



**HP**  
**Helion**

**rackspace**  
HOSTING

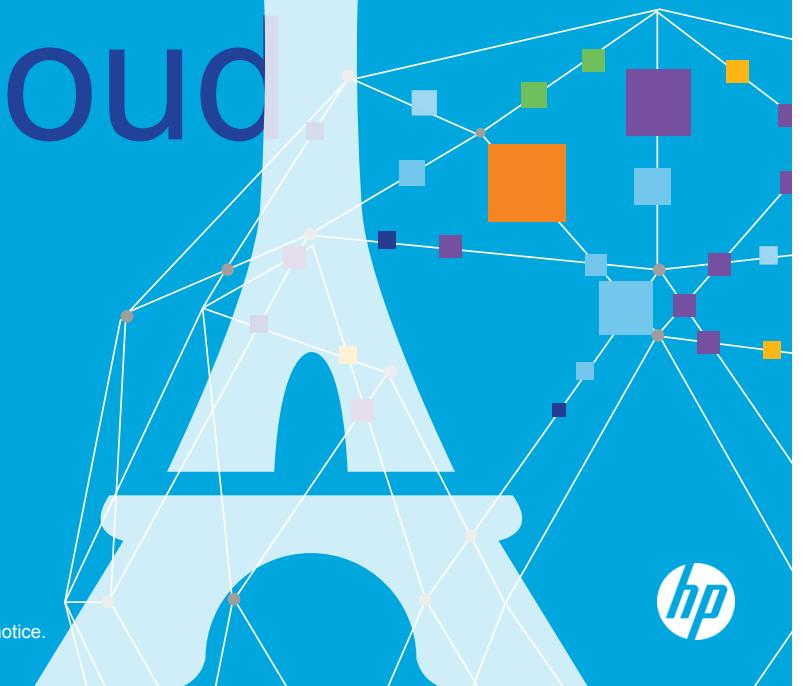
**IBM**

**I**

# Paris OpenStack® Summit

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# Monasca Deep Dive

Monitoring-as-a-Service (at Scale)

Roland Hochmuth, Sandy Walsh, Tong Li / November 5, 2014

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# Agenda

## Problem Statement

## What is Monasca?

- Architecture
- Metrics
- Events/StackTach.v3
- Anomaly Detection

## Current Status

Performance

## Next Steps

## Demo

## Q&A



# Problem Statement



**Monitoring-as-a-Service:** Lacking multi-tenant model

**Performance, scalability and data retention**

**Multiple uses of the data:** SLA calculations, business analytics, RCA, ...

**Elasticity and dynamic run-time configurability**

- Metrics and Alarm management
- Spammy alerts and alert fatigue.

**Real-time event stream processing**

**Extensibility:** Integrate with other systems via API or internally

**Multiple Systems:** Internal/operational monitoring and external/customer-facing monitoring are separate systems. Health/Status different from metrics.

**Cryptic data:** Force fit metric/event names results in an impedance mismatch



# What is Monasca?

**Monitoring-as-a-Service solution based on a first-class REST API**

- Multi-tenancy based on Keystone authentication. Supports self-service.



**Highly-performant, scalable, fault-tolerant and capable of big data retention**

**Metrics storage/retrieval/statistics and alarm/thresholding engine**

**Notification system**

**Real-time event stream processing**

**Open-source and built-on open-source technologies such as:**

- Kafka: Performant, scalable, fault-tolerant, durable message queue. Used by LinkedIn, Twitter, ...
- Apache Storm:
- Time-series databases: InfluxDB supported today. Elastic-search in progress.

