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Cloud native monitoring with Prometheus

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Talk overview

Cloud native monitoring with Prometheus

Índice

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1. Prometheus

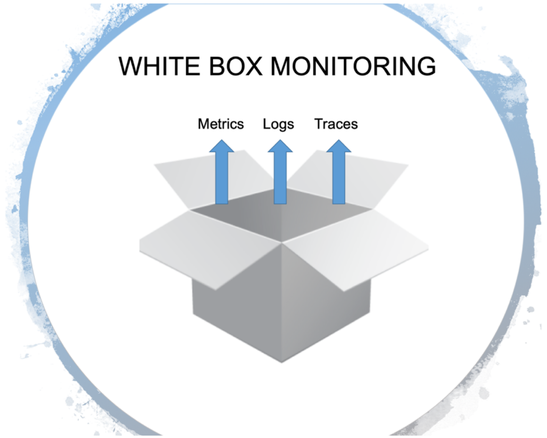
Monitoring from the way we used to, to cloud-native world

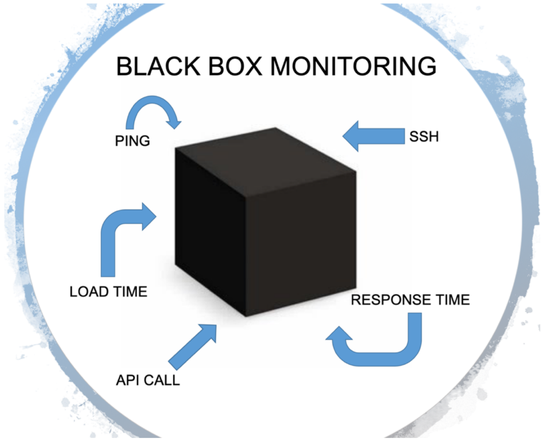
1.1 Monitoring

What do we understand for monitoring?

Ensure both systems and applications works as they should.

- Automatic or manual monitoring systems.
- Blackbox or Whitebox systems.





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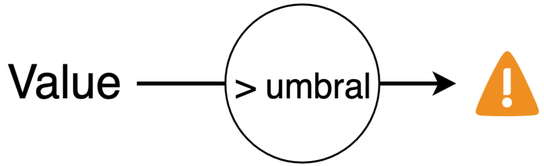
1.2 Monitoring systems space

Well known monitoring systems

We used to ensure the system health based on some basic checks available such as:

- CPU load
- Memory use
- Disk use
- Network use



Monitoring systems with this behaviour:

- Nagios (1999)
- Sensu

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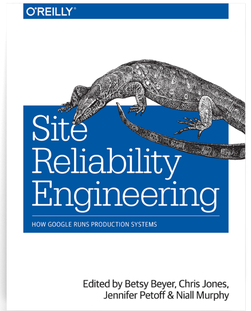
1.2 Monitoring systems space

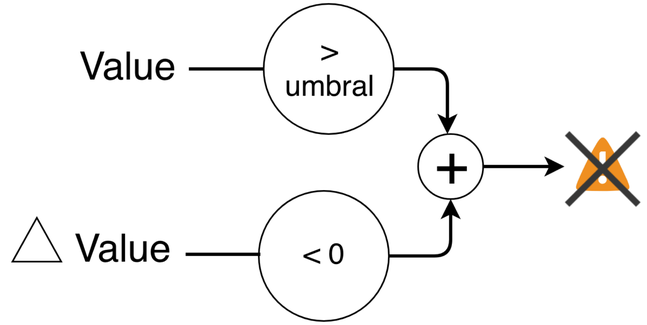
Today necessities

Today must-have metrics we should be obtaining out of any system (RED method):

- **R**equest rate
- **E**rror rate
- **D**uration, response time (Latency)



Monitoring systems metrics based:
- Graphite
- Prometheus



Allow alerts based on more complex queries and correlate data:

High CPU System A	High Error Rate System B
High Duration	High Request Rate

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1.2 Monitoring systems space

Observability

- know when **things go wrong**
- Be able to **debug** and gain **insight**

- Trending to see changes over time, and **drive** technical/business **decisions**
- **Feed** into **other systems** (QA, security, automation, ...)

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1.2 Monitoring systems space

Working with metrics

In order to get metrics of the system or app insight:

- **Logs** based metrics
- Specific **metrics** systems

Even being able to graph same events with both, they **complement** and are used for specific goals.

Logs always have higher **computational cost**, so correlations and complex queries made with metrics would be preferable.

```
x.x.x.90 - - [13/Sep/2006:07:01:53 -0700] "PROPFIND /svn/[xxxx]/Extranet/branches/SOW-101 HTTP/1.1" 401 587
x.x.x.90 - - [13/Sep/2006:07:01:51 -0700] "PROPFIND /svn/[xxxx]/[xxxx]/trunk HTTP/1.1" 401 587
x.x.x.90 - - [13/Sep/2006:07:00:53 -0700] "PROPFIND /svn/[xxxx]/[xxxx]/2.5 HTTP/1.1" 401 587
x.x.x.90 - - [13/Sep/2006:07:00:53 -0700] "PROPFIND /svn/[xxxx]/Extranet/branches/SOW-101 HTTP/1.1" 401 587
```

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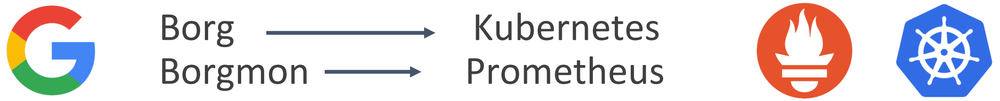
1.3 Prometheus

The Development History of this instrumentation and monitoring stack.



- Inspired by Google's Borgmon monitoring system.
- **Started in 2012** by ex-Googlers working in Soundcloud as an **open source** project
- Mainly written in **Go**.
- Publicly **launched** in early **2015**
- Today continues to be independent of any company.
- K8s and Prometheus, along with envoy are the only three **graduated CNCF projects.**

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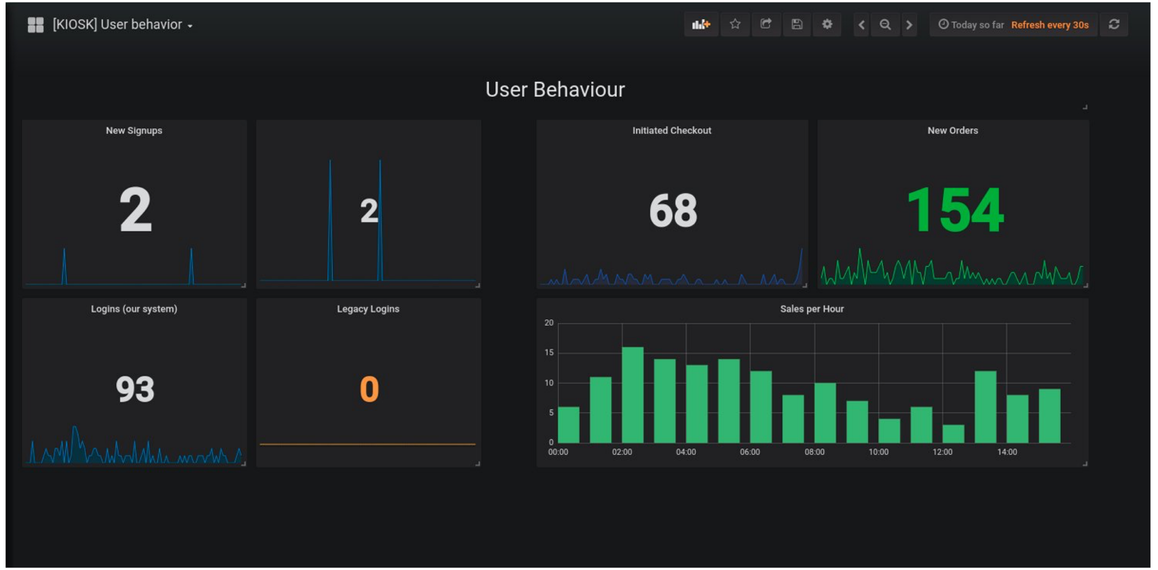
1.3 Prometheus

Why Prometheus?

