OpenStack Gnocchi

Metric as a Service
Scalable timeseries database and resource index

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on *28th September 2015*
at *OpenStack Paris meetup #16*

OpenStack developer since 2011

Principal Software Engineer
since 2014

Free Software Hacker since 1998

(Debian, awesome, GNU Emacs, Python…)

Author of
The Hacker's Guide to Python

Why?

Is it the NIH syndrom again?

History of the Gnocchi project as told by the guy who did the first commit.

Ceilometer meters your OpenStack cloud.

Ceilometer stores a lot of data.

Too much data.

Thinking about the problem.

Landscape of solutions.
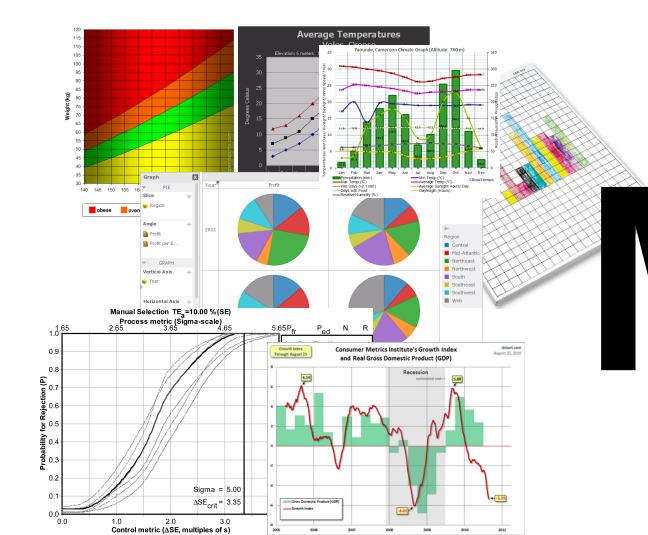
Making Gnocchi!

How does it work?

And does it work?

How we built a scalable metric storage system and a resource index for the cloud.

