Elastic Data Processing

Big Data Frameworks Course
Spring 2015

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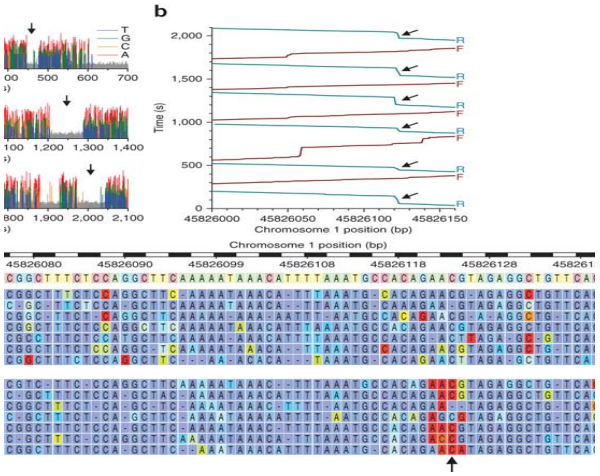
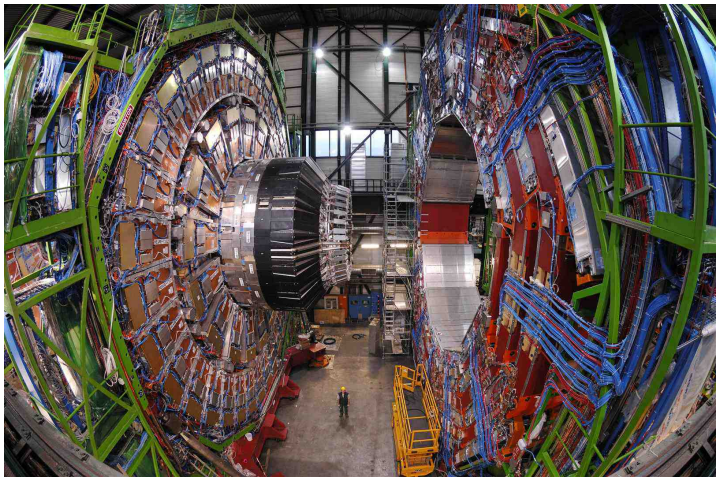
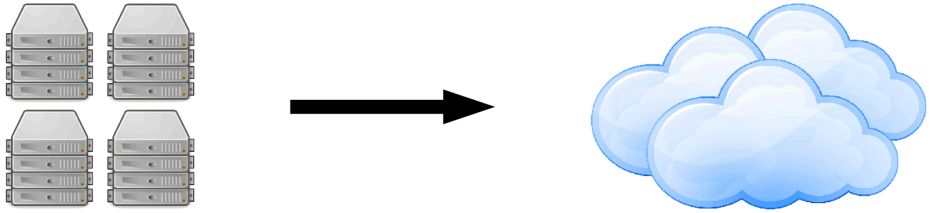
What do they have in-common.!?





