MesosCon
NORTH AMERICA

Day 2 Operations Best Practices

Janet Yu, Software Engineer, SignalFx
Ben Lin, APAC Tech Lead, Mesosphere

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Agenda

- Overview
- Architecture
- Metrics API
- Demo

Continuously Connected World

Mobile 4.4B

Internet of Things (IoT) 6B

Modern Enterprise Architecture

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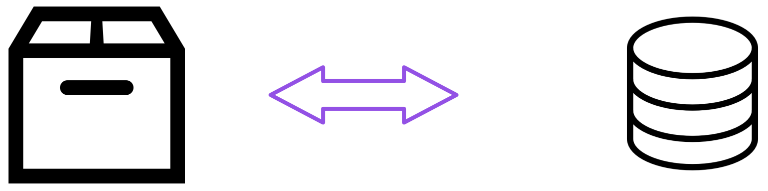
App Transformation

App | **Data**

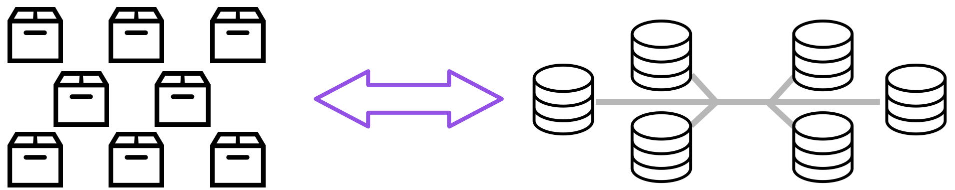
Traditional Enterprise Apps



Monolithic packaged software (in VMs)

Big databases (e.g., Oracle, SQL Server)

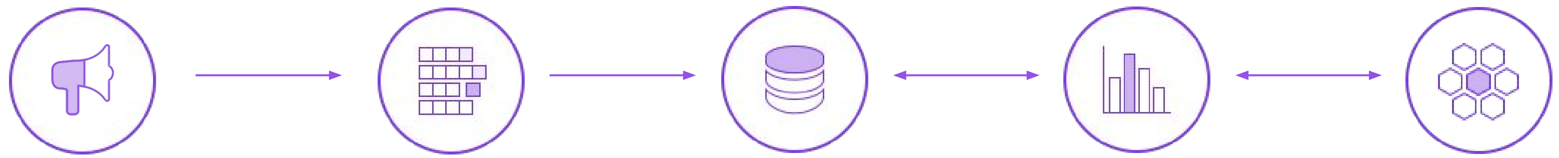
Modern Enterprise Apps



Microservices (in containers)

Cloud native data services (e.g., Spark, Kafka, Cassandra)

Data Intensive



EVENTS	INGEST	STORE	ANALYZE	ACT
Ubiquitous data streams from connected devices	Ingest millions of events per second	Distributed & highly scalable database and file system	Real-time and batch process data	Visualize data and build data driven applications

Sensors

Devices

Clients

ALLUXIO

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Key Challenges

- Scalable Capacity
- Dynamic Architecture
- Load Balancing

Scalable Capacity

Benefit:

- Nodes added or removed, based on load

Concern:

- When does it need to occur

Dynamic Architecture

Benefit:

One piece can be easily swapped out with another

Concern:

Obtaining meaningful view of application as a whole when pieces can change

Load Balancing

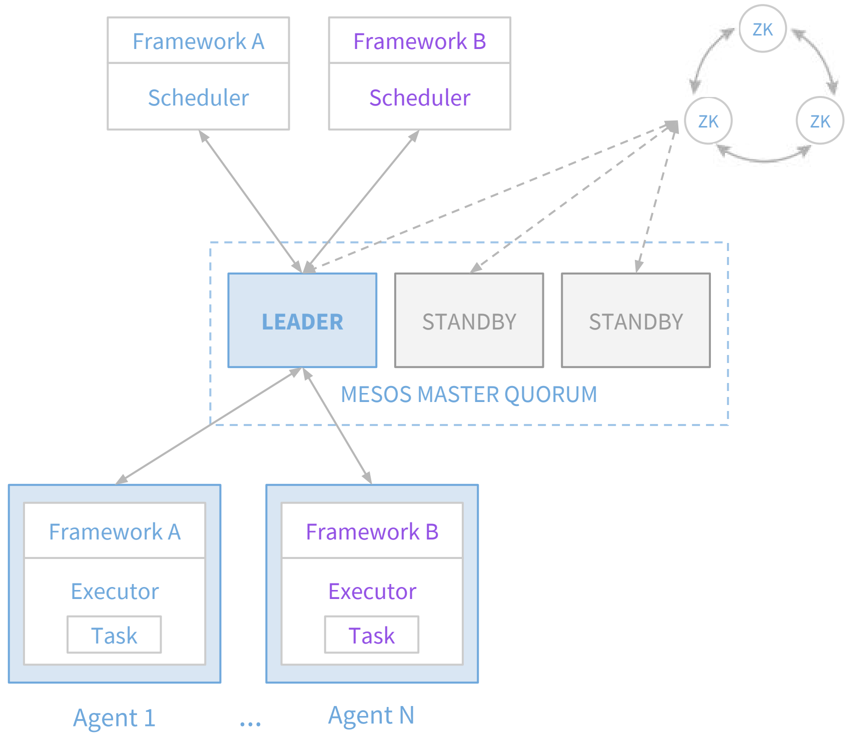
Benefit:

- Work is fairly shared among resources

Concern:

- How effective is the algorithm

Mesos Architecture



Metric Categories

- Logins & Usage

BUSINESS

- Region
- Profile

USERS

- Latency
- Availability/SLA

APPS - Internal or 3rd party services

- CPU
- Memory
- Disk space

INFRASTRUCTURE - Resources which apps rely on

Metrics

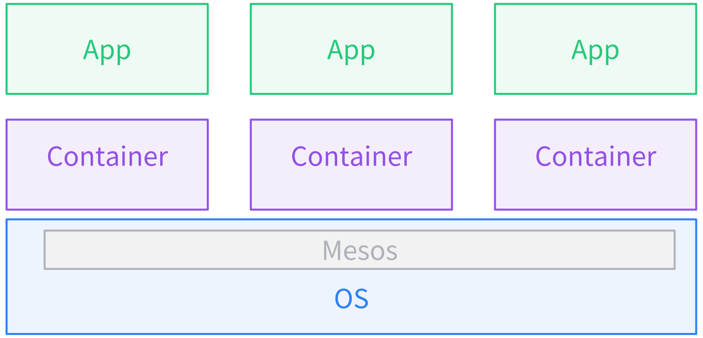
Metric: Anything that is measurable and variable

Measurements captured to determine health and performance of cluster:

- How utilized is the cluster?
- Are resources being optimally used?
- Is the system performing better or worse over time?
- Are there bottlenecks in the system?
- What is the response time of applications?

