Storing metrics at scale with Gnocchi

Julien Danjou – *OpenStack Days UK 2017 – 26 September 2017*

Hello!

I am Julien Danjou

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You can find me at **julien@danjou.info** and **@juldanjou**

I **hack**, **create** and **contribute** to FOSS projects:

What we'll talk about today

- **What is Gnocchi?**
  (history, reasons, features)
- **How does Gnocchi work?**
  (technology, principles)
- **How to use Gnocchi?**
  (install, config, SDK)

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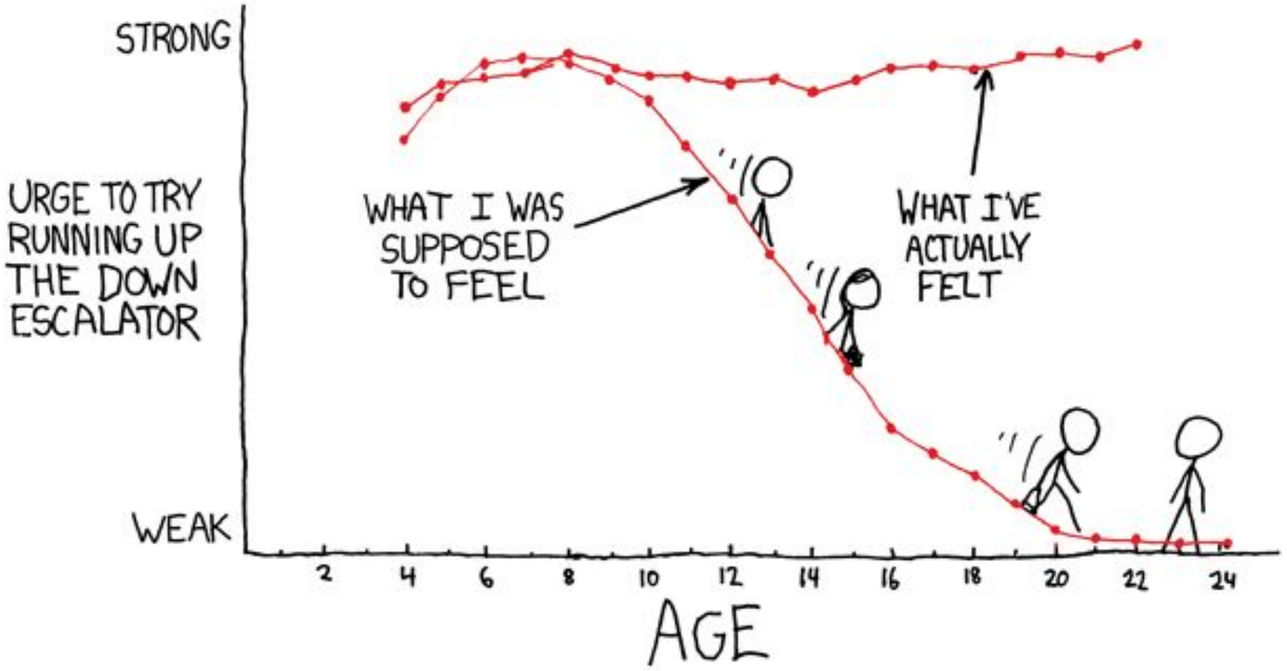
What's Gocchi?

Why is it there?

Time series


STRONG
URGE TO TRY RUNNING UP THE DOWN ESCALATOR
WEAK
WHAT I WAS SUPPOSED TO FEEL
WHAT I'VE ACTUALLY FELT
2
4
6
8
10
12
14
16
18
20
22
24
AGE

Perfect solution

Scalable

Targeting cloud platforms where thousands of instances and resources pop up every day.

Storing and retrieving data should be fast.

Easy to use

Provide an API that makes it easy to program against the solution. Build any kind of solution easily (billing, capacity planning, statistical analysis…)

Easy to operate

Installation and operation should be easy for administrators used to standard UNIX tools.

Existing solutions

- Graphite
  - Not scalable
  - Poor code base
  - Not modulable
- InfluxDB
  - Does not work
  - Does not scale
- OpenTSDB
  - Need to set up Hadoop

…

Gnocchi – started in May 2014

Started in OpenStack Telemetry

Designed to solve Ceilometer storage issue back then.

But work stand-alone since the beginning!

Easy to install

pip install gnocchi

Written in Python

With some standard used libraries (SQLAlchemy, Pandas…)

Free Software

Apache Licensed.

Documented

Everything is documented.

“No doc: no merge” policy.

Distributed & resilient

Design to run on cloud platforms. Native high-availability and workload distribution support.

Awesome features!

Search by metric value, compute aggregations

Look into metrics value and search for outliers.

Compute aggregation across several metrics.

