

# Better Testing Through Statistics

Matthew Treinish

[mtreinish@kortar.org](mailto:mtreinish@kortar.org)

mtreinish on Freenode

Masayuki Igawa

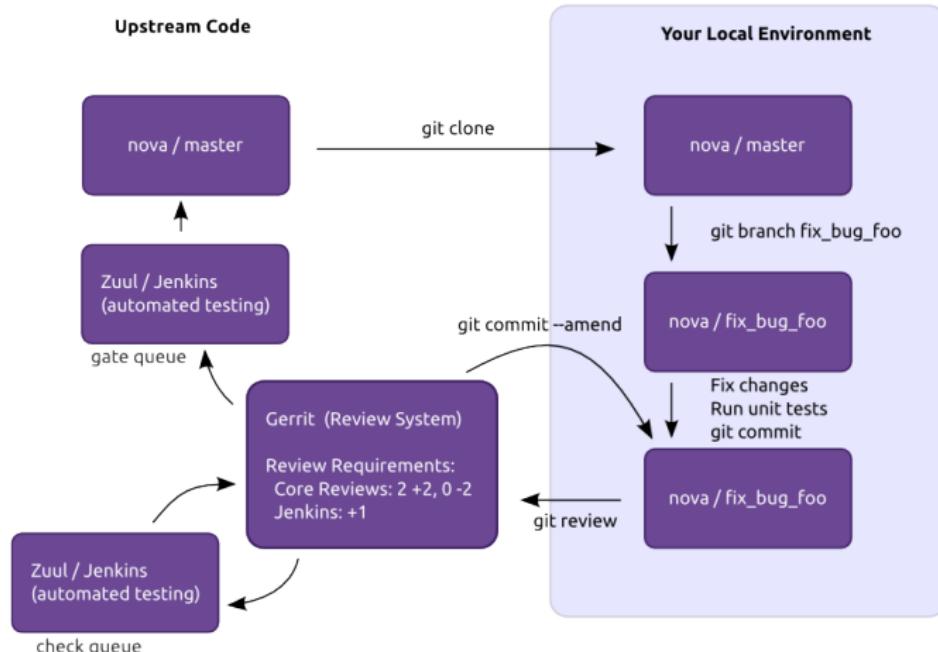
[masayuki.igawa@gmail.com](mailto:masayuki.igawa@gmail.com)