Mesos Metric Sources

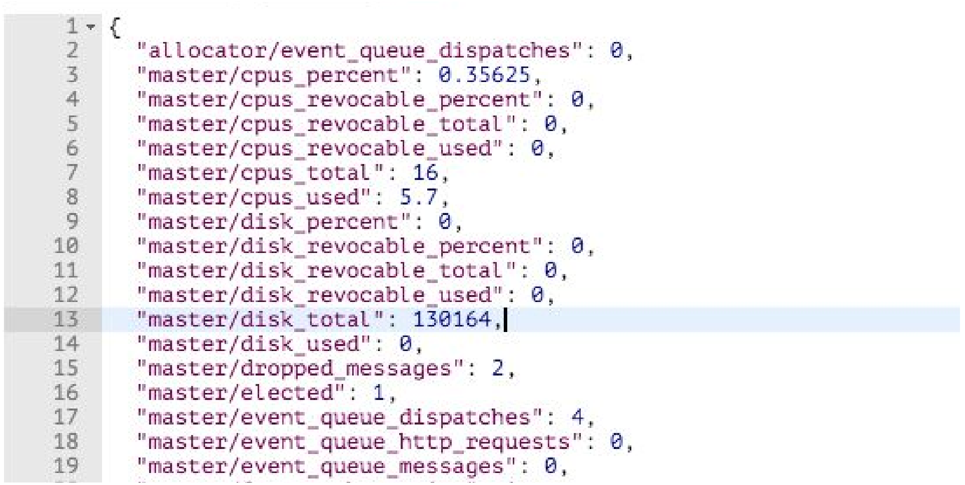
- Mesos metrics
  - Resource, frameworks, masters, agents, tasks, system, events
- Container Metrics
  - CPU, mem, disk, network
- Application Metrics
  - QPS, latency, response time, hits, active users, errors



Master Metrics

- Metrics for the master node are available at the following URL:
  - http://<mesos-master-ip>/mesos/master/metrics/snapshot
  - The response is a JSON object that contains metrics names and values as key-value pairs.

- Metric Groups:
  - Resources
  - Master
  - System
  - Slaves
  - Frameworks
  - Tasks
  - Messages
  - Event Queue
  - Registrar



```
{
  "allocator/event_queue_dispatches": 0,
  "master/cpus_percent": 0.35625,
  "master/cpus_revocable_percent": 0,
  "master/cpus_revocable_total": 0,
  "master/cpus_revocable_used": 0,
  "master/cpus_total": 16,
  "master/cpus_used": 5.7,
  "master/disk_percent": 0,
  "master/disk_revocable_percent": 0,
  "master/disk_revocable_total": 0,
  "master/disk_revocable_used": 0,
  "master/disk_total": 130164,
  "master/disk_used": 0,
  "master/dropped_messages": 2,
  "master/elected": 1,
  "master/event_queue_dispatches": 4,
  "master/event_queue_http_requests": 0,
  "master/event_queue_messages": 0,
```

Master Basic Alerts

Metric Value	Inference
master/uptime_secs is low	The master has restarted
master/uptime_secs < 60 for sustained periods of time	The cluster has a flapping master node
master/tasks_lost is increasing rapidly	Tasks in the cluster are disappearing. Possible causes include hardware failures, bugs in one of the frameworks or bugs in Mesos
master/slaves_active is low	Slaves are having trouble connecting to the master
master/cpus_percent > 0.9 for sustained periods of time	DCOS Cluster CPU utilization is close to capacity
master/mem_percent > 0.9 for sustained periods of time	DCOS Cluster Memory utilization is close to capacity
master/disk_used & master/disk_percent	DCOS Disk space consumed by Reservations
master/elected is 0 for sustained periods of time	No Master is currently elected

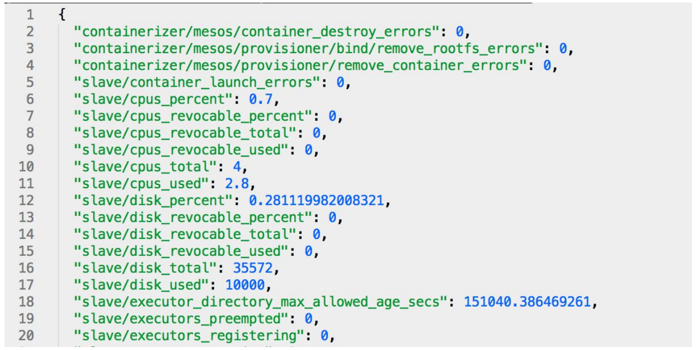
Agent Metrics

- Metrics for the agent node are available at the following URL:

  `http://<mesos-agent-ip>:5051/metrics/snapshot`

  - The response is a JSON object that contains metrics names and values as key-value pairs.

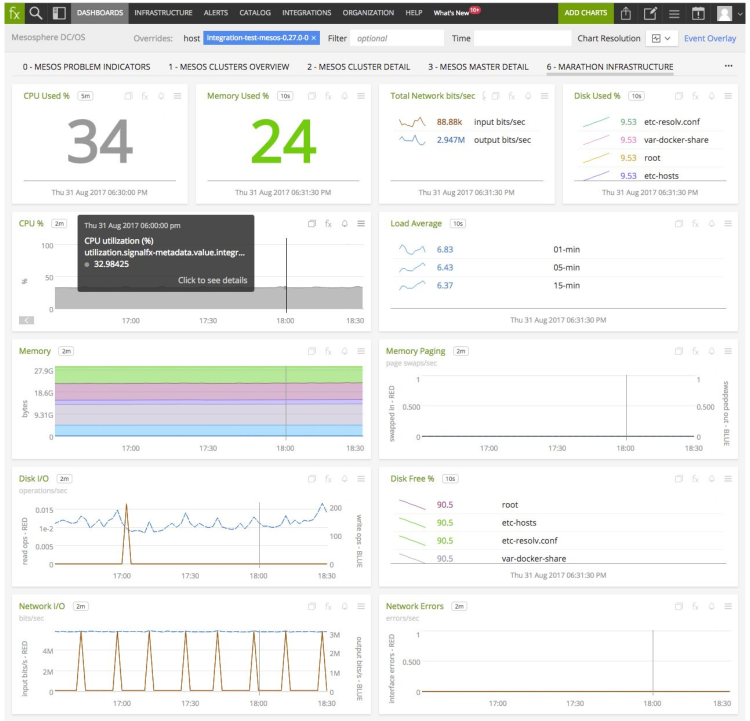
- Metric groups:
  - Resources
  - Slave
  - System
  - Executors
  - Tasks
  - Messages