Batching

Send batch of measures in one single HTTP call.

Trigger alarms

Using Aodh to evaluate your alarms.

Compression

Using LZ4 compression to compress data on the fly. Fast, reduce storage usage between x2-5.

Collectd, Nagios & statsd support

If you’re already a Graphite user or you’re polling tool support statsd, it’s drop-in compatible.

Same for Nagios.

Aggregation as first class

Aggregate measures on ingestion rather than on request.

Multi-tenant

ACL that guarantees your different tenants can’t see each other resources. But the admin can see everything. Customizable.

HTTP REST API

That’s what’s used by the `gnocchi’ CLI. Add --debug to discover the HTTP requests, or read the API specs!

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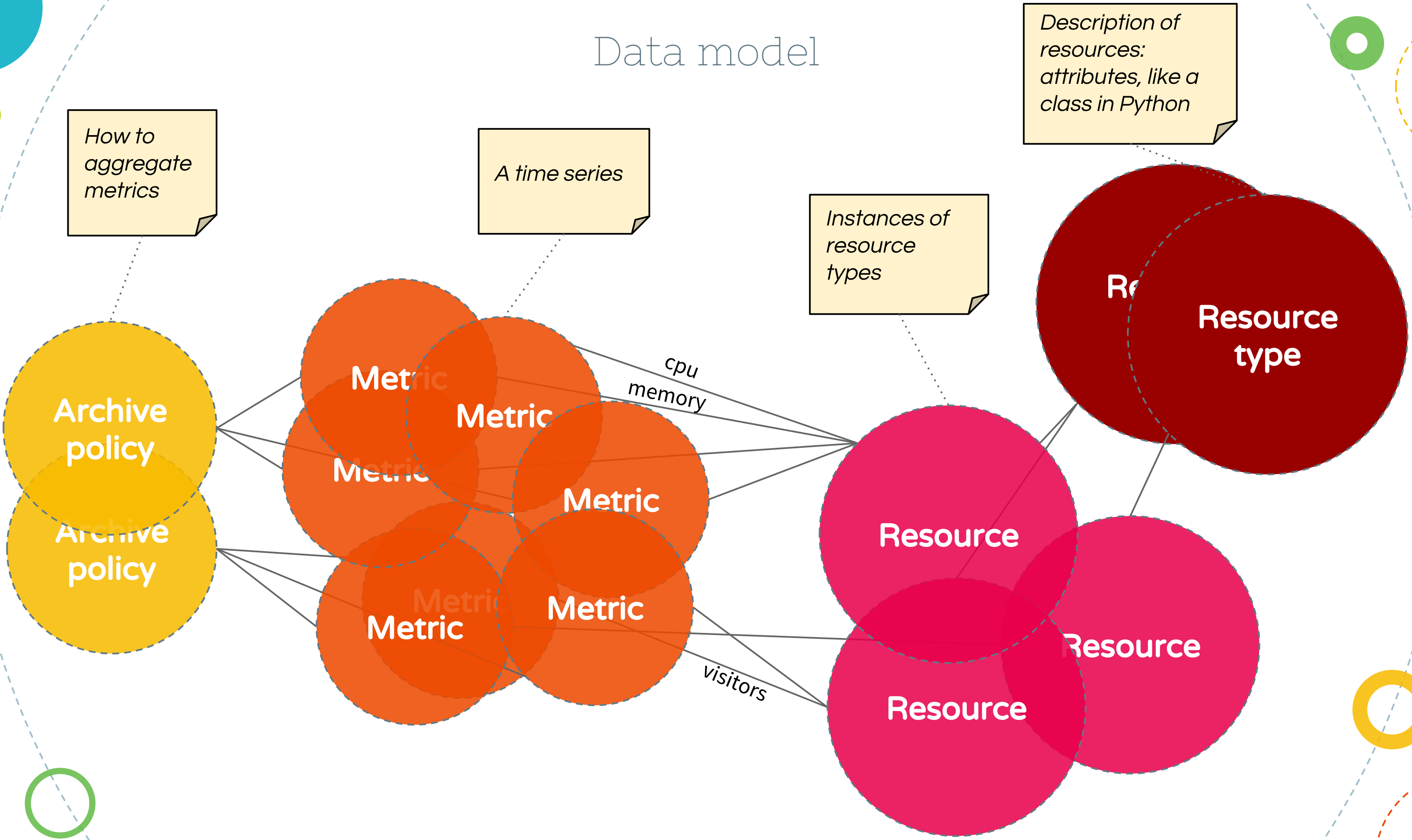
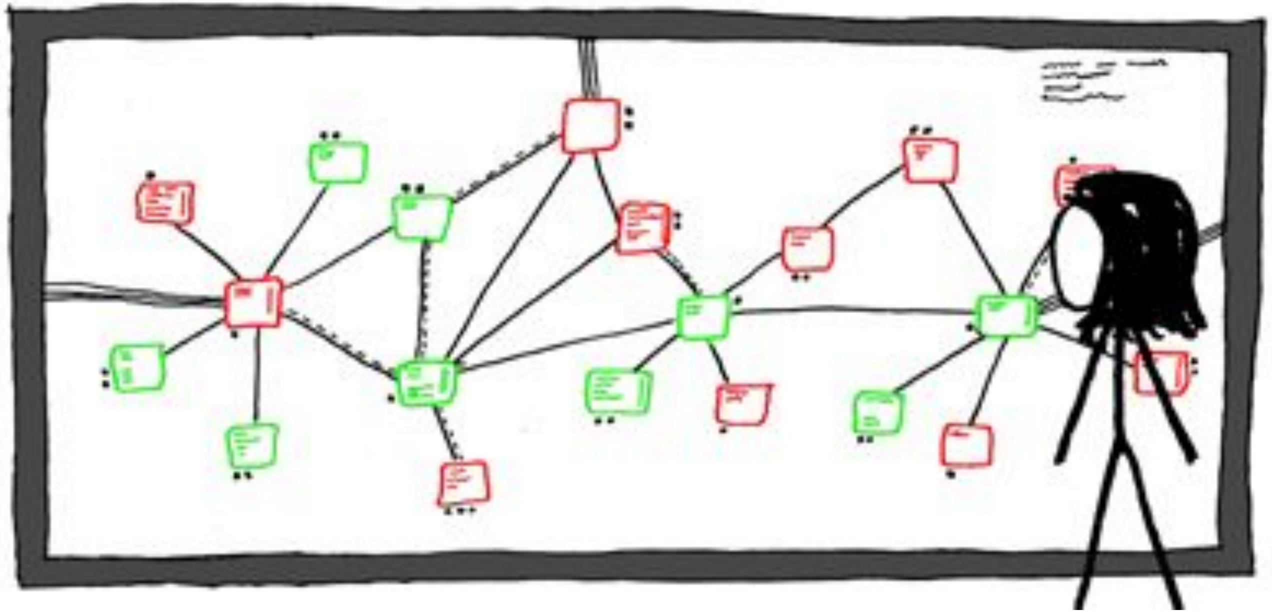
How does it work?

