ENDPOINT VISIBILITY WITH OSQUERY AND LOKI

WHO WE ARE

GEORGE ADAMS IV & ED WELCH

USE CASE

DETECTING SSH CONNECTIONS AND ALERTING.

FOLLOW ALONG

https://github.com/geowa4/learn-loki

OSQUERY

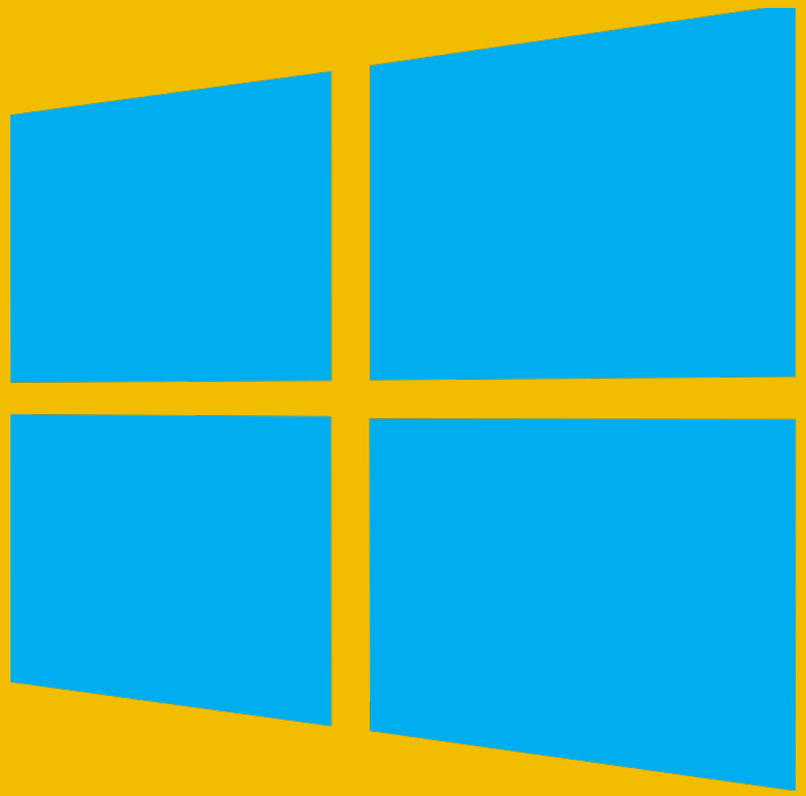
RELEASED BY FACEBOOK IN 2014

```
commit 73a32b729403b2f5a7c204b0f7cfb86fdfdd0a85
Author: mike@arpaia.co <mike@arpaia.co>
Date:   Wed Jul 30 17:35:19 2014 -0700

    Initial commit
```

OSQUERY

WORKS ON MY MACHINE



OSQUERY

SQL INTERFACE TO YOUR ENDPOINTS

```
.schema processes

CREATE TABLE processes(
  `pid` BIGINT, `name` TEXT, `path` TEXT, `cmdline` TEXT,
  `disk_bytes_read` BIGINT, `disk_bytes_written` BIGINT,
  ...
  PRIMARY KEY (`pid`)
) WITHOUT ROWID;
```

OSQUERY

```
select max(disk_bytes_read), pid, name, cmdline, cwd from processes;

+----------------------+------+------+---------+---------------+
| max(disk_bytes_read) | pid  | name | cmdline | cwd           |
+----------------------+------+------+---------+---------------+
| 10465280             | 5478 | bash | -bash   | /vagrant/demo |
+----------------------+------+------+---------+---------------+
```

OSQUERY

```
select p.name, l.port, l.protocol
from processes p inner join listening_ports l on p.pid = l.pid
where p.name = 'VBoxHeadless' and l.port <> 0;
```

```
+--------------+------+----------+
| name         | port | protocol |
+--------------+------+----------+
| VBoxHeadless | 3000 | 6        |
| VBoxHeadless | 3100 | 6        |
| VBoxHeadless | 9080 | 6        |
| VBoxHeadless | 9090 | 6        |
| VBoxHeadless | 2222 | 6        |
+--------------+------+----------+
```

OSQUERY

```
select c.name, p.port, p.host_port
from docker_containers c inner join docker_container_ports p
on c.id = p.id;
```

```
+--------------------+------+-----------+
| name               | port | host_port |
+--------------------+------+-----------+
| /demo_loki_1       | 80   | 0         |
| /demo_loki_1       | 3100 | 3100      |
| /demo_grafana_1    | 3000 | 3000      |
| /demo_prometheus_1 | 9090 | 9090      |
| /demo_promtail_1   | 9080 | 9080      |
+--------------------+------+-----------+
```