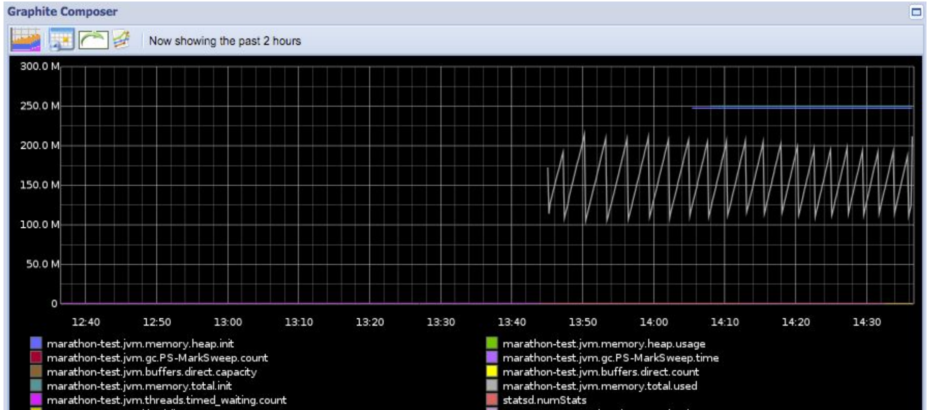


```
{
  "containerizer/mesos/container_destroy_errors": 0,
  "containerizer/mesos/provisioner/bind/remove_rootfs_errors": 0,
  "containerizer/mesos/provisioner/remove_container_errors": 0,
  "slave/container_launch_errors": 0,
  "slave/cpus_percent": 0.7,
  "slave/cpus_revocable_percent": 0,
  "slave/cpus_revocable_total": 0,
  "slave/cpus_revocable_used": 0,
  "slave/cpus_total": 4,
  "slave/cpus_used": 2.8,
  "slave/disk_percent": 0.281119982008321,
  "slave/disk_revocable_percent": 0,
  "slave/disk_revocable_total": 0,
  "slave/disk_revocable_used": 0,
  "slave/disk_total": 35572,
  "slave/disk_used": 10000,
  "slave/executor_directory_max_allowed_age_secs": 151040.386469261,
  "slave/executors_preempted": 0,
  "slave/executors_registering": 0,
```

Marathon Metrics

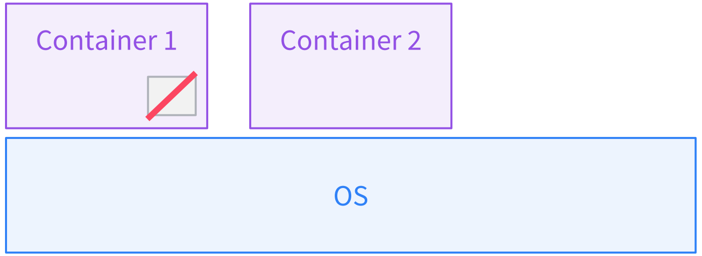
- Metrics for Marathon are available at the following URL:
  - http://<marathon-ip>:8080/metrics
  - for DC/OS http://<master-ip>:/marathon/metrics
- Redirect metrics to graphite when you start the Marathon process by adding the following flag: --reporter_graphite tcp://<graphite-server>:2003?prefix=marathon-test&interval=10


DASHBOARDS
INFRASTRUCTURE
ALERTS
CATALOG
INTEGRATIONS
ORGANIZATION
HELP
What's New
ADD CHARTS
Mesosphere DC/OS
Overrides: host integration-test-mesos-0.27.0-0
Filter optional
Time
Chart Resolution
Event Overlay
0 - MESOS PROBLEM INDICATORS
1 - MESOS CLUSTERS OVERVIEW
2 - MESOS CLUSTER DETAIL
3 - MESOS MASTER DETAIL
6 - MARATHON INFRASTRUCTURE
CPU Used % 34
Memory Used % 24
Total Network bits/sec 88.88k input bits/sec 2.947M output bits/sec
Disk Used % 9.53 etc-resolv.conf 9.53 var-docker-share 9.53 root 9.53 etc-hosts
CPU %
Thu 31 Aug 2017 06:00:00 pm CPU utilization (%) utilization.signalfx-metadata.value.integr... 32.98425 Click to see details
Load Average 6.83 01-min 6.43 05-min 6.37 15-min
Memory
Memory Paging
Disk I/O
Disk Free % 90.5 root 90.5 etc-hosts 90.5 etc-resolv.conf 90.5 var-docker-share
Network I/O
Network Errors


Graphite Composer
Now showing the past 2 hours
300.0 M
250.0 M
200.0 M
150.0 M
100.0 M
50.0 M
0
12:40
12:50
13:00
13:10
13:20
13:30
13:40
13:50
14:00
14:10
14:20
14:30
marathon-test.jvm.memory.heap.init
marathon-test.jvm.gc.PS-MarkSweep.count
marathon-test.jvm.buffers.direct.capacity
marathon-test.jvm.memory.total.init
marathon-test.jvm.threads.timed_waiting.count
marathon-test.jvm.memory.heap.usage
marathon-test.jvm.gc.PS-MarkSweep.time
marathon-test.jvm.buffers.direct.count
marathon-test.jvm.memory.total.used
statsd.numStats

Container Level Metrics

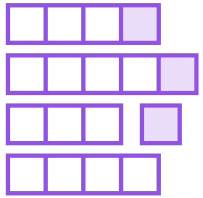
- Monitoring agent per container?
  - Not scalable
  - Increased footprint



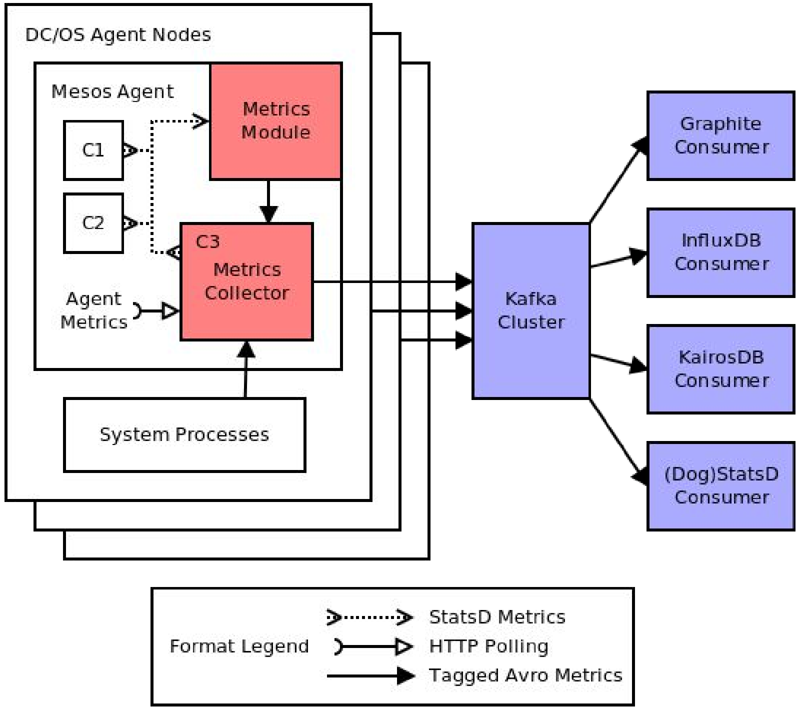
Mesos Metrics Module

Simplified config
- Container metrics (automated)
- Application metrics (statsd env vars)

Context injection
- Automated source tagging (container, agents, …)



Metrics API Architecture



Metrics API

Poll for data about cluster, hosts, containers, applications

```
GET http://<cluster>/system/v1/agent
/<agent_id>/metrics/v0/<resource_path>
Accept: application/json
Authorization: token=<token_string>
```