How the magic happens.

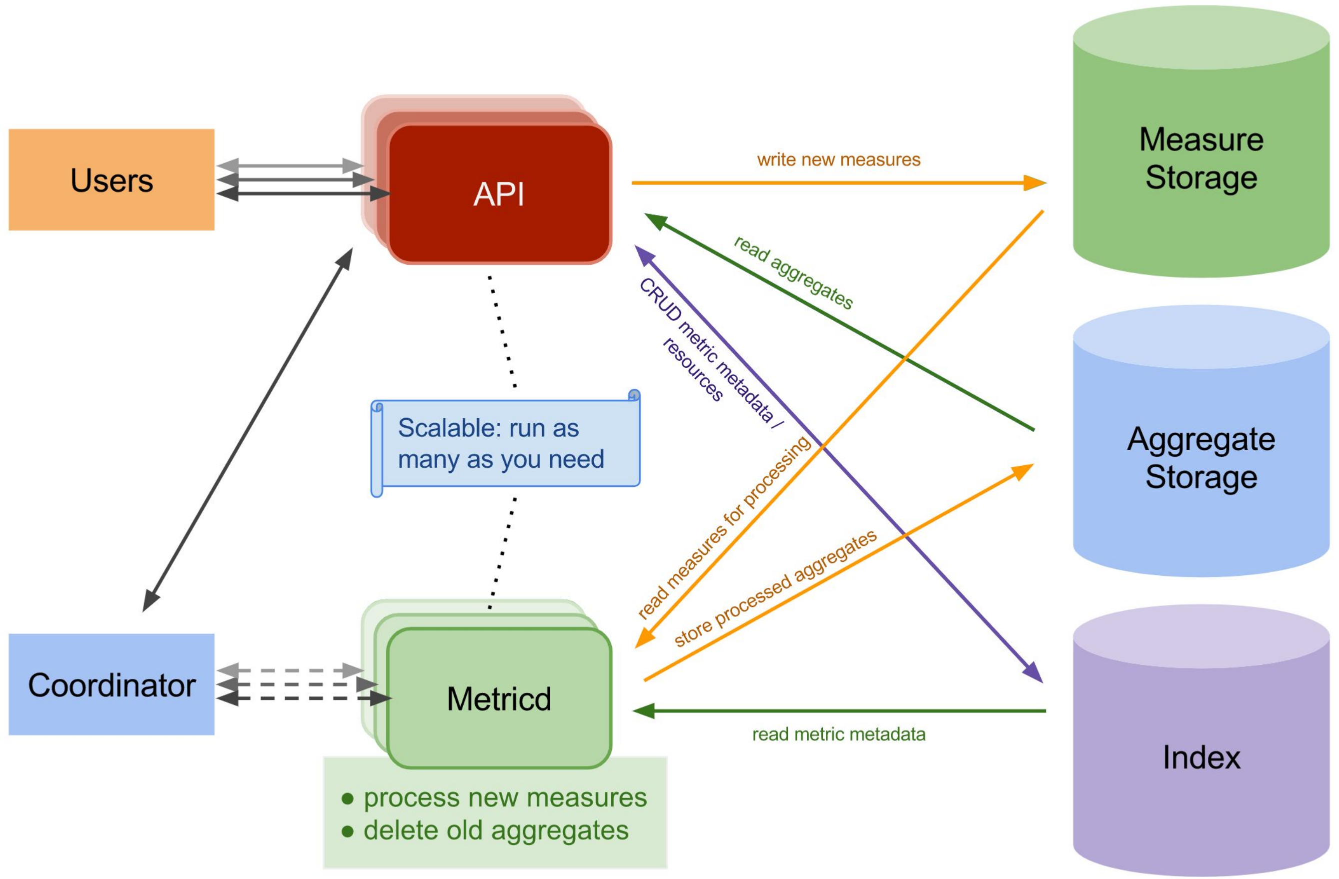
Data model


How to aggregate metrics
A time series
Instances of resource types
Description of resources: attributes, like a class in Python
Archive policy
Archive policy
Metric
Metric
Metric
Metric
Metric
Metric
Metric
cpu
memory
visitors
Resource
Resource
Resource
Resource type

Index



Architecture



Backends

Index

Any RDBMS supported by SQLAlchemy.

Best choice: **PostgreSQL**.

Though **MySQL** is also supported, sigh.

Storage

Simple deployment? **Plain files** (with NFS if you want).

Scalable and robust? Go for **Ceph**.

Got OpenStack? Leverage **Swift**.

On AWS, use **S3**.

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How to use it?

Basic things you need to know

Installation

pip install gnocchi[file,postgresql] gnocchiclient

$EDITOR /etc/gnocchi/gnocchi.conf

Run:
gnocchi-upgrade

Run:
gnocchi-api &
gnocchi-metricd &

List archive policies and create a metric

```
➔ gnocchi archive-policy list
+--------+-------------+-----------------------------------------------------------------------+------------------------------------------------+
| name   | back_window | definition                                                            | aggregation_methods                            |
+--------+-------------+-----------------------------------------------------------------------+------------------------------------------------+
| high   |           0 | - points: 3600, granularity: 0:00:01, timespan: 1:00:00               | std, count, 95pct, min, max, sum, median, mean |
|        |             | - points: 10080, granularity: 0:01:00, timespan: 7 days, 0:00:00      |                                                |
|        |             | - points: 8760, granularity: 1:00:00, timespan: 365 days, 0:00:00     |                                                |
| medium |           0 | - points: 1440, granularity: 0:01:00, timespan: 1 day, 0:00:00        | std, count, 95pct, min, max, sum, median, mean |
|        |             | - points: 168, granularity: 1:00:00, timespan: 7 days, 0:00:00        |                                                |
|        |             | - points: 365, granularity: 1 day, 0:00:00, timespan: 365 days, 0:00:00 |                                              |