OSQUERY - LAST SCHEMA

```
.schema last
```

```
CREATE TABLE last(
  `username` TEXT, `time` INTEGER, `host` TEXT,
  `pid` INTEGER, `tty` TEXT, `type` INTEGER
);
```

OSQUERY - LAST QUERY

```
select * from last;
```

```
+----------+------+------+------+------------+-------------------+
| username | tty  | pid  | type | time       | host              |
+----------+------+------+------+------------+-------------------+
| reboot   | ~    | 0    | 2    | 1566866107 | 4.15.0-52-generic |
| runlevel | ~    | 53   | 1    | 1566866118 | 4.15.0-52-generic |
|          | ttyS0| 859  | 5    | 1566866119 |                   |
| LOGIN    | ttyS0| 859  | 6    | 1566866119 |                   |
|          | tty1 | 879  | 5    | 1566866119 |                   |
| LOGIN    | tty1 | 879  | 6    | 1566866119 |                   |
| vagrant  | pts/0| 5396 | 7    | 1566869034 | 10.0.2.2          |
| vagrant  | pts/1| 6465 | 7    | 1566870878 | 10.0.2.2          |
|          | pts/1| 6465 | 8    | 1566870880 |                   |
| vagrant  | pts/1| 6571 | 7    | 1566870886 | 10.0.2.2          |
|          | pts/1| 6571 | 8    | 1566870910 |                   |
+----------+------+------+------+------------+-------------------+
```

OSQUERY - PACKS

```
{
  "queries": {
    "last": {
      "query": "select * from last;",
      "interval": "60",
      "platform": "posix",
      "version": "1.4.5",
      "description": "..."
    }
  }
}
```

OSQUERY - DECORATORS

```
{
  "decorators": {
    "load": [
      "SELECT uuid AS host_uuid FROM system_info;",
      "SELECT user AS username FROM logged_in_users ORDER BY time DESC LIMIT 1;"
    ]
  }
}
```

OSQUERY - RESULTS

/var/log/osquery/osqueryd.results.log


```
{
  "name": "pack_incident-response_last",
  "hostIdentifier": "ubuntu-bionic",
  "calendarTime": "Tue Aug 27 01:55:13 2019 UTC",
  "decorations": {
    "host_uuid": "2401CCE9-23EA-4D4D-8C84-D5C8437EBE15",
    "username": "vagrant"
  },
  "columns": {
    "host": "10.0.2.2",
    "pid": "6465",
    "time": "1566870878",
    "tty": "pts/1",
    "type": "7",
    "username": "vagrant"
  },
  "action": "added"
}
```