masayukig on Freenode

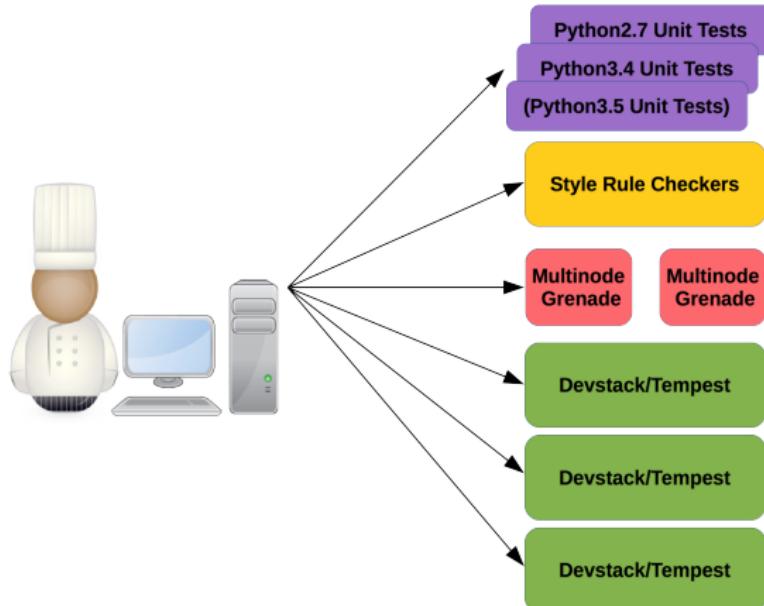
January 17, 2016

<https://github.com/masayukig/better-testing-through-statistics/tree/lca2017>

# What is “the OpenStack Gate”?



# What Happens when you push a change?



check	(268)	gate	(26)	post	(79)
Newly uploaded patchesets enter this pipeline to receive an initial +1 Verified vote from Jenkins.					
Change queue: openstack/heutron					
openstack/heutron 18387423	unknown 3 hr 57 min				
gate-neutron-docs:	SUCCESS				
gate-neutron-pep8:	SUCCESS				
gate-neutron-python3:	FAILURE				
gate-neutron-pybind4:	FAILURE				
gate-tempест-dvne-neutron-full:	queued				
gate-granade-dvne-neutron:	SUCCESS				
gate-neutron-dvne-functional:	SUCCESS				
gate-neutron-dvne-fullstack (non-voting)	SUCCESS				
gate-rally-dvne-neutron-reviews: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvr:	SUCCESS				
gate-tempест-dvne-neutron-identity v3-only-full-m:	(non-voting)				
gate-tempест-dvne-neutron-karbi:	SUCCESS				
gate-tempест-dvne-neutron/pg_hl: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron/pg_m: (non-voting)	SUCCESS				
gate-granade-dvne-neutron-malicode: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvr-malicode: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvr-malicode-v3: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvne_pg_ipa_m: (non-voting)	SUCCESS				
Change queue: openstack/networking-generic-sai...					
openstack/networking-generic-sai... 3088863	unknown 3 hr 10 min				
gate-networking-generic-sai-docs:	SUCCESS				
gate-networking-generic-sai-pep8:	SUCCESS				
gate-networking-generic-sai-pep82:	SUCCESS				
gate-networking-generic-sai-pep83:	SUCCESS				
gate-networking-generic-sai-dvne:	SUCCESS				
Change queue: openstack/heutron					
openstack/heutron 20035952	unknown 3 hr 18 min				
gate-neutron-docs:	SUCCESS				
gate-neutron-pep8:	SUCCESS				
gate-neutron-pybind7:	SUCCESS				
gate-neutron-pybind4:	SUCCESS				
gate-tempест-dvne-neutron-full:	SUCCESS				
gate-granade-dvne-neutron:	SUCCESS				
gate-neutron-dvne-functional:	SUCCESS				
gate-neutron-dvne-fullstack: (non-voting)	SUCCESS				
gate-rally-dvne-neutron-reviews: (non-voting)	FAILURE				
gate-tempест-dvne-neutron-dvr:	queued				
gate-tempест-dvne-neutron-identity v3-only-full-m:	(non-voting)				
gate-tempест-dvne-neutron-karbi:	SUCCESS				
gate-tempест-dvne-neutron/pg_hl: (non-voting)	SUCCESS				
gate-neutron-haasv2-dvne-realm:	SUCCESS				
gate-granade-dvne-neutron-malicode: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvr-malicode: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvr-malicode-v3: (non-voting)	SUCCESS				
gate-tempест-dvne-neutron-dvne_pg_ipa_m: (non-voting)	SUCCESS				
Change queue: integrated					
openstack/integrated 3072931	0 min 1 hr 10 min				
gate-neva-docs:	SUCCESS				
gate-neva-pep8:	SUCCESS				
gate-neva-python27-db:	SUCCESS				
gate-neva-python34-db:	SUCCESS				
gate-neva-requirements:	SUCCESS				
gate-tempест-dvne-full:	SUCCESS				
gate-granade-dvne-functional:	SUCCESS				
gate-neva-dvne:	SUCCESS				
gate-neva-releases:	SUCCESS				
gate-neva-tox-dvne-functional:	SUCCESS				
gate-granade-dvne-malicode:	SUCCESS				
gate-tempест-dvne-dvne-calls:	SUCCESS				
gate-tempест-dvne-full-devstack-plugin-ceph:	SUCCESS				
Change queue: openstack/intel-project-concurrency					
openstack/intel-project-concurrency 342695	unknown 5 hr 2 min				
oslo.concurrency-branch-tarball:	SUCCESS				
oslo.concurrency-docs:	queued				
oslo.concurrency-upstream-translation-update:	SUCCESS				
oslo.concurrency-coverage:	queued				
Change queue: openstack/intel-project-config					
openstack/intel-project-config 680010	unknown 5 hr 9 min				
publish-intro-docs-index:	queued				
publish-spec-site:	queued				
Change queue: openstack/intel-project-config					
openstack/intel-project-config 670705	unknown 4 hr 59 min				
publish-intro-docs-index:	queued				
publish-spec-site:	queued				
Change queue: openstack/networking-vspHERE					
openstack/networking-vspHERE 195986	unknown 4 hr 55 min				
networking-vspHERE-branch-tarball:	queued				
networking-vspHERE-docs:	queued				
Change queue: openstack/intel-project-config					
openstack/intel-project-config 670708	unknown 4 hr 54 min				
publish-intro-docs-index:	queued				
publish-spec-site:	queued				
Change queue: openstack/intel-project-config					
openstack/intel-project-config 683637	unknown 4 hr 52 min				
publish-intro-docs-index:	queued				
publish-spec-site:	queued				
Change queue: openstack/stackalytics					
openstack/stackalytics 409776	unknown 4 hr 7 min				
hook-stackalytics-rbd:	SUCCESS				
stackalytics-branch-tarball:	queued				
Change queue: openstack/stackalytics					
openstack/stackalytics 409777	unknown 4 hr 7 min				
hook-stackalytics-rbd:	SUCCESS				
stackalytics-branch-tarball:	queued				
Change queue: openstack/governance					
openstack/governance 416124a	unknown 4 hr 2 min				
static-governance-publish:	queued				
Change queue: openstack/glance-store					
openstack/glance-store 2166519	unknown 3 hr 54 min				
glance_store-branch-tarball:	queued				
glance_store-docs:	queued				
glance_store-releases:	queued				
glance_store-upstream-translation-update:	SUCCESS				