Metrics API Response

```
"datapoints": [
    {
        "name": "processes",
        "value": 209,
        "unit": "",
        "timestamp": "2017-08-31T01:00:19Z"
    },
    …
],
"dimensions": {
    "mesos_id": "a29070cd-2583-4c1a-969a-3e07d77ee665-S0",
    "hostname": "10.0.2.255"
}
```

Metrics API Tips

- Get authentication token

```
POST http://<cluster>/acs/api/v1/auth/login
{"username": "<user>", "password": "<pw>"}
```

- Datapoint timestamp format may vary

```
2017-09-01T00:25:23.502867353Z,
2017-09-01T06:25Z
```

- Error check datapoint value type

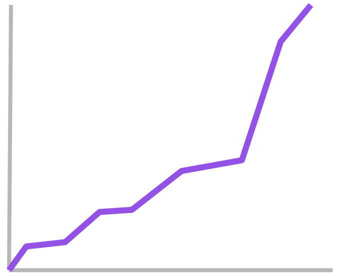
```
{u'timestamp': u'2017-09-06T21:07:03Z',
u'unit': u'', u'name':
u'org.apache.cassandra.metrics.Table.ReadLatency
.system.peer_events.mean', u'value': u'NaN'}
```

Datapoint

Single reported value of a metric from a particular source at a particular time

- Metric name
- Value
- Timestamp
- Metric type
- Dimensions

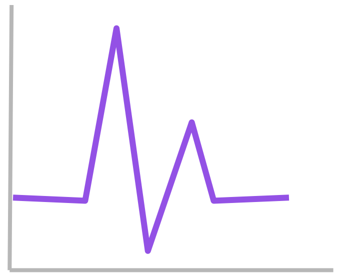
Metric Types



Counters

Discrete events that are monotonically increasing.

- # of failed tasks
- # of agent registrations



Gauges

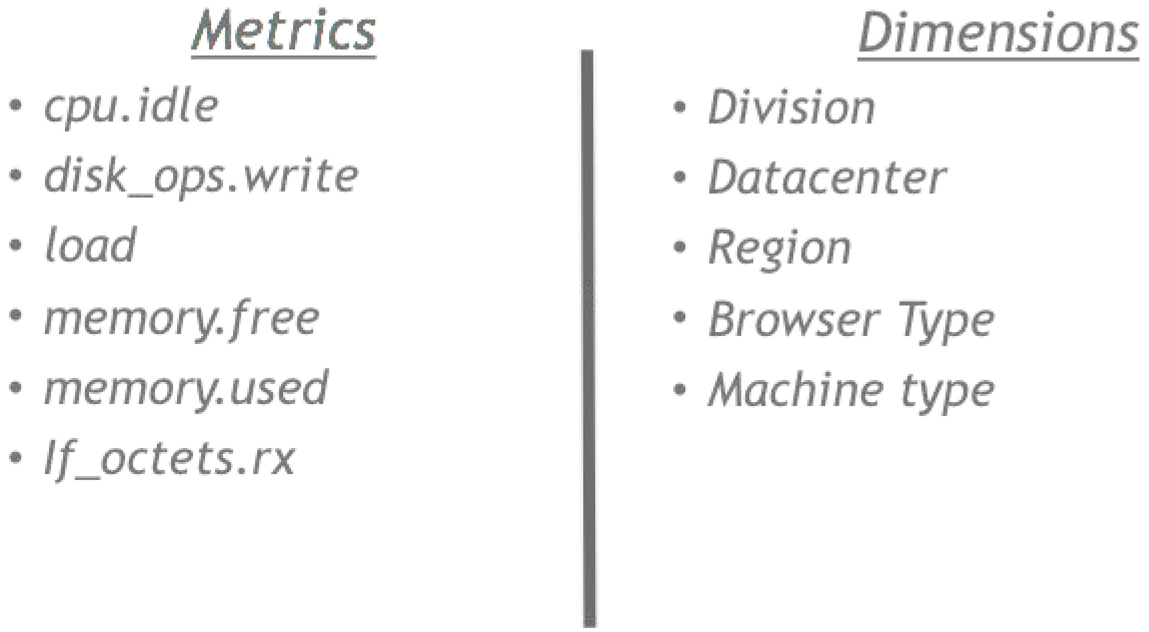
An instantaneous sample of some magnitude.

- % of used memory in cluster
- # of connected slaves

Dimensions

- Key/value pairs
- Set of dimensions represents the source of a datapoint
- Correlates related datapoints, patterns
- Enables classification, aggregation, filtering

Metrics vs. Dimensions



Metrics

- *cpu.idle*
- *disk_ops.write*
- *load*
- *memory.free*
- *memory.used*
- *If_octets.rx*

Dimensions

- *Division*
- *Datacenter*
- *Region*
- *Browser Type*
- *Machine type*

Metric + Dimensions = Time Series

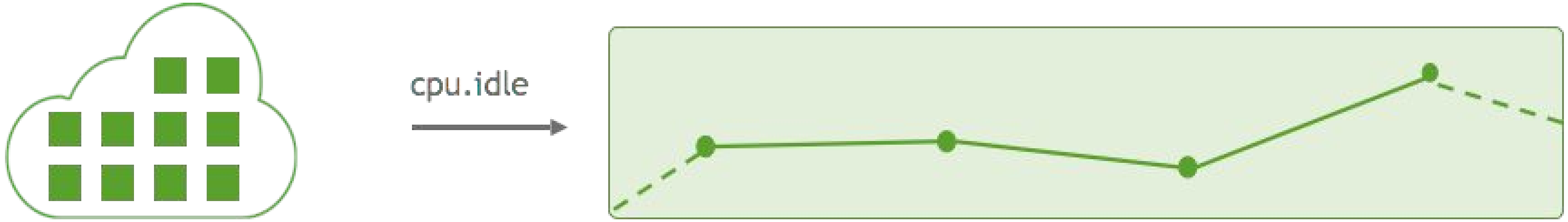


Figure 1

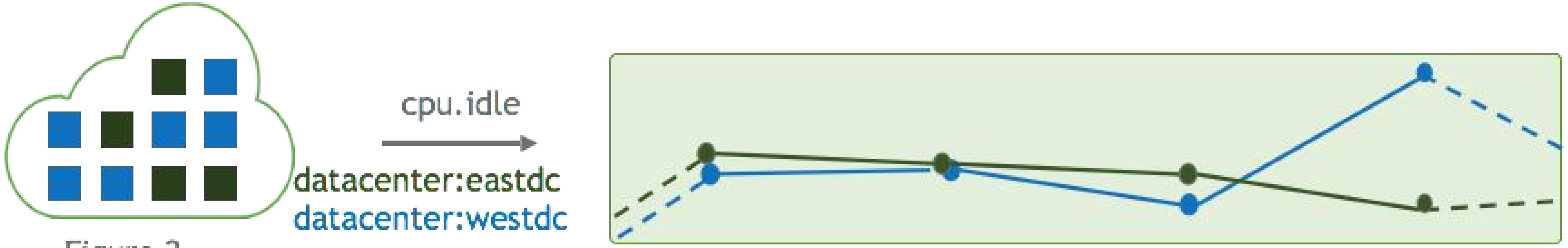


Figure 2

Tips for Sending Metrics

- Structure names hierarchically
- Use a single, consistent delimiter for wildcard searches
- Separate dimensions from metric names
- Don't use dimensions with high cardinality
  - Timestamps, task ids
- Don't send metric type as a dimension
  - Gauges average, counters summed