Workloads are evolving
Server vs Cloud



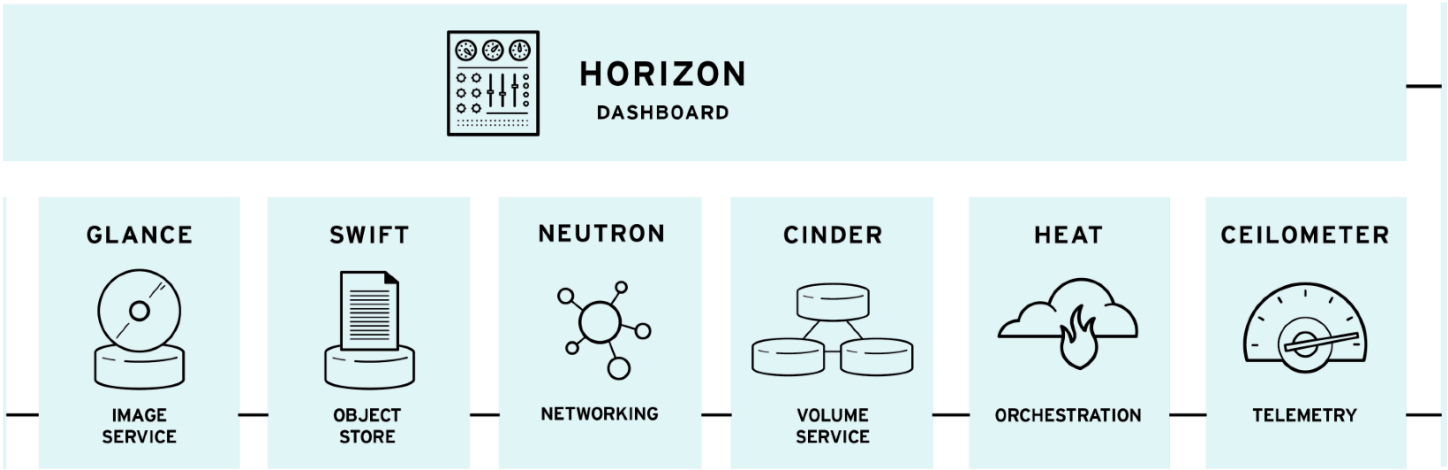
TRADITIONAL WORKLOADS

- Typically resides on a single large server machine;
- Cannot tolerate any downtime;
- Needs expensive high availability tools;
- Application scales up rather than out;

CLOUD WORKLOADS

- Workload resides on multiple Virtual Machines;
- Tolerates VM failure – if one fails, another quickly replaces it;
- Fault tolerance often build into workload ;
- Application scales out rather than up;

OpenStack Architecture



- Modular architecture;
- Designed to easy scale out;
- Based on a set of core services;

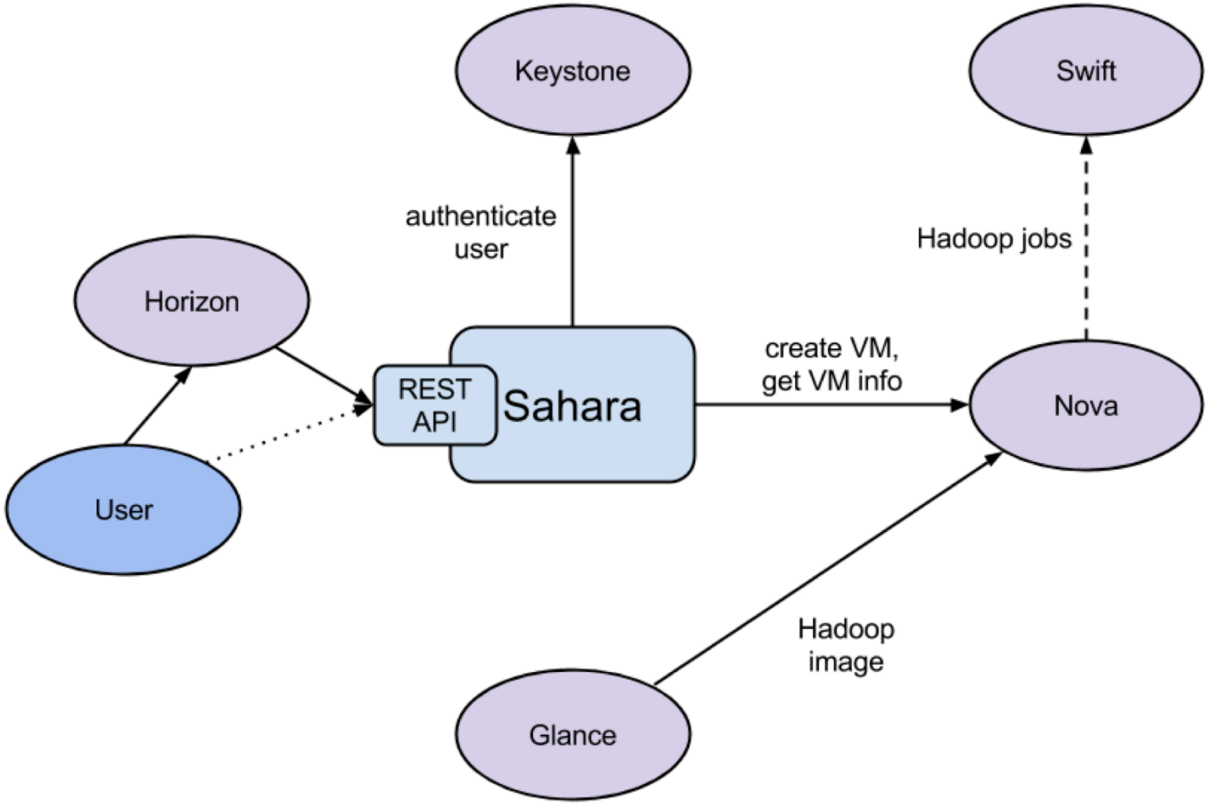
Why OpenStack?