# The Size of the Gate

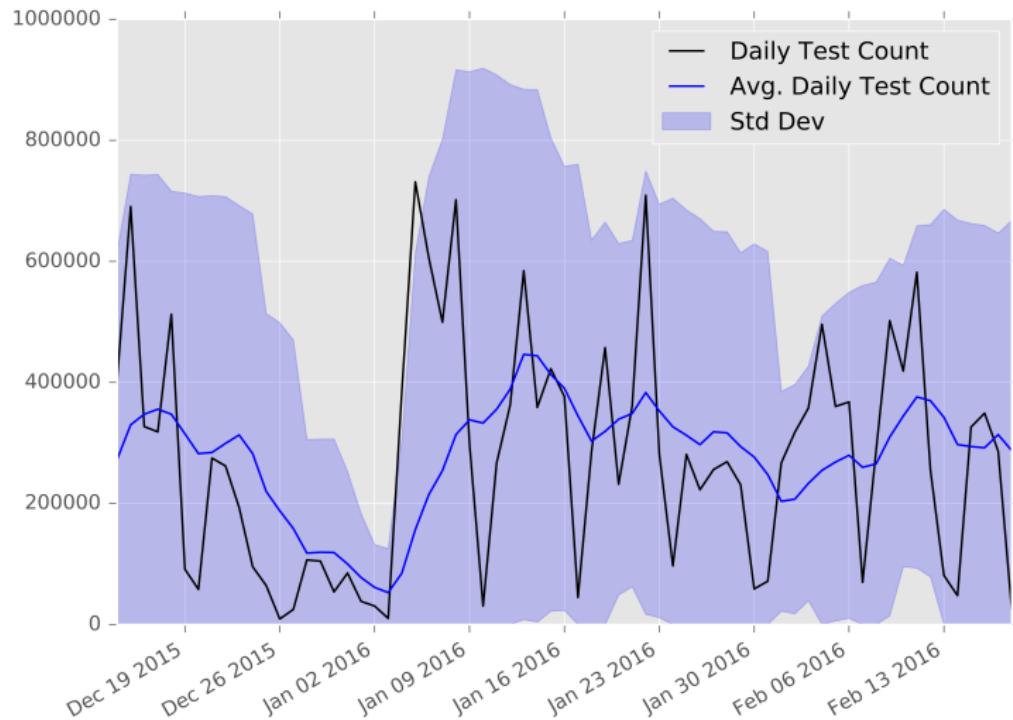
## One Proposed Change Generates:

- ▶ 5–25 Devstacks
- ▶ ~10,000 integration tests (roughly 1.5k per devstack)
- ▶ ~151 2nd level guests created in each devstack cloud
- ▶ ~1 GB of logs uncompressed for each run

