Heat: OpenStack Orchestrator

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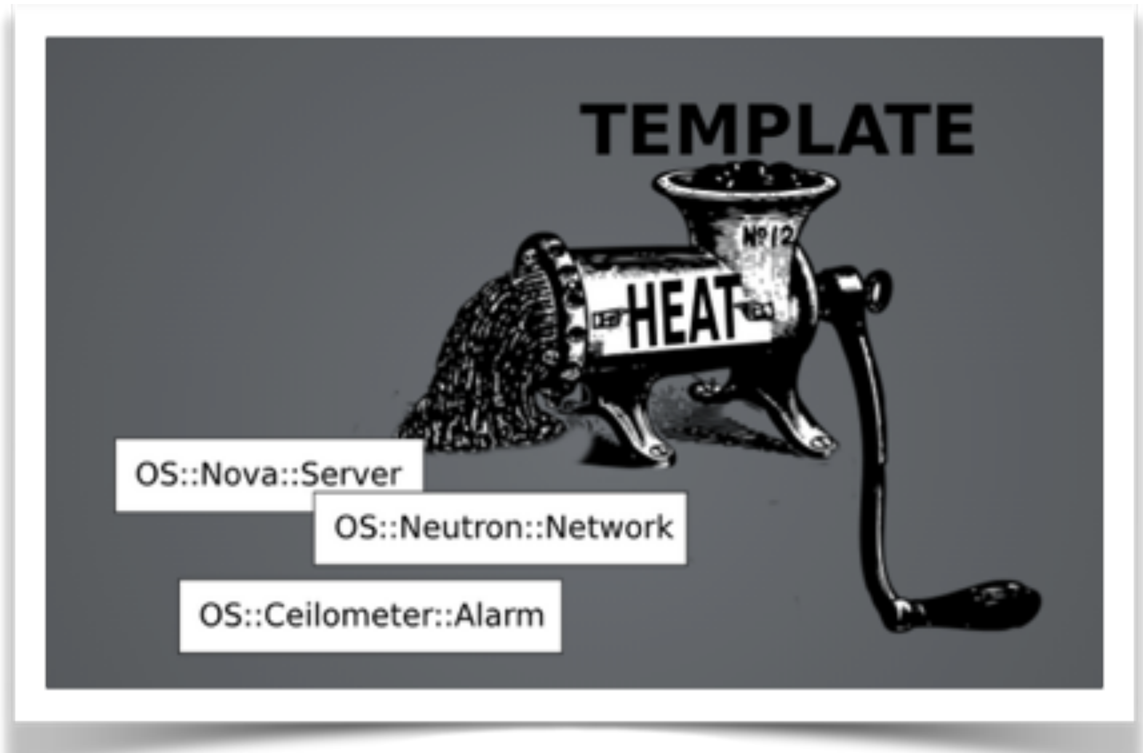
Outline

- Heat
- Architecture
- Template, Environment, Nested Templates
- WaitConditions
- Autoscaling