OSQUERY - RECAP

IT'S BEEN AROUND A WHILE

CROSS-PLATFORM

IT'S JUST SQL

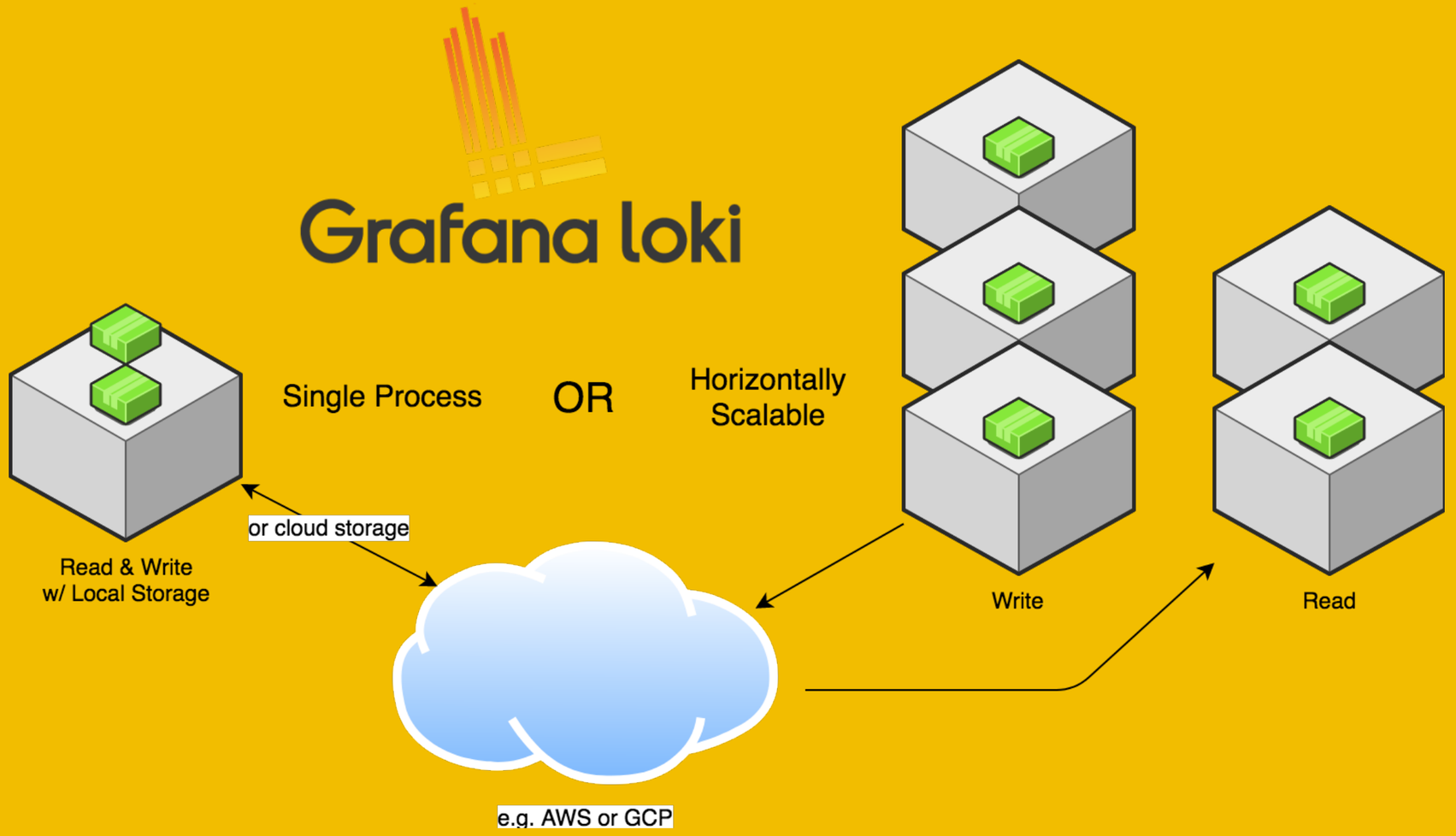
SCHEDULE QUERIES WITH "PACKS"

LOKI

PROMETHEUS-INSPIRED LOGGING FOR CLOUD NATIVES.

MADE BY GRAFANA

LOKI


Grafana loki
Single Process
OR
Horizontally
Scalable
Read & Write
w/ Local Storage
or cloud storage
Write
Read
e.g. AWS or GCP

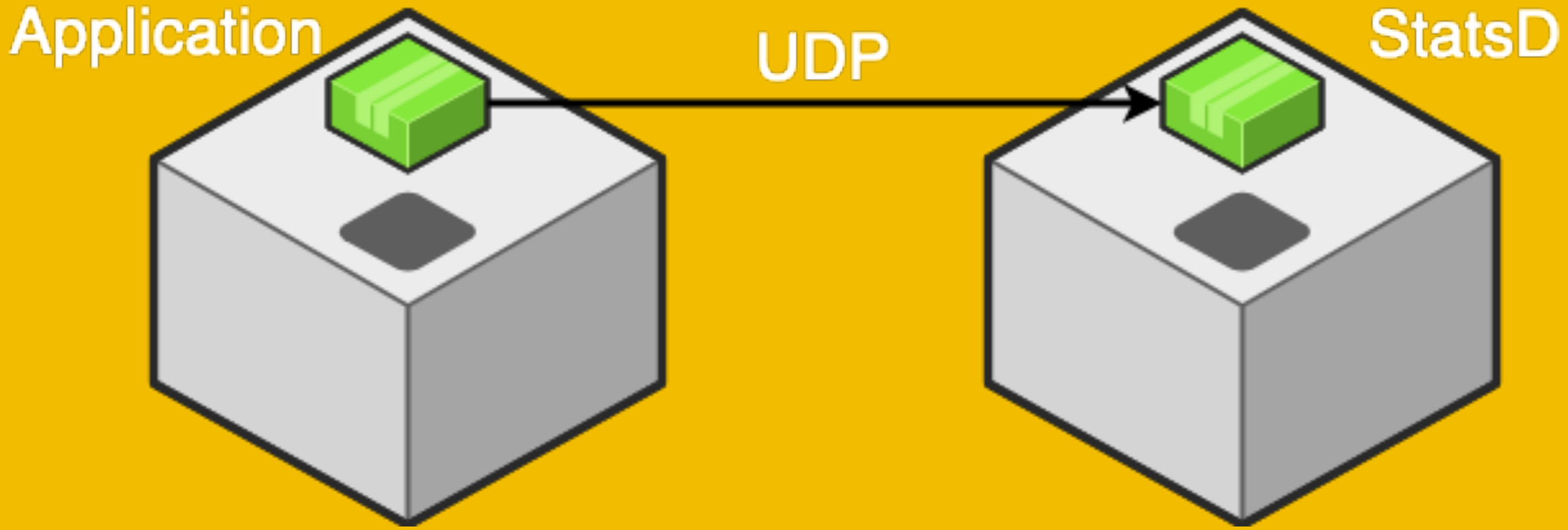
PROMETHEUS

FIRST A LITTLE BACKGROUND ON PROMETHEUS:

