ms   = 32
  svc_b_dur_ms   = 90
  request_bytes  = 2456
  response_bytes = 5324
}
```

```
{
  time           = "1970-01-01T18:32:20"

  status         = 200
  method         = "GET"
  path           = ...
  host           = "i-123456af"
  region         = "eu-central-1"
  zone           = "eu-central-1a"
  client_ip      = "10.2.3.4"
  user_agent     = "curl/7.54.0"
  client_country = "de"
  kernel         = "5.0.0-1018-aws"
}
```

```
{
  user_id          = 30032
  tweet_id         = 2297111098
  partition_id     = 31
  build_id         = "9045e1"
  request_id       = "f2a3bdc4"
  customer_plan    = "platinum"
  feature_blub     = true
  cache            = "miss"
  endpoint         = "tweet_detail"
}
```

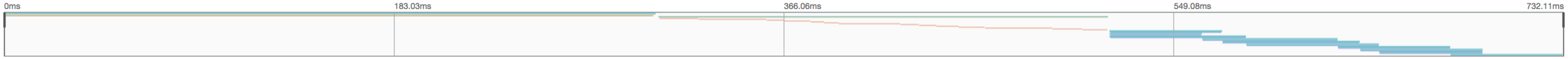
```
{
  request_dur_ms = 325
  db_dur_ms      = 5
  db_pool_dur_ms = 3
  db_query_count = 63
  cache_dur_ms   = 2
  svc_a_dur_ms   = 32
  svc_b_dur_ms   = 90
  request_bytes  = 2456
  response_bytes = 5324
}
```

Jaeger UI | Lookup by Trace ID... | Search | Dependencies | About Jaeger

frontend: HTTP GET /dispatch

Search... | View Options

Trace Start: **July 20, 2018 2:48 PM** | Duration: **732.11ms** | Services: **6** | Depth: **5** | Total Spans: **51**

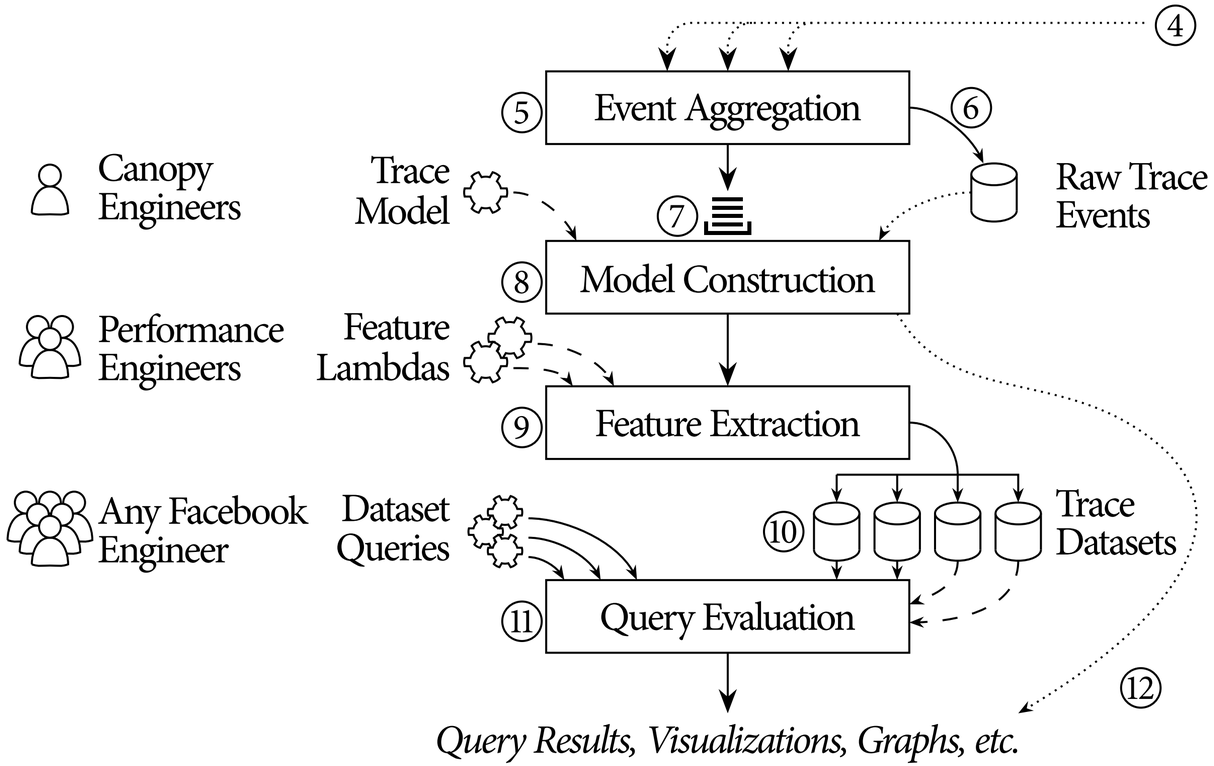


Service & Operation	Duration
frontend HTTP GET /dispatch	
frontend HTTP GET: /customer	305.89ms
frontend HTTP GET	305.88ms
customer HTTP GET /customer	304.46ms
mysql SQL SELECT	304ms
frontend Driver::findNearest	211.15ms
driver Driver::findNearest	210.78ms
redis FindDriverIDs	18.23ms
redis GetDriver	32ms