## In aggregate:

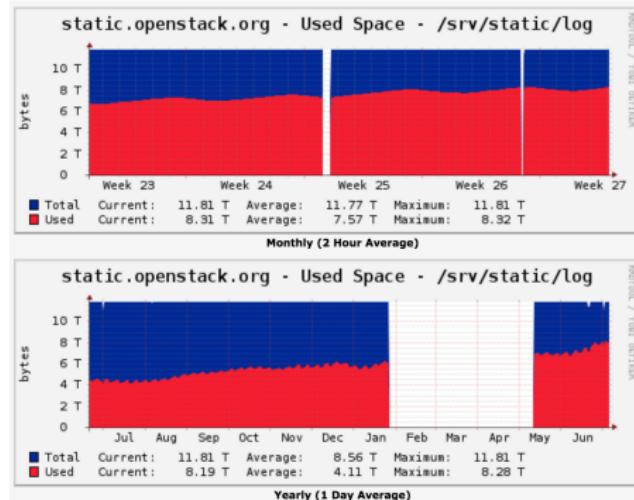
- ▶ ~12,500 jobs run in check and gate daily
- ▶ ~0.01% individual tempest test failure rate
- ▶ ~.77% tempest run failure rate

# Number of Tempest Tests per Day in the Gate Queue:



# Log Server

- ▶ Log Server: <http://logs.openstack.org/>
- ▶ Archive of all artifacts from all jobs for ~4 months
- ▶ ~8 TB of data compressed



## Problems/Issues when Running in the Gate

- ▶ Works fine for looking at results 1 at a time
- ▶ Difficult to find a non-deterministic failures
- ▶ Difficult to find performance regressions
- ▶ Finding out how often something passes or fails is impossible

## General Approach

- ▶ Look at things on the larger scale
- ▶ Use statistics and data mining to find previously unknown trends in OpenStack
- ▶ Make the data from test runs open and accessible to everyone
- ▶ Ensure there are APIs available for accessing everything

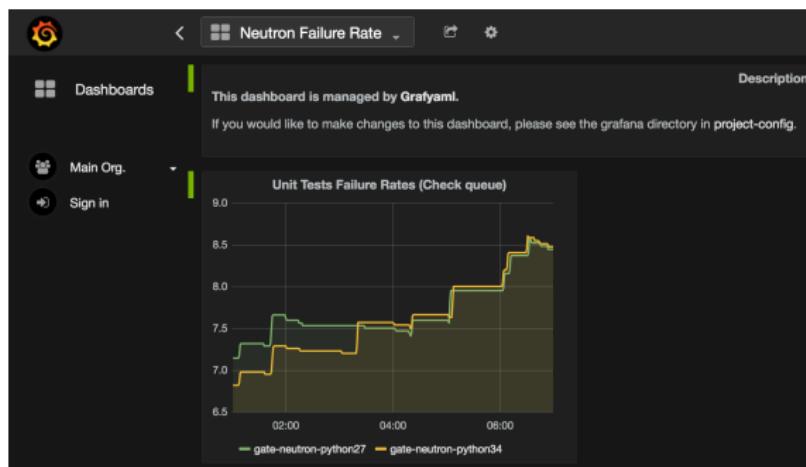
# Graphite

- ▶ <http://graphite.openstack.org/>
- ▶ Infra services report to graphite
- ▶ Include job results
- ▶ Limited to job level data
- ▶ Time based, can't be linked to an individual job



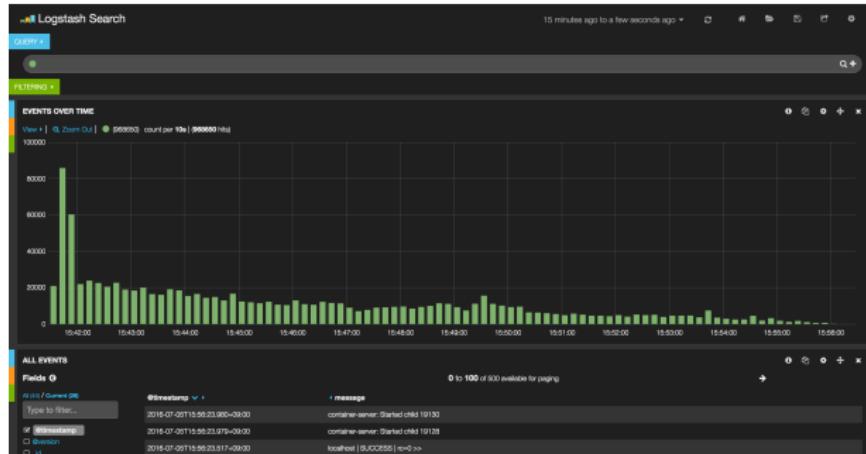
# Grafana

- ▶ <http://grafana.openstack.org/>
- ▶ Provides a layer on top of graphite to easily make useful visualizations
- ▶ Adds a number of dashboards
- ▶ Some projects using this to track job failure rates