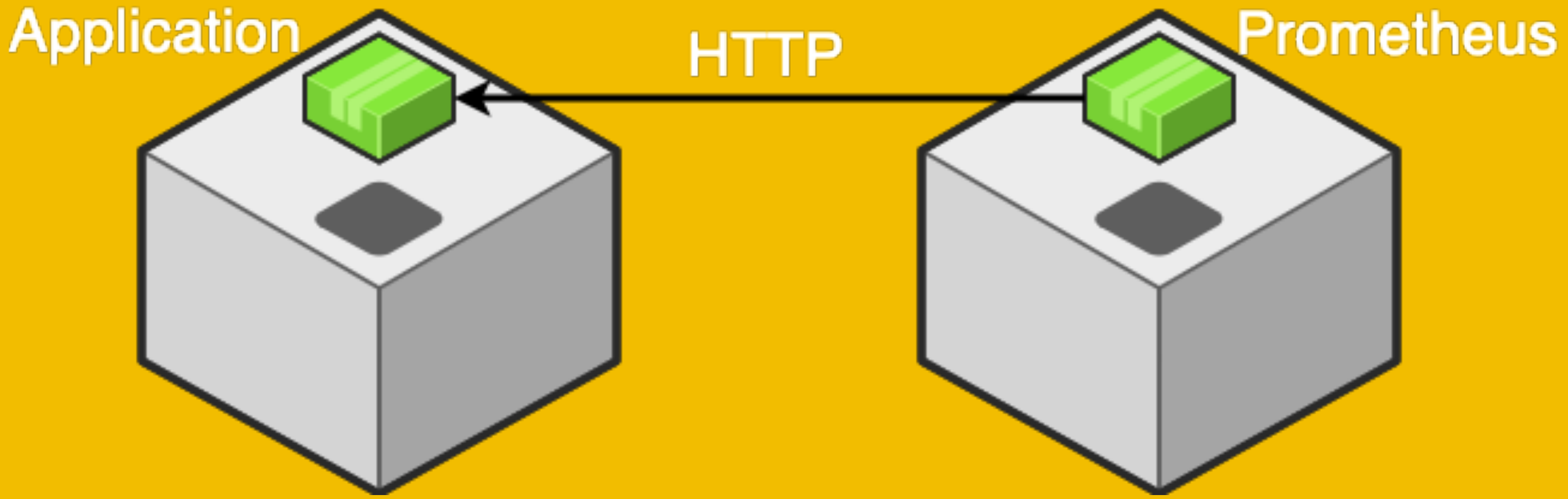
A TIME-SERIES METRIC COLLECTION, STORAGE AND QUERYING APPLICATION.

PROMETHEUS - PUSH

STATSD



PROMETHEUS - PULL



PROMETHEUS - TIME-SERIES

QUERYABLE VIA PROMQL

```
sum by (instance) rate(http_requests_total{cluster="us-central1",app="loki"}[5m])
increase(promtail_custom_last_logins{name="pack_incident-response_last"}[5m])
```

PROMETHEUS - SCRAPING

```
scrape_configs:
  - job_name: "promtail"
    static_configs:
      - targets:
          - promtail:9080
```

PROMETHEUS - DATA STRUCTURE

METRICS HAVE LABELS IN ADDITION TO VALUES.

```
rss_attendance_total{track="tech", talk="osquery_loki"} 30
sum(rss_attendance_total{track="tech"}) 100
```

LOKI - DATA STRUCTURE

LOG ENTRIES HAVE LABELS, TOO.

```
{track="tech", talk="osquery_loki"} "best talk ever"
{track="tech", talk="osquery_loki"} "i want to know more"
{track="tech", talk="osquery_loki"} "i hear that one guy runs rocdev"
```

LOKI - STORAGE

{component="printer",location="f2c16",level="error"} "Printing is not supported by this printer"

Label key/values hashed to form Stream ID: 3b2cea09797978fc

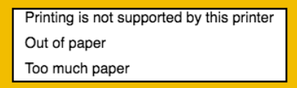
The log entry is added to a "chunk"