host = host1

name = www-1

started_at = 2015-07-23 23:34:54

ended_at = None

user_id = f00-b4r-b33f

server_group = mystack

Resource

Indexer

Storage

Stores timestamp/values of metric

Resource generic

Resource instance

Resource instance

Resource disk

Metric foobar

Metric cpu.util

Metric memory

Metric cpu.util

Metric memory

Metric usage

Stores metadata information abouts resources and metrics and their relationships
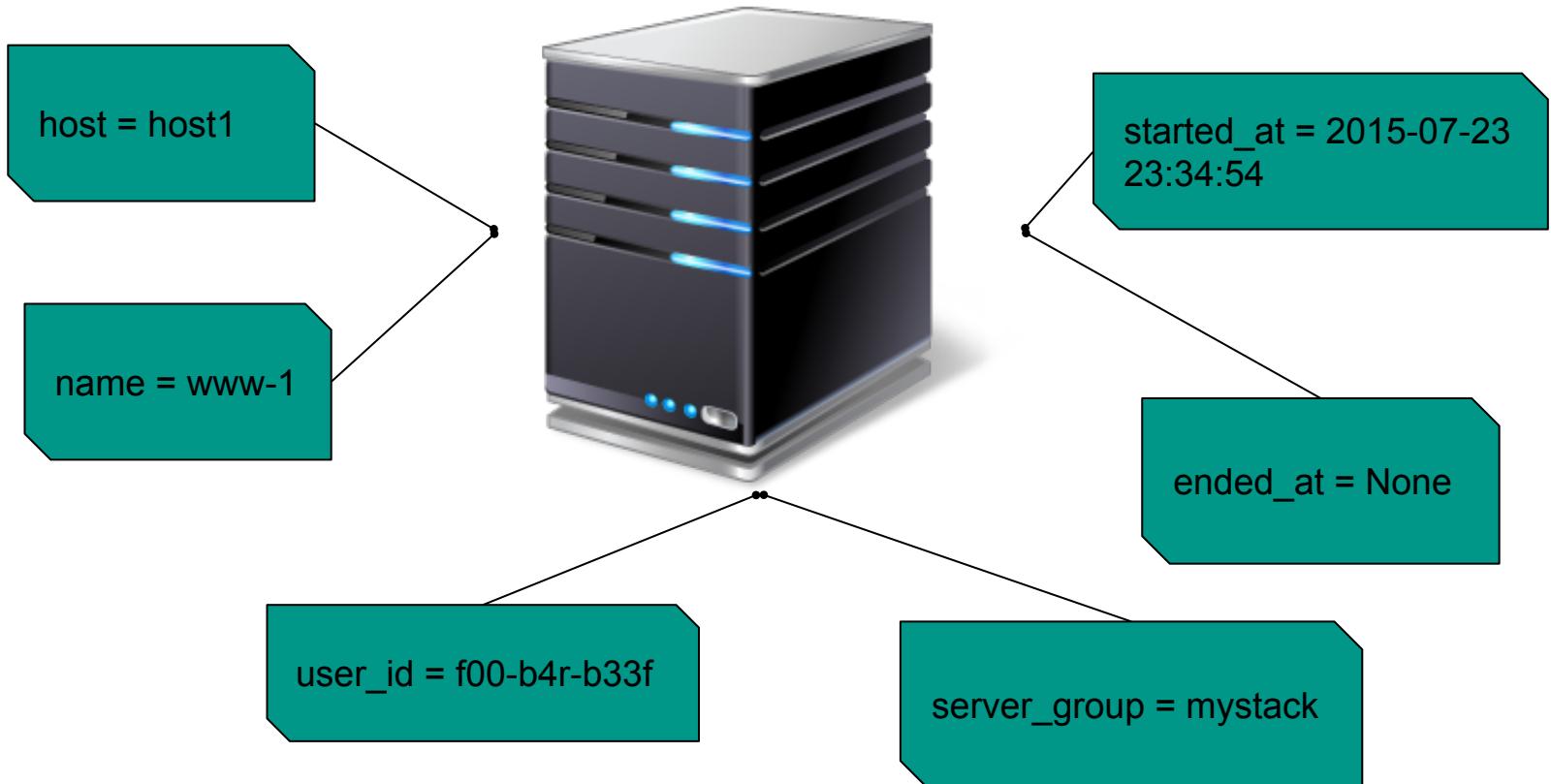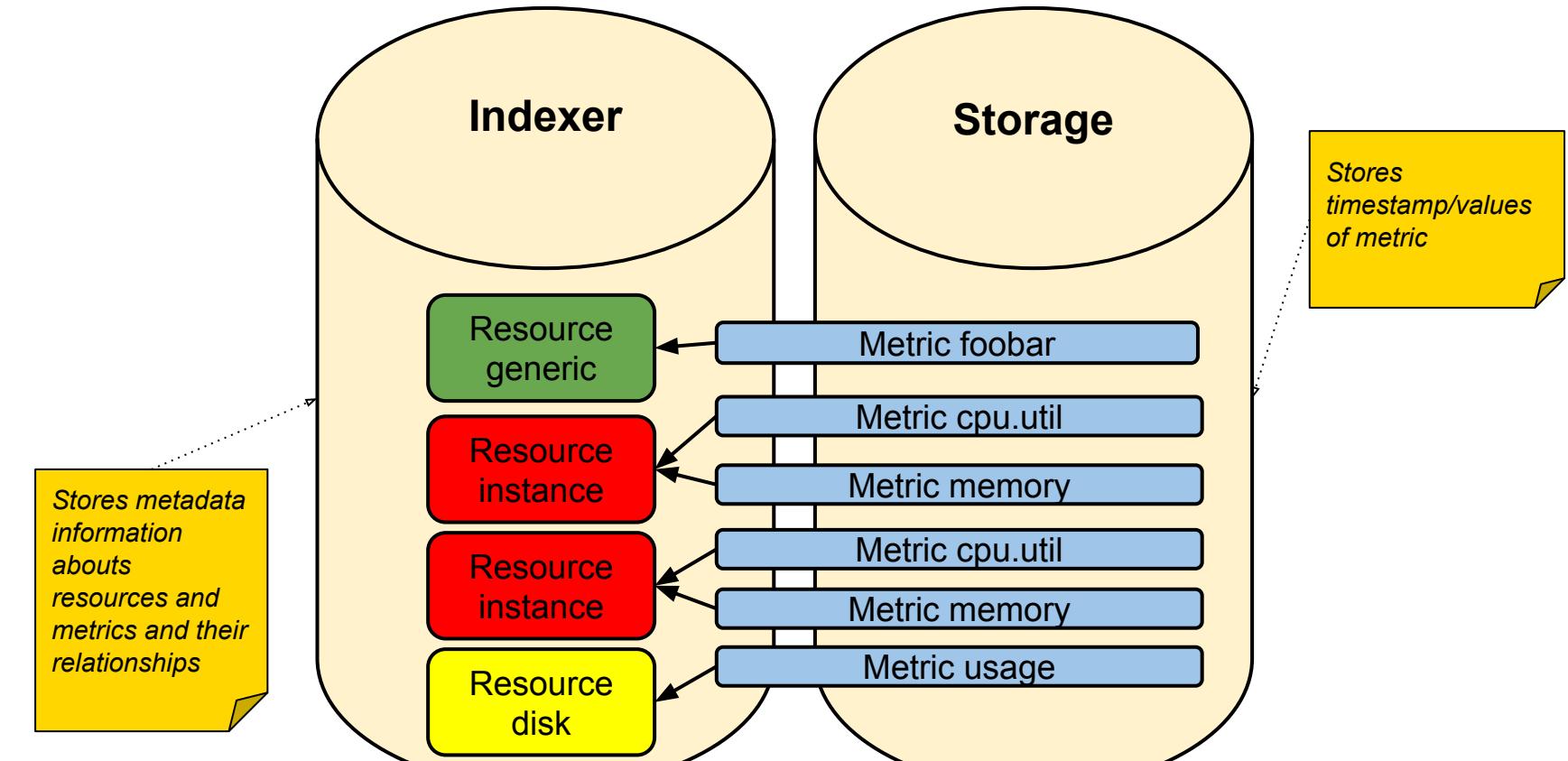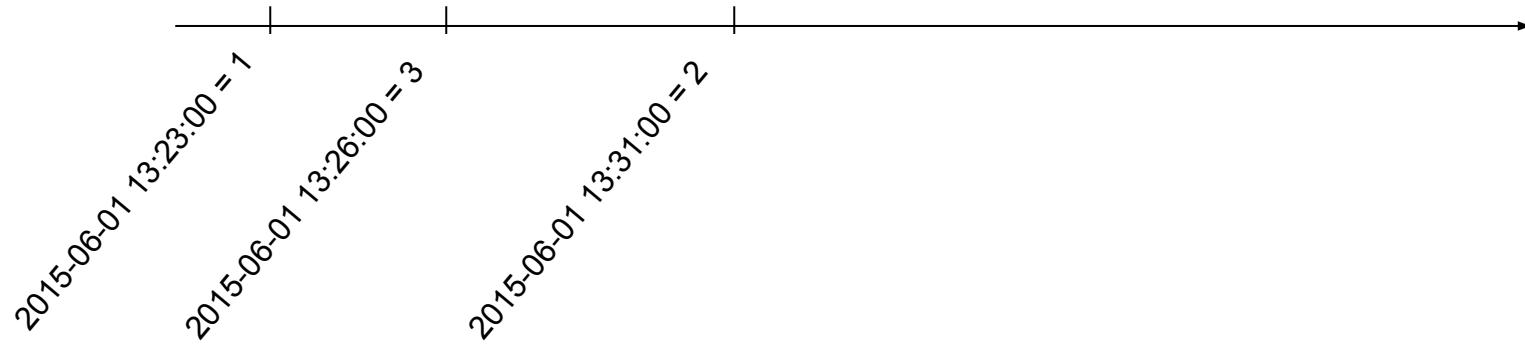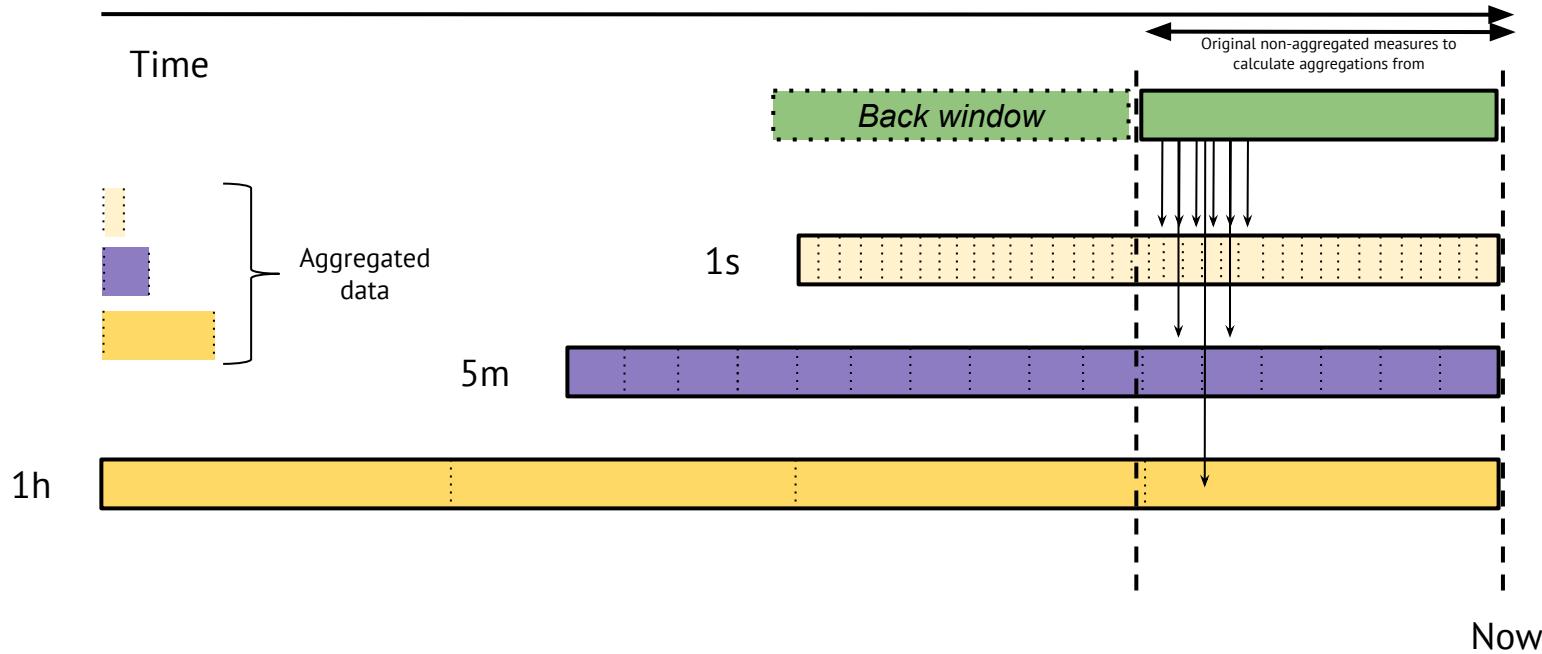
Metric & resources relationship