Monitoring

Send data to monitoring app for analysis

```
POST https://ingest.signalfx.com
Content-Type: application/json
X-SF-TOKEN: <token_string>
{ “gauges”: [{
    “metric”: “processes”,
    “dimensions”: { “host”: “10.0.2.255”, ...},
    “value”: 209}, ...}], ...}
```

DEMO

Key Takeaways

- Scalable Capacity
  - Collect system and custom **metrics**, find outliers that might be bottlenecks
- Dynamic Architecture
  - Use **dimensions** common across all related pieces vs. tracking per-instance identifier
- Load Balancing
  - Compare **time series**, calculate ratios

Resources

Visit the SignalFx and Mesosphere booths :)

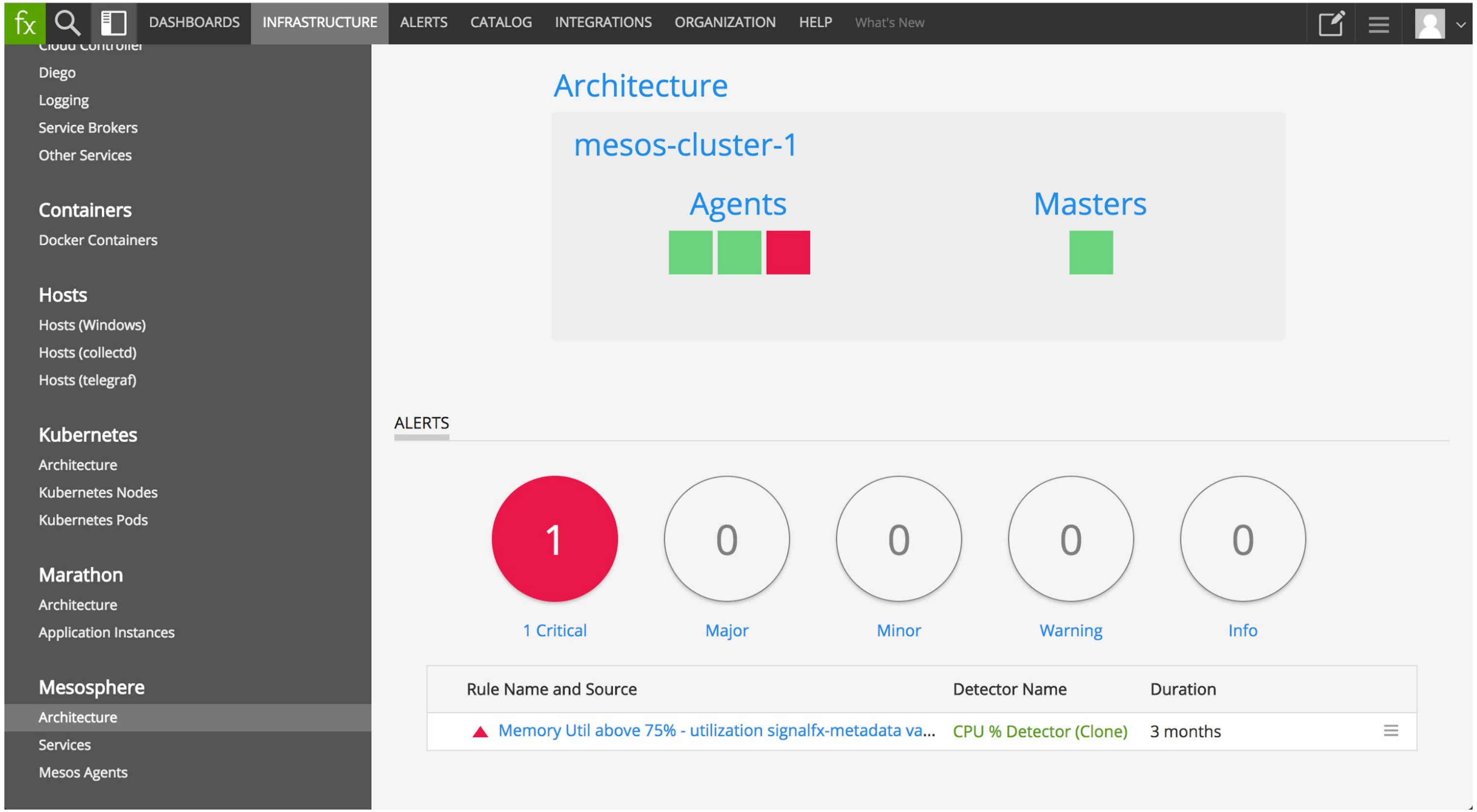
- http://mesos.apache.org/documentation/latest/monitoring/
- https://mesosphere.github.io/marathon/docs/metrics.html
- https://dcos.io/docs/1.9/metrics/metrics-api/
- https://developers.signalfx.com/docs/signalfx-api-overview
- https://github.com/signalfx/collectd-mesos