Heat: IaaS automation

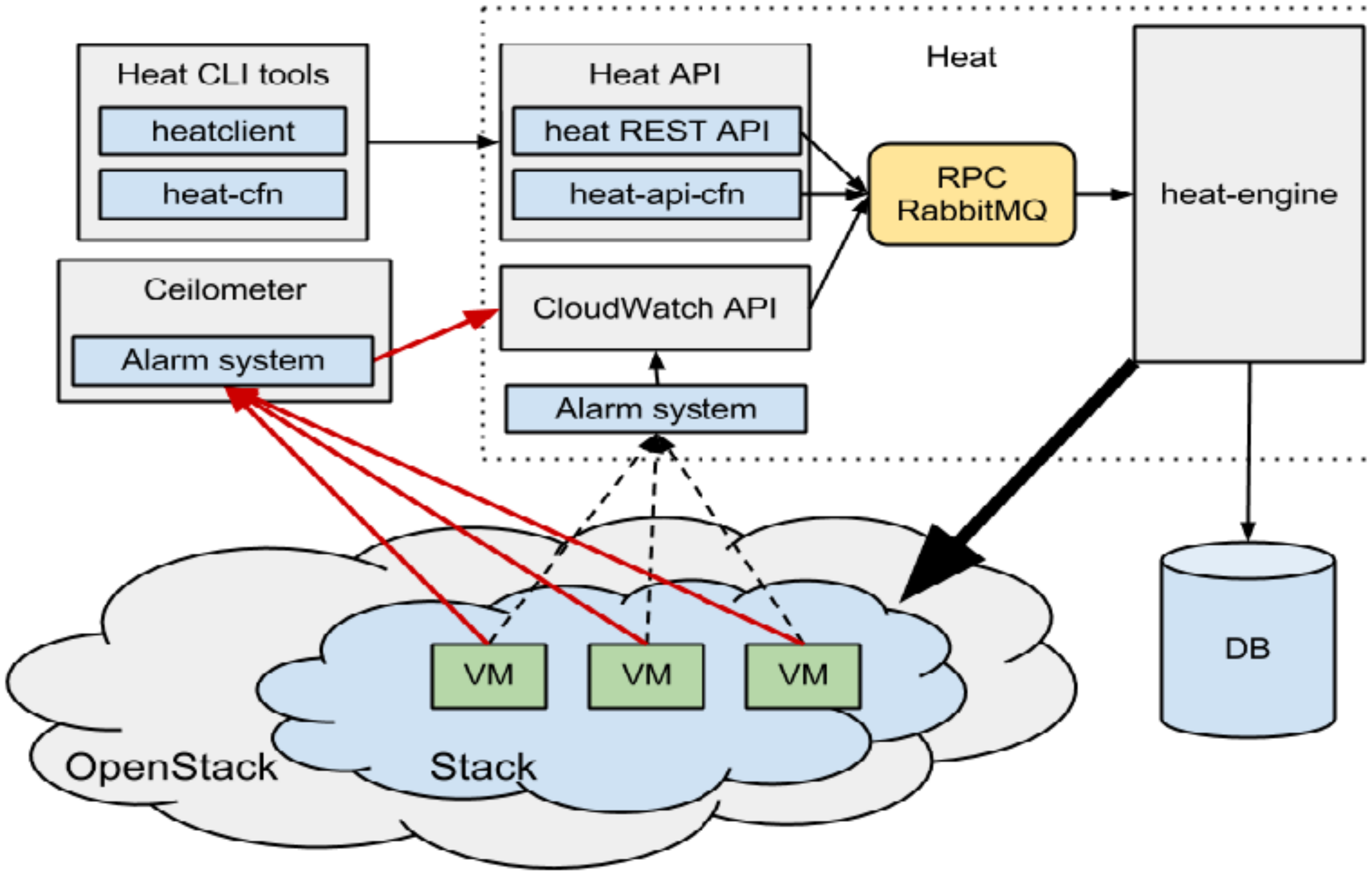
- Orchestration service for OpenStack
- Uses templating mechanism
- Controls complex groups of cloud resources
- Huge potential and multiple use cases