Additional log messages with the same labels are added to the same "chunk":

{component="printer",location="f2c16",level="error"} "Out of paper"
{component="printer",location="f2c16",level="error"} "Too much paper"

Chunks are filled then compressed and stored:

Printing is not supported by this printer
Out of paper
Too much paper



A separate and small index is kept to lookup chunks

Different label keys or values will hash to a different stream and different chunk:

{component="printer",location="f2c16",**level="info"**} "Consider the environment before printing this log message"

fd9a709ddf43a93a

LOKI - QUERY

LOGQL

LABEL MATCHING (REDUCES CHUNKS LOADED FOR QUERIES):

- `{name=~"mysql.+"}`
- `{name!~"mysql.+"}`

LOKI - FILTERING

grep AND grep -v

- `{job="mysql"} |= "error"`
- `{name="kafka"} |~ "tsdb-ops.*io:2003"`
- `{instance=~"kafka-[23]",name="kafka"} != kafka.server:type=ReplicaManager`
- `{job="mysql"} |= "error" != "timeout"`

LOKI - AGGREGATIONS

PROMQL STYLE AGGREGATIONS (`wc -l`) OR MORE COMPLICATED THINGS LIKE RATE

- `count_over_time({job="mysql"}[5m])`
- `rate(( {job="mysql"} |= "error" != "timeout)[10s] ))`

LOKI - ONE MORE NOTE ON LABELS

CONSISTENT LABELING BETWEEN METRICS IN PROMETHEUS AND LOGS IN LOKI ALLOW SWITCHING BACK AND FORTH BETWEEN METRICS AND LOGS FREELY.

LOKI - COLLECTION

PROMTAIL

PROMTAIL

FORWARDS LOGS
AND
EXTRACTS METRICS

PROMTAIL - SCRAPING

```
clients:
  - url: http://loki:3100/api/prom/push
scrape_configs:
  - job_name: osquery
    static_configs:
      - targets:
          - localhost
        labels:
          job: osquery_results
          __path__: /var/log/osquery/osqueryd.results.log
```

PROMTAIL - RESULT REMINDER


```
{
  "name": "pack_incident-response_last",
  "hostIdentifier": "ubuntu-bionic",
  "calendarTime": "Thu Aug 29 03:01:37 2019 UTC",
  "unixTime": 1567047697,
  "epoch": 0,
  "counter": 115,
  "decorations": {
    "host_uuid": "661449FD-E11A-462B-9EA9-63A3EE8F9BDC",
    "username": "vagrant"
  },
  "columns": {
    "host": "10.0.2.2",
    "username": "vagrant",
    "type": "7",
    "time": "1567047680",
    "tty": "pts/1",
    "pid": "7404"
  },
  "action": "added"
}
```

PROMTAIL - PIPELINES

```
pipeline_stages:
  - json:
      expressions:
        timestamp: unixTime
        name: name
  - timestamp:
      source: timestamp
      format: Unix
  - labels:
      name: name
```

PROMTAIL - METRICS

```
pipeline_stages:
  - ...
  - metrics:
      last_logins:
        type: Counter
        description: count last logins
        source: name
        config:
          value: pack_incident-response_last
          action: inc
```

PROMTAIL - PROMETHEUS

```
scrape_configs:
  - job_name: "promtail"
    static_configs:
      - targets:
          - promtail:9080
```

