Monitoring for Developers with Prometheus and Grafana

Isaac Rubio Torres / July 2018

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1. Prometheus Manifesto
2. Setup
3. How to...
4. Prometheus works for Developers (and Ops)

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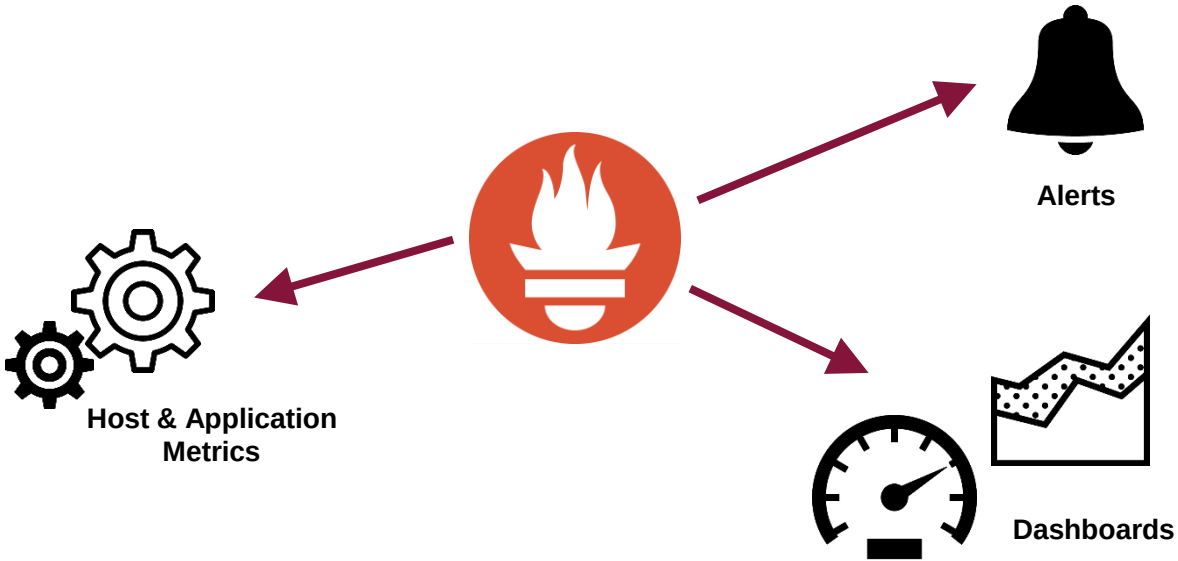
Monitoring



Prometheus is a Monitoring System and Time Series Database

Prometheus is an opinionated solution

for

instrumentation, collection, storage
querying, alerting, dashboards, trending

Prometheus values …

operational systems monitoring (not only) for the cloud	over	raw logs and events, tracing of requests, magic anomaly detection, accounting, SLA reporting
simple single node w/ local storage for a few weeks	over	horizontal scaling, clustering, multitenancy
configuration files	over	Web UI, user management
pulling data from single processes	over	pushing data from processes, aggregation on nodes
NoSQL query & data massaging multidimensional data everything as float64	over	point-and-click configurations, data silos, complex data types

1. PromCon 2016: Prometheus Design and Philosophy - Why It Is the Way It Is - Julius Volz https://youtu.be/4DzoajMs4DM / https://goo.gl/1oNaZV