2015-06-01 13:23:00 = 1

2015-06-01 13:26:00 = 3

2015-06-01 13:31:00 = 2

+　name
+　resource

Metric

Time

Original non-aggregated measures to calculate aggregations from

Back window

Aggregated data

1s

5m

1h

Now

Archive policy

Archive policy creation

POST **/v1/archive_policy** **HTTP**/1.1

```
{
  "back_window": 0,
  "definition": [
    { "granularity": "1s", "timespan": "1 hour" },
    { "points": 48, "timespan": "1 day" }
  ],
  "name": "low"
}
```

HTTP/1.1 201 Created
Location: http://localhost/v1/archive_policy/low
Content-Type: application/json; charset=UTF-8

```
{
  "aggregation_methods": [
    "median", "mean", "count", "min", "sum", "max", "std", "95pct"
  ],
  "back_window": 0,
  "definition": [
    { "granularity": "0:00:01", "points": 3600, "timespan": "1:00:00" },
    { "granularity": "0:30:00","points": 48, "timespan": "1 day, 0:00:00" }
  ],
  "name": "low"
}
```

Create a metric

POST **/v1/metric HTTP**/1.1
Content-Type: application/json

```
{
  "archive_policy_name": "low"
}
```

HTTP/1.1 201 Created
Location: http://localhost/v1/metric/26863efb-9bb5-46f1-851b-f65360a68d42

Content-Type: application/json; charset=UTF-8

```
{
  "archive_policy_name": "low",
  "created_by_project_id": "b8fdbdc6-8ad1-4b5f-ba19-7b97b0788fd6",
  "created_by_user_id": "cc095a10-9526-4457-aa61-38693ab10f26",
  "id": "26863efb-9bb5-46f1-851b-f65360a68d42",
  "name": null,
  "resource_id": null
}
```