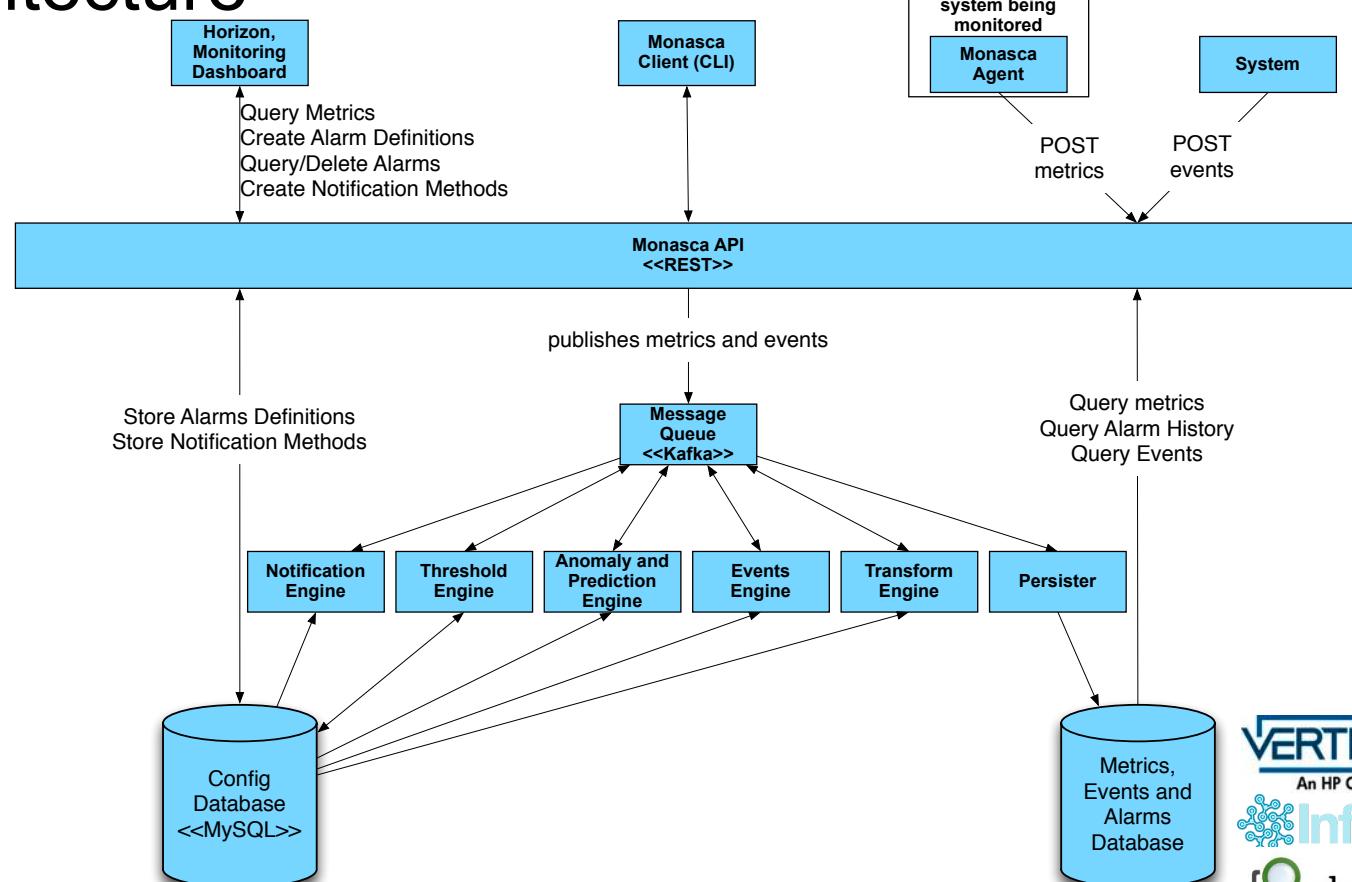
**Consolidates multiple monitoring systems into a single solution**

- Used for both operational and customer facing monitoring.

**Extensible based on micro-services message bus architecture**



# Architecture





# Metrics



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# REST API

## Metrics: Create, query and get statistics for metrics

```
{  
    name: cpu.user_perc,  
    dimensions: {  
        hostname: hostname.domain.com,  
        region: uswest,  
        zone: 1,  
        service: compute  
    }  
}
```

Simple, concise beautiful flexible description  
Name (string)  
Dimensions: Dictionary of arbitrary (key, value) pairs



## Alarm Definitions

- Alarm definitions are templates that are used to automatically create alarms based on matching metric names and dimensions
- Simple compound expression grammar: `avg(cpu.user_perc{}) > 85` or `avg(disk_read_ops{device=vda}, 120) > 1000`
- Actions associated with alarms for state transitions to ALARM, OK and UNDETERMINED
- Severity (LOW, MEDIUM, HIGH, CRITICAL).

## Alarms: Query and Delete alarms and query alarm state history

## Notification Methods: e.g. Email address. Associated with alarm definitions



# Monasca Agent

**Python monitoring agent**

**System metrics (cpu, memory, ...)**

**Service metrics**

- RabbitMQ, MySQL, Kafka, and many others

**Application metrics**

- Built-in statsd daemon
- Python Monasca Statsd library

**VM metrics**

**Active checks**

- HTTP status checks and response times
- System up/down checks (ping and ssh)

**Runs any Nagios plugin**

**Extensible/Pluggable: Additional services can be easily added**

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# UI



## Horizon Dashboard

- Overview/Top-level drill-down
- Create/Read/Update/Delete alarm definitions using an expression builder
- Read/Delete alarms and alarm history
- Create/Read/Update/Delete notification methods