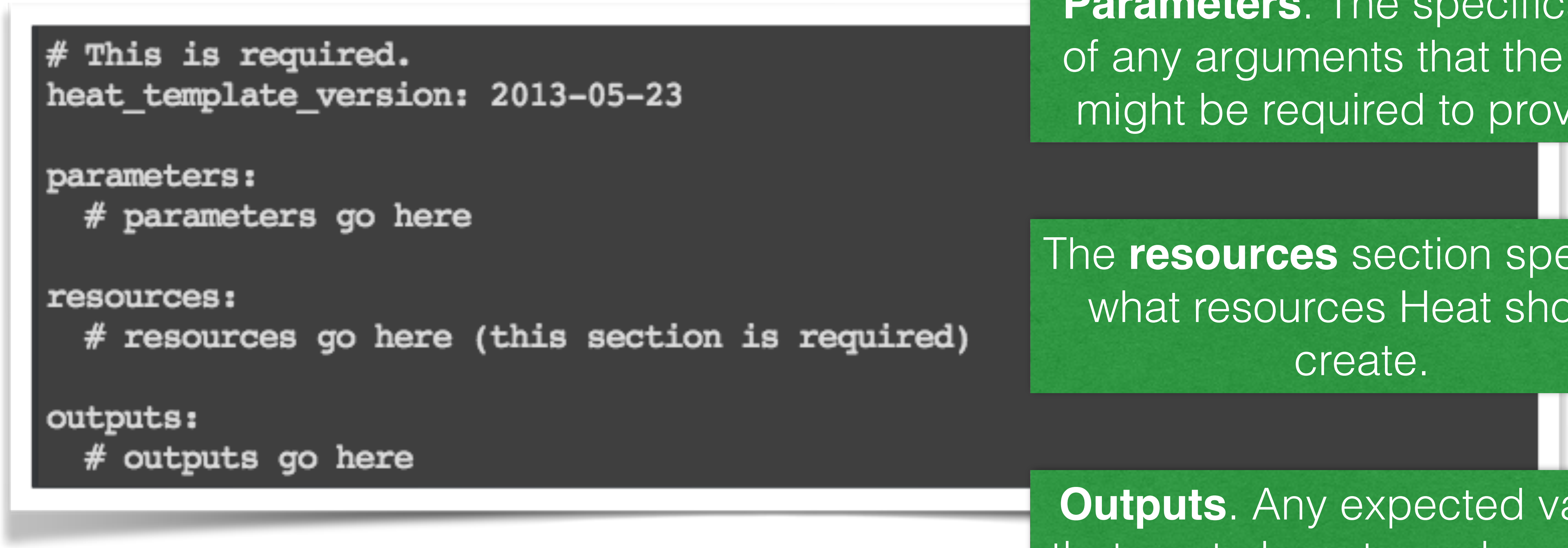
Heat components

- Heat consists of several components:
    - heat-api: provides the REST API
    - heat-api-cfn: provides EC2 CloudFormation API
    - heat-engine: orchestrates the launching of templates and provides events back to the API consumer.
    - heat: a CLI which communicates with the heat-api

Logical architecture



Templates



```
# This is required.
heat_template_version: 2013-05-23

parameters:
  # parameters go here

resources:
  # resources go here (this section is required)

outputs:
  # outputs go here
```

Parameters. The specification of any arguments that the user might be required to provide.

The **resources** section specifies what resources Heat should create.

Outputs. Any expected values that are to be returned once the template has been processed

Resources

**** Autoscaling:**

AWS::AutoScaling::LaunchConfiguration

AWS::AutoScaling::AutoScalingGroup

AWS::AutoScaling::ScalingPolicy':

