Building a Heat Template from the Ground up

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Introduction

What is Heat?

- Orchestration Service controlled by instructions in HOT resource description language (or CloudFormation CFN templates)
- Introduced in OpenStack Icehouse
- Really usable as of OpenStack Kilo (some teething trouble)
- Terminology: Heat *Templates* (written in HOT) describe a setup consisting of one or more resources and are instantianted as Heat *Stacks*.

This Workshop

- Heat Services and Architecture
- Anatomy of a Heat Template
- Hands on: Let's try and break things...

Services and Architecture

- heat-api: OpenStack API
- heat-api-cfn: Cloud Formation Compatible API
- heat-engine: sends resource creation requests to other services (Nova, Neutron, ...)

Anatomy of a Heat Template

Overview

- Two possible formats for data payload: YAML or JSON (YAML recommended)
- Sections:
  - `heat_template_version`: Governs available features
  - `parameters`: Parameters that can be supplied through command line or web interface
  - `resources`: The resources to be created
  - `outputs`: data to pass back to the user upon stack creation

Command Line Heat Client (1)

Prerequisite: Environment with valid OpenStack credentials

Create stack *mystack* from */tmp/stack.yaml*

```
heat stack-create -f /tmp/stack.yaml mystack
```

With parameter

```
heat stack-create -f /tmp/stack.yaml -P
flavor=m1.tiny mystack
```

Delete stack *mystack*

```
heat stack-delete mystack
```

Command Line Heat Client (2)

Detailed Information about stack *`mystack`*

```
heat stack-show mystack
```

Error messages (if any) in field `stack_status_reason` (more readable in `heat-engine.log`, if you have access)

List resources of stack *`mystack`*

```
heat resource-list -n 5 mystack
```

List outputs for stack *`mystack`*

```
heat output-list mystack
```

Get Output *`floating_ip`* from stack mystack

```
heat output-show mystack floating_ip
```

Heat Resources: An example

```
resources:
  myserver:
    type: OS::Nova::Server
    properties:
      name: myserver
      key_name: { get_param: key_name }
      image: { get_param: image }
      flavor: { get_param: flavor }
      networks:
        - port:
            get_resource: myport
```

Heat Functions

get_param

```
key_name: { get_param: key_name }
```

get_resource

```
networks:
        - port: { get_resource: myport }
```

get_attr

```
outputs:
  floating_ip_address:
    description: The server's floating IP address.
    value:
      get_attr:
        - myfloating_ip         # resource
        - floating_ip_address   # attribute
```

Hands-on: Creating a Heat Stack

Preparations

Get a local copy of slides

```
git clone https://github.com/jgrassler/heat-workshop-barcelona
```

Install Heat command line client

```
sudo zypper install python-heatclient      # SUSE
sudo yum install python-heatclient         # RedHat
sudo aptitude install python-heatclient    # Debian/Ubuntu
```

Prepare openrc

Log in to the cloud dashboard using one of the credentials sheets we handed out and download an openrc to ~/openrc.workshop. Source that openrc:

```
source ~/openrc.workshop
```

A minimal template

with-errors/01-minimal.yaml

```
heat_template_version: 2525-01-01
```

Try to create stack

```
. /root/openrc.myuser
heat stack-create --poll -f \
     /tmp/stack.yaml mystack
```

Partial: `partial01-broken.yaml`

Error 1: *heat_template_version*

Partial: `partial01-broken.yaml`

Error Message

```
ERROR: The template version is invalid:
"heat_template_version: 2525-01-01".
"heat_template_version" should be one of: 2013-
05-23, 2014-10-16, 2015-04-30, 2015-10-15
```

Resolution

Pick one of the template versions supported by your cloud (`2015-10-15` or lower for the cloud we provided) from the list above.