## Grafana Dashboard (<http://grafana.org/>)

- Provides visualization of metrics





# Events



StackTach.v3

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# Anomaly Detection



**Monasca Anomaly Engine implements real-time streaming anomaly detection**

## Two algorithms:

- Numenta Platform for Intelligent Computing (NuPIC) used by  **GROK**
  - An open-source Python/C++ implementation of Hierarchical Temporal Memory
- Kolmogorov-Smirnov (K-S) Two Sample Test

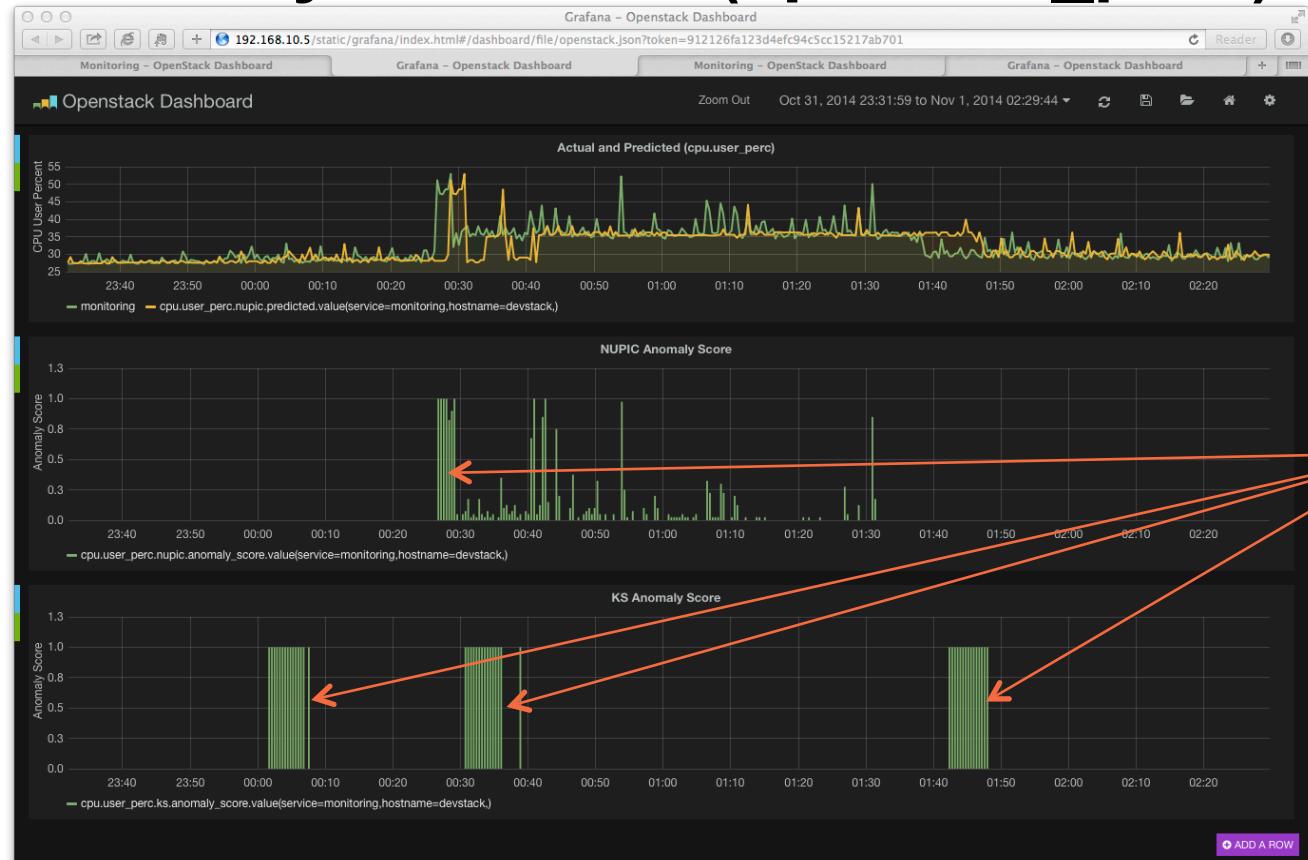
## Anomaly Engine

- Consumes metrics from the Kafka metrics topic
- Calculates predicted value and anomaly score (probability of an anomaly)
- Publishes calculated values as metrics to the Kafka metrics topic

## A l a r m s c a n b e c r e a t e d f o r A n o m a l s c o r e s



# Anomaly Detection (cpu.user\_perc)



# Current Status



**Monasca and Stacktach.v3 is open-sourced in StackForge  
Not an OpenStack incubated project, but we are targeting incubation  
Metrics, Alarm Definitions, Alarms and Notification Methods completely  
supported/functional and ready for production deployment**

## Who is working on it?

- HP
- RackSpace
- IBM

## Who is deploying it?

- HP: Public Cloud and Helion distribution
- Time Warner Cable (TWC)
- Workday



# Performance (Metrics inserts/sec)



## Test Deployment (HP R&D Cluster):

- Three HP Proliant SL390s G7 servers
- InfluxDB cluster

## Performance:

- Total end-to-end performance including storage in InfluxDB: Approximately 25K to 30K metrics/second.
- monasca-api: > 50K metrics/sec per single API server.
- monasca-api > 150K metrics/sec for a three node cluster with a load-balancing VIP.