OS::Heat::CWLiteAlarm

OS::Ceilometer::Alarm

**** High Availability:**

OS::Heat::HARestarter

**** Object storage**

OS::Swift::Container

**** Virtual Machines**

AWS::EC2::Instance

OS::Nova::Server

AWS::CloudFormation::Stack

**** Volumes:**

OS::Cinder::Volume

OS::Cinder::VolumeAttachment

***** Neutron SDN:**

OS::Neutron::FloatingIP

OS::Neutron::FloatingIPAssociation

OS::Neutron::Port

OS::Neutron::Router

OS::Neutron::RouterInterface

OS::Neutron::RouterGateway

OS::Neutron::Subnet

***** Neutron Load balancer:**

OS::Neutron::HealthMonitor

OS::Neutron::Pool

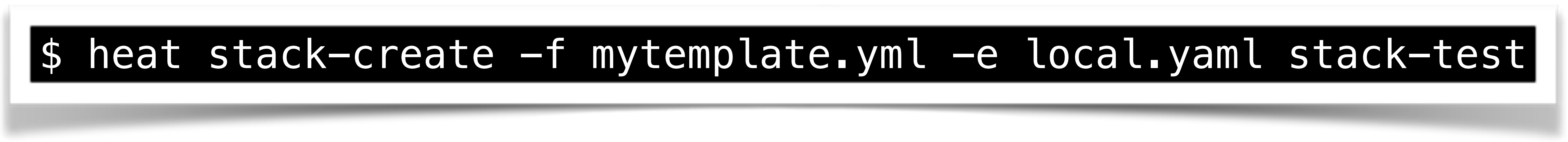
OS::Neutron::LoadBalancer

Heat Icehouse: New resources

- OS::Heat::CloudConfig
- OS::Heat::MultipartMime
- OS::Heat::SoftwareConfig
- OS::Heat::SoftwareDeployment
- OS::Heat::StructuredConfig
- OS::Heat::StructuredDeployment
- OS::Heat::RandomString
- OS::Heat::ResourceGroup
- OS::Heat::AutoScalingGroup
- OS::Heat::ScalingPolicy
- OS::Neutron::SecurityGroup
- OS::Neutron::MeteringLabel
- OS::Neutron::MeteringRule
- OS::Neutron::ProviderNet
- OS::Neutron::NetworkGateway
- OS::Neutron::PoolMember
- OS::Nova::KeyPair
- OS::Nova::FloatingIP
- OS::Nova::FloatingIPAssociation
- OS::Trove::Instance

Environment

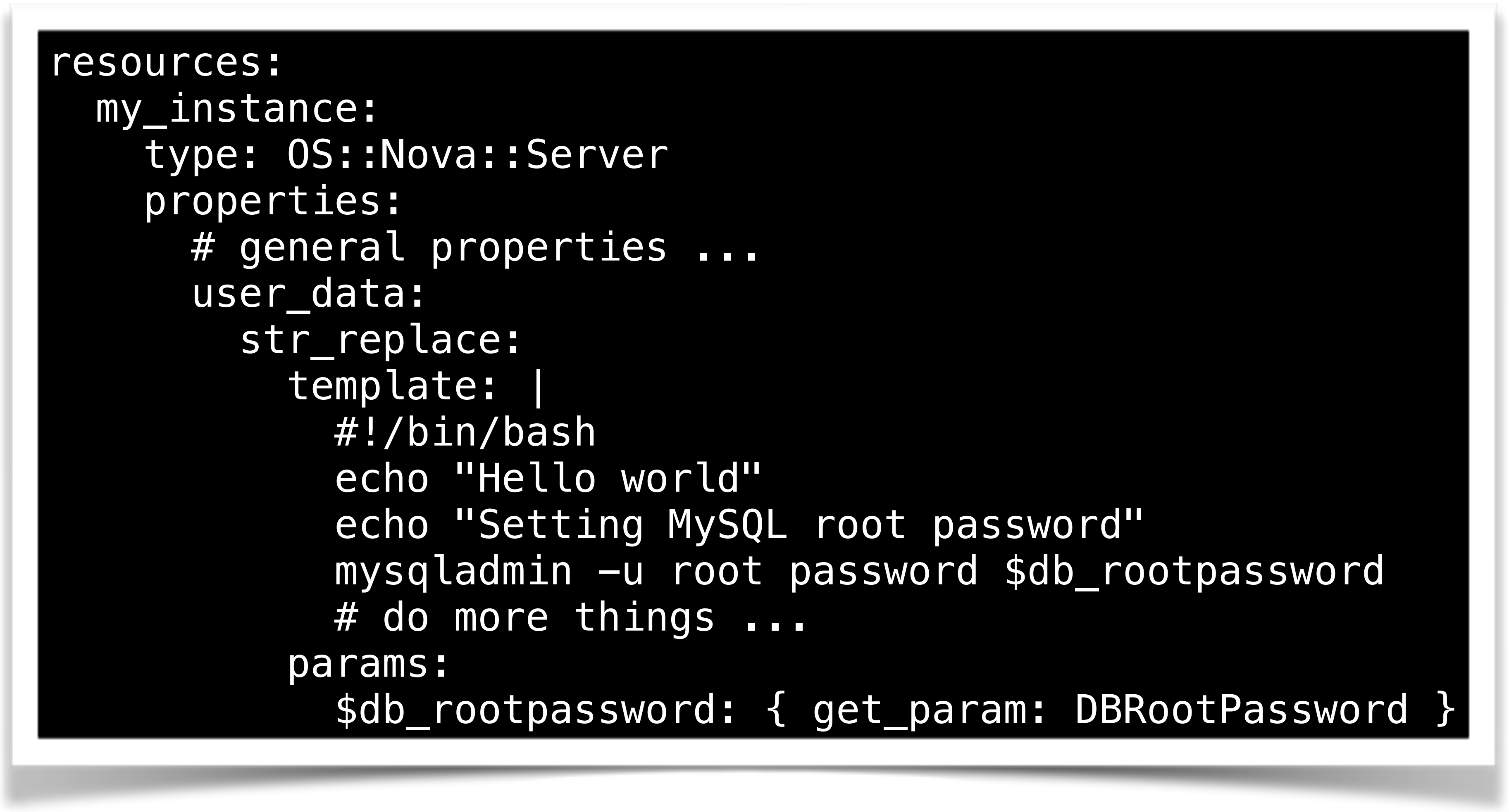
- An environment file is a YAML file with a parameters section containing values for parameters declared in your template



```
$ heat stack-create -f mytemplate.yml -e local.yaml stack-test
```