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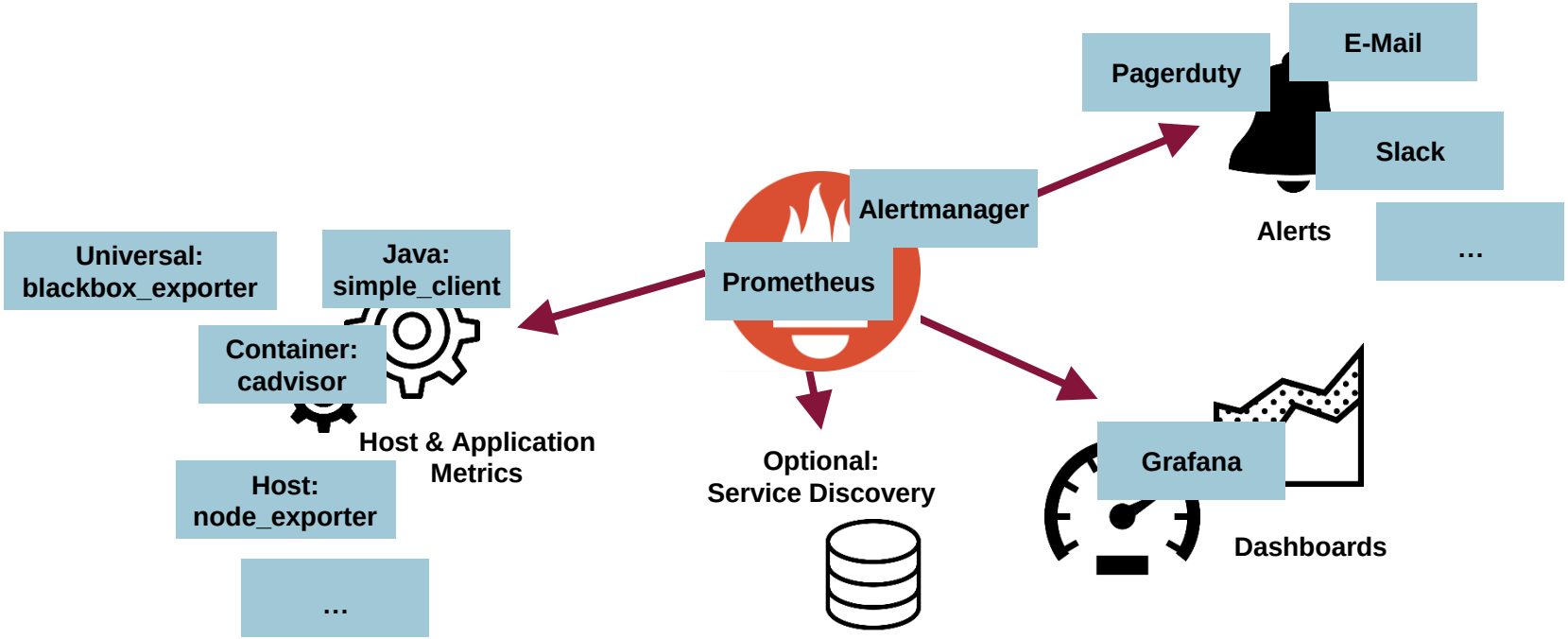
Setup


Pagerduty
E-Mail
Slack
Alerts
…
Alertmanager
Prometheus
Universal:
blackbox_exporter
Java:
simple_client
Container:
cadvisor
Host & Application
Metrics
Host:
node_exporter
…
Optional:
Service Discovery
Grafana
Dashboards