Partial: `partial01.yaml`

Adding parameters to your template

02-parameters.yaml

```
parameters:
  floating_network:
    type: string
    default: floating
  image:
    type: string
    default: cirros-0.3.4-x86_64
  flavor:
    type: string
    default: m1.tiny
  key_name:
    type: string
    default: root
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial02.yaml`

Error 2: Tabs versus spaces

Partial: `partial02-broken.yaml`

Error Message

```
Error parsing template file:///crypt/home/johannes/src/talks/heat-
workshop/partial/partial02-broken.yaml while scanning for the next
token
found character that cannot start any token
  in "<unicode string>", line 13, column 1
```

Resolution

Check the problematic line for a mix of tabs and spaces. Depending on your tabstop setting it may not be obvious at first. The same error may also occur due to a key starting with non-alphanumeric characters.

Retry stack creation

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial02.yaml`

Creating a Network

Begin resources section after parameters section

```
resources:
```

03-network.yaml

```
  mynetwork:
    type: OS::Neutron::Net
    properties:
      name: mynet
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial03.yaml`

Creating a Subnet

04-subnet.yaml

```
mysubnet:
  type: OS::Neutron::Subnet
  properties:
    cidr: 10.0.0.1/24
    name: mysubnet
    network:
      get_resource: mynetwork
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial04.yaml`

A Port on your Network

05-port.yaml

```
myport:
  type: OS::Neutron::Port
  properties:
    network:
      get_resource: mynetwork
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml
mystack
```

Partial: `partial05.yaml`

Creating an Instance

06-server.yaml

```
myserver:
  type: OS::Nova::Server
  properties:
    name: myserver
    config_drive: true
    flavor: { get_param: flavor }
    image: { get_param: image }
    key_name: { get_param: key_name }
    networks:
      - port: { get_resource: myport }
    user_data_format: RAW
    user_data: |
      #!/bin/sh
      echo 'Hello, World' >> /etc/motd
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial06.yaml`

Error 4: SSH key not found

Error Message

```
ERROR: Property error: :
resources.myserver.properties.key_name: : Error
validating value 'mykey': The Key (mykey) could
not be found.
```

Resolution

```
nova keypair-add --pub-key ~/.ssh/id_rsa.pub
mykey
```

Partial: `partial06.yaml`

Error 5: No valid host was found

Modified command

```
heat stack-create --poll -f /tmp/stack.yaml -P flavor
m1.ginormous mystack
```

Error message

```
resources.myserver: Went to status ERROR due to
"Message: No valid host was
found. There are not enough hosts available., Code: 500"
```

Resolution

Have enough resources available, either by picking a smaller flavor or by having more/bigger compute nodes.

Partial: `partial06.yaml`

Attempt to associate a floating IP

09-float.yaml

```
  myfloatingip:
    type: OS::Neutron::FloatingIP
    properties:
      port_id: { get_resource: myport }
      floating_network:
        get_param: floating_network
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial09-broken.yaml`

Error 6: External network not reachable

Check stack status

```
heat stack-show mystack
```

Error message

```
NotFound: resources.floatingip: External network
27011e4a-1727-499a-9c1f-b372a62071a9 is not reachable from
subnet
dbe382bd-0ccf-4107-9f96-8cecad3797f1  Therefore, cannot
associate Port
162b6498-13ce-46b9-a436-76fb50f06c67 with a Floating IP.
```

Resolution

Comment/Remove the `floatingip` resource for now. We need a router first.

Partial: `partial06.yaml`

Creating a Router

07-router.yaml

```
router:
  type: OS::Neutron::Router
  properties:
    external_gateway_info:
      network:
        get_param: floating_network
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml mystack
```

Partial: `partial07.yaml`

Adding A RouterInterface

08-interface.yaml

```
  router_interface:
    type: OS::Neutron::RouterInterface
    properties:
      router: { get_resource: router }
      subnet: { get_resource: mysubnet }
```

Create the stack

```
heat stack-create --poll -f /tmp/stack.yaml
mystack
```

Partial: `partial08.yaml`

Associating a Floating IP

09-float.yaml