Contextualization

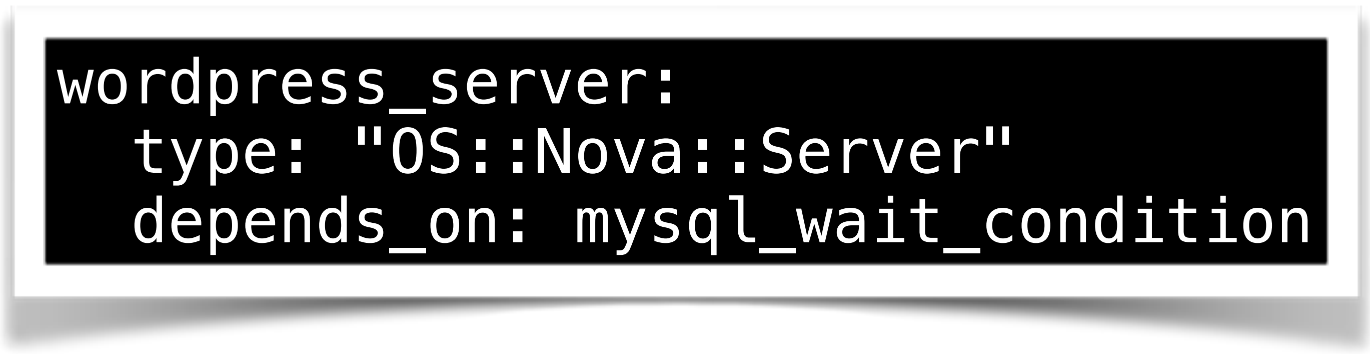
- user_data



```
resources:
  my_instance:
    type: OS::Nova::Server
    properties:
      # general properties ...
      user_data:
        str_replace:
          template: |
            #!/bin/bash
            echo "Hello world"
            echo "Setting MySQL root password"
            mysqladmin -u root password $db_rootpassword
            # do more things ...
          params:
            $db_rootpassword: { get_param: DBRootPassword }
```