| low    |           0 | - points: 12, granularity: 0:05:00, timespan: 1:00:00                 | std, count, 95pct, min, max, sum, median, mean |
|        |             | - points: 24, granularity: 1:00:00, timespan: 1 day, 0:00:00          |                                                |
|        |             | - points: 30, granularity: 1 day, 0:00:00, timespan: 30 days, 0:00:00 |                                                |
+--------+-------------+-----------------------------------------------------------------------+------------------------------------------------+

➔ gnocchi metric create --archive-policy-name low
+------------------------------------+-----------------------------------------------------------------------+
| Field                              | Value                                                                 |
+------------------------------------+-----------------------------------------------------------------------+
| archive_policy/aggregation_methods | std, count, 95pct, min, max, sum, median, mean                        |
| archive_policy/back_window         | 0                                                                     |
| archive_policy/definition          | - points: 12, granularity: 0:05:00, timespan: 1:00:00                 |
|                                    | - points: 24, granularity: 1:00:00, timespan: 1 day, 0:00:00          |
|                                    | - points: 30, granularity: 1 day, 0:00:00, timespan: 30 days, 0:00:00 |
| archive_policy/name                | low                                                                   |
| created_by_project_id              | admin                                                                 |
| created_by_user_id                 | admin                                                                 |
| id                                 | 95fdc8ff-1aed-4dd3-b65b-bfb53f91081b                                  |
| name                               | None                                                                  |
| resource/id                        | None                                                                  |
+------------------------------------+-----------------------------------------------------------------------+
```