WHERE WE ARE NOW

OSQUERY PRODUCING RESULTS

PROMTAIL FORWARDING TO LOKI

QUERY AND TAIL LOGS IN LOKI

PROMTAIL EXTRACTING METRICS

PROMETHEUS SCRAPING PROMTAIL

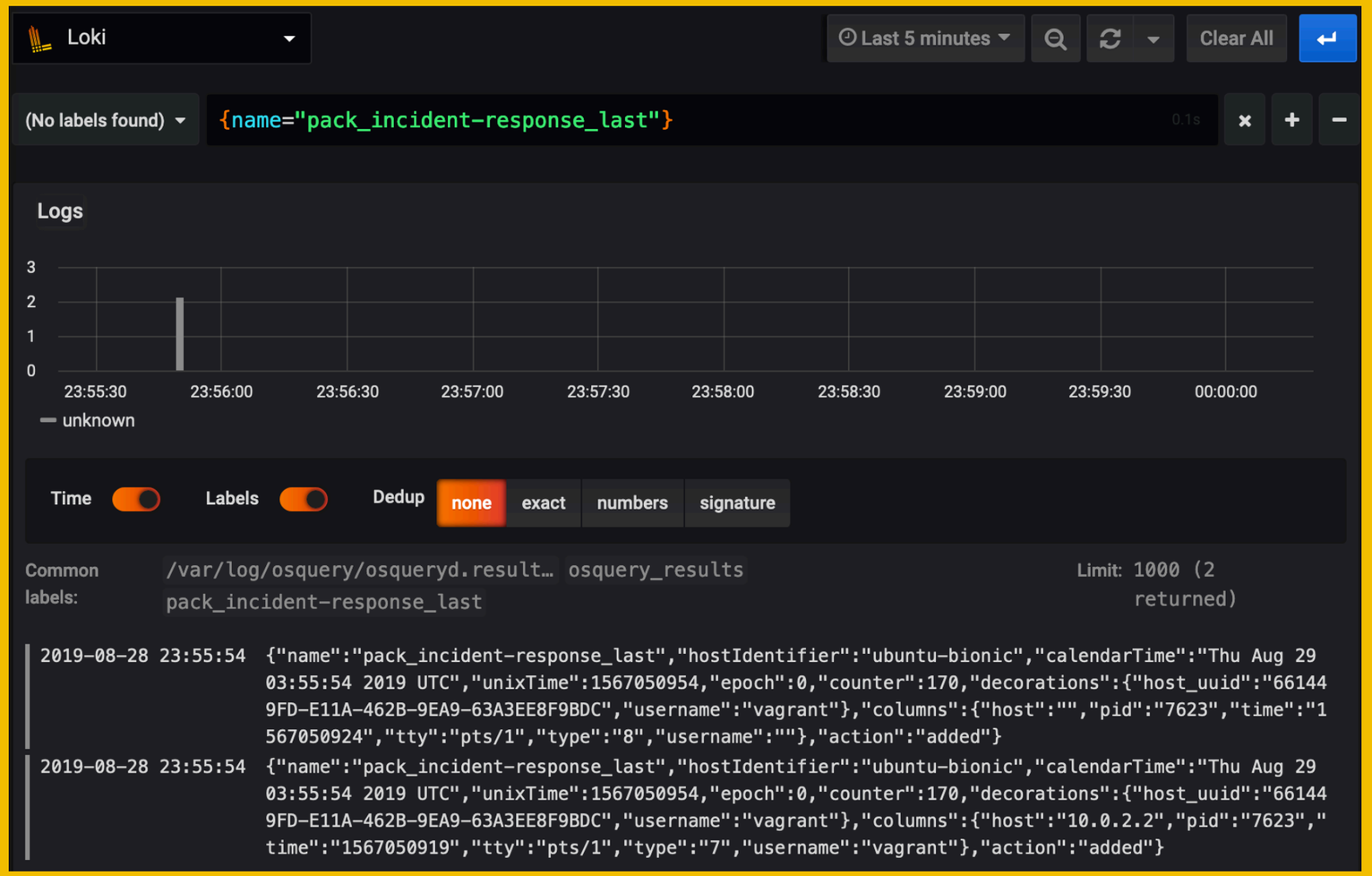
WHAT'S LEFT