BACKUP SLIDES

Logging

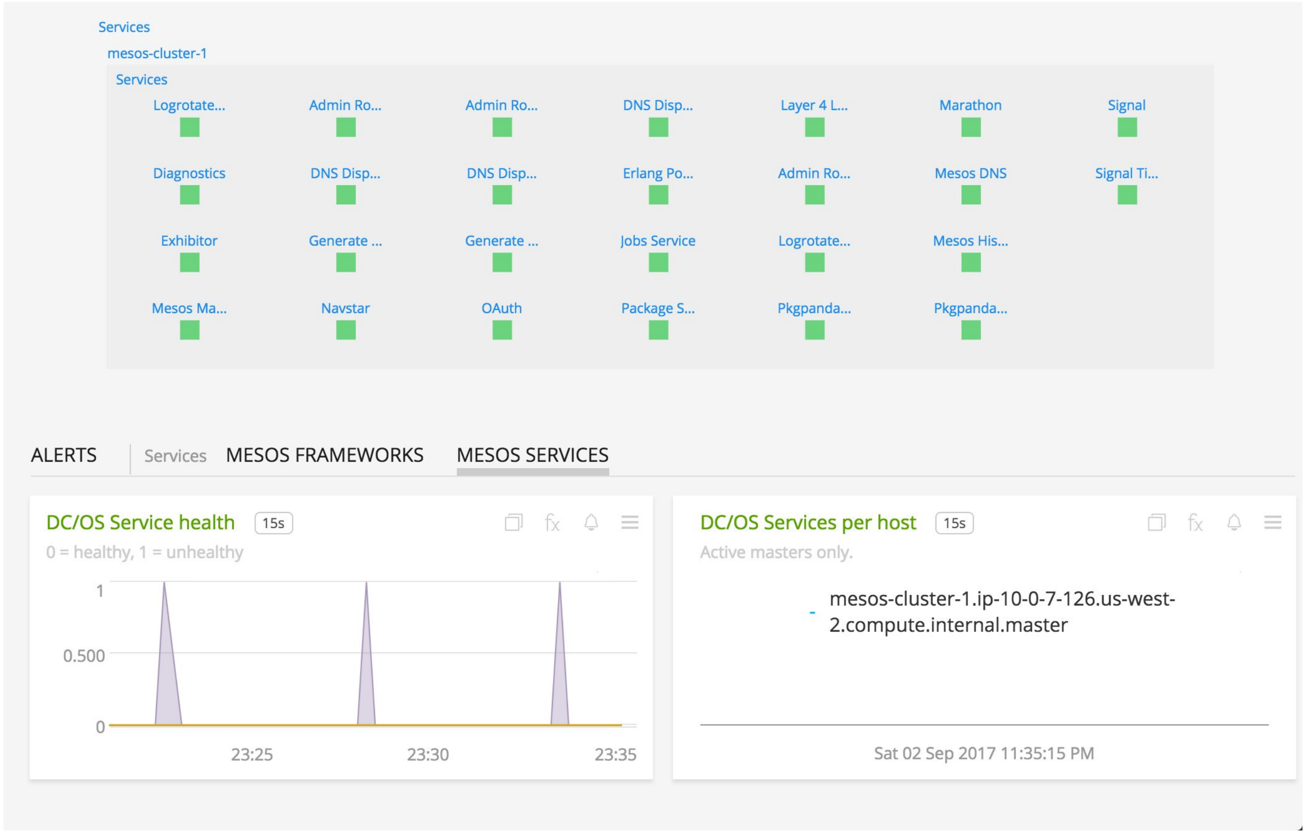
Troubleshooting

Infrastructure Outliers



Rule Name and Source	Detector Name	Duration
Memory Util above 75% - utilization signalfx-metadata va...	CPU % Detector (Clone)	3 months

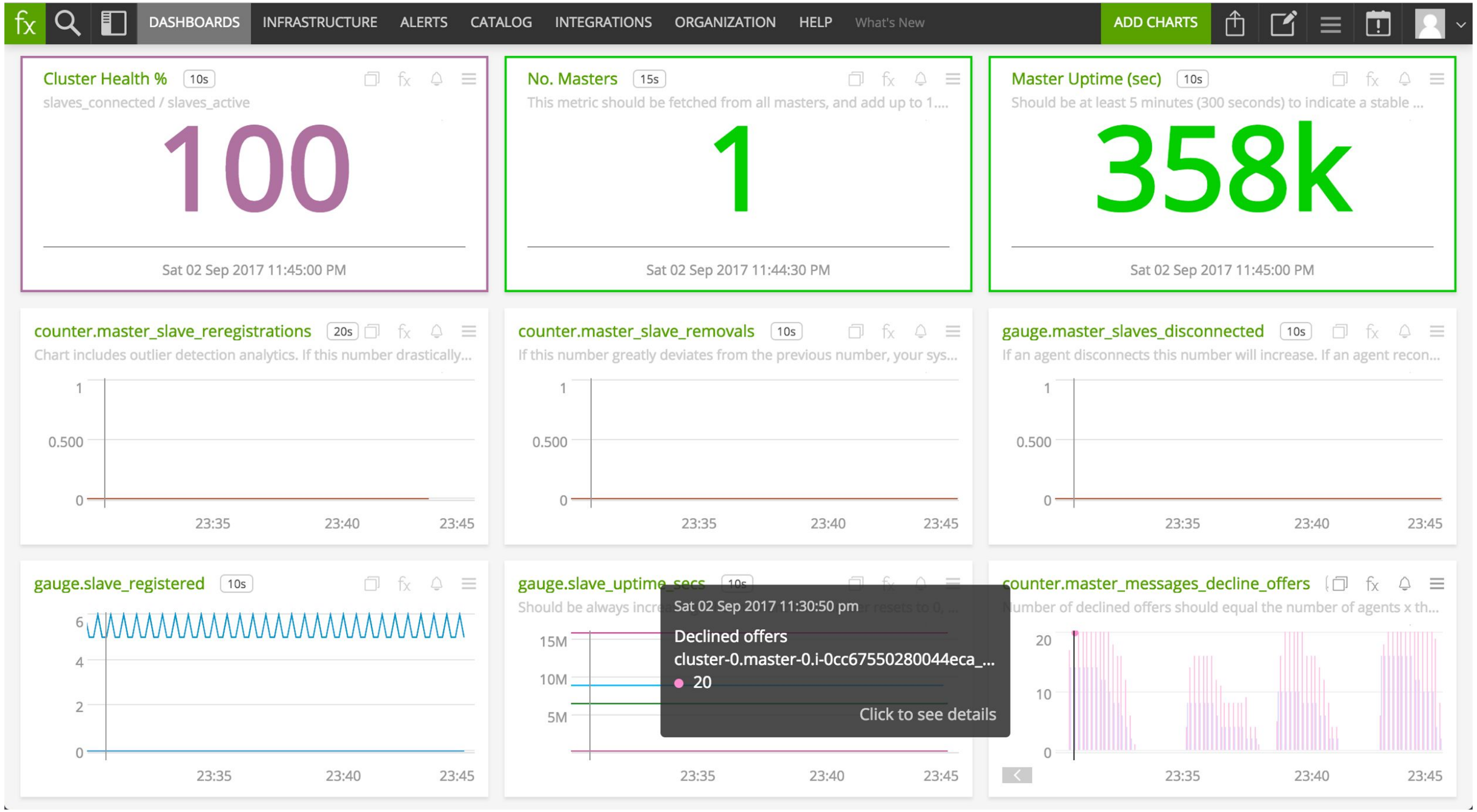
Service Health



Services
mesos-cluster-1
Services

Logrotate... 🟩	Admin Ro... 🟩	Admin Ro... 🟩	DNS Disp... 🟩	Layer 4 L... 🟩	Marathon 🟩	Signal 🟩
Diagnostics 🟩	DNS Disp... 🟩	DNS Disp... 🟩	Erlang Po... 🟩	Admin Ro... 🟩	Mesos DNS 🟩	Signal Ti... 🟩
Exhibitor 🟩	Generate ... 🟩	Generate ... 🟩	Jobs Service 🟩	Logrotate... 🟩	Mesos His... 🟩	
Mesos Ma... 🟩	Navstar 🟩	OAuth 🟩	Package S... 🟩	Pkgpanda... 🟩	Pkgpanda... 🟩	

Problem Indicators



Cluster Health % 10s
slaves_connected / slaves_active
100
Sat 02 Sep 2017 11:45:00 PM

No. Masters 15s
This metric should be fetched from all masters, and add up to 1....
1
Sat 02 Sep 2017 11:44:30 PM

Master Uptime (sec) 10s
Should be at least 5 minutes (300 seconds) to indicate a stable ...
358k
Sat 02 Sep 2017 11:45:00 PM

counter.master_slave_reregistrations 20s
Chart includes outlier detection analytics. If this number drastically...

counter.master_slave_removals 10s
If this number greatly deviates from the previous number, your sys...

gauge.master_slaves_disconnected 10s
If an agent disconnects this number will increase. If an agent recon...