If you need more database performance?

-  is supported. Scales to hundreds of thousands of metrics per second.



# Next Steps



**Events/StackTach.v3 integration is in progress**

**Anomaly detection is in progress**

**Formalize micro-services architecture**

- Define message formats
- Define how services are published and registered

**Python port is in progress:**

- All components Python except for API and Threshold Engine
  - API is 75% ported to Python. Note, Java API is 100% functional
  - Threshold Engine is the only remaining Java component

# Call to Action



## Looking for contributors

- Monasca Service, StackTach.v3, Events, Anomaly Detection
- Monasca Agent: Help extend with additional services. E.g. Sensor data
- Help Integrate, Deploy, Test and Performance benchmarking

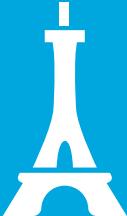
## More info:

- Launchpad: <https://launchpad.net/monasca>
- Wiki: <https://wiki.openstack.org/wiki/Monasca>
- IRC: #openstack-monasca

## Monasca development environment:

- monasca-vagrant (<https://github.com/stackforge/monasca-vagrant>): A turn-key development environment that installs Monasca and a Devstack VM
- Newly upgraded to use Ansible





# Demo



StackTach.v3

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# Demo Recap



## What did we just show?

1. An OpenStack Notification is sent to the Monasca Events API
2. The API publishes the notification to the Kafka raw events topic
3. The Transform Engine consumes, transforms (using StackTach Distiller) and publishes the event to the transformed event topic
4. The Events Engine consumes, adds to the StackTach Winchester Pipeline.
5. If the notification is a “compute.instance.create.end” event the Winchester pipeline handler fires, calculates the delta, and publishes to the Kafka metrics topic
6. The metric can then be alarmed on in the metrics pipeline or visualized