It has knowledge about what the world should look like (which endpoints should exists, what time series means trouble, ..) and actively tries to find faults.

- Whitebox: Instrumenting applications and systems.
- Metrics based: **gaining insights** both systems and **business**.
- Manageable and Reliable
- Advanced service discovery
- Efficient: single server can handle millions of metrics, hundreds of thousands of datapoints per second
- Scalable
- Easy to integrate with
- ….



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1.3 Prometheus

Becoming the standard

Prometheus metrics:

- Databases
- Hardware related
- Messaging systems
- Storage
- HTTP
- APIs
- Logging
- ....

Official exporters:

Native:

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1.3 Prometheus

Becoming the standard

Open Metrics Project

- Standard based on prometheus exposign format.
- Exploit metrics beyond Prometheus.
- Accepted by **Cloud Native Computing Foundation**. Sandbox (early-stage project) Mars 2018.
- Aims to bring useful metrics to cloud-native deployments
- At its core, is an effort to develop a neutral metrics exposition format.
- Define an **efficient way to transport the metrics over the wire**, and a flexible way to attach information to them: label sets.

OPEN METRICS

An effort to create an open standard for transmitting metrics at scale, with support for both text representation and Protocol buffers.

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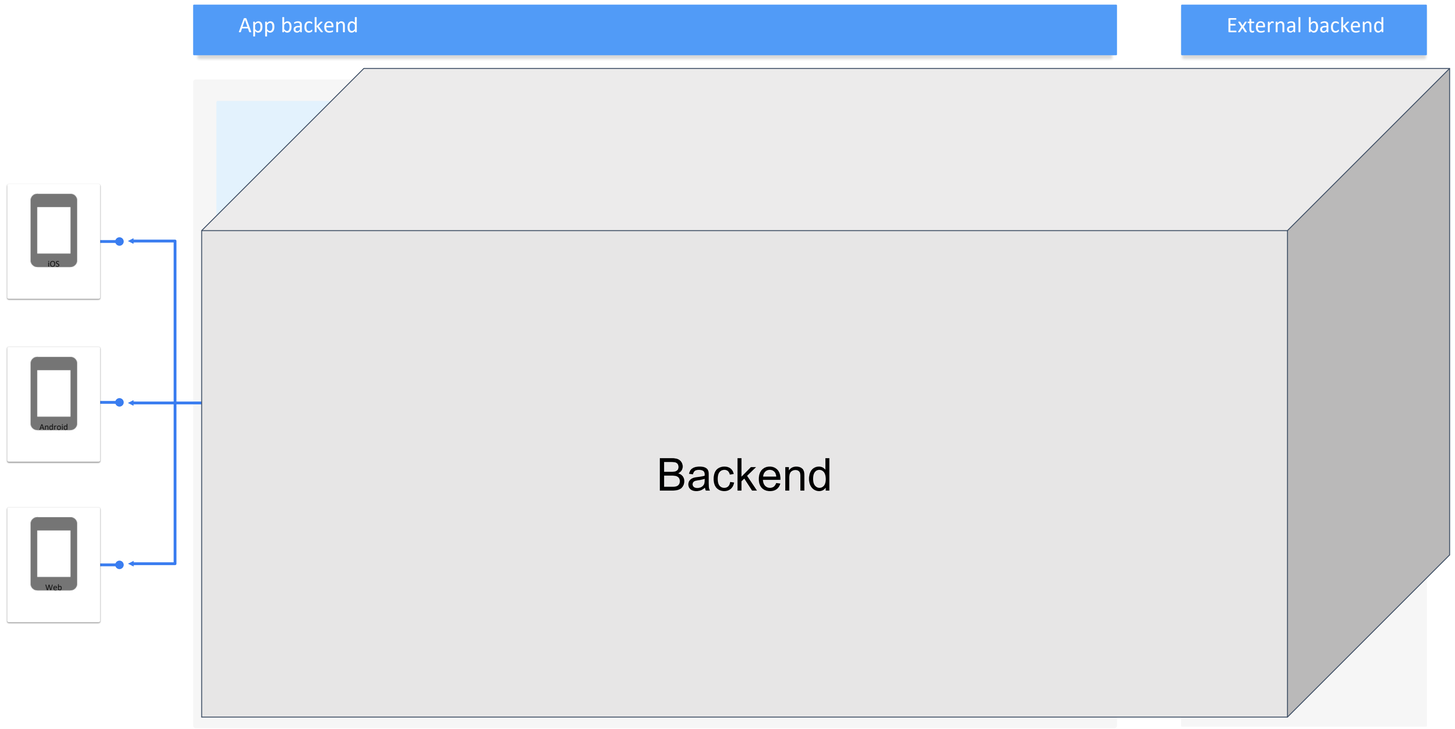
1.4 Cloud-native monitoring