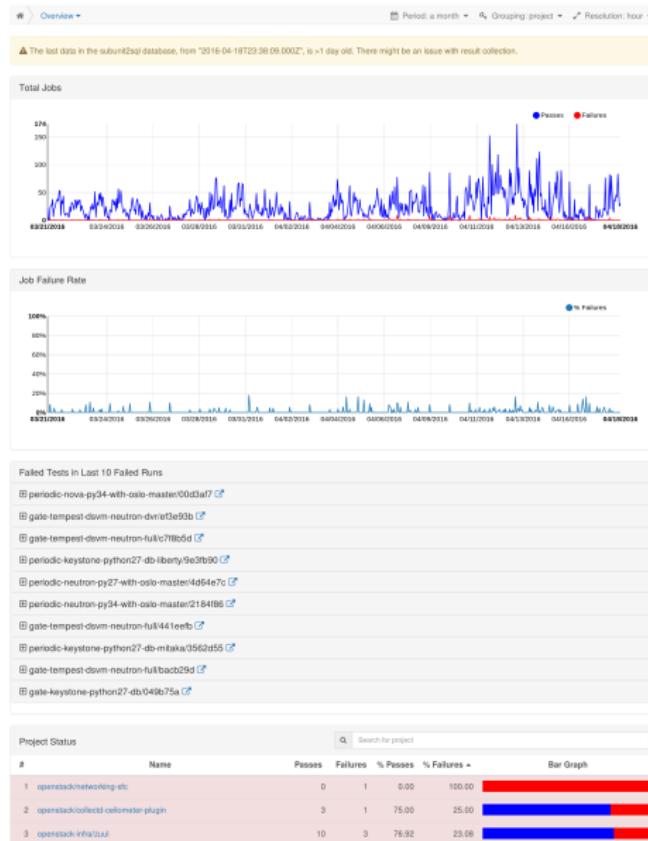
# ELK

- ▶ Elasticsearch, Logstash, Kibana
- ▶ <http://logstash.openstack.org>
- ▶ Provides a search engine on top of are job artifacts
- ▶ Limited to 10 days of results



# Using OpenStack Health

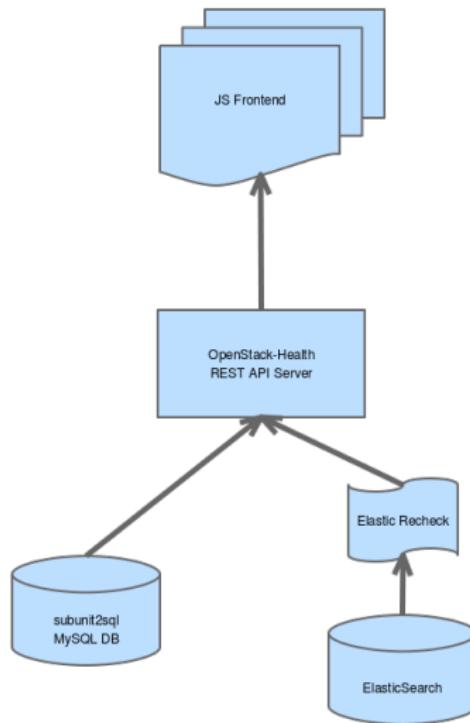
OpenStack Health is a dashboard for visualizing test results of OpenStack CI jobs.



## openstack-health

- ▶ <http://status.openstack.org/openstack-health/#/>
- ▶ Designed to be a single point of access for all the data about the gate
- ▶ Currently can leverage subunit2sql and elastic-recheck