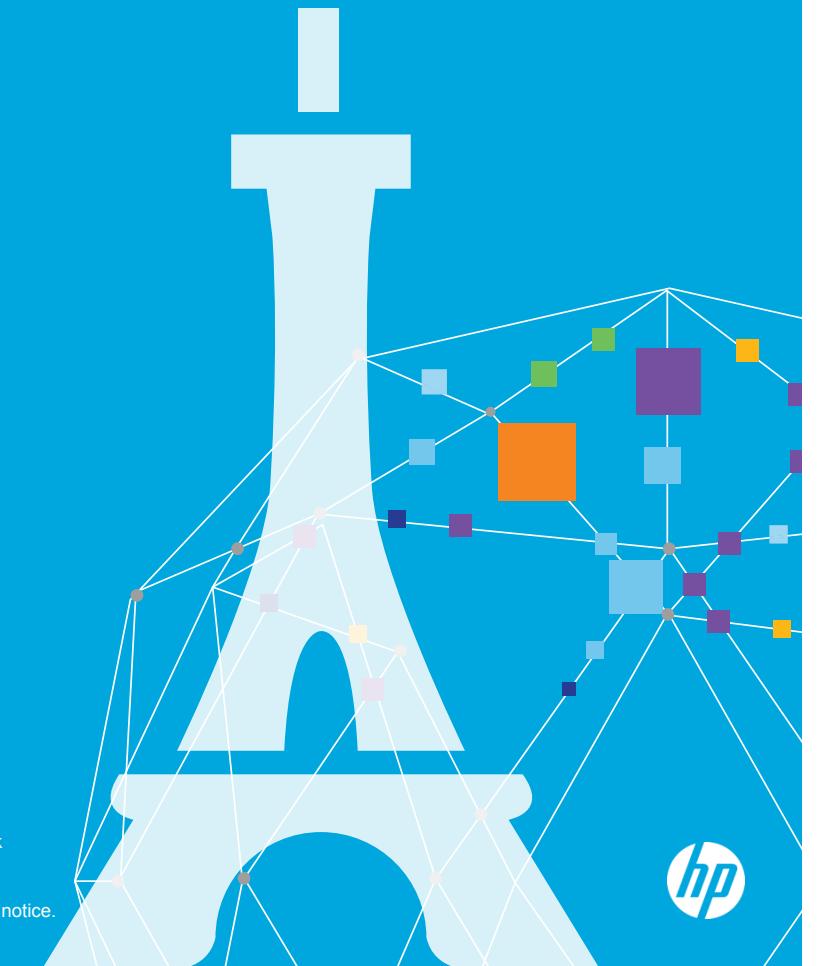


# Thank you

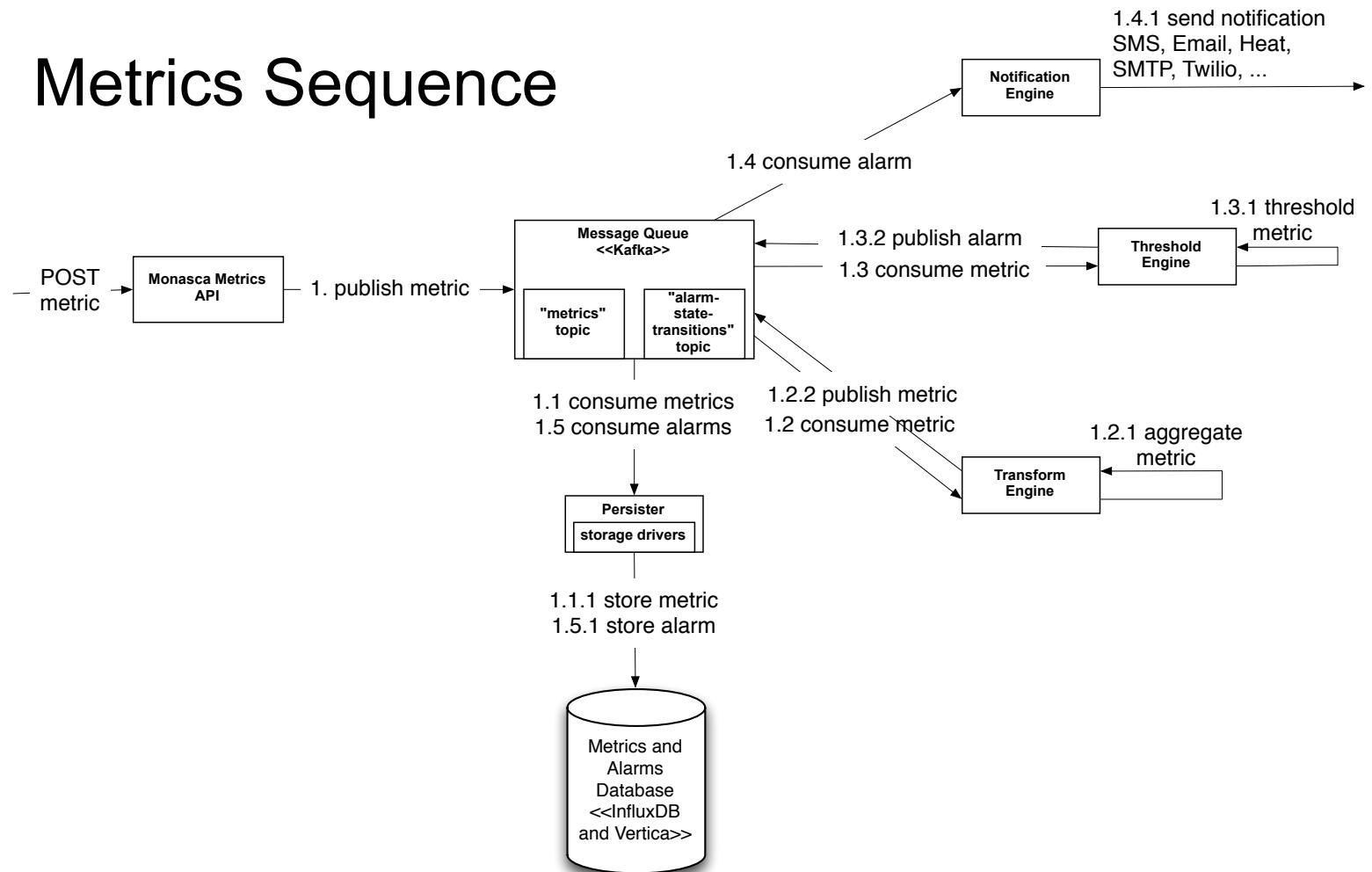


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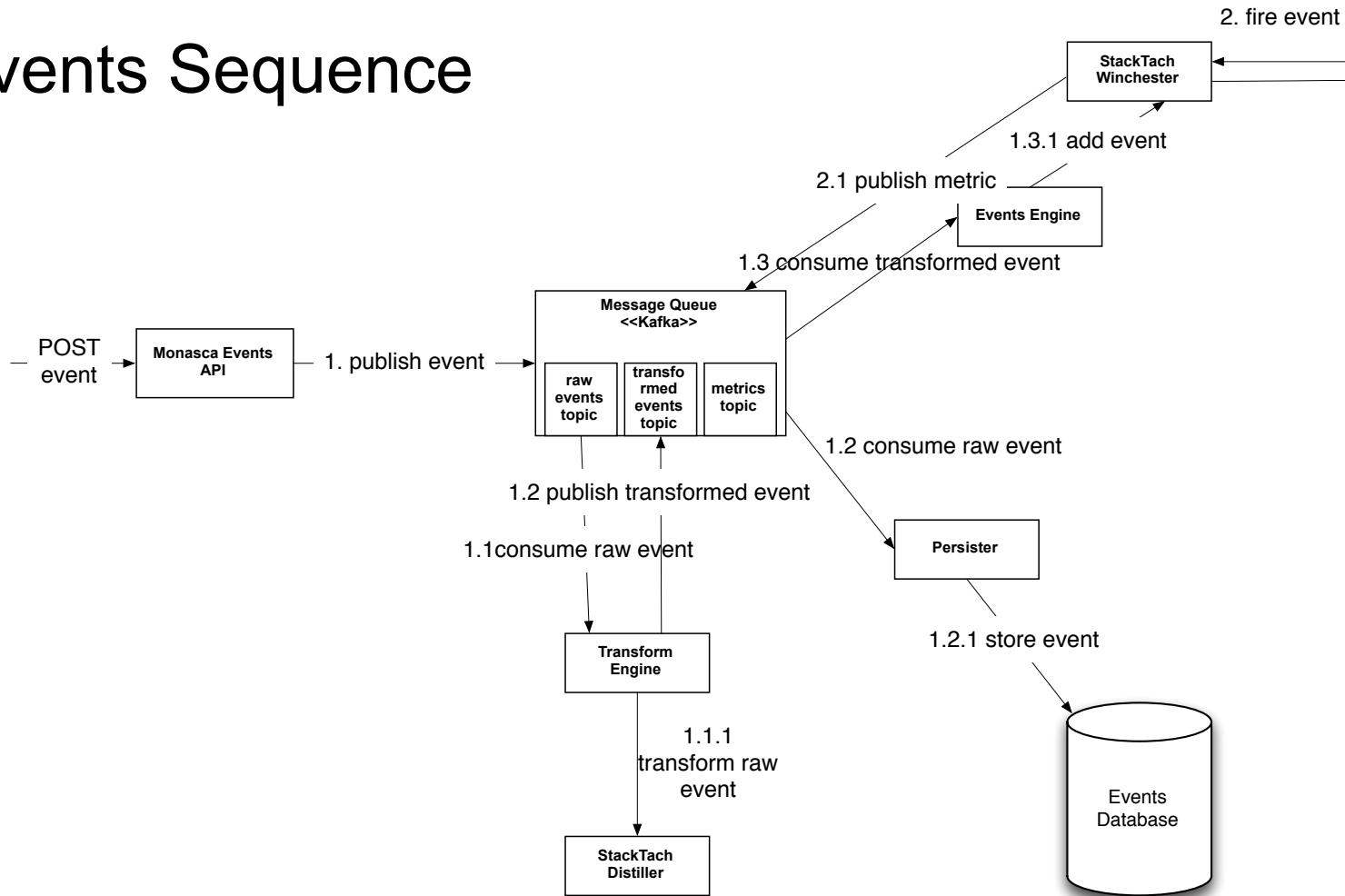
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# Metrics Sequence



# Events Sequence



# Monitoring Overview (All Services Healthy)



Monitoring – OpenStack Dashboard

192.168.10.5/monitoring/ mini-mon Sign Out

openstack mini-mon

Project Identity Monitoring

Overview Alarm Definitions Alarms Notifications

## Monitoring

All Alarms Dashboard

### OpenStack Services

cinder\_api nova\_api monitoring swift\_api glance\_api

### Servers

devstack mini-mon

A screenshot of the OpenStack Monitoring dashboard. The left sidebar shows navigation options like Project, Identity, Monitoring (with Overview selected), Alarm Definitions, Alarms, and Notifications. The main content area is titled 'Monitoring' and shows two tabs: 'All Alarms' and 'Dashboard' (which is selected). Under 'OpenStack Services', there are five boxes: cinder\_api, nova\_api, monitoring, swift\_api, and glance\_api, each with a green checkmark. Under 'Servers', there are two boxes: devstack and mini-mon, also with green checkmarks. The URL in the browser bar is 192.168.10.5/monitoring/.