Send & retrieve measures

```
➔ gnocchi measures add -m 2016-05-16T12:00:00@42 -m 2016-05-16T12:01:03@45 -m 2016-05-16T12:06:07@22
95fdc8ff-1aed-4dd3-b65b-bfb53f91081b
➔ gnocchi measures show 95fdc8ff-1aed-4dd3-b65b-bfb53f91081b
+---------------------------+-------------+---------------+
| timestamp                 | granularity |         value |
+---------------------------+-------------+---------------+
| 2016-05-16T00:00:00+00:00 |     86400.0 | 36.3333333333 |
| 2016-05-16T12:00:00+00:00 |      3600.0 | 36.3333333333 |
| 2016-05-16T12:00:00+00:00 |       300.0 |          43.5 |
| 2016-05-16T12:05:00+00:00 |       300.0 |          22.0 |
+---------------------------+-------------+---------------+
➔ gnocchi measures show --aggregation min 95fdc8ff-1aed-4dd3-b65b-bfb53f91081b
+---------------------------+-------------+-------+
| timestamp                 | granularity | value |
+---------------------------+-------------+-------+
| 2016-05-16T00:00:00+00:00 |     86400.0 |  22.0 |
| 2016-05-16T12:00:00+00:00 |      3600.0 |  22.0 |
| 2016-05-16T12:00:00+00:00 |       300.0 |  42.0 |
| 2016-05-16T12:05:00+00:00 |       300.0 |  22.0 |
+---------------------------+-------------+-------+
➔ gnocchi measures show --aggregation 95pct 95fdc8ff-1aed-4dd3-b65b-bfb53f91081b
+---------------------------+-------------+-------+
| timestamp                 | granularity | value |
+---------------------------+-------------+-------+
| 2016-05-16T00:00:00+00:00 |     86400.0 |  44.7 |
| 2016-05-16T12:00:00+00:00 |      3600.0 |  44.7 |
| 2016-05-16T12:00:00+00:00 |       300.0 | 44.85 |
| 2016-05-16T12:05:00+00:00 |       300.0 |  22.0 |
+---------------------------+-------------+-------+
```

Create a resource

```
➔ gnocchi resource-type create --attribute name:string --attribute host:string server
+-----------------+----------------------------------------------------------+
| Field           | Value                                                    |
+-----------------+----------------------------------------------------------+
| attributes/host | max_length=255, min_length=0, required=True, type=string |
| attributes/name | max_length=255, min_length=0, required=True, type=string |
| name            | server                                                   |
+-----------------+----------------------------------------------------------+
➔ gnocchi resource create --attribute name:www-42 --attribute host:compute1 --create-metric cpu:medium
--create-metric memory:low --type server `uuidgen`
+-----------------------+----------------------------------------------+
| Field                 | Value                                        |
+-----------------------+----------------------------------------------+
| created_by_project_id | admin                                        |
| created_by_user_id    | admin                                        |
| ended_at              | None                                         |
| host                  | compute1                                     |
| id                    | e4c2eab7-52ed-4447-bbcb-48cb04f12015         |
| metrics               | cpu: d51d8ba3-ab06-4f0c-af6c-d88dbac8c2a8    |
|                       | memory: 0240ceb8-d1d6-435d-a37c-f7f3bf99a388 |
| name                  | www-42                                       |
| original_resource_id  | E4C2EAB7-52ED-4447-BBCB-48CB04F12015         |
| project_id            | None                                         |
| revision_end          | None                                         |
| revision_start        | 2016-05-16T13:35:43.985927+00:00             |
| started_at            | 2016-05-16T13:35:43.985815+00:00             |
| type                  | server                                       |
| user_id               | None                                         |
+-----------------------+----------------------------------------------+
```

Update a resource

```
➔ gnocchi resource update --attribute host:compute2 --type server
e4c2eab7-52ed-4447-bbcb-48cb04f12015
+-----------------------+------------------------------------------------+
| Field                 | Value                                          |
+-----------------------+------------------------------------------------+
| created_by_project_id | admin                                          |
| created_by_user_id    | admin                                          |
| ended_at              | None                                           |
| host                  | compute2                                       |
| id                    | e4c2eab7-52ed-4447-bbcb-48cb04f12015           |
| metrics               | cpu: d51d8ba3-ab06-4f0c-af6c-d88dbac8c2a8      |
|                       | memory: 0240ceb8-d1d6-435d-a37c-f7f3bf99a388   |
| name                  | www-42                                         |
| original_resource_id  | E4C2EAB7-52ED-4447-BBCB-48CB04F12015           |
| project_id            | None                                           |
| revision_end          | None                                           |
| revision_start        | 2016-05-16T13:37:38.140460+00:00               |
| started_at            | 2016-05-16T13:35:43.985815+00:00               |
| type                  | server                                         |
| user_id               | None                                           |
+-----------------------+------------------------------------------------+
```