Microservices observability



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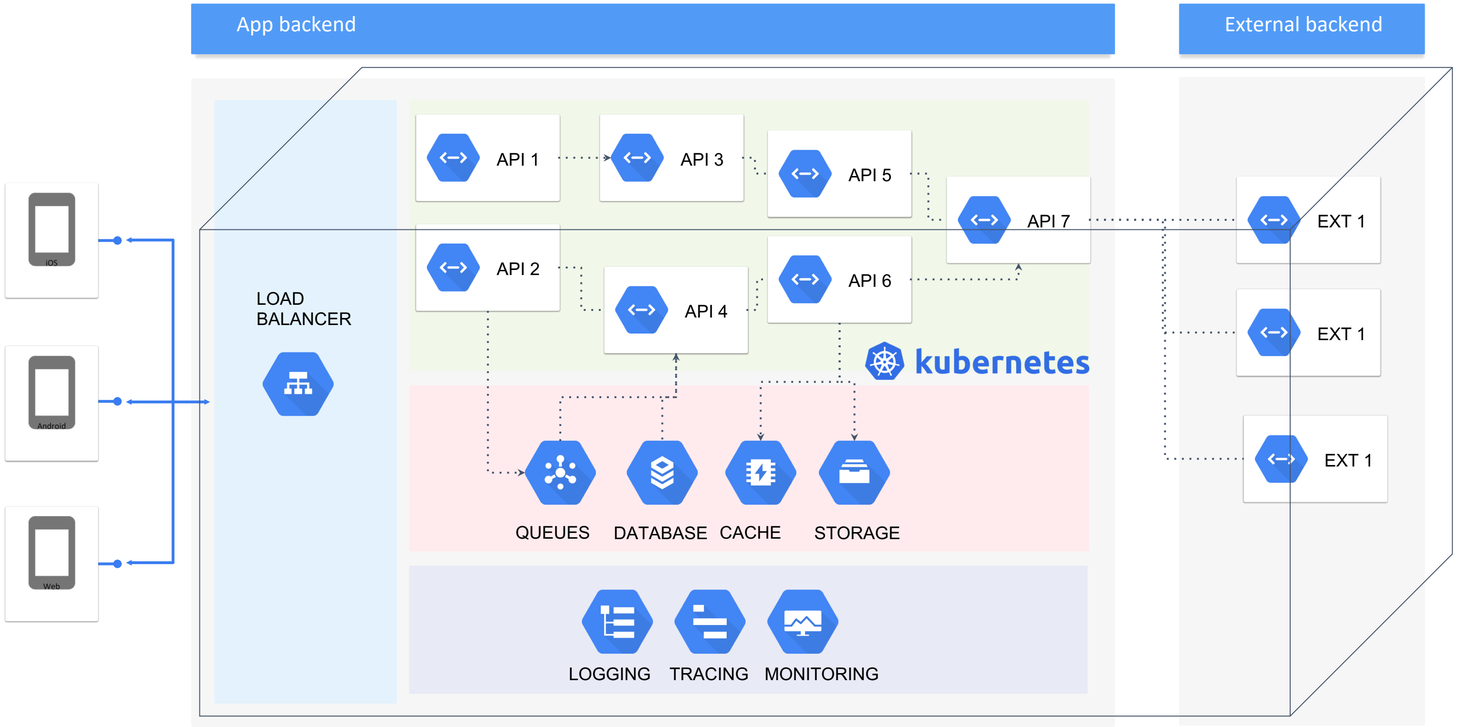
1.4 Cloud-native monitoring

Microservices observability



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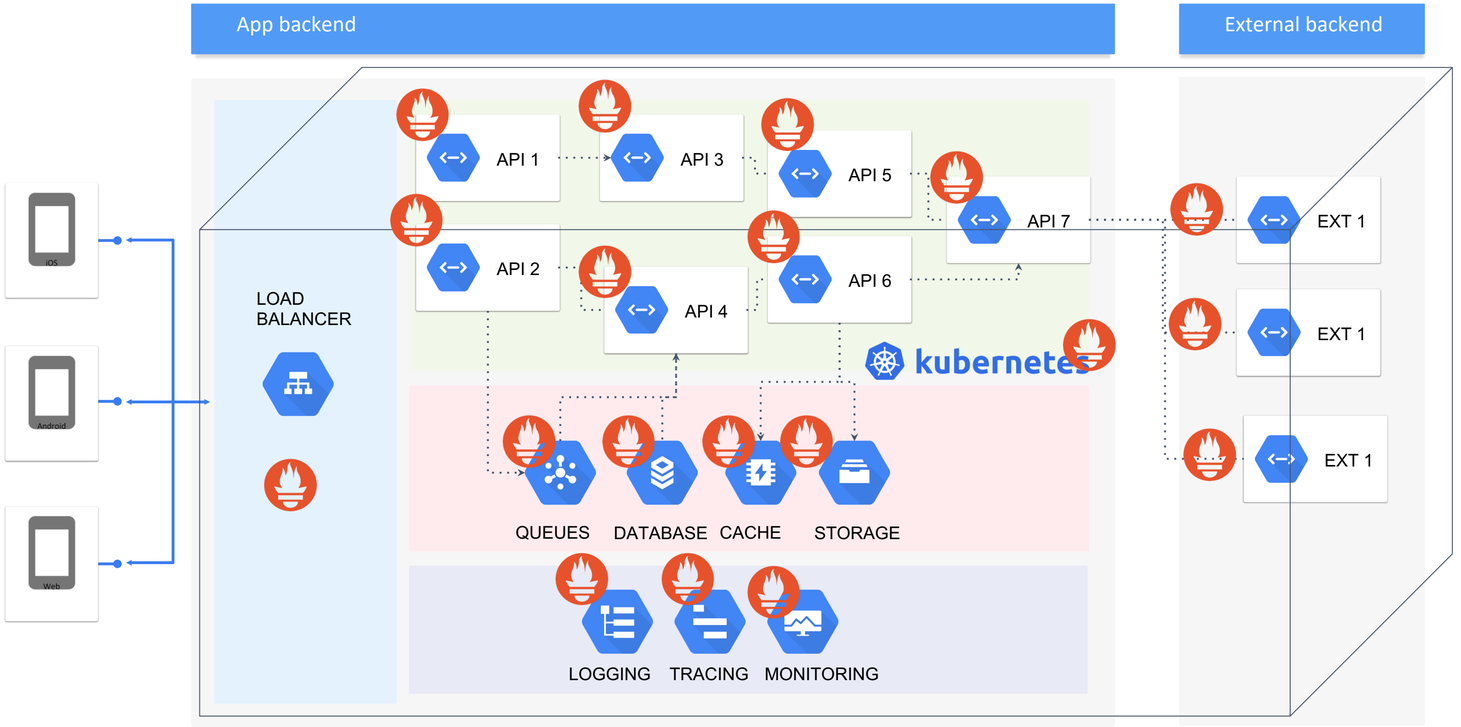
1.4 Cloud-native monitoring

Microservices observability

Prometheus



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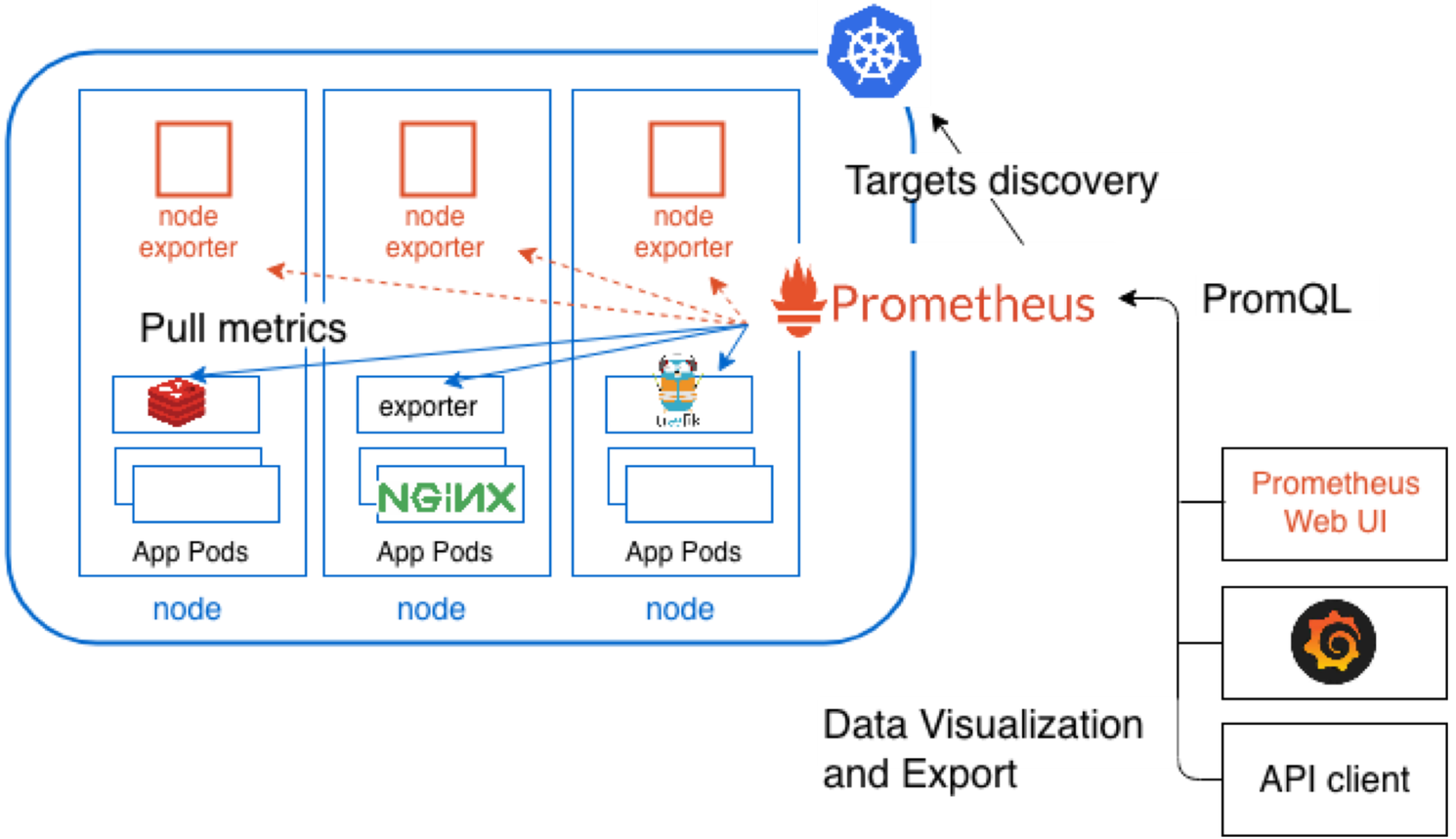
2. Monitoring systems and applications