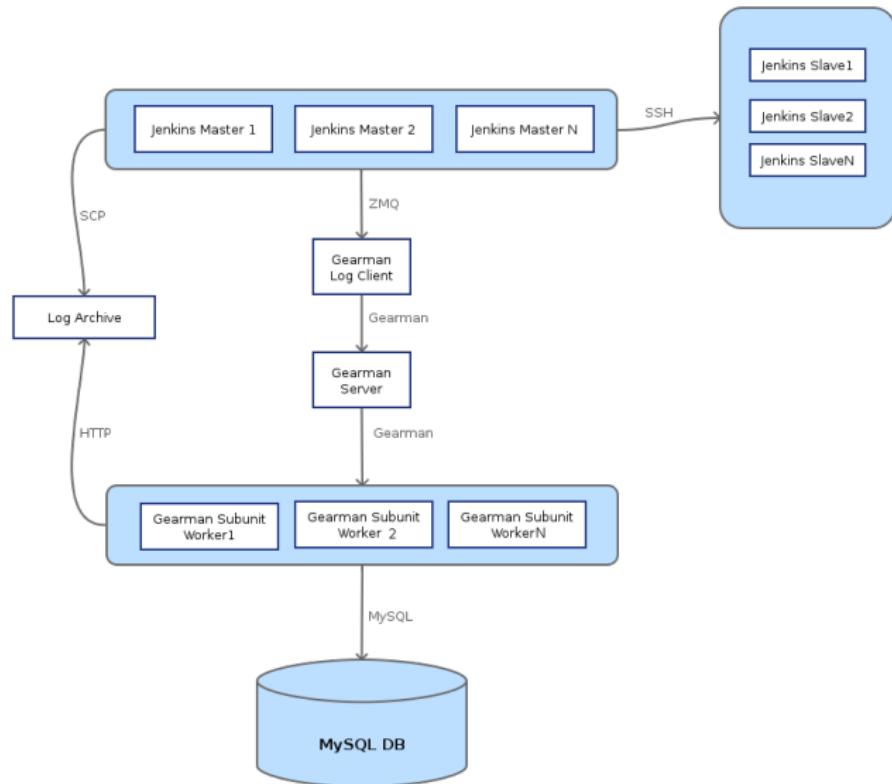
# OpenStack-Health Architecture



## subunit2sql

- ▶ Designed to store test results data in a sql database
- ▶ Provides a DB schema and a python API for interacting with the database
- ▶ CLI utilities for storing and retrieving results in the DB as subunit v2
- ▶ A public database of everything with subunit output run in OpenStack-Infra
- ▶ Used to store the results from test runs for 6 months

# subunit2sql in OpenStack Infrastructure



## Elastic Recheck

- ▶ Designed to answer the question “Have you seen this recently?”
- ▶ Leverages elastic search to identify failures with known fingerprints
- ▶ Contains a repository of elastic-search queries with known failures
- ▶ Has 2 parts:
  - ▶ A bot which watches changes and reports identified failures to gerrit and IRC
  - ▶ A dashboard which shows failure categorization

# Elastic Recheck

<http://status.openstack.org/elastic-recheck/>

All Pipelines

Gate Pipeline

Uncategorized

The elastic-recheck project uses Elasticsearch to classify and track OpenStack gate failures. Documentation can be found [here](#). You can also learn more by reading this post on the Elasticsearch blog: [OpenStack elastic-recheck: powered by the elk stack](#)

Data Last Updated: Tue Jul 12 2016 13:00:01 GMT+0900 (JST)

Last Elastic Search Index Update: Tue Jul 12 2016 12:59:20 GMT+0900 (JST)

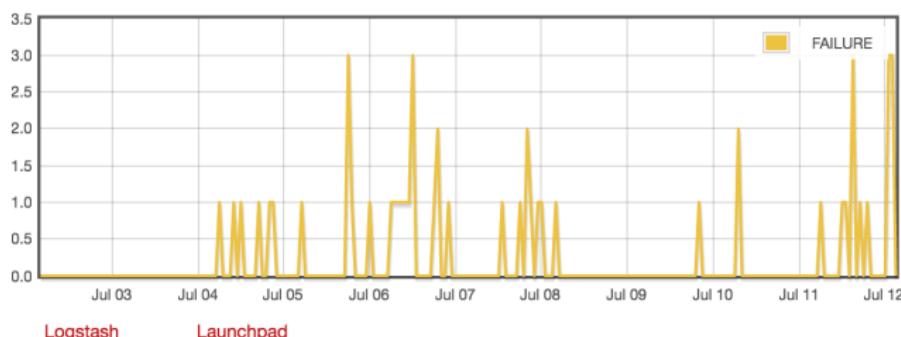
Delay in Elastic Search: Up to date

Cluster Health: green

## Bug 1539271 - Libvirt live block migration migration stalls

14 fails in 24 hrs / 50 fails in 10 days

Projects: (nova - Confirmed)