View a metric

GET **/v1/metric/26863efb-9bb5-46f1-851b-f65360a68d42 HTTP**/1.1

HTTP/1.1 200 OK
Content-Length: 502
Content-Type: application/json; charset=UTF-8

```
{
  "archive_policy": "low",
  "created_by_project_id": "b8fdbdc6-8ad1-4b5f-ba19-7b97b0788fd6",
  "created_by_user_id": "cc095a10-9526-4457-aa61-38693ab10f26",
  "id": "26863efb-9bb5-46f1-851b-f65360a68d42",
  "name": null,
  "resource": null
}
```

Send measures to a metric

POST **/v1/metric/26863efb-9bb5-46f1-851b-f65360a68d42/measures** **HTTP**/1.1
Content-Type: application/json

```
[
  { "timestamp": "2014-10-06T14:33:57", "value": 43.1 },
  { "timestamp": "2014-10-06T14:34:12", "value": 12 },
  { "timestamp": "2014-10-06T14:34:20", "value": 2 }
]
```

HTTP/1.1 202 Accepted

Get measures from a metric

GET **/v1/metric/f29e6a1f-519d-434e-b72f-087b4a68e0e9/measures** **HTTP**/1.1

HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

```
[
  [ "2014-10-06T14:30:00+00:00", 1800.0, 19.033 ],
  [ "2014-10-06T14:33:57+00:00", 1.0, 43.1 ],
  [ "2014-10-06T14:34:12+00:00", 1.0, 12.0 ],
  [ "2014-10-06T14:34:20+00:00", 1.0, 2.0 ]
]
```

Get measures from a metric (max + start)

GET **/v1/metric/f29e6a1f-519d-434e-b72f-087b4a68e0e9/measures?**
start=2014-10-06T14:34&aggregation=max HTTP/1.1

HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

```
[
  [ "2014-10-06T14:34:12+00:00", 1.0, 12.0 ],
  [ "2014-10-06T14:34:20+00:00", 1.0, 2.0 ]
]
```

Search metric with values

POST **/v1/search/metric?metric_id=f29e6a1f-519d-434e-b72f-087b4a68e0e9** **HTTP**/1.1
Content-Type: application/json

```
{
  "and": [
    { ">=": [ { "+": 23 }, 50 ] },
    { "!=": 55 }
  ]
}
```
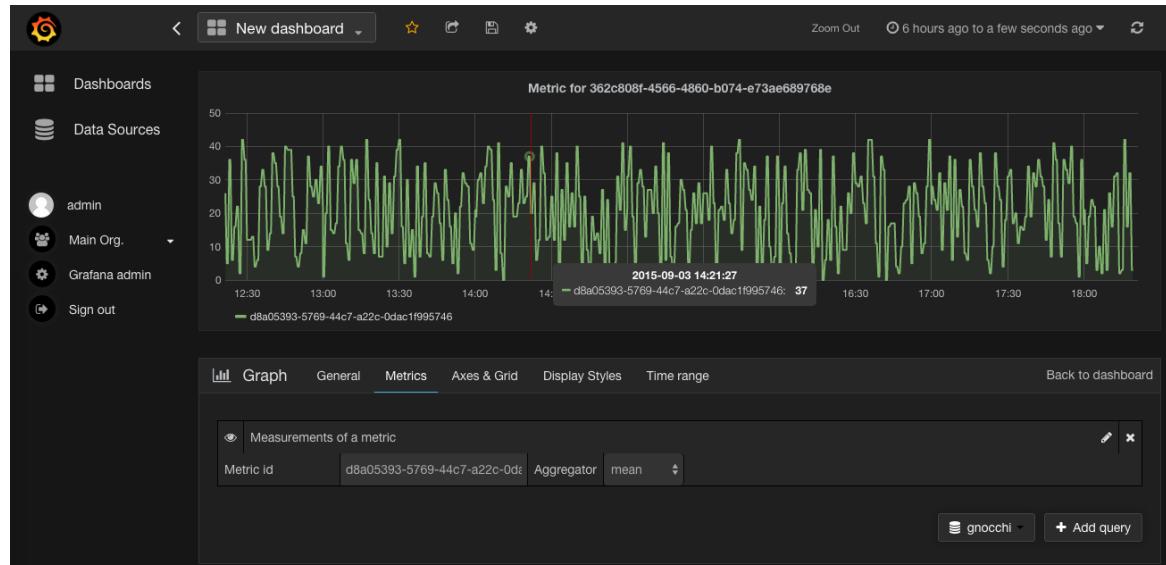
HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

```
{
  "f29e6a1f-519d-434e-b72f-087b4a68e0e9": [
    [ "2014-10-06T14:33:57+00:00", 1.0, 43.1 ]
  ]
}
```

And more...