Metrics, scraping, querying, graphing, prometheus-native apps



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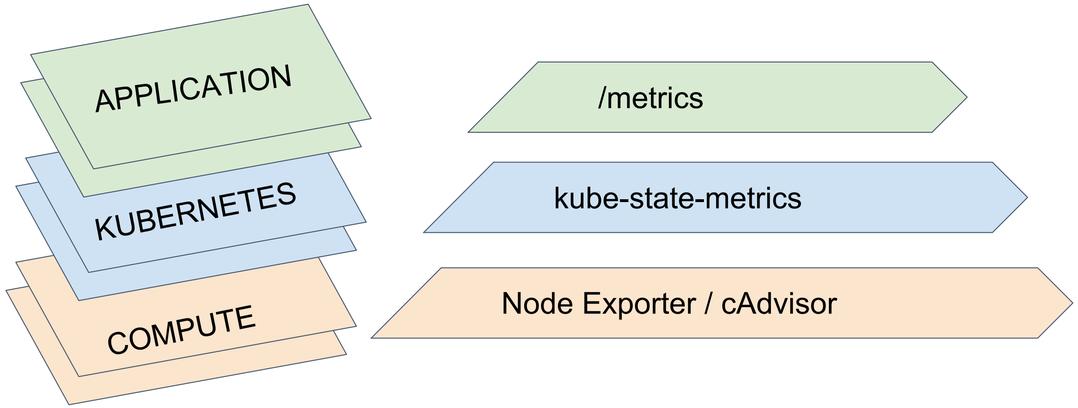
2.1 Monitoring systems

Available exporters

- node-exporter (Prometheus)
- kube-state-metrics (Kubernetes)
- cadvisor (Google)
- Docker daemon (Docker)



node-exporter metrics

arp, boottime, cpu, diskstats, entropy, exec, filesystem, ipvs, loadavg, meminfo, netclass, netstat, nfs, sockstat, stat, **textfile**, time, timex, vmstat, zfs ...

cadvisor metrics

container_accelerator_memory_used_bytes, container_cpu_load_average_10s, container_fs_reads_total, container_last_seen, container_network_receive_errors_total ....

kube-state-metrics metrics

kube_cronjob_status_active, kube_namespace_annotations, kube_service_labels, kube_service_created, kube_replicaset_status_replicas, kube_node_status_condition .

docker daemon metrics

engine_daemon_container_action_seconds_bucket, process_cpu_seconds_total

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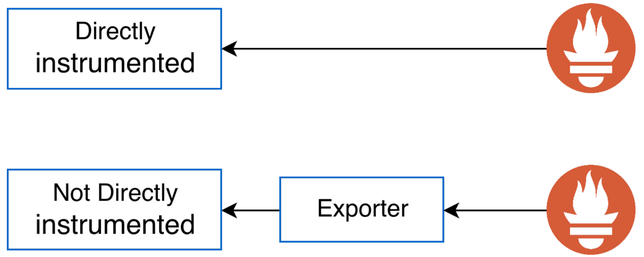
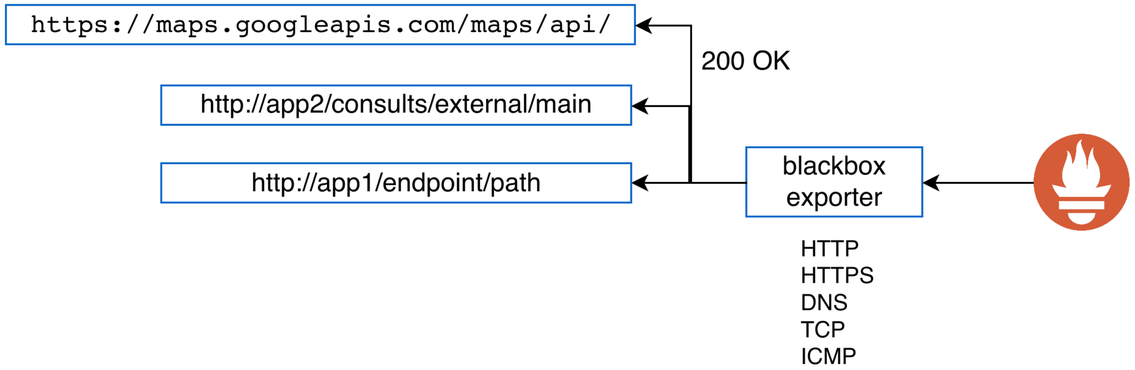
2.2 Monitoring applications

Application metrics

- Blackbox exporter: monitoring microservices endpoints
- Official exporters
- prometheus-native applications





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2.3 prometheus-native applications

Instrumenting applications

Before you can **monitor your services**, you need to add instrumentation to their code.

1. Implement the Prometheus metric types
2. Choose a Prometheus **client library** that matches the language of your application.
3. **Define** internal **metrics**
4. **Expose** them via an HTTP endpoint on your application instance.

Available client libraries:

- Go
- Java or Scala
- Python
- Ruby
- Unofficial, third-party: bash, PHP, node.js, …..