See previous updates in JSON

```
➔ gnocchi resource history --format json --details e4c2eab7-52ed-4447-bbcb-48cb04f12015
[
  {
    "created_by_user_id": "admin",
    "started_at": "2016-05-16T13:35:43.985815+00:00",
    "user_id": null,
    "revision_end": "2016-05-16T13:37:38.140460+00:00",
    "ended_at": null,
    "created_by_project_id": "admin",
    "metrics": "cpu: d51d8ba3-ab06-4f0c-af6c-d88dbac8c2a8\nmemory: 0240ceb8-d1d6-435d-a37c-f7f3bf99a388",
    "host": "compute1",
    "revision_start": "2016-05-16T13:35:43.985927+00:00",
    "project_id": null,
    "type": "server",
    "id": "e4c2eab7-52ed-4447-bbcb-48cb04f12015",
    "name": "www-42"
  },
  {
    "created_by_user_id": "admin",
    "started_at": "2016-05-16T13:35:43.985815+00:00",
    "user_id": null,
    "revision_end": null,
    "ended_at": null,
    "created_by_project_id": "admin",
    "metrics": "cpu: d51d8ba3-ab06-4f0c-af6c-d88dbac8c2a8\nmemory: 0240ceb8-d1d6-435d-a37c-f7f3bf99a388",
    "host": "compute2",
    "revision_start": "2016-05-16T13:37:38.140460+00:00",
    "project_id": null,
    "type": "server",
    "id": "e4c2eab7-52ed-4447-bbcb-48cb04f12015",
    "name": "www-42"
  }
]
```

Send & get measures on a metric attached to a resource & search

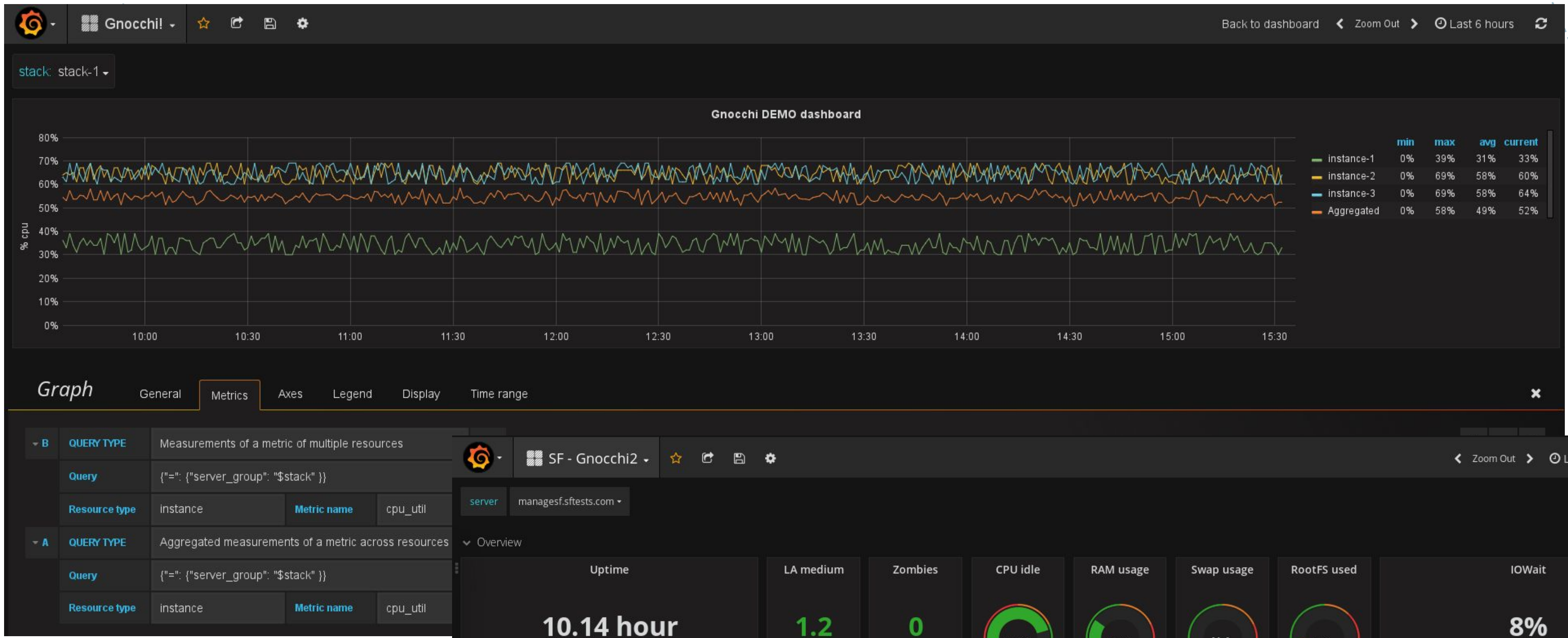
```
➔ gnocchi measures add -m 2016-05-16T12:00:00@42 -m 2016-05-16T12:01:03@45 -m 2016-05-16T12:06:07@22 --resource-id
e4c2eab7-52ed-4447-bbcb-48cb04f12015 cpu
➔ gnocchi measures show --resource-id e4c2eab7-52ed-4447-bbcb-48cb04f12015 cpu
+---------------------------+-------------+---------------+
| timestamp                 | granularity |         value |
+---------------------------+-------------+---------------+
| 2016-05-16T00:00:00+00:00 |     86400.0 | 36.3333333333 |
| 2016-05-16T12:00:00+00:00 |      3600.0 | 36.3333333333 |
| 2016-05-16T12:00:00+00:00 |        60.0 |          42.0 |
| 2016-05-16T12:01:00+00:00 |        60.0 |          45.0 |
| 2016-05-16T12:06:00+00:00 |        60.0 |          22.0 |
+---------------------------+-------------+---------------+
```

```
➔ gnocchi resource search --type server host=compute2
+----------------------------+--------+------------+---------+----------------------------+----------+----------------------------+--------------+
| id                         | type   | project_id | user_id | started_at                 | ended_at | revision_start             | revision_end |
+----------------------------+--------+------------+---------+----------------------------+----------+----------------------------+--------------+
| e4c2eab7-52ed-4447-bbcb-   | server | None       | None    | 2016-05-16T13:35:43.985815 | None     | 2016-05-16T13:37:38.140460+ | None         |
| 48cb04f12015               |        |            |         | +00:00                     |          | 00:00                      |              |
+----------------------------+--------+------------+---------+----------------------------+----------+----------------------------+--------------+
```

