Tempest Scenario Tests
An Introduction for Testing your OpenStack cloud

CloudOpen Japan
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Agenda

- Who am I?
- Overview of OpenStack
  - Operator’s wish
- What is Tempest?
  - Purpose and use cases of Tempest
  - Key points of Tempest
- What is ‘Scenario test’?
  - Overview of the current Scenario tests
- How to use Scenario Tests
- Demonstration
- Issue/Future of Scenario tests
- Summary
- Q&A
Who am I?

- OpenStack Active Technical Contributor
  - Since the Grizzly release

- Tempest core
  - Proposed **Scenario Tests** at Havana Summit

- Software Design & Production Specialist & Project Manager
  - At NEC Solution Innovators, Ltd.
Overview of OpenStack
Overview of OpenStack

- Most popular OSS Cloud infrastructure Software in the world!
- Consists of several loosely-coupled components
- Many features are being evolved with six month release cycle

Verifying multiple components is one of the greatest concerns from developer’s and operator’s viewpoint.
Operator’s wish

They want to verify their cloud works well **easily in a short time**

- **Why?**
  - To avoid any regression
  - To compare the stability of different software version

- **When?**
  - During/after setting up
  - After adding compute/controller nodes
  - Minor software update
  - Minor bug fix
  - Periodically

Do you want to verify?
... How?

How do you ensure the stability?
We need tests for it!

By David Bleasdale: http://www.flickr.com/photos/sidelong/246816211/
Do you know “Tempest”?

http://en.wikipedia.org/wiki/The_Tempest
What is Tempest?
What is Tempest? (1/2)

Tempest is one of the projects of OpenStack Programs

OpenStack Programs
- Compute (Nova)
- Object Storage (Swift)
- Image Service (Glance)
- Identity (Keystone)
- Dashboard (Horizon)
- Networking (Neutron)
- Block Storage (Cinder)
- Telemetry (Ceilometer)
- Orchestration (Heat)
- Database Service (Trove)
- Bare metal (Ironic)
- Queue service (Marconi)
- Data processing (Sahara)
- Key management (Barbican)
- Common Libraries (Oslo)
- Infrastructure
- Documentation

- **Quality Assurance (QA)**
  - Deployment (TripleO)
  - Devstack (DevStack)
  - Release cycle management

Projects
- **Tempest**
  - A set of integration tests to be run against a live OpenStack cluster.
- Grenade
  - Grenade is a test harness to exercise the OpenStack upgrade process between releases.

https://wiki.openstack.org/wiki/Programs
What is Tempest?(2/2) - Tempest in Zuul/Gerrit

Tempest runs in the Zuul at every patch codes. We need to have Tempest code for integrated projects to ensure their validity.
Purpose and use cases of Tempest (1/2)

For Developers

1. New code can be tested to check the expected behavior
2. To verify whether new code introduce any regression.
3. On each new patch, Tempest runs in Zuul to make sure it qualify the expected quality/stability.

https://wiki.openstack.org/wiki/Gerrit_Workflow#Gerrit_Workflow_Quick_Reference
Purpose and use cases of Tempest (2/2)

For Operators
1. Checking their cloud works correctly → test suite for production environments
2. To check/avoid regression while software upgrade etc.
3. Can compare the stability of different software versions

RefStack/DefCore
- RefStack uses Tempest as a verifying tool set.

What is Refstack?
- An existence proof of the certified openstack APIs.
- A reference OpenStack environment for tools developers.
- A certification process for OpenStack service and product vendors.

Validating with simple processes
OpenStack Cloud

http://refstack.org/
Implementing of Tempest tests is one of the minimal graduation requirements.
There are 12 services in Tempest now.

Code names:
- Ironic (EC2 compatible)
- Nova
- Sahara
- Trove
- Keystone
- Glance
- Neutron
- Swift
- Heat
- Marconi
- Ceilometer
- Cinder

http://git.openstack.org/cgit/openstack/tempest/tree/tempest/services
Key points of Tempest (3/5)

Growth of the Tempest code

Line of Tempest code

<table>
<thead>
<tr>
<th>Code</th>
<th>Length (LoC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diablo</td>
<td>6745</td>
</tr>
<tr>
<td>Essex</td>
<td></td>
</tr>
<tr>
<td>Folsom</td>
<td></td>
</tr>
<tr>
<td>Grizzly</td>
<td></td>
</tr>
<tr>
<td>Havana</td>
<td></td>
</tr>
<tr>
<td>Icehouse</td>
<td></td>
</tr>
</tbody>
</table>

10 times more than Diablo!
Tempest directories

Tempest source code directories are separated by its category.