Available metrics types:

- Counter
- Gauge
- Histogram
- Summary

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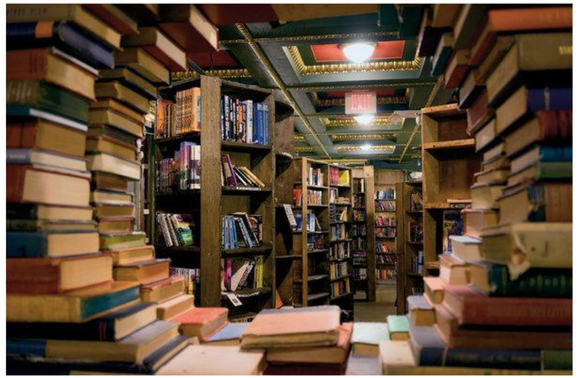
2.3.1 prometheus-native applications

Book store app



Possible actions taken by users:

- Buy a book

Every book categorized by:

- Genre: Terror, Romance, Science Fiction
- Pages

- I would like to know, **which genres** are buy the most by my clients.
- **Which editions** are preferred, pocket editions, portable..
- If a specific genre is most buy to read in a comfortable light edition.
- Number of **visits**
- **Time** spend before buying

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2.3.1 prometheus-native applications

What metrics look like

```
# HELP books_sold Number of books sold
# TYPE books_sold counter
books_sold{genre="terror"} 199.0
books_sold{genre="romance"} 70.0
# HELP uptime uptime
# TYPE uptime gauge
uptime 4.2769899E7
# HELP systemload_average systemload_average
# TYPE systemload_average gauge
systemload_average 0.55
# HELP heap_committed heap_committed
# TYPE heap_committed gauge
heap_committed 2234880.0
```

For every metric

Description

Metric type

Values are float64

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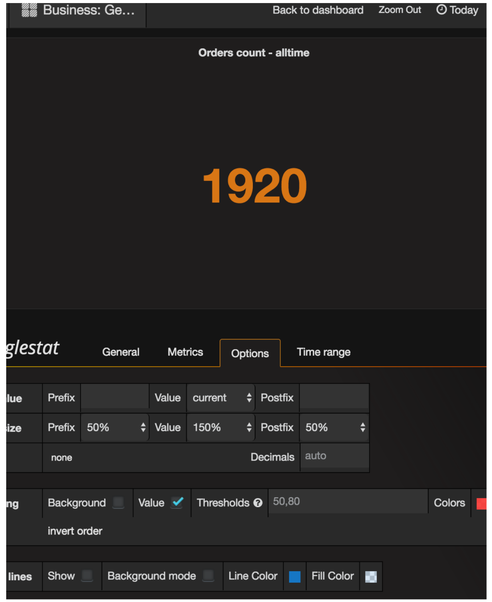
2.3.2 prometheus-native applications

Metrics types: Counter and Gauge



Counter:

- Increment or reset
- Number of visits or books sold

Gauge:

- Type of counter
- Increment or decrement
- Common use: represent memory or CPU

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2.3.2 prometheus-native applications

Metrics types: Counter

```
# HELP books_sold Number of books sold
# TYPE books_sold counter
books_sold{genre="terror"} 2
books_sold{genre="romance"} 1
```

```
booksSold = promauto.NewCounterVec(prometheus.CounterOpts{
        Name: "books_sold",
        Help: "The total number of books sold",
    },
        []string{"genre"})
```

```
r.POST("/buy/:genre", func(c *gin.Context) {
        genre := c.Param("genre")
        booksSold.WithLabelValues(genre).Inc()
        c.JSON(200, gin.H{
            "message": "Thank you for purchasing a book",
        })
})
```

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2.3.2 prometheus-native applications

Metrics types: Gauge

```
# HELP online_users Users that are online
# TYPE online_users gauge
online_users 3
```

```
onlineUsers = promauto.NewGauge(prometheus.GaugeOpts{
        Name: "online_users",
        Help: "Users that are online",
    })
```

```
r.GET("/", func(c *gin.Context) {
    onlineUsers.Inc()
    c.JSON(200, gin.H{
      "message": "Look at all the books we have!",
          })
 })
```

```
r.POST("/buy/:genre", func(c *gin.Context) {
    onlineUsers.Dec()
    c.JSON(200, gin.H{
        "message": "Thank you for purchasing a book",
    })
 })
```

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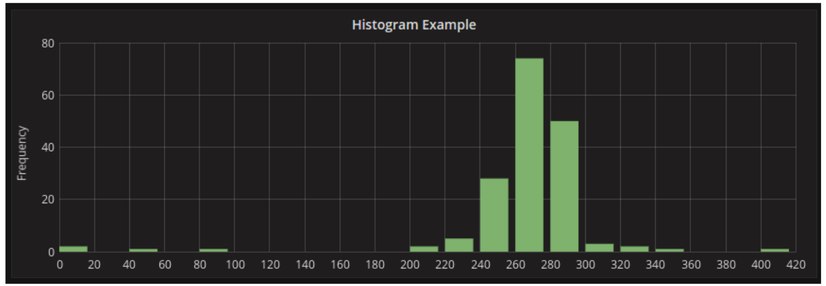
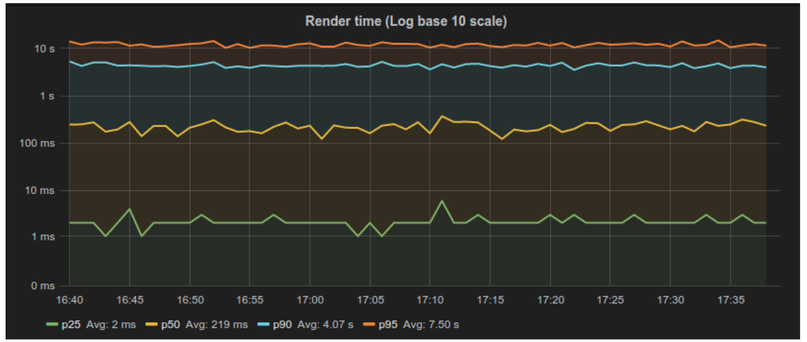
2.3.3 prometheus-native applications

Metrics types: Histogram and Summary

Histogram:

- Values grouped in buckets
- **Cumulative**
- Number of books with number of pages ranged from 50 to 100 pages.





Summary:

- **Average** and **Percentiles** information
- Get extremes behaviours
- Time spent in the application previous to buy anything

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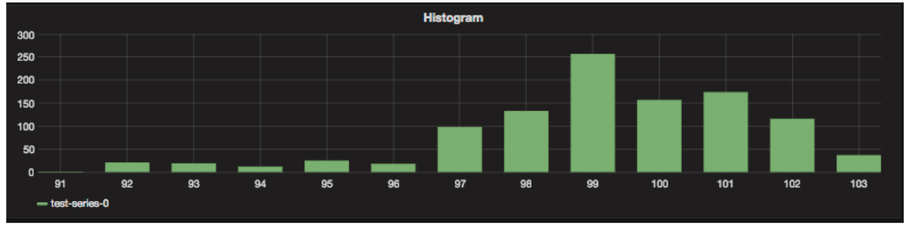
2.3.3 prometheus-native applications