Wait condition

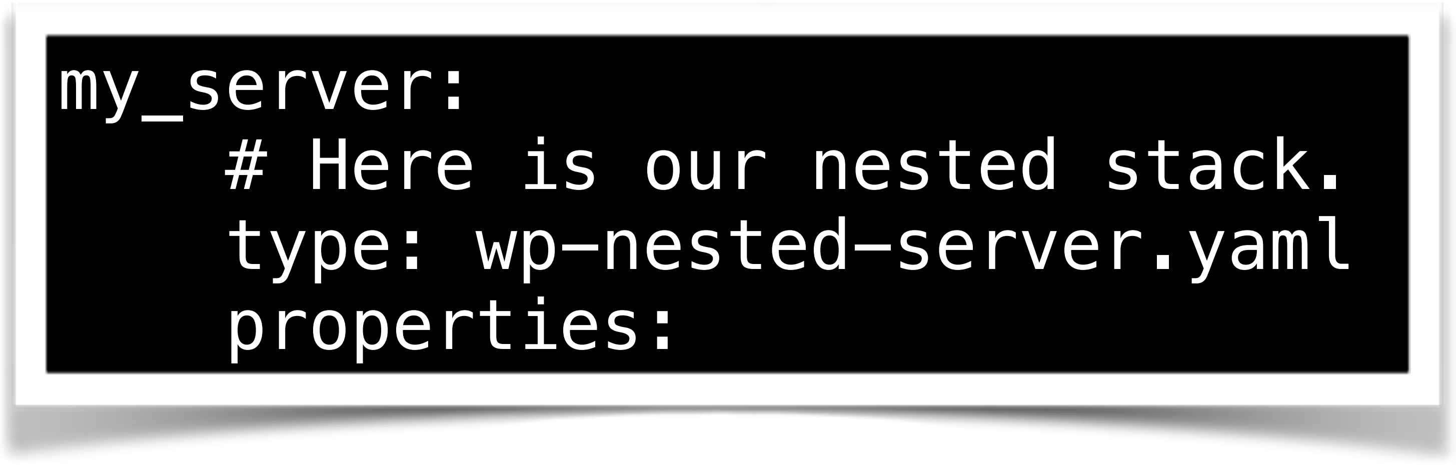
- Most resources (like OS::Nova::Server) transition state automatically (CREATE_IN_PROGRESS -> CREATE_COMPLETE)
- A wait condition (AWS::CloudFormation::WaitCondition) is a resource that only transitions upon receiving an external signal.
- This permits us to make parts of our Heat template wait for an external event before they are created:



```
wordpress_server:
  type: "OS::Nova::Server"
  depends_on: mysql_wait_condition
```

Nested stack

- Heat can treat a template as a resource primitive.
- Allows you to reuse complex configurations in other stacks.
- Create a library of components appropriate to your environment



```
my_server:
    # Here is our nested stack.
    type: wp-nested-server.yaml
    properties:
```

Autoscaling

AutoScalingGroup is a resource that can create and destroy other resources on demand.

ScalingPolicy defines an action that Heat can take on an AutoScalingGroup.

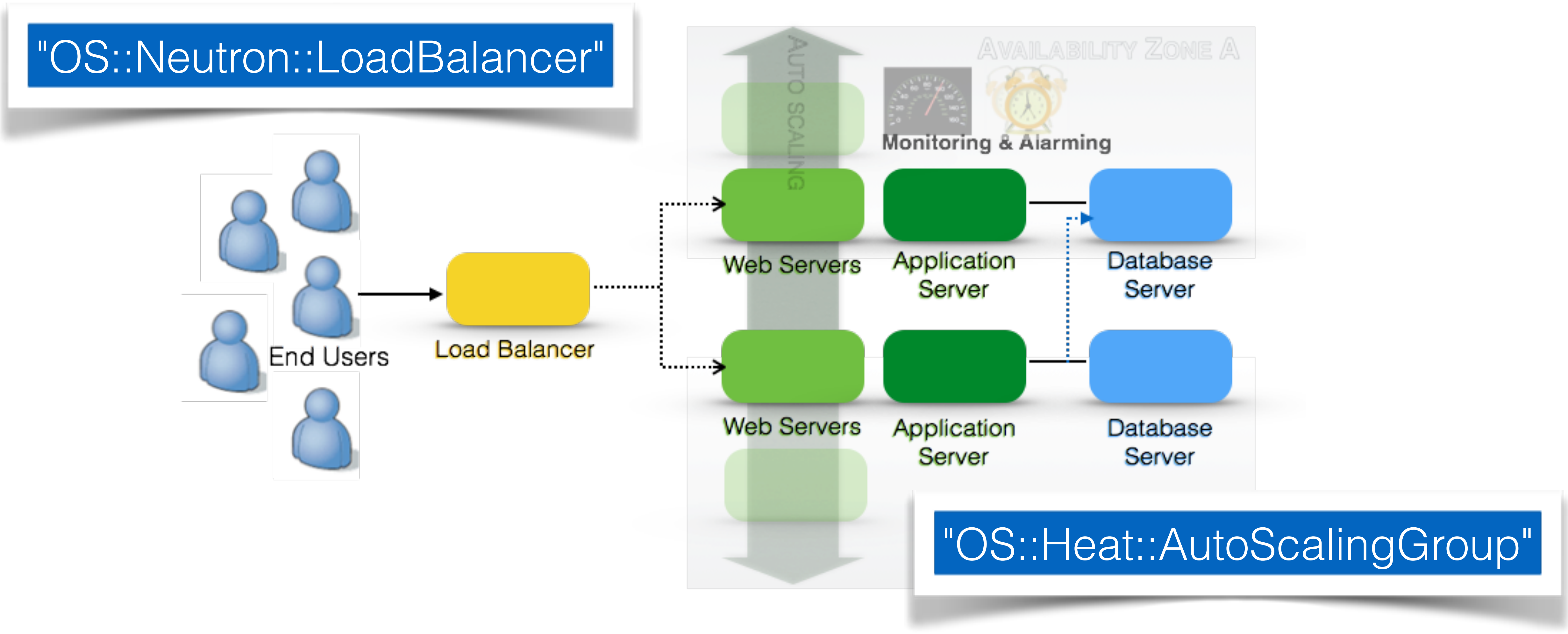
Ceilometer Alarms. An alarm allows Ceilometer to POST to a URL when a metric matches certain values.