Technical Building Blocks

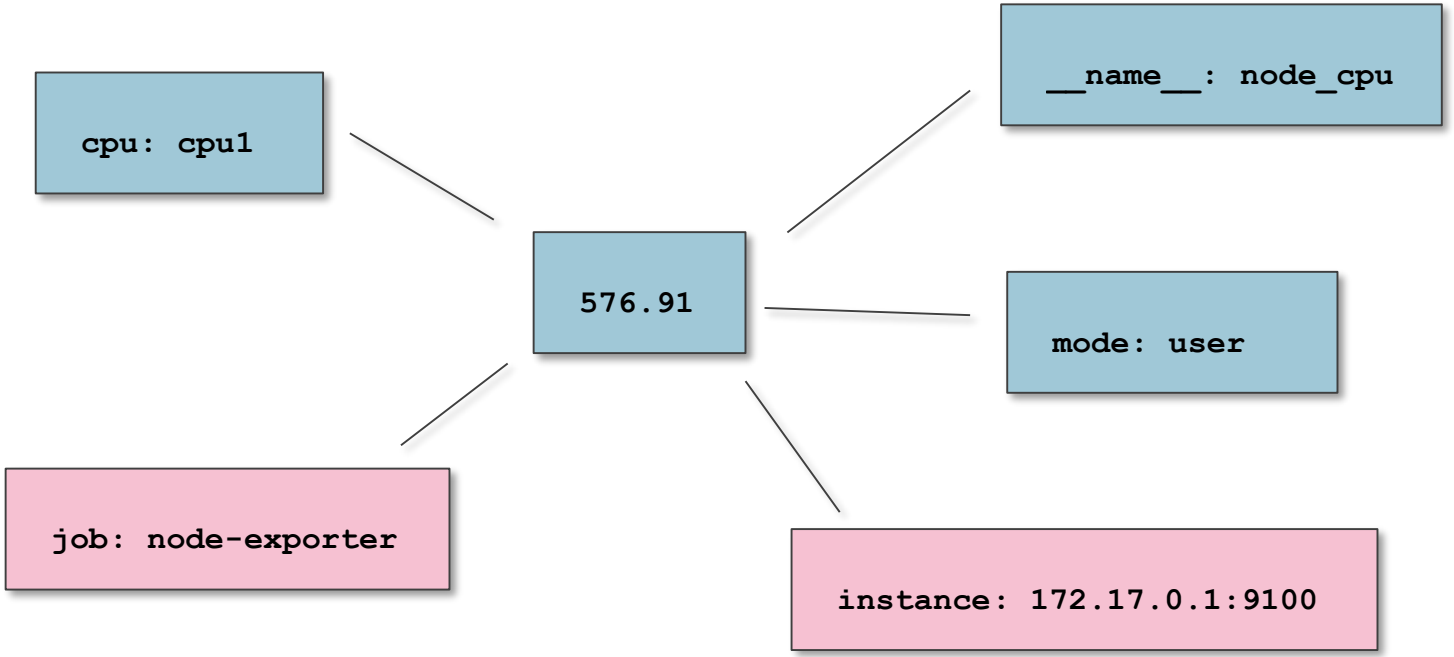

Disk Total
84.4 GiB
Total Memory
15.7 GiB
Load
0.5000%
Uptime
26.1 week
Scrape CPU use
0.04%
CPU Usage
13:30
14:00
14:30
15:00
15:30
user
iowait
softirq
system
user
iowait
softirq
system
user
user
Memory usage
17 GiB
15 GiB
13 GiB
11 GiB
9 GiB
13:00
13:30
14:00
14:30
15:00
15:30
Used
Buffers
Cached
Free
Available memory
30%
Swap Activity
13:30
14:00
14:30
15:00
15:30
Network Usage
500 kBps
0 Bps
-500 kBps
13:00
13:30
14:00
14:30
15:00
15:30
docker0 outbound
eno16777984 outbound
docker0 inbound
eno16777984 inbound
Free Filesystem Space (Lowest)
78.4%
5 most used filesystems
13:30
14:00
14:30
15:00
15:30
Uso de Filesystem
Metric
Current
Max
/boot
21.60%
21.60%
/
17.56%
17.56%
Tamaño de Filesystem
Metric
Current
/
84 GiB
/boot
497 MiB
IOPs
10 ms
8 ms
6 ms
4 ms
2 ms
0 ms
13:10
13:20
13:30
13:40
13:50
14:00
14:10
14:20
14:30
14:40
14:50
15:00
15:10
15:20
15:30
IOPS
io time
Tiempo de IO por device (ms/s)
0.6 ms
0.4 ms
0.2 ms
0 ms
12:40
12:50
13:00
13:10
13:20
13:30
13:40
13:50
14:00
14:10
14:20
14:30
14:40
14:50
15:00
15:10
15:20
15:30
dm-0
dm-1
dm-2
dm-4
dm-5
dm-6
dm-7
dm-8
sda
sdb

```
scrape_configs:
 - job_name: 'node-exporter'
    scrape_interval: 5s
    static_configs:
      - targets: ['172.17.0.1:9100']
```

CPU Metric as exported by the Node Exporter

```
# HELP node_cpu Seconds the cpus spent in each mode.
# TYPE node_cpu counter
node_cpu{cpu="cpu0",mode="guest"} 0
node_cpu{cpu="cpu0",mode="idle"} 4533.86
node_cpu{cpu="cpu0",mode="iowait"} 7.36
...
node_cpu{cpu="cpu0",mode="user"} 445.51
node_cpu{cpu="cpu1",mode="guest"} 0
node_cpu{cpu="cpu1",mode="idle"} 4734.47
...
node_cpu{cpu="cpu1",mode="iowait"} 7.41
node_cpu{cpu="cpu1",mode="user"} 576.91
...
```

Multidimensional Metric as stored by Prometheus



Calculations based on metrics

Metric:

node_cpu: Seconds the CPUs spent in each mode (Type: Counter).

What percentage of a CPU is used per core?

```
1 - rate(node_cpu{mode='idle'} [5m])
```

What percentage of a CPU is used per instance?

```
avg by (instance) (1 - rate(node_cpu{mode='idle'} [5m]))
```

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Information about your containers

Presented by: cadvisor

RAM Usage per container:

Variable: container_memory_usage_bytes

Expression: container_memory_usage_bytes{name=~'.+',id=~'/docker/.*'}

CPU Usage per container:

Variable: container_cpu_usage_seconds_total

Expression: rate(container_cpu_usage_seconds_total [30s])
irate(container_cpu_usage_seconds_total [30s])
sum by (instance, name) (irate(container_cpu_usage_seconds_total{name=~'.+'} [15s]))

Information about your JVM

Presented by: Java simple_client

RAM Usage of Java VM:

Variable: jvm_memory_bytes_used

Expressions: irate(container_cpu_usage_seconds_total [30s]) sum by (instance, job) (jvm_memory_bytes_used) sum by (instance, job) (jvm_memory_bytes_committed)

CPU seconds used by Garbage Collection:

Variable: jvm_gc_collection_seconds_sum

Expression: sum by (job, instance) (irate(jvm_gc_collection_seconds_sum [10s]))

Information about your JVM

Add a Configuration to Spring Boot to serve standard JVM metrics using /prometheus actuator endpoint.

```
@Configuration
@EnablePrometheusEndpoint
public class ApplicationConfig {

    @PostConstruct
    public void metrics() {
        DefaultExports.initialize();
        /* ... */
    }
}
```

Information about your Application Metrics

Presented by: Java simple_client and Spring

Timings of a method call:

Java Annotation: @PrometheusTimeMethod(name = "example", help = "...") Variables:

example_count

example_sum

Information about your Application Metrics

Add a Configuration to collect Prometheus timings from Annotations.

```
@Configuration
@EnablePrometheusTiming
public class MetricsApplicationConfig {

      /* ... */
}
```

Information

about your Application Metrics

Add @PrometheusTimeMethod annotations to any method of any Bean to collect metrics

```
@Component
public class RestEndpoint {

    @Path("countedCall")
    @GET
    @PrometheusTimeMethod(name = "example", help = "...")
    public Response countedCall() throws InterruptedException {
        /* ... */
        return Response.ok("ok").build();
    }

}
```

Information about your External Interfaces

Presented by: Java simple_client, Hystrix/Spring

Hystrix Metrics:

Java Annotation: @HystrixCommand

Variables: hystrix_command_total {command_name="externalCall", …}
hystrix_command_error_total {command_name="externalCall", …}

Expressions: histogram_quantile(0.99,
rate(hystrix_command_latency_execute_seconds_bucket[1m]))

External Interfaces – Hystrix Metrics

Register the Hystrix Publisher and add @HystrixCommand for resilience and timing of external calls.

Information about your

```
HystrixPrometheusMetricsPublisher.register();
```

```
@Component
public class ExternalInterfaceAdapter {

    @HystrixCommand(commandKey = "externalCall", groupKey = "interfaceOne")
    public String call() {
        /* ... */
    }
}
```

Information about your Spring Servlet Container

Presented by: your own Java metric provider

Tomcat Connector:

Java Class: Write your own: TomcatStatisticsCollector

Variables: tomcat_thread_pool_current_thread_count
tomcat_thread_pool_current_threads_busy

Tomcat DB Connection Pool:

Java Class: Write your own: DatasourceStatisticsCollector

Variables: tomcat_datasource_active tomcat_datasource_idle
tomcat_datasource_max_idle

Information about your

Spring Servlet Container

```
public class DatasourceStatisticsCollector extends Collector {

    /* ... */

    @Override
    public List<MetricFamilySamples> collect() {
        /* ... */
        result.add(buildGauge("active", "number of connections in use",
            labelNames, labelValues, tomcatDS.getActive()));
        return result;
    }

}
```

```
new DatasourceStatisticsCollector(dataSource).register();
```

Information about your

Information about your Vert.x application

Presented by: Java Simple Client for Vert.x

Internal Event Bus:

Variables: vertx_eventbus_messages_sent_total
vertx_eventbus_messages_pending
vertx_eventbus_messages_delivered_total
vertx_eventbus_messages_reply_failures_total

HTTP Server metrics:

Variables: vertx_http_servers_..._requests_count
vertx_http_servers_..._open_netsockets

Vert.x application

```
// During Setup
vertx = Vertx.vertx(new VertxOptions().setMetricsOptions(
            new DropwizardMetricsOptions()
                .setRegistryName("vertx")
                .addMonitoredHttpClientEndpoint(
                    new Match().setValue(".*").setType(MatchType.REGEX))
                .setEnabled(true)
        ));

DefaultExports.initialize();
new DropwizardExports(SharedMetricRegistries.getOrCreate("vertx")).register();

// When starting up Routes and a HTTP Server
final Router router = Router.router(vertx);
router.route("/metrics").handler(new MetricsHandler());
```

Information about your Federation of Prometheus

Any Metric can be exported to other Prometheus instances

http://localhost/prometheus/federate?match[]={job=%22prometheus%22}

Alerting with Prometheus

Any expression can be used for alerting

```
alert: HDD_Alert_warning
        (1 - node_filesystem_free{mountpoint=~".*"} / node_filesystem_size{mountpoint=~".*"}) * 100 > 70
expr: for: 5m labels:
  severity: warning
annotations: summary: High disk usage on {{ $labels.instance }}: filesystem {{$labels.mountpoint}} more
  than 70 % full.
```