Metrics types: Histogram




```
# HELP books_sold_pages Books sold with number of pages
# TYPE books_sold_pages histogram
books_sold_pages_bucket{genre="terror",le="20"} 5
books_sold_pages_bucket{genre="terror",le="100"} 21
books_sold_pages_bucket{genre="terror",le="150"} 29
books_sold_pages_bucket{genre="terror",le="200"} 32
books_sold_pages_bucket{genre="terror",le="+Inf"} 32
books_sold_pages_sum{genre="terror"} 2624
books_sold_pages_count{genre="romance"} 32
```

```
bSoldPages = promauto.NewHistogramVec(
prometheus.HistogramOpts{
    Name:    "books_sold_pages",
    Help:    "Books sold with number of pages",
    Buckets: []float64{20.0, 100.0, 150.0, 200.0}
  },
  []string{"genre"})
```

```
r.POST("/buy/:genre", func(c *gin.Context) {
  genre := c.Param("genre")
  bSoldPages.WithLabelValues(genre).Observe(rand.Float64()* 200)
   c.JSON(200, gin.H{
      "message": "Thank you for purchasing a book",
    })
})
```

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2.3.3 prometheus-native applications

Metrics types: Summary

```
# HELP time_spent Time spent to buy a book
# TYPE time_spent summary
time_spent{genre="romance",quantile="0.5"} 36.08
time_spent{genre="romance",quantile="0.9"} 68.68
time_spent{genre="romance",quantile="0.99"} 94.05
time_spent_sum{genre="romance"} 912.74
time_spent_count{genre="romance"} 22
```

```
timeSpent = promauto.NewSummaryVec(prometheus.SummaryOpts{
  Name:       "time_spent",
  Help:       "Time spent to buy a book",
  Objectives: map[float64]float64{0.5: 0.05, 0.9: 0.01, 0.99:
0.001},
    },
[]string{"genre"})
```

```
r.POST("/buy/:genre", func(c *gin.Context) {
  genre := c.Param("genre")
  timeSpent.WithLabelValues(genre).Observe(rand.Float64()*100)
  c.JSON(200, gin.H{
     "message": "Thank you for purchasing a book",
   })
})
```

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2.3.4 prometheus-native applications

Book Store insights

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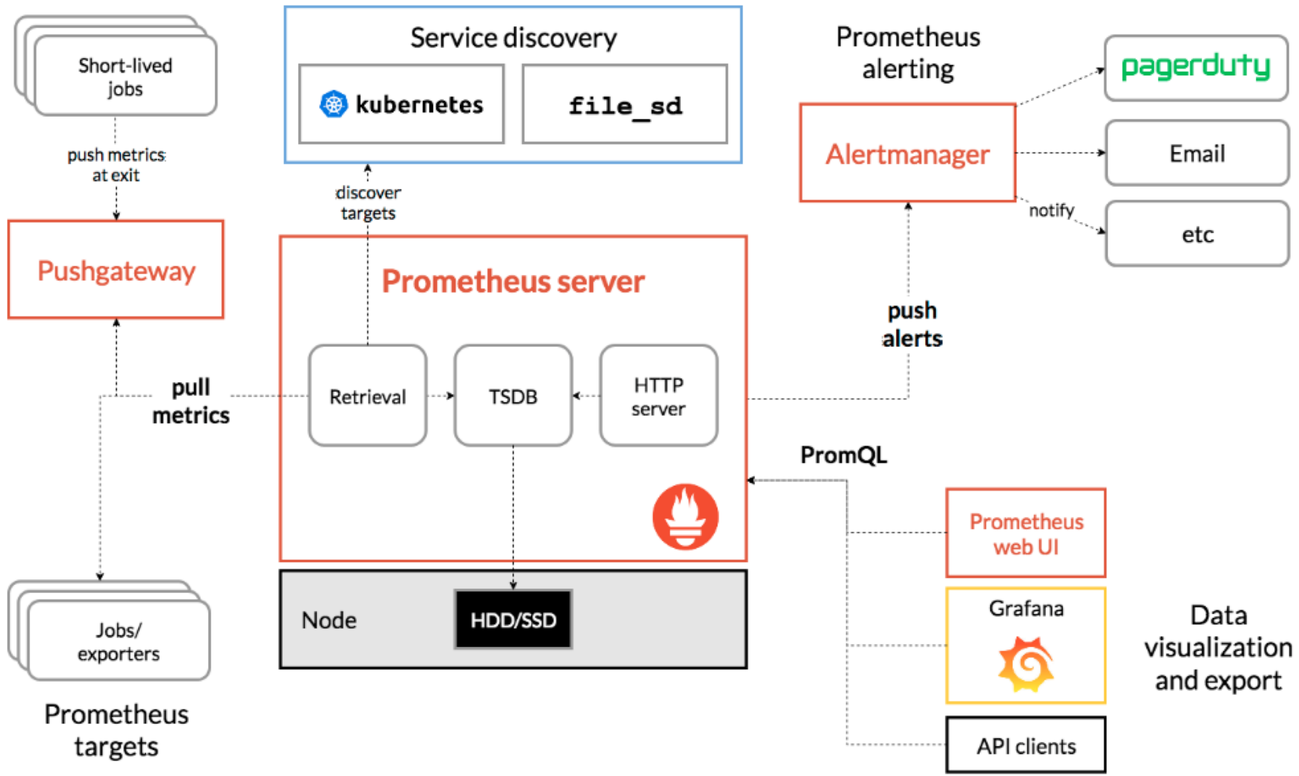
3. Alerting and Integrations

Grouping, silencing, alerting



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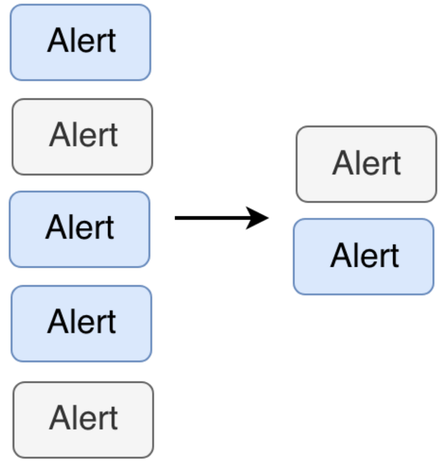
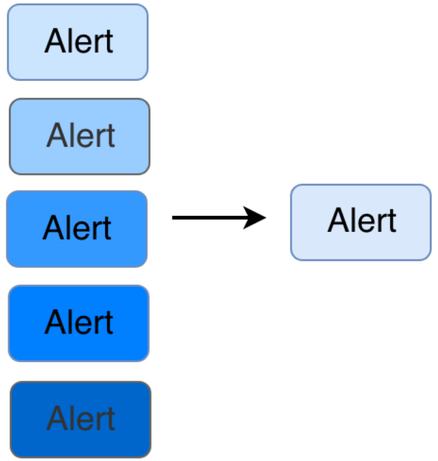
3.1 Alertmanager

Alerts notification management

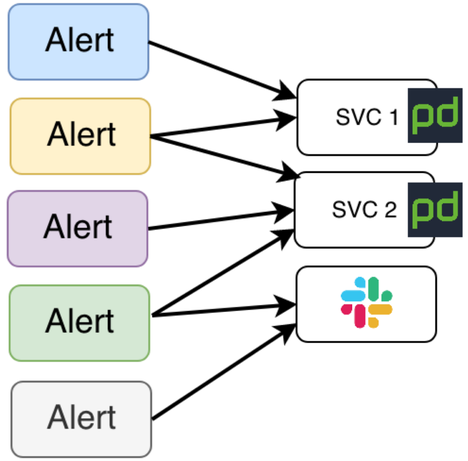
- Deduplicates
- Groups
- Routes
- Inhibits
- Silence



Deduplicates



Groups



Routes

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4. Scaling and Ecosystem

Federation, Thanos, K8s operator, Signifai

Getting the most out of Prometheus in real life case scenarios.