- Brings Public Cloud like capabilities to the datacenter;
- Provides massive on-demand scalability;
  - 1,000's → 10,000's of VMs;
- It's OPEN!;
  - Provides flexibility to customize and interoperate;
- Community development = higher "feature velocity";
  - Features and functions you need, faster to spin a proof-of-concept;
- Constantly "under development"…..Achilles heel;

OpenStack Data Processing Sahara

- Provides a scalable data processing stack and associated management interfaces;
- Provision and operate Hadoop/Spark clusters;
- Schedule and operate Hadoop/Spark jobs;
- Self-service provisioning of clusters;
- Utilization of compute capacity for bursty workloads;
- Run big-data workloads in few clicks without expertise in cluster operations;

Sahara Integration with OpenStack



Sahara Features - Jobs

- EDP – API to execute MapReduce jobs without exposing details of underlying infrastructure (similar to AWS EMR)
  - Pluggable data sources:Swift,HDFS,Ceph
  - Supported job types:Jar,Pig,Hive
- User-friendly UI or ad-hoc analytics queries based on Hive or Pig;
- Spark jobs on Spark standalone clusters;
- Access and Storage of job binaries/output in Swift or Sahara's own database;
- Configuration of jobs at submission time;
- Execution of jobs on existing clusters;

Sahara Features – Cluster Operations

- Hadoop/Spark clusters operation and provisioning
  - Templates for Hadoop/Spark cluster configuration
  - REST API for cluster startup and operations
  - Manual cluster scaling (add/remove nodes)
  - Swift(storage) integration
- UI integrated in dashboard (Horizon)
- Plugin mechanism for integration with different Hadoop distributions – Vanilla apache, Hortonworks,Cloudera,Spark

Sahara - General workflow

- Sahara provides two level of abstractions for API and UI for: cluster provisioning and analytics-as-a-service
- For cluster provisioning:
  - Select cluster version (Hadoop,Spark);
  - Select base image with or without pre-installed software;
  - Define cluster configuration, including size and topology and setting the different type of cluster parameters (e.g.heap size);
  - Provision the cluster: Sahara will provision VMs, install and configure your cluster (Hadoop,Spark);
  - Operation of the cluster: add/remove nodes;
  - Terminate the cluster when it’s not needed anymore;

Sahara - General workflow

- For analytics as a service the workflow is:
  - Select one of the predefined cluster versions;
  - Configure the job;
    - Choose type of job:pig,hive,jar-file,etc;
    - Provide the job script source or jar location;
    - Select input and output data location;
    - Select location for logs;
  - Set the limit for the cluster size;
  - Execute the job:
    - All cluster provisioning and job execution will happen transparently to the user;
    - Cluster will be removed automatically after the job completion;
  - Get the results of computation (e.g.Swift)