Setup of the Environment

Technical Building Blocks for Load Testing

Load Test:

Purple (including Prometheus): Provided as infrastructure in a testing environment
Blue: Setup and maintained by product team (developers/testers)

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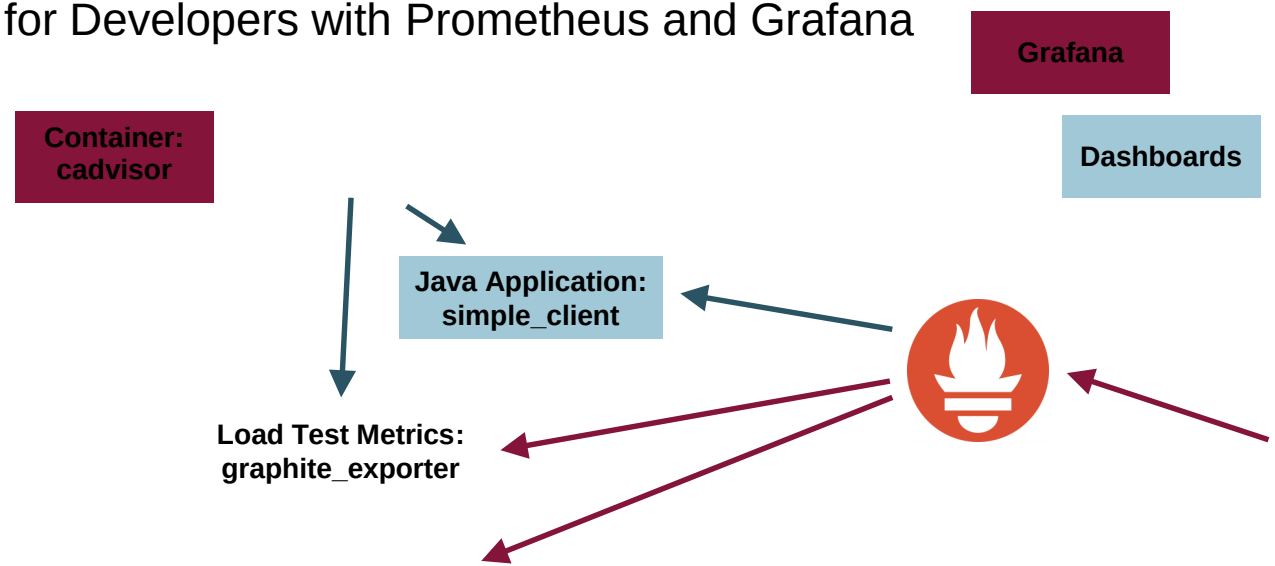

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What to expect

Lessons learned

The approach worked well for us to pass the load tests:

- Load Tool metrics correlated with application and infrastructure metrics
- Inter-application communication captured by Hystrix
- Self-service functionality for product teams to add applications and metrics

… but to use the instrumentation also in production create awareness:

- Exported metrics should following Prometheus naming conventions
- Collector for Dropwizard Metrics can’t fill HELP text of metrics
- Counters and averages vs. histograms, summaries and percentiles
- Consistent use of USE Method (utilization – saturation – errors) or RED Method (rate – errors – duration) for metrics

1. http://www.brendangregg.com/usemethod.html
2. https://www.weave.works/blog/prometheus-and-kubernetes-monitoring-your-applications/

Prometheus works for Developers (and Ops)

Prometheus is “friendly tech” in your environment

Team friendly

- Every team can run its own Prometheus instance to monitor their own and neighboring systems
- Flexible to collect and aggregate the information that is needed

Coder and Continuous Delivery friendly

- All configurations (except dashboard) are kept as code and are guarded by version control
- Changes can be tested locally and easily staged to the next environment

Simple Setup

- Go binaries for *prometheus* and *alertmanager* available for major operating systems
- Client libraries for several languages available (also adapters to existing metrics libraries)
- Several existing exporters for various needs

Links

Prometheus:
https://prometheus.io

Java Simple Client
https://github.com/prometheus/client_java

Hystrix
https://github.com/Netflix/Hystrix

Prometheus Hystrix Metrics Publisher
https://github.com/ahus1/prometheus-hystrix

Dropwizard Metrics
http://metrics.dropwizard.io

Prometheus Design and Philosophy - Why It Is the Way It Is
https://youtu.be/4DzoajMs4DM
https://goo.gl/1oNaZV

CAdvisor
https://github.com/google/cadvisor