- New necessities are born: **Scaling** Prometheus
- A whole ecosystem appears to:
  - **Enable** an easy deployment, management and operation (Helm, Operator, ...)
  - **Complement** functionalities and support new approaches to cover specific necessities (Thanos, M3,Cortex ..)
  - Provide new paths to **exploit** the observability and instrumentations of our applications (Signifai)

kubernetes
OPERATOR
Prometheus

Thanos

M3

HELM

signifai

cortex

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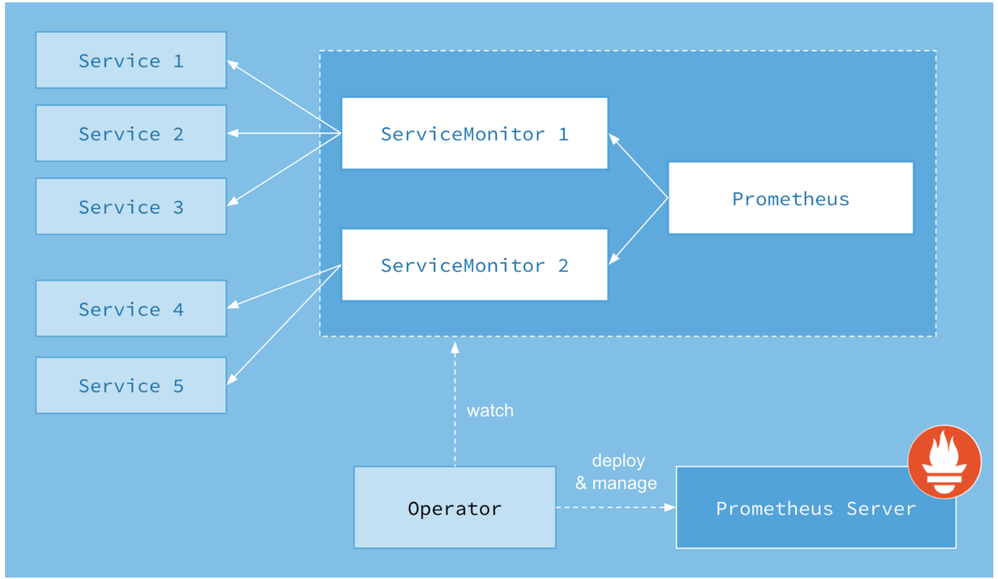
4.1 Deploying Prometheus

K8s prometheus-operator

kubernetes
OPERATOR
Prometheus

Custom resources:

- **Prometheus**
- ServiceMonitor
- Alertmanager
- PrometheusRule



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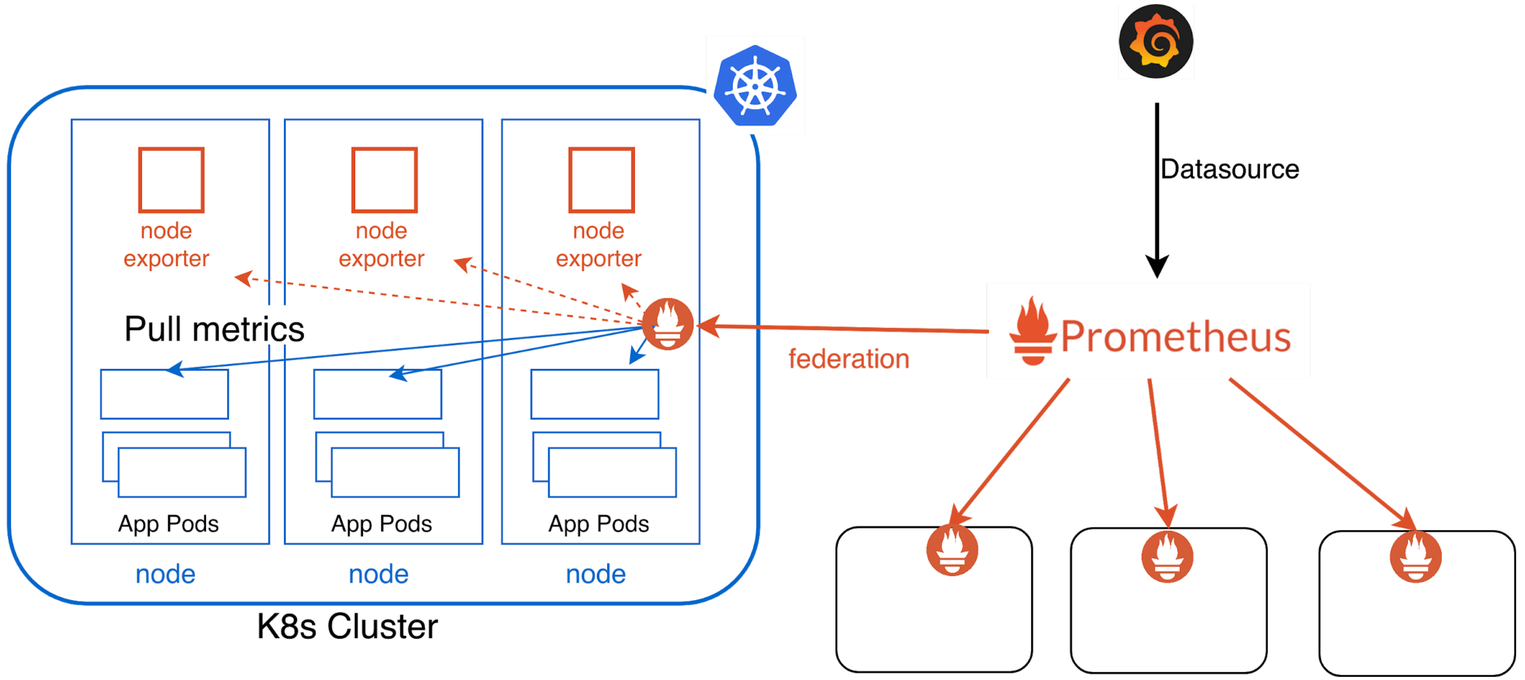
4.2 Scaling Prometheus