- Aggregation across metrics
- Archive policy rules
- Visualization !

Resource creation

POST **/v1/resource/generic HTTP**/1.1
Content-Type: application/json

```
{
  "id": "75C44741-CC60-4033-804E-2D3098C7D2E9",
  "project_id": "BD3A1E52-1C62-44CB-BF04-660BD88CD74D",
  "user_id": "BD3A1E52-1C62-44CB-BF04-660BD88CD74D"
}
```

HTTP/1.1 201 Created
Location: http://localhost/v1/resource/generic/75c44741-cc60-4033-804e-2d3098c7d2e9
ETag: "09a41c6f84e35b149c52efd498f3ccefed522c65"
Last-Modified: Thu, 17 Sep 2015 13:05:00 GMT
Content-Type: application/json; charset=UTF-8

```
{
  "created_by_project_id": "2c5d2df4-a781-4fdf-bea9-e7e72697ddb0",
  "created_by_user_id": "ec0dfba4-c842-4c2b-bb4e-d9516e09f6ff",
  "ended_at": null,
  "id": "75c44741-cc60-4033-804e-2d3098c7d2e9",
  "metrics": {},
  "project_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d",
  "revision_end": null,
  "revision_start": "2015-09-17T13:05:00.911362+00:00",
  "started_at": "2015-09-17T13:05:00.911329+00:00",
  "type": "generic",
  "user_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d"
}
```

Metric & resource association

POST **/v1/resource/instance** **HTTP**/1.1
Content-Type: application/json

```
{
  "display_name": "myvm2",
  "flavor_id": "2",
  "host": "compute1",
  "id": "6F24EDD9-5A2F-4592-B708-
FFBED821C5D2",
  "image_ref": "http://image",
  "metrics": {
    "cpu.util": "1848ef8d-29c7-4a14-bf0c-
1bd117390df8"
  },
  "project_id": "BD3A1E52-1C62-44CB-BF04-
660BD88CD74D",
  "server_group": "my_autoscaling_group",
  "user_id": "BD3A1E52-1C62-44CB-BF04-
660BD88CD74D"
}
```

HTTP/1.1 201 Created
Location: http://localhost/v1/resource/instance/6f24edd9-5a2f-4592-b708-ffbed821c5d2
ETag: "5cd7f12ef36bd470017a56f626cfa807295c9915"
Last-Modified: Thu, 24 Sep 2015 15:15:05 GMT
Content-Type: application/json; charset=UTF-8

```
{
  "created_by_project_id": "7e88b91f-91eb-4024-baa5-67b20197ef64",
  "created_by_user_id": "4d1c24a6-5155-47f1-b94a-9a0dd06f09a8",
  "display_name": "myvm2",
  "ended_at": null,
  "flavor_id": "2",
  "host": "compute1",
  "id": "6f24edd9-5a2f-4592-b708-ffbed821c5d2",
  "image_ref": "http://image",
  "metrics": {
    "cpu.util": "1848ef8d-29c7-4a14-bf0c-1bd117390df8"
  },
  "project_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d",
  "revision_end": null,
  "revision_start": "2015-09-24T15:15:05.272964+00:00",
  "server_group": "my_autoscaling_group",
  "started_at": "2015-09-24T15:15:05.272946+00:00",
  "type": "instance",
  "user_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d"
}
```

Resource modification

PATCH **/v1/resource/instance/6868da77-fa82-4e67-aba9-270c5ae8cbca HTTP**/1.1

Content-Type: application/json

```
{
  "host": "compute2"
}
```

HTTP/1.1 200 OK
ETag: "42b0024811f68c352b6125894574e14824cc35cd"
Last-Modified: Thu, 17 Sep 2015 13:05:01 GMT
Content-Type: application/json; charset=UTF-8

```
{
  "created_by_project_id": "2c5d2df4-a781-4fdf-bea9-e7e72697ddb0",
  "created_by_user_id": "ec0dfba4-c842-4c2b-bb4e-d9516e09f6ff",
  "display_name": "myvm",
  "ended_at": "2014-01-04T10:00:12+00:00",
  "flavor_id": "2",
  "host": "compute2",
  "id": "6868da77-fa82-4e67-aba9-270c5ae8cbca",
  "image_ref": "http://image",
  "metrics": {},
  "project_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d",
  "revision_end": null,
  "revision_start": "2015-09-17T13:05:01.141250+00:00",
  "server_group": null,
  "started_at": "2014-01-02T23:23:34+00:00",
  "type": "instance",
  "user_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d"
}
```