# Monitoring Overview (nova-api down)



Monitoring – OpenStack Dashboard

192.168.10.5/monitoring/ mini-mon Sign Out

openstack mini-mon

All Alarms Dashboard

Project Identity Monitoring

Overview Alarm Definitions Alarms Notifications

## Monitoring

OpenStack Services

cinder_api	nova_api	monitoring	swift_api	glance_api
------------	----------	------------	-----------	------------

Servers

devstack	mini-mon
----------	----------

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# List Alarm Definitions

The screenshot shows the OpenStack Dashboard interface. The top navigation bar includes icons for Home, Help, Log Out, and a search bar. The URL in the address bar is 192.168.10.5/monitoring/alarmdefs/. The left sidebar has a 'Project' dropdown, 'Identity' dropdown, and a 'Monitoring' section with 'Overview', 'Alarm Definitions' (which is selected and highlighted in red), 'Alarms', and 'Notifications'. The main content area is titled 'Alarm Definitions' and displays a table with four items:

<input type="checkbox"/>	Name	Description	Notifications Enabled	Actions
<input type="checkbox"/>	API Status	API Status	True	<button>Edit Alarm Definition</button>
<input type="checkbox"/>	Disk Space	Disk space utilization percentage	True	<button>Edit Alarm Definition</button>
<input type="checkbox"/>	Compute Instance Create Time	Compute Instance Create Time	True	<button>Edit Alarm Definition</button>
<input type="checkbox"/>	CPU User Percent	CPU User Percent	True	<button>Edit Alarm Definition</button>

At the bottom of the table, it says 'Displaying 4 items'.

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# Create Alarm Definition (Disk Space)

The screenshot shows the OpenStack Dashboard at [192.168.10.5/monitoring/alarmdefs/](http://192.168.10.5/monitoring/alarmdefs/). The left sidebar is under the 'Monitoring' project, with 'Alarm Definitions' selected. A modal window titled 'Create Alarm Definition' is open. In the 'Name' field, 'Disk Space Utilization' is entered. The 'Expression' field contains 'avg disk\_space\_utilization\_perc > 85'. The 'Matching Metrics' section lists numerous metrics, many of which are highlighted in yellow. An annotation with an arrow points from the text 'Matching metrics' to this list.

**Description:**  
The Name field is used to identify the notification method.  
The Expression field which if true, triggers a notification to be sent. See [Alarm Expressions](#) for how to write an expression.  
The Alarm Actions field contains the list of Notification that should be sent when transitioning to an ALARM state.

**Name \***  
Disk Space Utilization

**Expression \***  
avg disk\_space\_utilization\_perc > 85

**Matching Metrics**

name	dimensions
disk_space_utilization_perc	{device: "/dev/sda1", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "/dev/sda1", hostname: "mini-mon", service: "monitoring"}
disk_space_utilization_perc	{device: "tmpfs", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "tmpfs", hostname: "mini-mon", service: "monitoring"}
disk_space_utilization_perc	{device: "udev", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "udev", hostname: "mini-mon", service: "monitoring"}
disk_space_utilization_perc	{device: "v-csc-1", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "v-csb-3", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "v-csr-2", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant", hostname: "mini-mon", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant-cache", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant-cache", hostname: "mini-mon", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant_home", hostname: "devstack", service: "monitoring"}
disk_space_utilization_perc	{device: "vagrant_home", hostname: "mini-mon", service: "monitoring"}

**Apply function to metrics**  
 individually  
 aggregate

← Matching metrics



# Edit Alarm Definition (API Status)

Alarm Definitions – OpenStack Dashboard

192.168.10.5/monitoring/alarmdefs/ mini-mon

Edit Alarm Definition

Description:

The Name field is used to identify the notification method.

The Expression field which if true, triggers a notification to be sent. See [Alarm Expressions](#) for how to write an expression.

The Alarm Actions field contains the list of Notification that should be sent when transitioning to an ALARM state.