Federation



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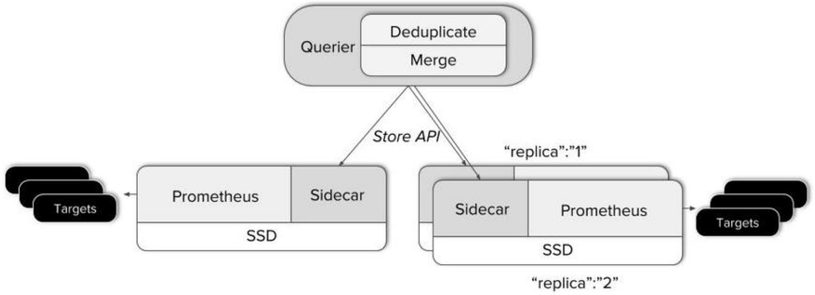
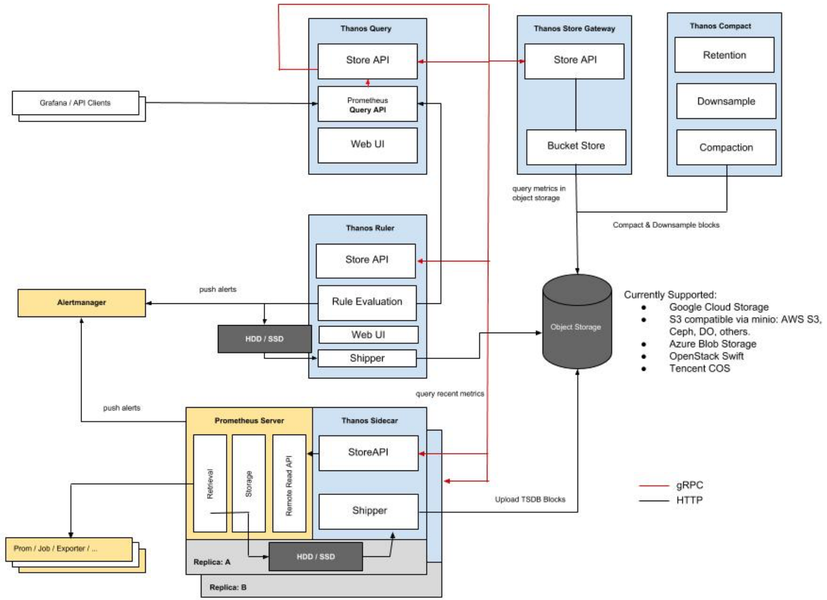
4.3 Thanos

Highly available Prometheus setup with long term storage capabilities

- Global view
- **Distributed queries**
- Unlimited retention





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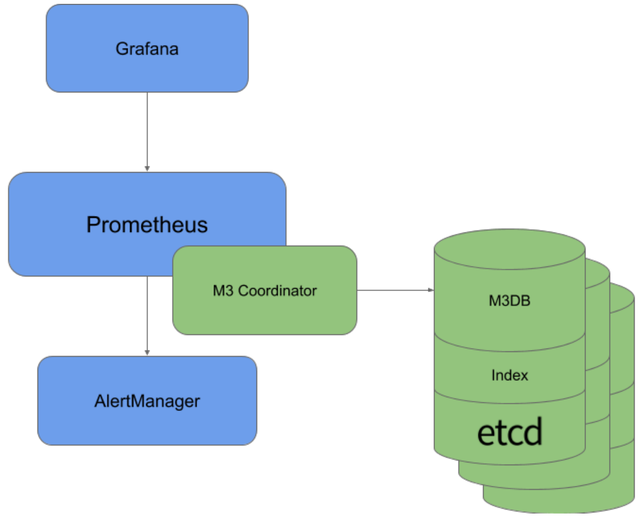
4.4 M3DB

Born to facilitate the growth of Uber's global operations

```
- name: Retain all disk_used metrics
   filter: name:disk_used* device:sd*
   policies:
     - resolution: 10s
       retention:  2d
     - resolution: 1m
       retention:  30d
     - resolution: 1h
       retention:  5y
```



- Reliably houses large-scale metrics over long retention time windows
- **Downsampling of metrics**

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4.5 Cortex

- Multi-tenant, horizontally scalable open source **Prometheus-as-a-Service**
- **CNCF** project since September 2018
- Provides a complete out-of-the-box solution for even most demanding monitoring and observability use cases.
- Hosted Cortex: Weave Cloud and Grafana Cloud

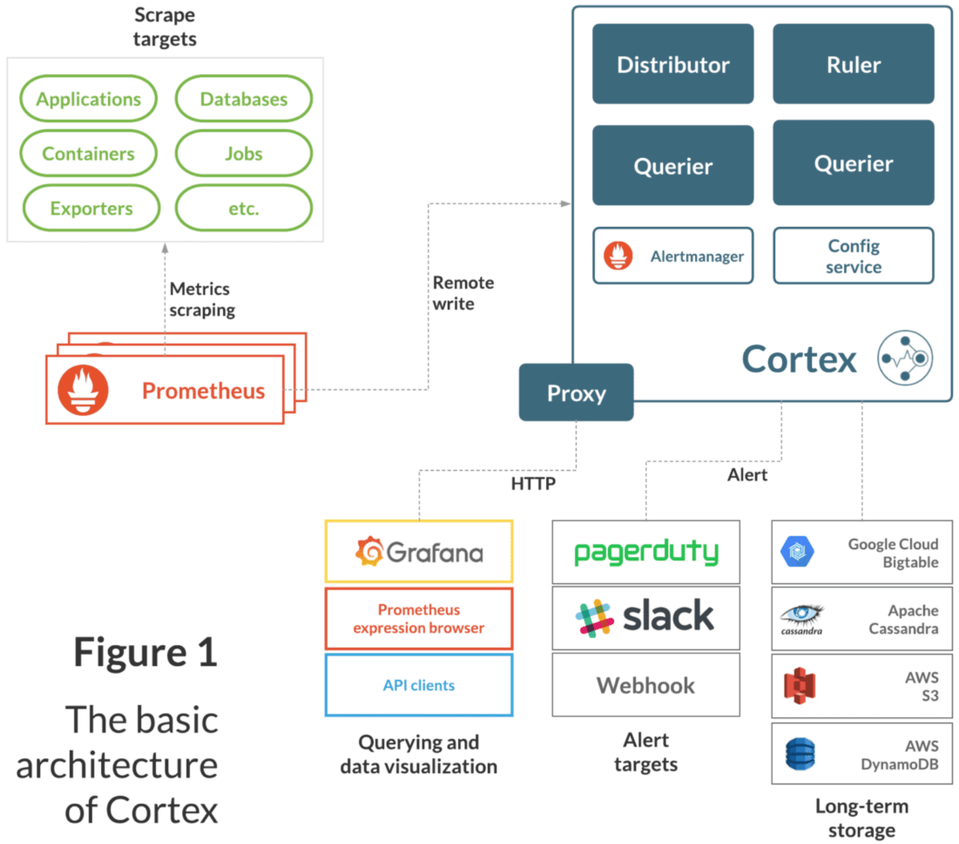

Figure 1

The basic architecture of Cortex

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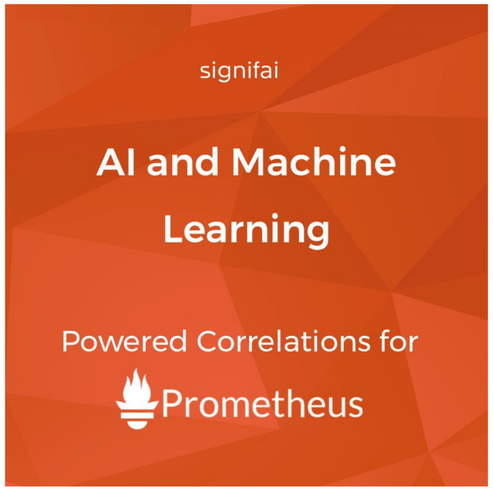
4.6 Signifai

AIOps with Prometheus

signifai

- Acquired by NewRelic
- AI and machine learning **powered correlation engine** for DevOps and Site Reliability Engineering.
- End-to-end systems analysis
- Get answers not alerts
- Automatic correlation, aggregation and prioritization of alerts.
- Be proactive not reactive



Conclusions

cloud-native monitoring: observability
RED metrics, don’t fly blind
Cross team implication
Instrumentation: not as painful after all

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