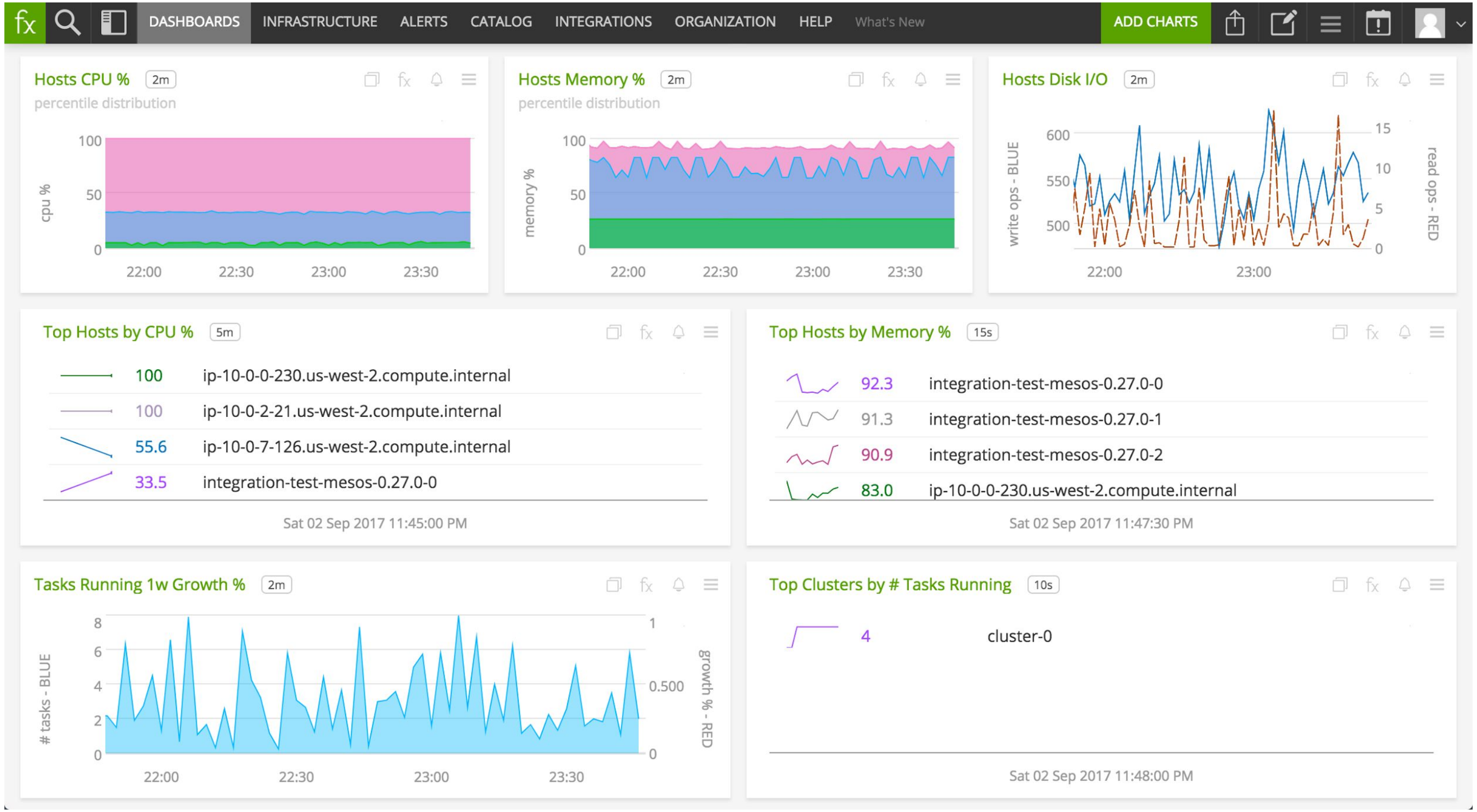
gauge.slave_registered 10s

gauge.slave_uptime_secs 10s
Should be always incre... r resets to 0, ...

Sat 02 Sep 2017 11:30:50 pm
Declined offers
cluster-0.master-0.i-0cc67550280044eca_...
● 20
Click to see details

counter.master_messages_decline_offers
Number of declined offers should equal the number of agents x th...

Cluster Trends



Top Hosts by CPU % 5m

100	ip-10-0-0-230.us-west-2.compute.internal
100	ip-10-0-2-21.us-west-2.compute.internal
55.6	ip-10-0-7-126.us-west-2.compute.internal
33.5	integration-test-mesos-0.27.0-0

Sat 02 Sep 2017 11:45:00 PM

Top Hosts by Memory % 15s

92.3	integration-test-mesos-0.27.0-0
91.3	integration-test-mesos-0.27.0-1
90.9	integration-test-mesos-0.27.0-2
83.0	ip-10-0-0-230.us-west-2.compute.internal