redis GetDriver	8.17ms
redis GetDriver	12.34ms
redis GetDriver	6.24ms
redis GetDriver	6.96ms
redis GetDriver	28.81ms
redis GetDriver	8.77ms
redis GetDriver	8.12ms
redis GetDriver	10.49ms
redis GetDriver	12.4ms
redis GetDriver	31.63ms
redis GetDriver	14.02ms
redis GetDriver	11.72ms
frontend HTTP GET: /route	52.92ms
frontend HTTP GET	52.89ms
route HTTP GET /route	52.08ms
frontend HTTP GET: /route	43.45ms
frontend HTTP GET	43.44ms
route HTTP GET /route	42.48ms
frontend HTTP GET: /route	64.18ms
frontend HTTP GET	64.15ms
route HTTP GET /route	63.48ms
frontend HTTP GET: /route	63.67ms
frontend HTTP GET	63.65ms
route HTTP GET /route	63.36ms

Jaeger, Uber

traces vs events:
a false dichotomy

we can derive events
from traces



Canopy, Facebook

Canopy: An End-to-End Performance Tracing And Analysis System

Jonathan Kaldor[†] Jonathan Mace[*] Michał Bejda[†] Edison Gao[†] Wiktor Kuropatwa[†]
Joe O'Neill[†] Kian Win Ong[†] Bill Schaller[†] Pingjia Shan[†] Brendan Viscomi[†]
Vinod Venkataraman[†] Kaushik Veeraraghavan[†] Yee Jiun Song[†]

[†]Facebook [*]Brown University

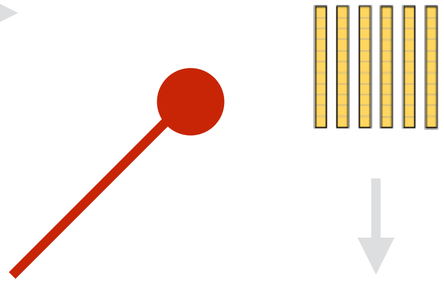
stick those events in kafka

app

events

{ k: v }

column store



analytical queries

SELECT ...
GROUP BY

users

😊

columnar storage changed my life

Table 2.3: Latency numbers that every WSC engineer should know. (Updated version of table from [Dea09].)

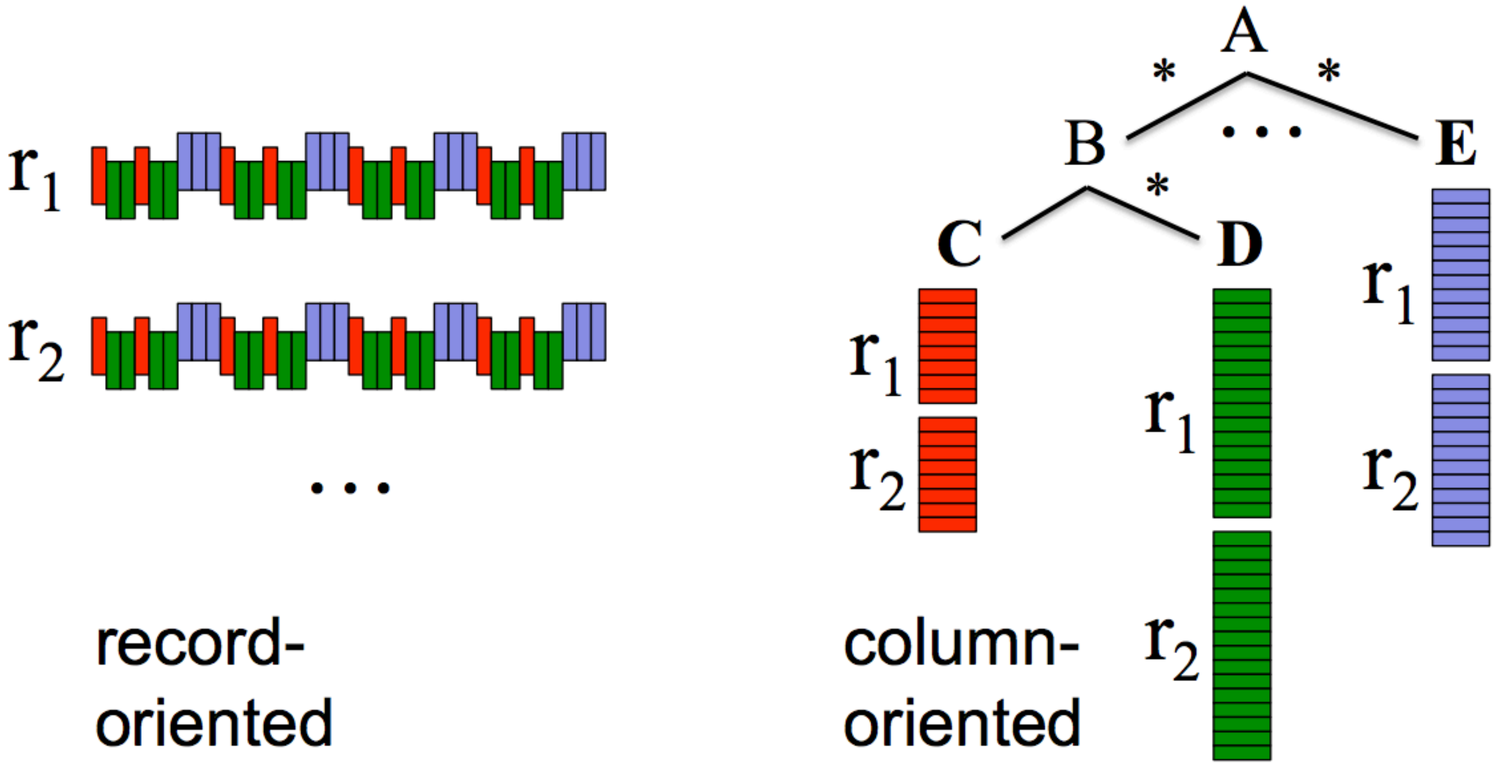
Operation	Time
L1 cache reference	1.5 ns
L2 cache reference	5 ns
Branch misprediction	6 ns
Uncontended mutex lock/unlock	20 ns
L3 cache reference	25 ns