Sahara - General workflow – Templates

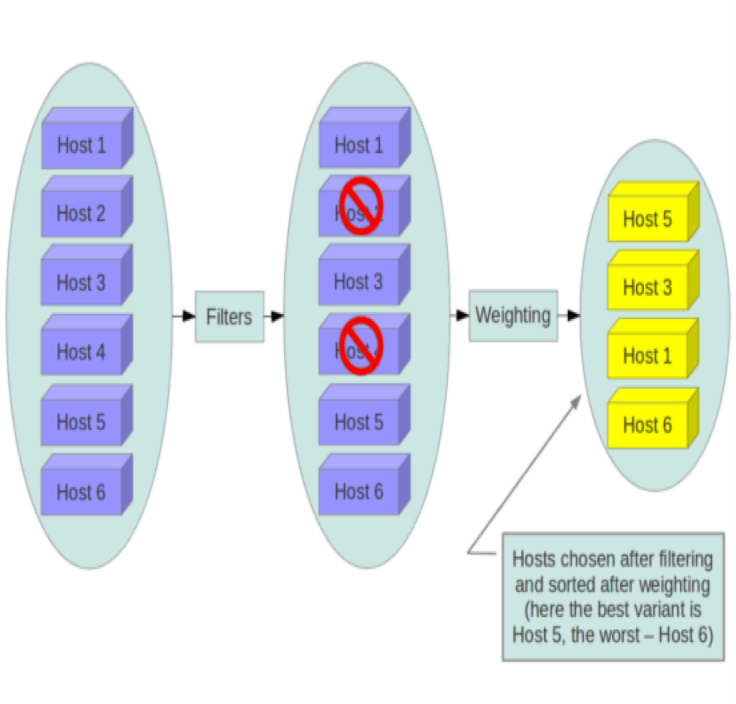
- Node Group Template:
  - Describes a group of nodes within a cluster;
  - Contains a list of Hadoop(Spark) processes that will be launched on each instance in a group;
  - Encapsulates hardware parameters (flavor) for the node VM and configuration for Hadoop(Spark) processes running on the node;
- Cluster Template:
  - Brings node group templates together to form a Cluster;
  - This template defines what Node Group will be included and how many instances will be created in each;
- The Cluster:
  - Represent the Cluster itself with pre-installed images software ready for deployment;

Elastic Data Processing – How?

Workload based scheduler

Flexible Scheduler Driver with filters:

- CoreFilter;
- RamFilter;
- RetryFilter;
- AvalabilityZoneFilter;
- ComputeFilter;
- ComputeCapabilitiesFilter;
- ImagePropertiesFilter;
- ServerGroupAffinityFilter;
- ServerGroupAntiAffinityFilter;



Scheduler examples

- `AvalabilityZoneFilter:`
  - return hosts where node_avalability_zone name is the same as the one requested;
- `RamFilter:`
  - return hosts where (free ram*ram_allocation_ratio) is greater than requested ram;
- `ComputeFilter`: return hosts where asked instance_type (with extra specs) match capabilities;

Elastic Data Processing – How?