```
myfloatingip:
  type: OS::Neutron::FloatingIP
  properties:
    port_id: { get_resource: myport }
    floating_network:
      get_param: floating_network
```

Create the stack and display floating IP

```
heat stack-create --poll -f /tmp/stack.yaml mystack
heat resource-show mystack myfloatingip
```

Partial: `partial09.yaml`

Error 7: Floating IP unreachable

Error

Pings or SSH to floating IP address time out

Resolution

Create a security group that allows inbound traffic (default is to block everything).

Partial: `partial09.yaml`

Security Groups to the Rescue

10-group.yaml

```
allow_inbound:
  type: OS::Neutron::SecurityGroup
  properties:
    description: "Allow inbound SSH and ICMP traffic"
    name: allow SSH and ICMP from anywhere
    rules:
      - direction: ingress
        remote_ip_prefix: 0.0.0.0/0
        protocol: tcp
        port_range_min: 22
        port_range_max: 22
      - remote_ip_prefix: 0.0.0.0/0
        protocol: icmp
```

Create the stack and display floating IP

```
heat stack-create --poll -f /tmp/stack.yaml mystack
heat resource-show mystack myfloatingip
```

Partial: `partial10.yaml`

Error 8: Security Group not associated

Error

Floating IP not reachable despite security group.

Resolution

Associate the security group with the port it is supposed to apply to.

Partial: `partial10.yaml`

Port revisited

11-port.yaml

```
  myport:
    type: OS::Neutron::Port
    properties:
      network:
        get_resource: mynetwork
      security_groups:                  # NEW
        - get_resource: allow_inbound # NEW
```

Create the stack and display floating IP

```
heat stack-create --poll -f /tmp/stack.yaml mystack
heat resource-show mystack floatingip
```

Partial: `partial11.yaml`

Outputs: What's my Floating IP?

12-outputs.yaml

```
outputs:
  floating_ip:
    value:
      get_attr:
        - myfloatingip
        - floating_ip_address
```

Create the stack and display floating IP

```
heat stack-create --poll -f /tmp/stack.yaml mystack
heat output-show mystack floating_ip
```

Partial: `partial12.yaml`

Error 9: Can't delete stack

Error message upon *`stack-delete`*

```
Unable to complete operation on subnet
d5bda832-2816-4453-932e-c739cc0f1152. One or more
ports
have an IP allocation from this subnet.
```

Resolution

```
neutron port-list | grep d5bda832-2816-4453-932e-
c739cc0f1152 | awk '{ print $2}'
```

This will give you a list of Neutron port IDs. One of them belongs to `myserver` from the Heat stack, the rest are freeloaders. You need to get rid of the freeloaders somehow (better talk to their owners first).

`CloudConfig` resources

Much saner way to include Nova *`user-data`*

Install `git` and `emacs` immediately on system boot-up

Partial: `partial13.yaml`

`WaitCondition` resources

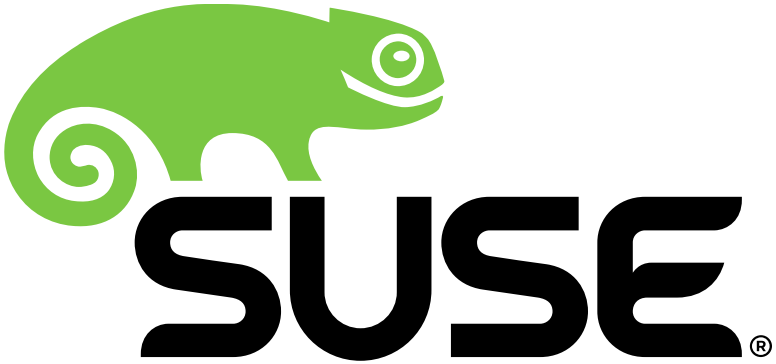
Wait for the **entire** stack to be fully initialized before reaching `CREATE_COMPLETE` status

Cleverly combine with `CloudConfig` by invoking `curl` from `runcmd`

Partial: `partial14.yaml`

Further Reading: Template Guide

Thank you.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