CHARTING & ALERTING

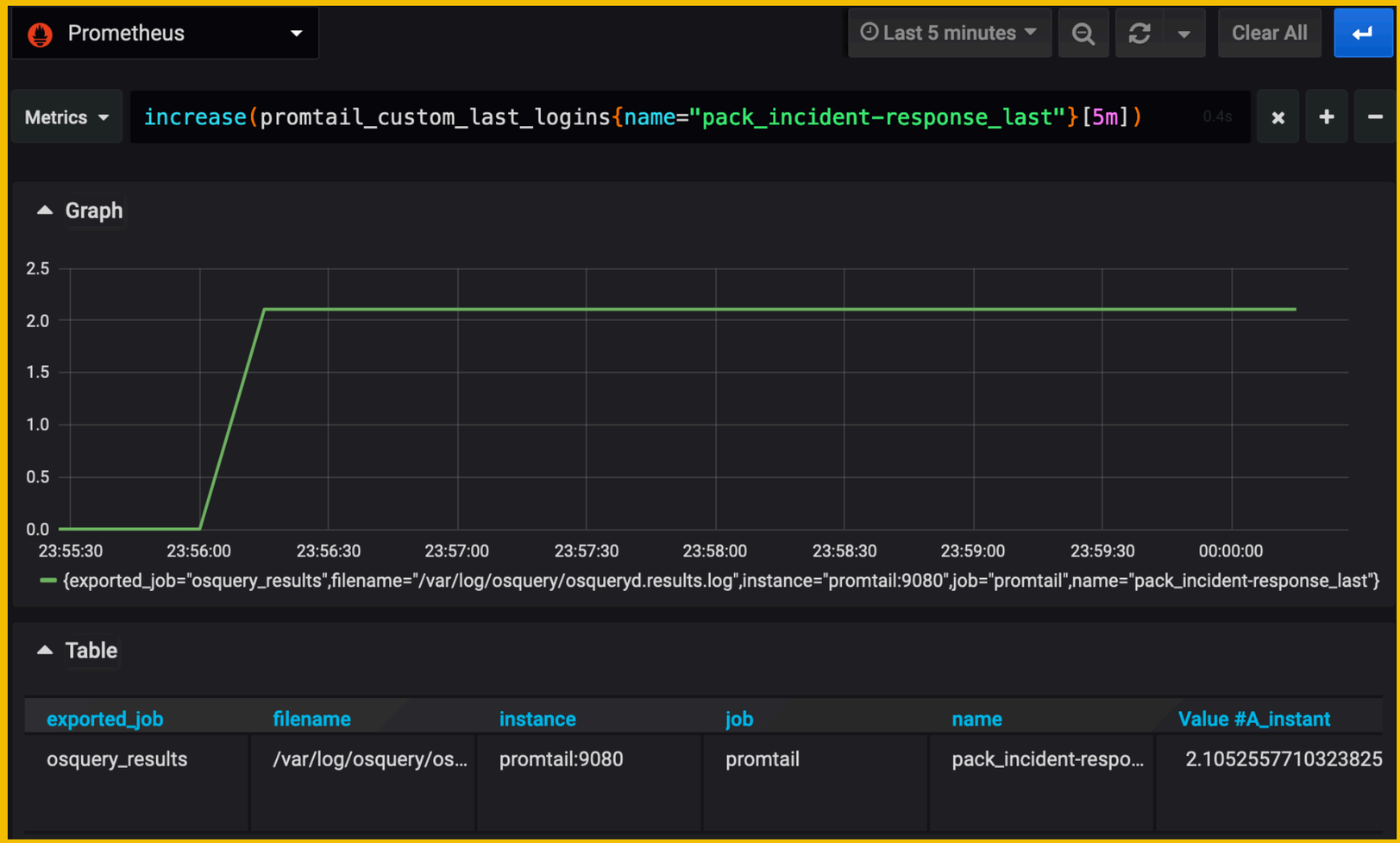
GRAFANA

SUPPORTS BOTH PROMTHEUS AND LOKI AS DATA SOURCES

GRAFANA - LOKI

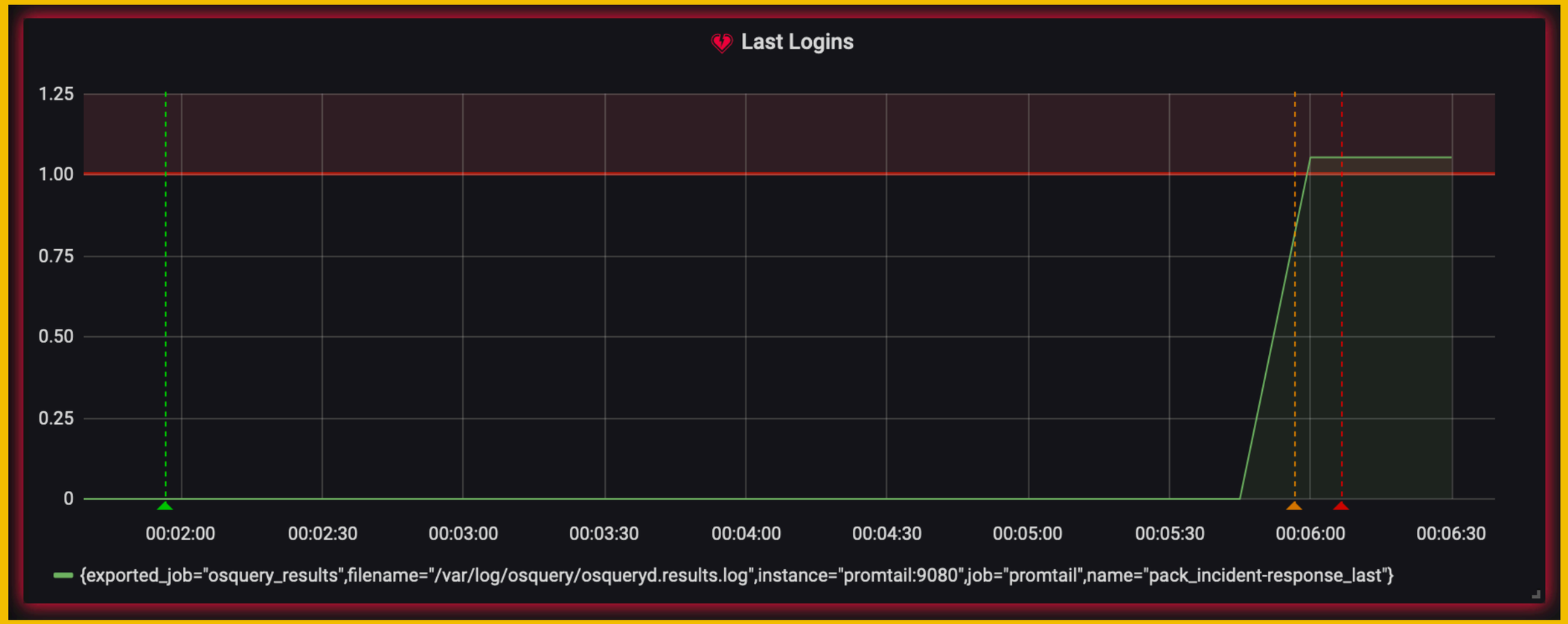


GRAFANA - PROMETHEUS