Resource history

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

[
  {
    "display_name": "myvm",
    "ended_at": "2014-01-04T10:00:12+00:00",
    "flavor_id": "2",
    "host": "compute1",
    "id": "6868da77-fa82-4e67-aba9-270c5ae8cbca",
    "image_ref": "http://image",
    "metrics": {},
    "revision_end": "2015-09-24T15:15:04.946615+00:00",
    "revision_start": "2015-09-24T15:15:04.714339+00:00",
    "started_at": "2014-01-02T23:23:34+00:00",
    "type": "instance"
  },
  {
    "display_name": "myvm",
    "ended_at": "2014-01-04T10:00:12+00:00",
    "flavor_id": "2",
    "host": "compute2",
    "id": "6868da77-fa82-4e67-aba9-270c5ae8cbca",
    "image_ref": "http://image",
    "metrics": {},
    "revision_end": null,
    "revision_start": "2015-09-24T15:15:04.946615+00:00",
    "started_at": "2014-01-02T23:23:34+00:00",
    "type": "instance"
  }
]
```

Resource search

```
POST /v1/search/resource/instance HTTP/1.1
Content-Type: application/json

{
  "and": [
    { "=": { "user_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d" } },
    { ">=": { "started_at": "2010-01-01" } }
  ]
}
```

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

[
  {
    "created_by_project_id": "2c5d2df4-a781-4fdf-bea9-e7e72697ddb0",
    "created_by_user_id": "ec0dfba4-c842-4c2b-bb4e-d9516e09f6ff",
    "display_name": "myvm",
    "ended_at": "2014-01-04T10:00:12+00:00",
    "flavor_id": "2",
    "host": "compute1",
    "id": "6868da77-fa82-4e67-aba9-270c5ae8cbca",
    "image_ref": "http://image",
    "metrics": {},
    "project_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d",
    "revision_end": null,
    "revision_start": "2015-09-17T13:05:00.933288+00:00",
    "server_group": null,
    "started_at": "2014-01-02T23:23:34+00:00",
    "type": "instance",
    "user_id": "bd3a1e52-1c62-44cb-bf04-660bd88cd74d"
  }
]
```