Autoscaling

```
"CPUAlarmHigh": {
  "Type": "OS::Metering::Alarm",
  "Properties": {
    "meter_name": "cpu_util", threshold: "75"
    "evaluation_periods": "5", "period": "60",
    "statistic": "avg", "comparison_operator": "gt",
    "description": "Scale-up if CPU > 75% for 300s",
    "alarm_actions":[…"ScaleUpPolicy", "AlarmUrl"…],
    "matching_metadata": {
      "metadata.user_metadata.server_group":
      "MyWebServerGroup"
}}}
```

Autoscaling: use-case

Heat stack creates a variable number of Wordpress servers depending on CPU load, and manages a load balancer to provide access to this service.



Application Software Configuration

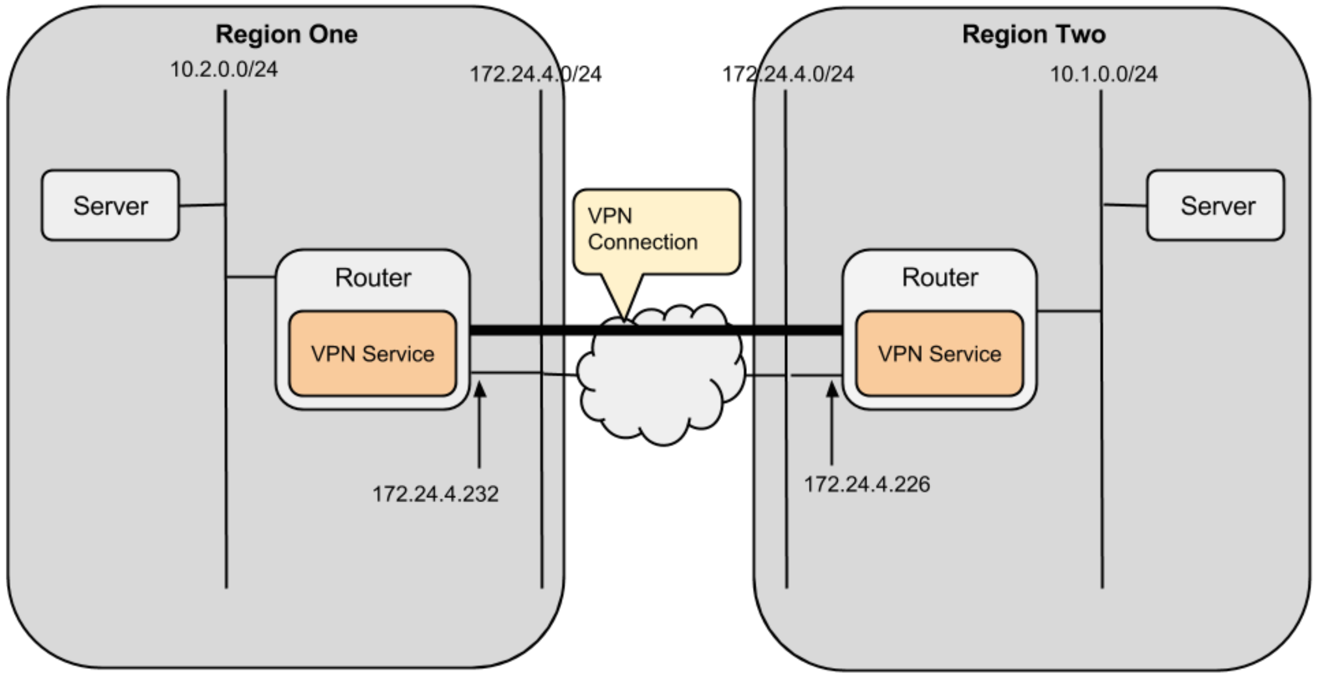
New heat software config and deployment resources