Name \*

 API Status

Expression \*

 avg(http\_status{}) > 0

Apply function to metrics

individually

as a group

Description

 API Status

Severity

 Critical

Notifications Enabled

Notifications

Name

 Roland Hochmuth

+ Add more

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# List All Alarms



Alarms – OpenStack Dashboard

192.168.10.5/monitoring/alarms/alarm/all/

mini-mon

Sign Out

Project ▾

Identity ▾

Monitoring ▾

- Overview
- Alarm Definitions
- Alarms**
- Notifications

## All Alarms

	Status	Metric Name	Metric Dimensions	Definition	Actions
<input type="checkbox"/>	<span style="color: green;">✓</span>	http_status	url=http://localhost:8081/healthcheck,hostname=mini-mon,service=monitoring	API Status	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: red;">-</span>	http_status	url=http://localhost:8774/v2.0,hostname=devstack,service=nova_api	API Status	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: green;">✓</span>	http_status	url=http://localhost:8776/v2.0,hostname=devstack,service=cinder_api	API Status	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: green;">✓</span>	http_status	url=http://localhost:8080/healthcheck,hostname=devstack,service=swift_api	API Status	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: green;">✓</span>	http_status	url=http://localhost:9292,hostname=devstack,service=glance_api	API Status	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: green;">✓</span>	disk_space_utilization_perc	device=v-csr-2,hostname=devstack,service=monitoring	Disk Space	<span>Graph Metric</span> ▾
<input type="checkbox"/>	<span style="color: green;">✓</span>	disk_space_utilization_perc	device=udev,hostname=devstack,service=monitoring	Disk Space	<span>Graph Metric</span> ▾



# List Alarm History

Alarm History – OpenStack Dashboard  
192.168.10.5/monitoring/alarms/history/036cba6b-ad9d-424c-abfc-854184a8d466/9a11447c-feaf-40be-8b71-cdb573cd179b

openstack mini-mon Sign Out

Project Identity Monitoring

Overview

Alarm Definitions

Alarms

Notifications

## Alarm History

Name	Old State	New State	Timestamp	Reason
036cba6b-ad9d-424c-abfc-854184a8d466	ALARM	OK	2014-11-04T17:46:30.000Z	The alarm threshold(s) have not been exceeded
036cba6b-ad9d-424c-abfc-854184a8d466	OK	ALARM	2014-11-04T17:44:30.000Z	Thresholds were exceeded for the sub-alarms: [avg(http_status) > 0.0]
036cba6b-ad9d-424c-abfc-854184a8d466	ALARM	OK	2014-11-04T17:42:30.000Z	The alarm threshold(s) have not been exceeded
036cba6b-ad9d-424c-abfc-854184a8d466	OK	ALARM	2014-11-04T17:40:30.000Z	Thresholds were exceeded for the sub-alarms: [avg(http_status) > 0.0]
036cba6b-ad9d-424c-abfc-854184a8d466	ALARM	OK	2014-11-04T17:35:30.000Z	The alarm threshold(s) have not been exceeded
036cba6b-ad9d-424c-abfc-854184a8d466	OK	ALARM	2014-11-04T17:31:30.000Z	Thresholds were exceeded for the sub-alarms: [avg(http_status) > 0.0]
036cba6b-ad9d-424c-abfc-854184a8d466	ALARM	OK	2014-11-04T17:19:30.000Z	The alarm threshold(s) have not been exceeded
036cba6b-ad9d-424c-abfc-854184a8d466	OK	ALARM	2014-11-04T16:50:30.000Z	Thresholds were exceeded for the sub-alarms: [avg(http_status) > 0.0]
036cba6b-ad9d-424c-abfc-854184a8d466	UNDETERMINED	OK	2014-11-04T08:07:45.000Z	The alarm threshold(s) have not been exceeded



# Show Alarm Definition



Alarm Definition Details – OpenStack Dashboard  
192.168.10.5 /monitoring/alarmdefs/036cba6b-ad9d-424c-abfc-854184a8d466/alarm\_detail/

mini-mon ▾ mini-mon Sign Out

openstack

Project ▾

Identity ▾

Monitoring ▾

- Overview
- Alarm Definitions
- Alarms
- Notifications

## Alarm Definition Details

### Info

**Name**  
API Status

**Description**  
API Status

**Expression**  
`avg(http_status{}) > 0`

**Severity**  
CRITICAL

**Notifications Enabled**  
True

### Notifications

Name	Type	Address
------	------	---------



# List Notifications

Monitoring – OpenStack Dashboard  
192.168.10.5/monitoring/notifications/

openstack mini-mon Sign Out

Project Identity Monitoring

Overview Alarm Definitions Alarms Notifications

## Notifications

<input type="checkbox"/>	Name	Type	Address	Actions
<input type="checkbox"/>	Roland Hochmuth	EMAIL	roland.hochmuth@hp.com	Edit Notification ▾
<input type="checkbox"/>	Sandy Walsh	EMAIL	sandy.walsh@rackspace.com	Edit Notification ▾
<input type="checkbox"/>	Tong Li	EMAIL	litong01@us.ibm.com	Edit Notification ▾

Displaying 3 items



# Grafana



# Grafana (compute\_instance\_create\_time)