- test directories
  - api
  - cli
  - scenario
- stress
- thirdparty
- tests
Key points of Tempest (5/5)

Characteristics of Tempest tests

<table>
<thead>
<tr>
<th>Category (type)</th>
<th>Summary</th>
<th>Scope</th>
<th>Access client</th>
</tr>
</thead>
<tbody>
<tr>
<td>api</td>
<td>Functional tests for OpenStack APIs</td>
<td>single component</td>
<td>Tempest original</td>
</tr>
<tr>
<td>cli</td>
<td>Tests for OpenStack Official command line interface tools</td>
<td>single component</td>
<td>Official clients</td>
</tr>
<tr>
<td>stress</td>
<td>Stress tests</td>
<td>single component</td>
<td>Tempest original</td>
</tr>
<tr>
<td>thirdparty</td>
<td>Tests for non native OpenStack APIs such as EC2 API of Nova</td>
<td>single component</td>
<td>Tempest original</td>
</tr>
<tr>
<td>tests</td>
<td>Unit tests for Tempest</td>
<td>single component</td>
<td>---</td>
</tr>
<tr>
<td><strong>scenario</strong></td>
<td>Through path Tests for between multiple OpenStack services</td>
<td>multiple components</td>
<td>Official clients</td>
</tr>
</tbody>
</table>

Scenario tests are “system tests” for verifying between multiple OpenStack components.
What is ‘Scenario test’?
What is ‘Scenario test’? (1/3)

Key points of Scenario tests

- Scenario tests are "through path" tests of OpenStack function.
- Complicated setups where one part might depend on completion of a previous part.
- They ideally involve the integration between multiple OpenStack services to exercise.

Typical Scenario
1. create a flavor
2. create a image
3. create a network
4. create & configure a project, a quota, a role, a user
5. create a keypair
6. boot a instance
7. list & show the instance
8. create a volume
9. list & show the volume
10. attach the volume:

Across the multiple components & sequential testing
What is ‘Scenario test’? (2/3)

Key points of Scenario tests

- Scenario tests should use the official python client libraries
- Tests should be tagged with which services they exercise, as determined by which client libraries are used directly by the test.

```python
@test.services('compute', 'volume', 'image', 'network')
def test_minimum_basic_scenario(self):
    self.glance_image_create()
    self.nova_keypair_add()
    self.nova_boot()
    self.nova_list()
    self.nova_show()
    self.cinder_create()
    self.cinder_list()
    self.cinder_show()
    self.nova_volume_attach()
```
What is ‘Scenario test’? (3/3)

The goal of the scenario tests

- **For operators**
  - Operators can use scenario tests for validating their cloud with simple process such as one command or one click.

- **For developers**
  - They can check whether new code will cause any regression on the other components easily.
    - Because scenario tests are comprehensive tests.

Example: Grenade[1] is using them now. As a result, we have been able to verify the OpenStack upgrade process in a short time.

Grenade: Ran 370 tests in **10mins**

Full test: Ran 2313 tests in **45mins**

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## Overview of the current Scenario tests (1/2)