Aggregation across metrics

POST **/v1/aggregation/resource/instance/metric/cpu.util?start=2014-10-06T14:34&aggregation=mean**
**HTTP**/1.1
Content-Type: application/json
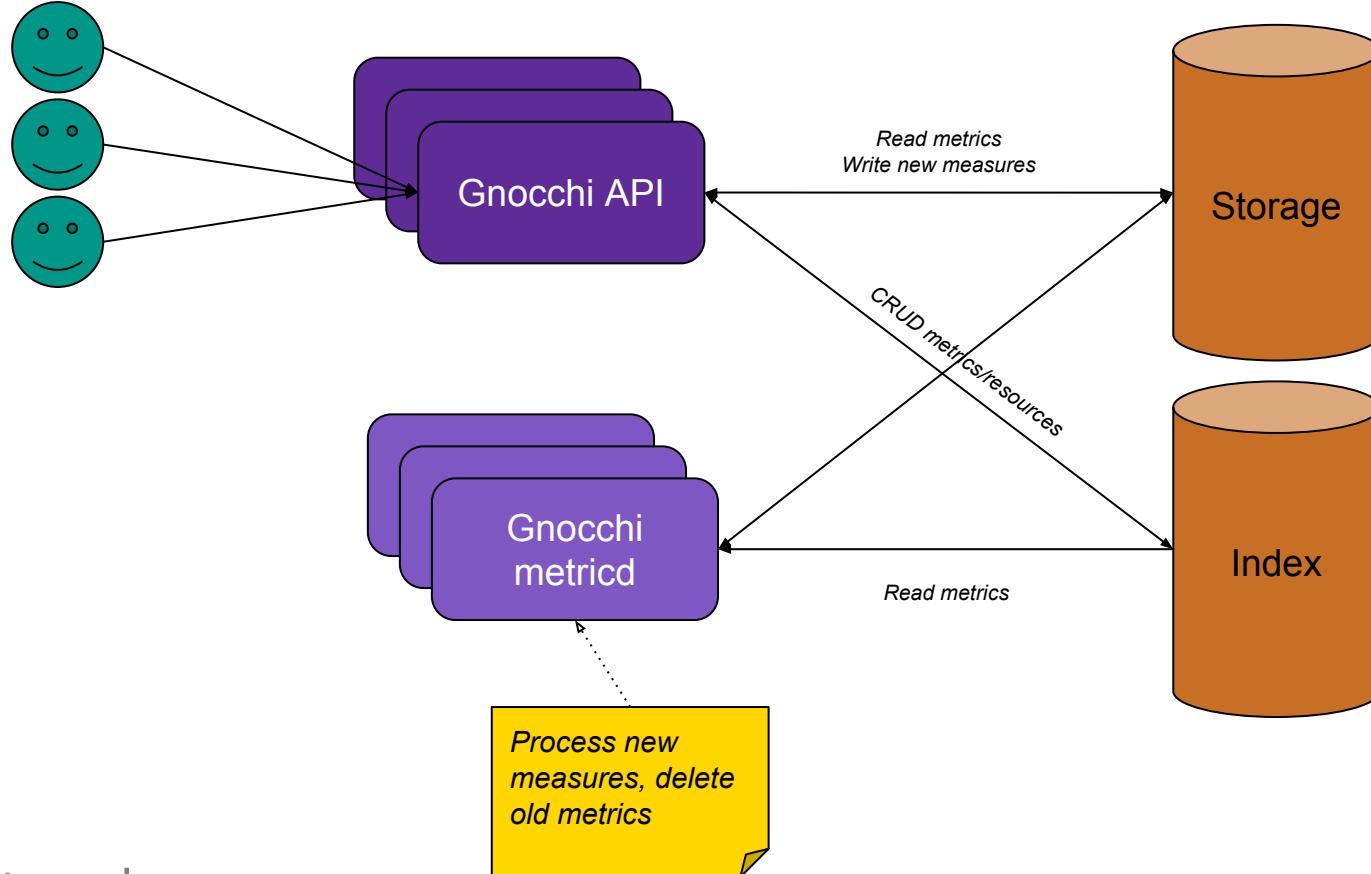
```
{
  "=": {
    "server_group": "my_autoscaling_group"
  }
}
```

HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8

```
[
  [ "2014-10-06T14:34:12+00:00", 1.0, 12.25 ],
  [ "2014-10-06T14:34:20+00:00", 1.0, 11.6 ]
]
```

How it works

Key design points

- Fast & scalable
  - metric retrieval O(1)
  - resources indexed with proper datatypes
  - metric asynchronous write
- Pluggable
  - Indexer drivers: PostgreSQL (recommended), MySQL
  - Storage drivers: file, Swift, Ceph or InfluxDB
  - Custom aggregations functions
  - Works with or without Keystone
- Documentation in-tree
- Documentation auto-generated
- Multi-tenant
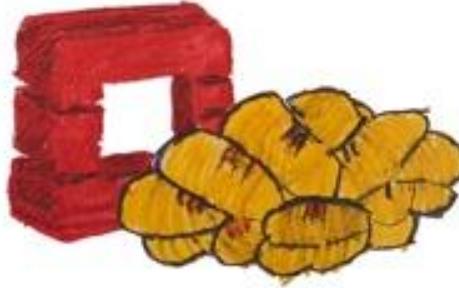
Can I use it?

- Devstack support
- pip install
- Packaged in Red Hat, Debian…
- Default configuration that works
- Support in Ceilometer (Liberty)
- Statsd support
- Entirely documented in-tree
- Gnocchi client available
- Python client SDK

Roadmap

- Better extension system for custom resource types
- Search resources based on metric values
- Improve large data support in Carbonara
- Grafana support in core

OpenStack Gnocchi

Homepage: http://launchpad.net/gnocchi

Git: https://git.openstack.org/cgit/openstack/gnocchi/

Docs: http://docs.openstack.org/developer/gnocchi/

IRC: #openstack-ceilometer@freenode