Logstash

Launchpad

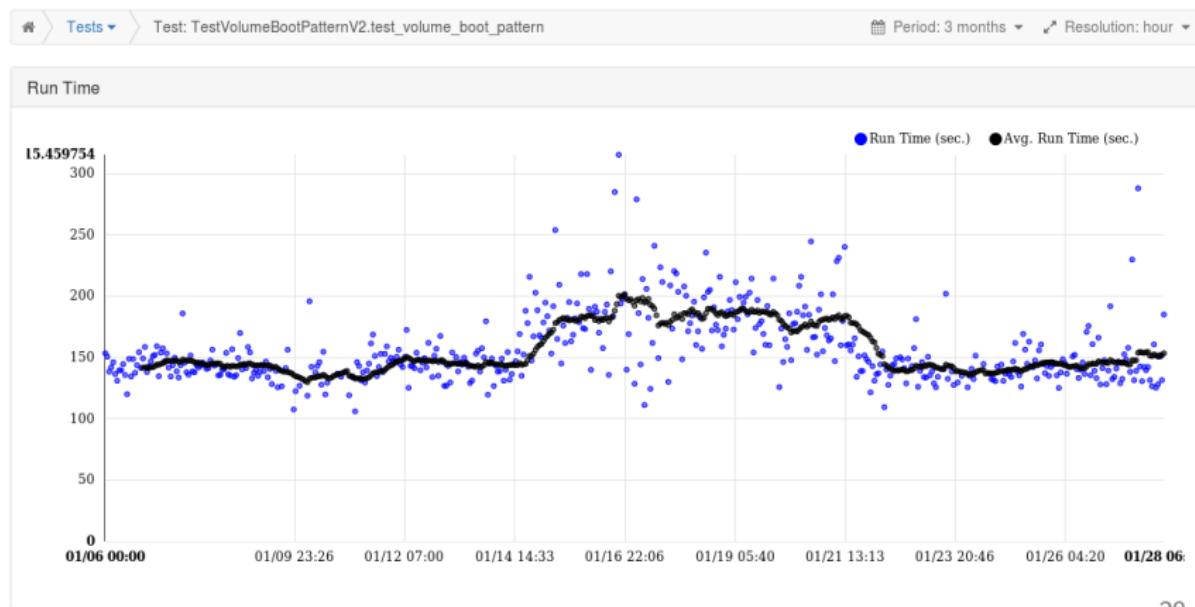
# Data Driven Decision Making

- ▶ Determine when it's time to skip a test
- ▶ Identify tests that are actually catching bugs
- ▶ Determine if failures are isolated to region, config, etc.

# Finding trends amongst the noise

- ▶ Catch performance regressions
- ▶ Identify relational trends in the data
- ▶ Find and identify non-deterministic bug/race conditions

## TestVolumeBootPatternV2.test\_volume\_boot\_pattern



## Issues

- ▶ Too many varied data sources each with unique limitations:
  - ▶ Only Gate and Periodic Job data (subunit2sql)
  - ▶ No views for infra failure (subunit2sql)
  - ▶ Limited to 1 line for searching (Elastic Search)
- ▶ Limited contribution in this space

## Future work

- ▶ Integrate all the things in openstack-health
- ▶ Use the data to optimize our test runner scheduler
- ▶ Enable automation around failure detection

## Where to get more information

- ▶ openstack-dev ML [openstack-dev@lists.openstack.org](mailto:openstack-dev@lists.openstack.org)
- ▶ #openstack-qa on Freenode
- ▶ <http://git.openstack.org/cgit/openstack/openstack-health/>
- ▶ <http://git.openstack.org/cgit/openstack-infra/subunit2sql>
- ▶ <http://git.openstack.org/cgit/openstack-infra/elastic-recheck/>

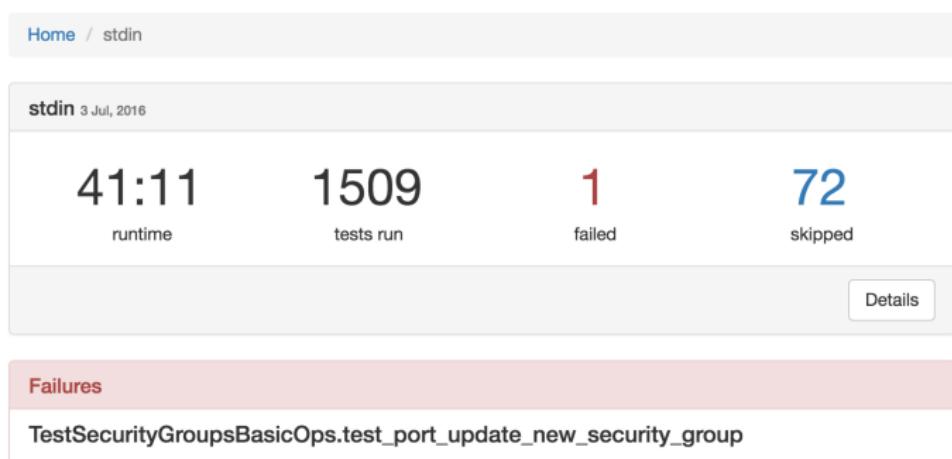
# Questions?