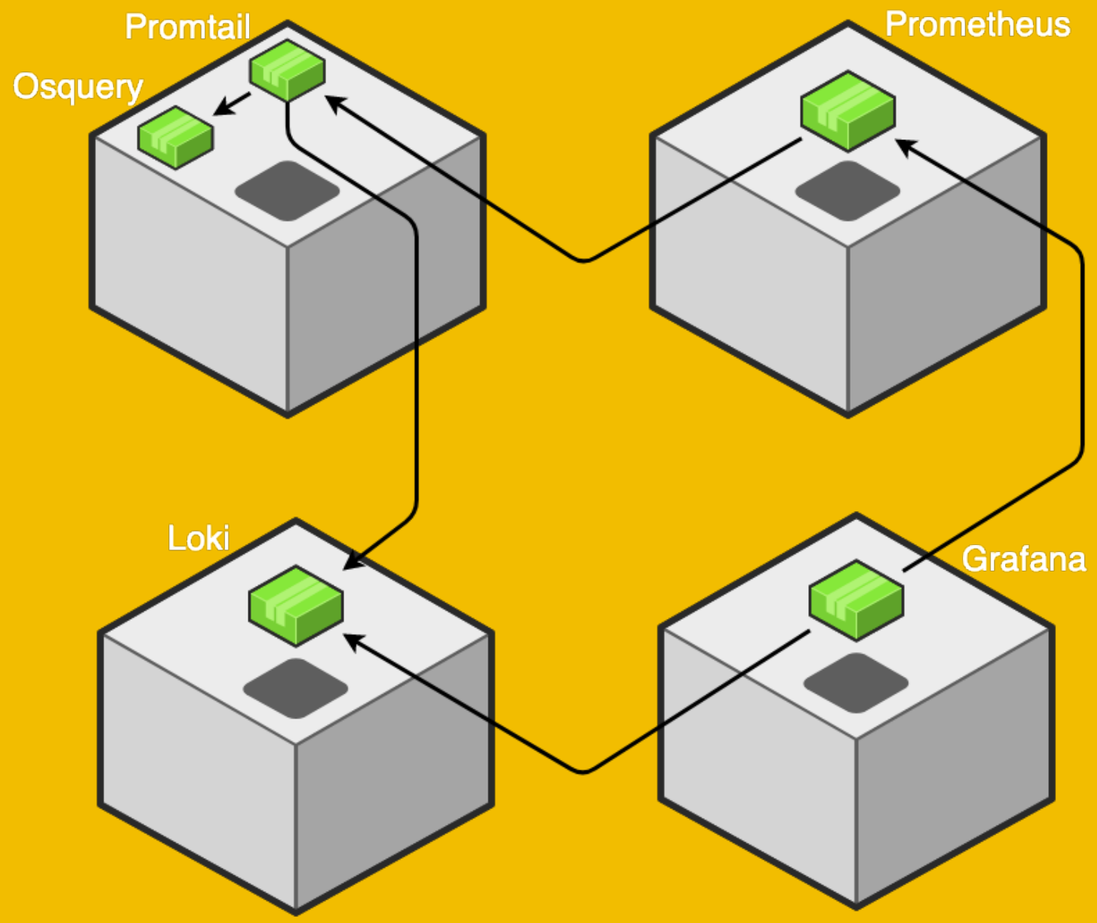


GRAFANA - ALERTING

```
increase(promtail_custom_last_logins{name="pack_incident-response_last"}[5m])
```



PUTTING IT ALL TOGETHER



LINKS & THINGS

- OSQUERY
- LOKI
- PROMETHEUS