- OS::Heat::SoftwareConfig
- OS::Heat::SoftwareDeployment

Integrating configuration tools

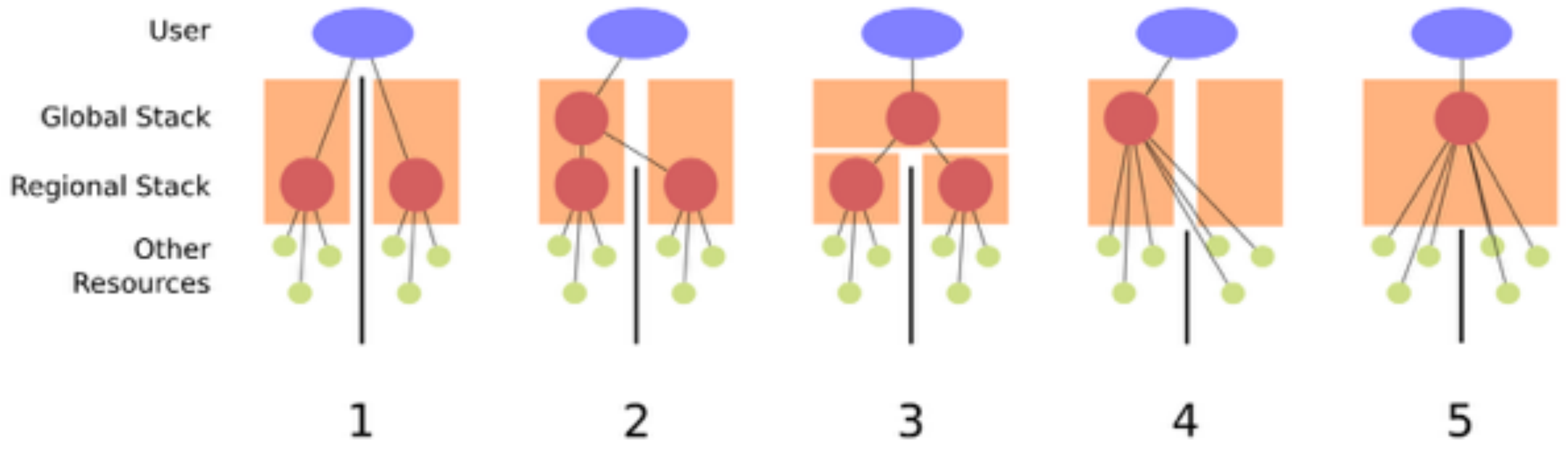
- Templates are well integrated with Puppet, Chef

Multi-region support



BLUEPRINT

- 1. Region Silos (current implementation)
- 2. Stack based Multi region
- 3. Master Orchestrator
- 4. Multi-region resources
- 5. Global Orchestrator



References

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- https://wiki.openstack.org/wiki/Heat
- http://docs.openstack.org/developer/heat/tem plate_guide/hot_spec.html
- https://wiki.openstack.org/wiki/Heat/AWSAutoScaling
- https://wiki.openstack.org/wiki/Heat/Environments