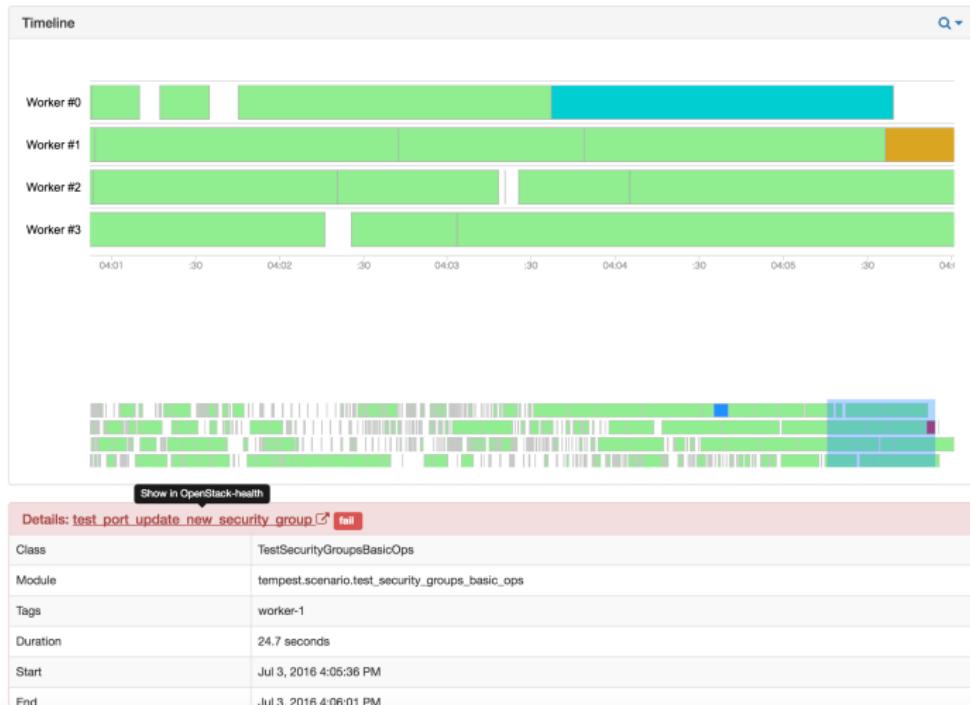
# Appendix: StackViz

Visualization tool of individual CI build results

- ▶ [git.openstack.org/cgit/openstack/stackviz](http://git.openstack.org/cgit/openstack/stackviz)

## Datasets





## TestSecurityGroupsBasicOps.test\_port\_update\_new\_security\_group

Summary    traceback    pythonlogging

Q ▾

```
Traceback (most recent call last):
  File "tempest/scenario/test_security_groups_basic_ops.py", line 188, in setUp
    self._deploy_tenant(self.primary_tenant)
  File "tempest/scenario/test_security_groups_basic_ops.py", line 352, in _deploy_tenant
    self._set_access_point(tenant)
  File "tempest/scenario/test_security_groups_basic_ops.py", line 320, in _set_access_point
    self._assign_floating_ips(tenant, server)
  File "tempest/scenario/test_security_groups_basic_ops.py", line 326, in _assign_floating_ips
    client=tenant.manager.floating_ips_client)
  File "tempest/scenario/manager.py", line 868, in create_floating_ip
    port_id, ip4 = self._get_server_port_id_and_ip4(thing)
  File "tempest/scenario/manager.py", line 847, in _get_server_port_id_and_ip4
    "No IPv4 addresses found in: %s" % ports)
File "/opt/stack/new/tempest/.tox/tempest/local/lib/python2.7/site-packages/unittest2/case.py", line 845, in assertNotEqual
  raise self.failureException(msg)
AssertionError: 0 == 0 : No IPv4 addresses found in: [{u'extra_dhcp_opts': [], u'admin_state_up': True, u'mac_address': u'fa:16:3e:ee:7f:bc'}
```

Timeline