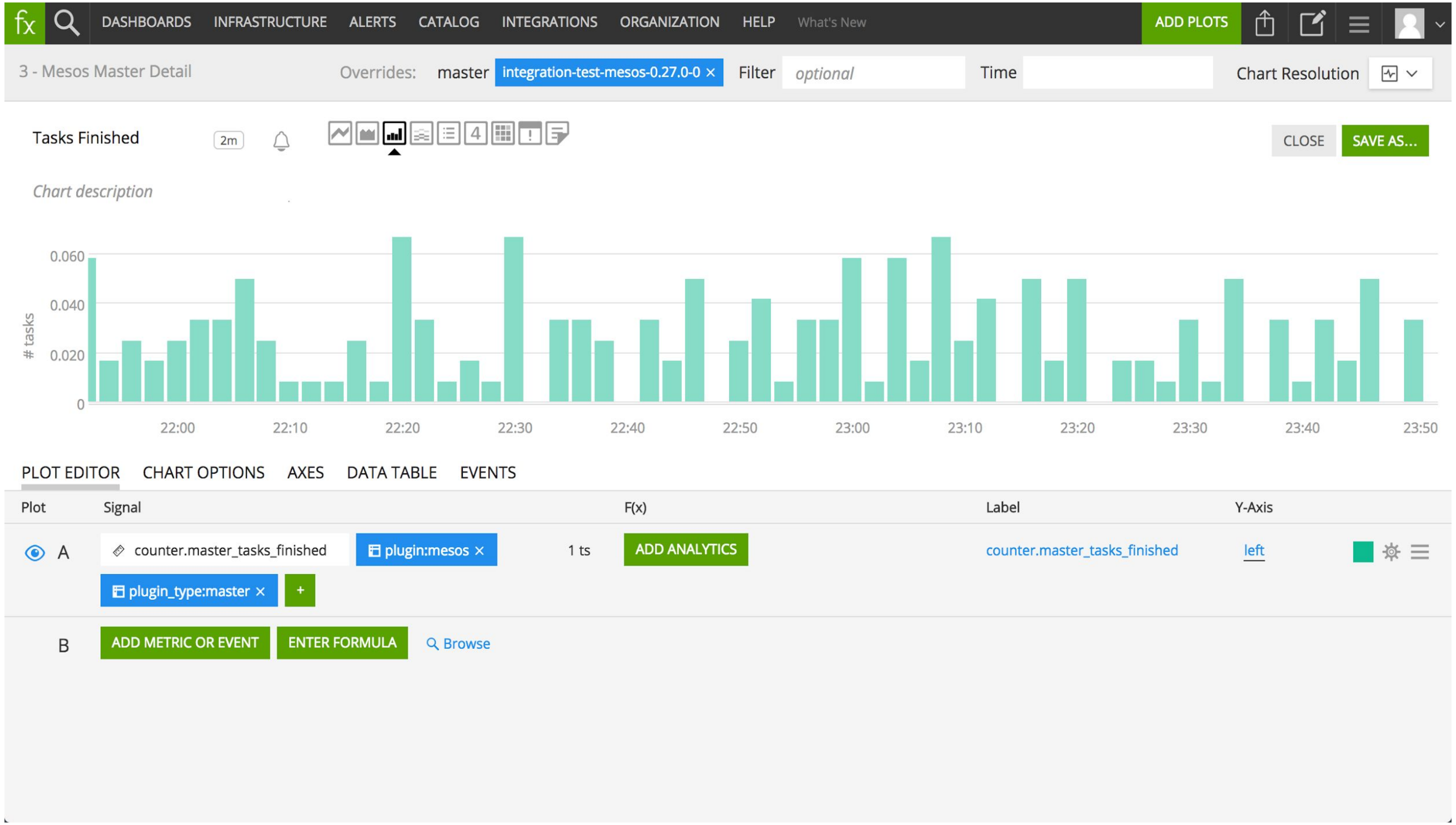
Sat 02 Sep 2017 11:47:30 PM

Top Clusters by # Tasks Running 10s

4	cluster-0

Sat 02 Sep 2017 11:48:00 PM

Filtering by Dimension



3 - Mesos Master Detail

Overrides: master integration-test-mesos-0.27.0-0 × Filter *optional* Time Chart Resolution

Tasks Finished

Plot	Signal		F(x)	Label	Y-Axis
A	counter.master_tasks_finished, plugin:mesos ×, plugin_type:master ×	1 ts	ADD ANALYTICS	counter.master_tasks_finished	left
B	ADD METRIC OR EVENT, ENTER FORMULA, Browse				

Inputs / Outputs

Input: **StatsD**

- Text records: either one-per-packet or newline separated.
- Optional tagging

```
memory.usage_mb:5|g
frontend.query.latency_ms:46|g|#shard_id:6,section:frontpage
```

Pseudocode:

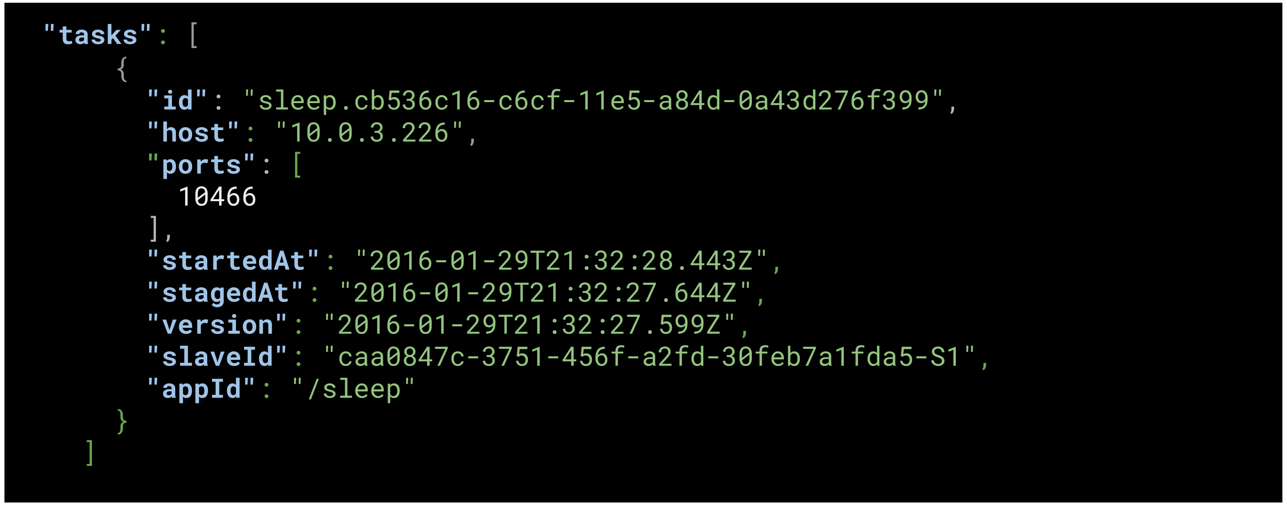
```
if (env["STATSD_UDP_HOST"] and env["STATSD_UDP_PORT"]) {
 // 1. Open UDP socket to the endpoint
 // 2. Send StatsD-formatted metrics
}
```

Output: **Apache Avro**

Marathon App Performance

$ curl <leader.mesos>/marathon/v2/apps/sleep | jq .

- Find the appId (sleep),“host”, and “id” (task ID) fields



```
"tasks": [
    {
      "id": "sleep.cb536c16-c6cf-11e5-a84d-0a43d276f399",
      "host": "10.0.3.226",
      "ports": [
        10466
      ],
      "startedAt": "2016-01-29T21:32:28.443Z",
      "stagedAt": "2016-01-29T21:32:27.644Z",
      "version": "2016-01-29T21:32:27.599Z",
      "slaveId": "caa0847c-3751-456f-a2fd-30feb7a1fda5-S1",
      "appId": "/sleep"
    }
  ]
```

Marathon App Performance

Curl the Agent host and look for the Marathon Task ID from previous step

```
$ curl http://<agent-internal-IP>:5051/monitor/statistics | jq .
```

```
{
    "executor_id": "sleep.cb536c16-c6cf-11e5-a84d-0a43d276f399",
    "executor_name": "Command Executor (Task:
sleep.cb536c16-c6cf-11e5-a84d-0a43d276f399) (Command: sh -c 'env && sleep...')",
    "framework_id": "caa0847c-3751-456f-a2fd-30feb7a1fda5-0000",
    "source": "sleep.cb536c16-c6cf-11e5-a84d-0a43d276f399",
    "statistics": {
      "cpus_limit": 0.2,
      "cpus_system_time_secs": 0,
      "cpus_user_time_secs": 0.01,
      "mem_limit_bytes": 50331648,
      "mem_rss_bytes": 200704
    }
  }
```