Using in your Python app

```
from gnocchiclient import auth
from gnocchiclient import client

# Create connection to gnocchi
g = client.Client(version=1, auth=auth.GnocchiBasicPlugin("admin", "http://localhost:8041"))

# Create an orphan metric
metric = g.metric.create({"archive_policy_name": "low"})

# Send some measures to it
g.metric.add_measures(metric["id"], [{"timestamp": "2017-02-05 10:00:00", "value": 42}])

# Create a generic resource called myapp that have a visitor metrics
resource = g.resource.create("generic", {"id": "myapp", "metrics": {"visitors": {}}})

# Send the current number of visitors on our app
g.metric.add_measures("visitors", [{"timestamp": "2017-02-05 10:00:00", "value": 42}, {"timestamp": "2017-02-05 10:01:00", "value": 34}],
resource_id="myapp", )

# Get maximum of visitors over an hour, equivalent to:
# $ gnocchi measures show -f json --resource-id myapp --aggregation max --granularity=300 visitors
measures = g.metric.get_measures("visitors", resource_id="myapp", aggregation="max", granularity=300)
# [
#   {
#     "timestamp": "2017-02-05T10:00:00+00:00",
#     "value": 42.0,
#     "granularity": 300.0
#   }
# ]
```

Grafana support

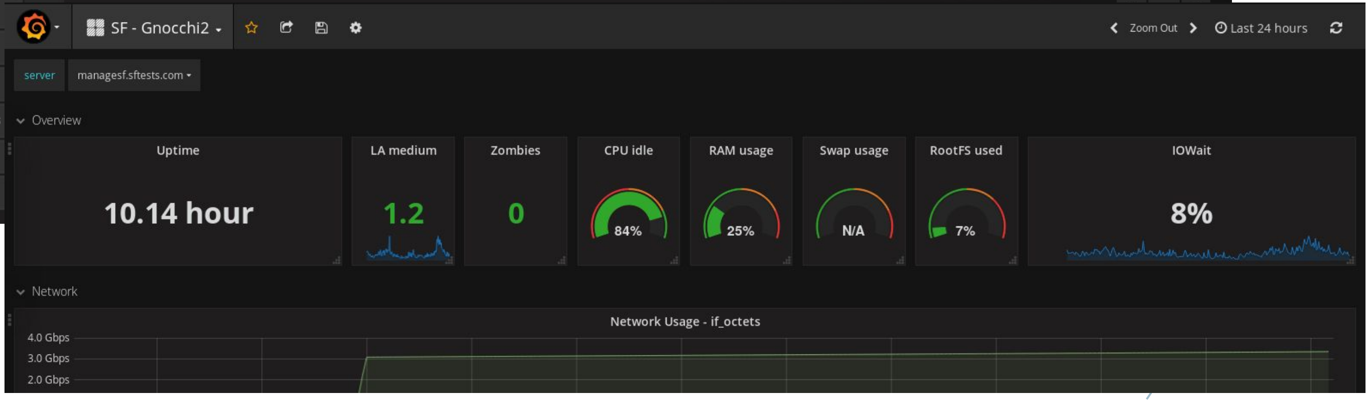


stack: stack-1

	min	max	avg	current
instance-1	0%	39%	31%	33%
instance-2	0%	69%	58%	60%
instance-3	0%	69%	58%	64%
Aggregated	0%	58%	49%	52%

B
QUERY TYPE: Measurements of a metric of multiple resources
Query: {"=": {"server_group": "$stack" }}
Resource type: instance
Metric name: cpu_util

A
QUERY TYPE: Aggregated measurements of a metric across resources
Query: {"=": {"server_group": "$stack" }}
Resource type: instance
Metric name: cpu_util



server: managesf.sftests.com

Uptime	LA medium	Zombies	CPU idle	RAM usage	Swap usage	RootFS used	IOWait
10.14 hour	1.2	0	84%	25%	N/A	7%	8%

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Performances

Does it scale?

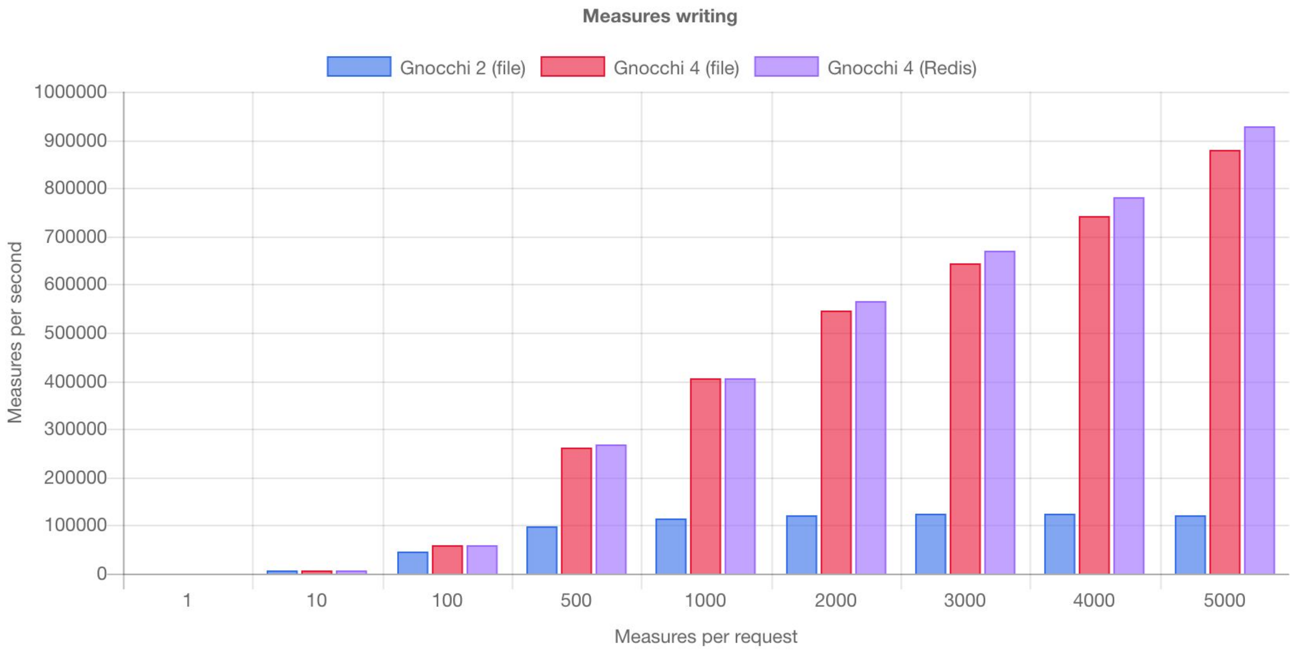
Write throughput

Hardware:
12 cores Xeon 1.9 GHz
1 SSD
32 GB RAM

Capacity:
Incoming: 1 million measures/s
Aggregation: 8400 measures/s

=

50 400 servers
@ 1 minute polling interval



Full report: https://julien.danjou.info/blog/2017/gnocchi-4-performances

Thanks!

http://gnocchi.xyz

#gnocchi @ Freenode

Any questions?

You can find me at @juldanjou and julien@danjou.info