<table>
<thead>
<tr>
<th>No.</th>
<th>file</th>
<th>test case</th>
<th>summary</th>
<th>services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>orchestration/test_auto_scaling.py</td>
<td>test_scale_up_then_down()</td>
<td>Scale up then down with heat</td>
<td>orchestration, compute</td>
</tr>
<tr>
<td>2</td>
<td>test_aggregates_basic_ops.py</td>
<td>test_aggregate_basic_ops()</td>
<td>Aggregates CRUD tests</td>
<td>compute</td>
</tr>
<tr>
<td>3</td>
<td>test_baremetal_basic_ops.py</td>
<td>test_baremetal_server_ops()</td>
<td>Baremetal basic ops</td>
<td>baremetal, compute, image, network</td>
</tr>
<tr>
<td>4</td>
<td>test_dashboard_basic_ops.py</td>
<td>test_basic_scenario()</td>
<td>Login to Horizon as a regular user and check the home page</td>
<td>dashboard</td>
</tr>
<tr>
<td>5</td>
<td>test_large_ops.py</td>
<td>test_large_ops_scenario()</td>
<td>Boot multiple instances in one nova call</td>
<td>compute, image</td>
</tr>
<tr>
<td>6</td>
<td>test_load_balancer_basic.py</td>
<td>test_load_balancer_basic()</td>
<td>Checking basic load balancing</td>
<td>compute, network</td>
</tr>
<tr>
<td>7</td>
<td>test_minimum_basic.py</td>
<td>test_minimum_basic_scenario()</td>
<td>Basic image, instance, volume, network CRUD test</td>
<td>compute, volume, image, network</td>
</tr>
</tbody>
</table>
| 8   | test_server_connectivity_stop_start() | test_server_connectivity_stop_start() | This test case checks VM connectivity after some advanced instance operations executed  *
* Stop/Start an instance | compute, network |
| 9   | test_server_connectivity_reboot() | test_server_connectivity_reboot()   | This test case checks VM connectivity after some advanced instance operations executed  *
* Reboot an instance | compute, network |
| 10  | test_network_advanced_server_ops.py | test_server_connectivity_rebuild() | This test case checks VM connectivity after some advanced instance operations executed  *
* Rebuild an instance | compute, network |
| 11  | test_server_connectivity_pause_unpause() | test_server_connectivity_pause_unpause() | This test case checks VM connectivity after some advanced instance operations executed  *
* Pause/Unpause an instance | compute, network |
| 12  | test_server_connectivity_suspend_resume() | test_server_connectivity_suspend_resume() | This test case checks VM connectivity after some advanced instance operations executed  *
* Suspend/Resume an instance | compute, network |
| 13  | test_server_connectivity_resize() | test_server_connectivity_resize()    | This test case checks VM connectivity after some advanced instance operations executed  *
* Resize an instance | compute, network |

There are 24 scenarios but there are some missing services such as Telemetry, Database.
### Overview of the current Scenario tests (2/2)

**There are 24 scenarios but there are some missing services such as Telemetry, Database**

<table>
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<th>summary</th>
<th>services</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>test_network_basic_ops.py</td>
<td>test_network_basic_ops()</td>
<td>This smoke test suite assumes that Nova has been configured to boot VM's with Neutron-managed networking, and attempts to verify network connectivity</td>
<td>compute, network</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>test_hotplug_nic()</td>
<td>Checking hotplug a nic to a VM</td>
<td>compute, network</td>
</tr>
<tr>
<td>16</td>
<td>test_security_groups_basic_ops.py</td>
<td>test_cross_tenant_traffic()</td>
<td>This test suite assumes that Nova has been configured to boot VM's with Neutron-managed networking, and attempts to verify cross tenant connectivity</td>
<td>compute, network</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>test_in_tenant_traffic()</td>
<td>Test for in-tenant check</td>
<td>compute, network</td>
</tr>
</tbody>
</table>
| 18  | test_server_advanced_ops.py | test_resize_server_confirm() | This test case stresses some advanced server instance operations  
* Resizing an instance | compute |
| 19  |       | test_server_sequence_suspend_resume() | This test case stresses some advanced server instance operations  
* Sequence suspend resume | compute |
| 20  | test_server_basic_ops.py | test_server_basicops() | This smoke test case follows this basic set of operations | compute, network |
| 21  | test_snapshot_pattern.py | test_snapshot_pattern() | This test is for snapshotting an instance and booting with it. | compute, network, image |
| 22  | test_stamp_pattern.py | test_stamp_pattern() | This test is for snapshotting an instance/volume and attaching the volume created from snapshot to the instance booted from snapshot. | compute, volume, image, network |
| 23  | test_swift_basic_ops.py | test_swift_basic_ops() | Swift basic operations test | object_storage |
| 24  | test_volume_boot_pattern.py | test_volume_boot_pattern() | This is a test for checking volume boot sequence. | compute, volume, image |
How to use Scenario Tests
How to use Scenario tests (1/3)

1. clone the source code
   $ git clone git://git.openstack.org/openstack/tempest

2. copy & customize the configuration file (tempest.conf)
   $ vim tempest.conf

3. run Tempest
   $ testr run --parallel tempest.scenario
   or
   $ ./run_tempest.sh tempest.scenario

4. check the result

Requirements
- command line operation skill
- knowledge of tempest.conf
  - There are about 300 config options..