Main memory reference	100 ns
Decompress 1 KB with Snappy [Sna]	500 ns
"Far memory"/Fast NVM reference	1,000 ns (1us)
Compress 1 KB with Snappy [Sna]	2,000 ns (2us)
Read 1 MB sequentially from memory	12,000 ns (12 us)
SSD Random Read	100,000 ns (100 us)
Read 1 MB bytes sequentially from SSD	500,000 ns (500 us)
Read 1 MB sequentially from 10Gbps network	1,000,000 ns (1 ms)
Read 1 MB sequentially from disk	10,000,000 ns (10 ms)
Disk seek	10,000,000 ns (10 ms)
Send packet California→Netherlands→California	150,000,000 ns (150 ms)

- 1TB Hitachi Deskstar 7K1000
  - disk seek time = 14ms
  - transfer rate = 69MB/s
- 62.5 billion rows (= 1TB / 16 bytes)
- 28 years (= 62.5 billion rows * 14 ms/row / 32×10^9 ms/year)

- 1TB Hitachi Deskstar 7K1000
  - transfer rate = 69MB/s
- 4 hours (= 1.000.000MB / 69MB/s / 3600 s/hour)

- SSD
  - transfer rate = 1GB/s
- 15 minutes (= 1.000GB / 1GB/s / 60 s/min)

10GB



Dremel: Interactive Analysis of Web-Scale Datasets, Google

10 GB / 8 bytes per data point

= 1.3 billion

events

status
200
200
200
200
404
200
200
200
404
200

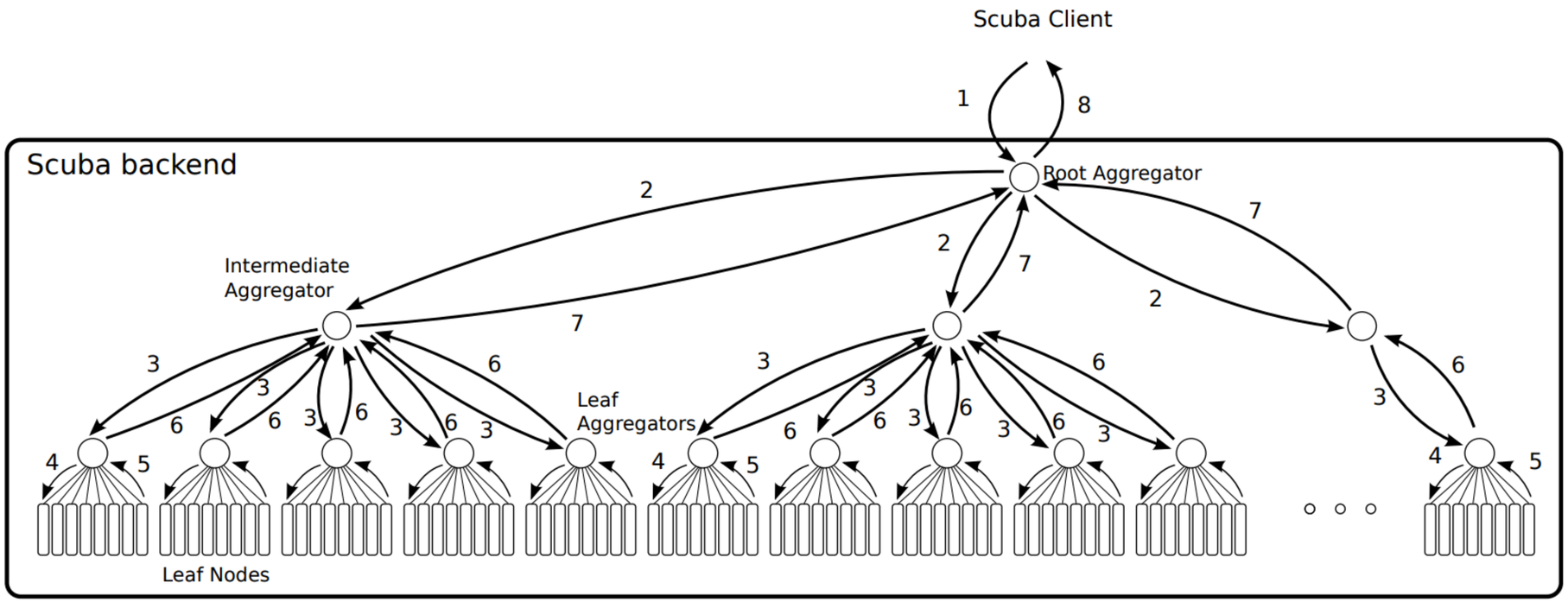
status
4 * 200
404
3 * 200
404
200

time-based partitioning

dynamic sampling

it's lossy, but that's fine

vectorized processing



Scuba: Diving into Data at Facebook, Facebook

sequential scans

✖

columnar layout

✖

time-based partitioning

✖

compression / sampling

✖

vectorized processing

✖

sharding

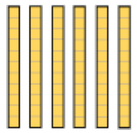
putting it all together

app

events

{ k: v }

column store



analytical queries

SELECT ...
GROUP BY

users

😊

we need more of this
in the **monitoring** space!

```
   SELECT user_id, COUNT(*)
     FROM requests
    WHERE status >= 500
GROUP BY user_id
ORDER BY COUNT(*) DESC
    LIMIT 10
```

✨ top-k 🥇

✨ cardinality 🌙

✨ events 🎆

Dremel: Interactive Analysis of Web-Scale Datasets

Sergey Melnik, Andrey Gubarev, Jing Jing Long, Geoffrey Romer,
Shiva Shivakumar, Matt Tolton, Theo Vassilakis
Google, Inc.
{melnik,andrey,jlong,gromer,shiva,mtolton,theov}@google.com

Scuba: Diving into Data at Facebook

Lior Abraham*
Vinayak Borkar
Daniel Merl
Subbu Subramanian
John Allen
Bhuwan Chopra
Josh Metzler
Janet L. Wiener
Oleksandr Barykin
Ciprian Gerea
David Reiss
Okay Zed
Facebook, Inc. Menlo Park, CA

- Dremel: Interactive Analysis of Web-Scale Datasets from Google, 2010
- Scuba: Diving into Data at Facebook from Facebook, 2016
- Canopy: An End-to-End Performance Tracing And Analysis System from Facebook, 2017
- Look at Your Data by John Rauser, Velocity 2011
- Observability for Emerging Infra by Charity Majors, Strange Loop 2017
- Why We Built Our Own Distributed Column Store by Sam Stokes, Strange Loop 2017
- The Design and Implementation of Modern Column-Oriented Database Systems by Abadi et al, 2013
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- Monitoring in the time of Cloud Native by Cindy Sridharan, 2017
- Logs vs. metrics: a false dichotomy by Nick Stenning, 2019
- Using Canonical Log Lines for Online Visibility by Brandur Leach, 2016
- The Datacenter as a Computer: Designing Warehouse-Scale Machines by Barroso et al, 2018

hi@igor.io

@igorwhilefalse