These execute all scenario tests. If you want to execute a specific test case, you can specify the test like this:

.....

tempest.scenario.test
_minimum_basic
How to use Scenario tests (2/3) – Check the result

This test was failed :-P

These tests were finished normally in these seconds.

This test was skipped.
How to use Scenario tests (3/3) – Check the result (cont’d)

These are details of the failure. You may need to check these and also server’s log.
Demonstration
Demonstration

- Demo environment
  - DevStack (May 6)

- Execute a scenario test case
  - No.7 test_minimum_basic.py:
    - Basic image, instance, volume, network CRUD test

- Check the result

Let’s see the demo.

A portion of the scenario test code

```python
@test.services('compute', 'volume', 'image', 'network')
def test_minimum_basic_scenario(self):
    self.glance_image_create()
    self.nova_keypair_add()
    self.nova_boot()
    self.nova_list()
    self.nova_show()
    self.cinder_create()
    self.cinder_list()
    self.cinder_show()
    self.nova_volume_attach()
    self.addCleanup(self.nova_volume_detach)
    self.cinder_show()
    self.nova_volume_detach()
    self.nova_keypair_delete()
    self.nova_boot()
    self.nova_list()
    self.nova_show()
    self.cinder_create()
    self.cinder_list()
    self.cinder_show()
    self.nova_volume_attach()
    self.addCleanup(self.nova_volume_detach)
    self.cinder_show()
    self.nova_volume_detach()
    self.nova_keypair_delete()
    self.nova_boot()
    self.nova_list()
    self.nova_suspend()
    self.nova_resume()
    self.nova_reboot()
    self.nova_stop()
    self.nova_start()
    self.cinder_delete()
    self.nova_delete()
    self.check_partitions()
```

[https://github.com/openstack/tempest/blob/master/tempest/scenario/test_minimum_basic.py](https://github.com/openstack/tempest/blob/master/tempest/scenario/test_minimum_basic.py)
Issue/Future of Scenario tests
Issues and Future of scenario tests

### Issues

- **Need more scenarios**
  - More services such as Telemetry(Ceilometer), Database(Trove)
  - More complicated but popular scenarios
- It’s **difficult to write scenarios** because it needs python development skills.
- It’s **difficult to prepare settings for existing clouds.**
  - ‘tempest.conf’ has about 300 options..
- It’s **difficult to analyze** the cause of failures.
  - ‘Elastic Recheck’ is one of the solutions for developers but not for operators…

### Future

- **Easier**
  - Operators want to verify their cloud without command line skills.
    - Tempest GUI!
- **More useful**
  - We can specified nodes and zones by settings.
    - Under reviewing the patch now: https://review.openstack.org/#/c/66882/
Summary
Summary

- OpenStack has an official test suite: **Tempest**
- Tempest is **not for only developers but also for operators** of OpenStack cloud.
- Especially, **scenario tests** are test cases across multiple components, **it can be used for system testing** for OpenStack cloud.
- By using the scenario tests, **it is possible to reduce the evaluation cost** of your cloud environment in comparison with making a test suite from scratch.

Please join us to enhance scenario tests!

- OpenStack Development Mailing List (not for usage questions)
  - openstack-dev@lists.openstack.org
  - Please add ‘[qa]’ tag to the subject for QA things.
- IRC
  - #openstack-qa channel on Freenode
Appendix
Links

- OpenStack Development Mailing List (not for usage questions)
  - openstack-dev@lists.openstack.org

- Tempest scenario test code

- Gerrit workflow
  - https://wiki.openstack.org/wiki/Gerrit_Workflow

- How To Contribute to OpenStack
  - https://wiki.openstack.org/wiki/How_To_Contribute
Overview of Tempest GUI (Now Proposing)

- REST APIs for List, Show, Run... Tempest tests and results
- Execute Tempest tests
- OpenStack Cloud

New modules:
- python-tempestclient
- Tempest Server
- Results Store
How to add more scenarios

Requirements
- python development skill
- OpenStack python library knowledge

Design a scenario
- What do you want to verify?

Write the code
- Before writing the code, I recommend you look at the code of existing scenario tests.
  - You will get the knowledge of how to implement scenarios.

Why Contribute the code to the OpenStack community?
- It increases OpenStack stability.