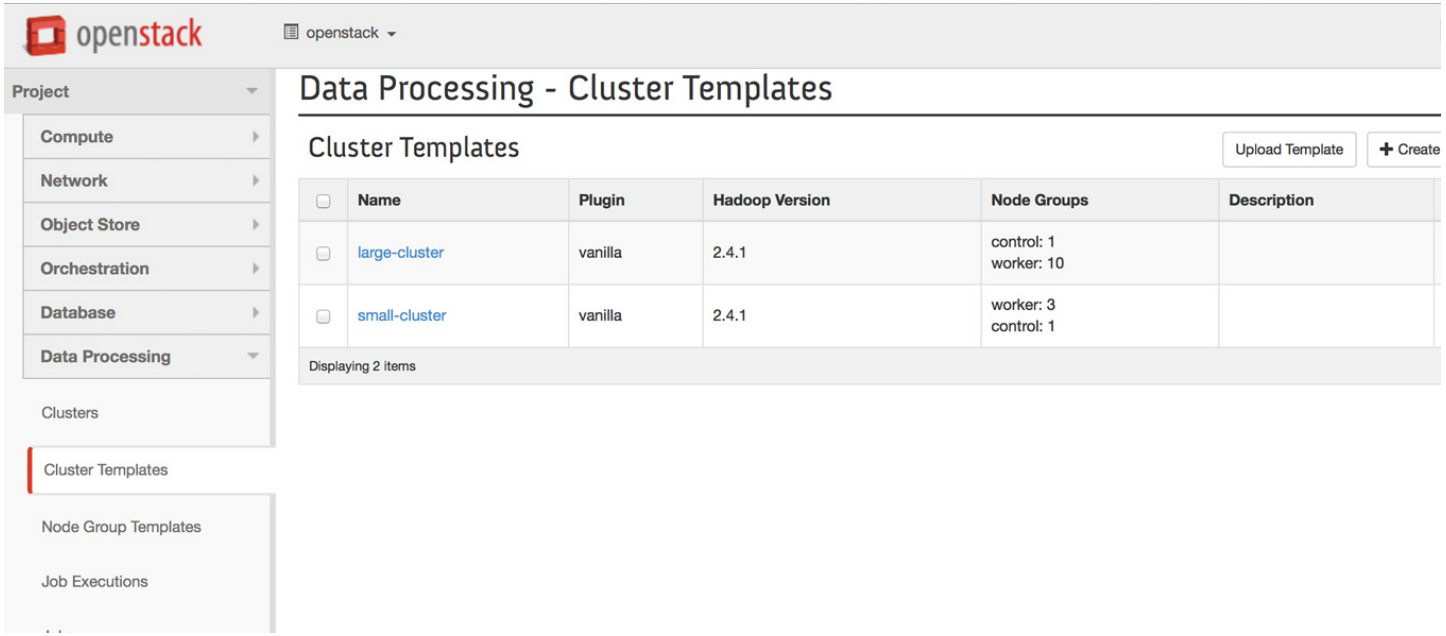
Metrics in Ceilometer

Nova

Name	Type	Unit	Resource	Origin	Note
instance	Gauge	instance	inst ID	both	Duration of instance
instance:<type>	Gauge	instance	inst ID	both	Duration of instance <type> (openstack types)
memory	Gauge	MB	inst ID	notification	Volume of RAM in MB
cpu	Cumulative	ns	inst ID	pollster	CPU time used
cpu_util	Gauge	%	inst ID	pollster	Average CPU utilisation
vcpus	Gauge	vcpu	inst ID	notification	Number of VCPUs
disk.read.requests	Cumulative	request	inst ID	pollster	Number of read requests
disk.write.requests	Cumulative	request	inst ID	pollster	Number of write requests
disk.read.bytes	Cumulative	B	inst ID	pollster	Volume of read in B
disk.write.bytes	Cumulative	B	inst ID	pollster	Volume of write in B
disk.root.size	Gauge	GB	inst ID	notification	Size of root disk in GB
disk.ephemeral.size	Gauge	GB	inst ID	notification	Size of ephemeral disk in GB
network.incoming.bytes	Cumulative	B	iface ID	pollster	number of incoming bytes on the network for a VM interface
network.outgoing.bytes	Cumulative	B	iface ID	pollster	number of outgoing bytes on the network for a VM interface
network.incoming.packets	Cumulative	packets	iface ID	pollster	number of incoming packets for a VM interface
network.outgoing.packets	Cumulative	packets	iface ID	pollster	number of outgoing packets for a VM interface

Elastic Data Processing

Cluster Templates



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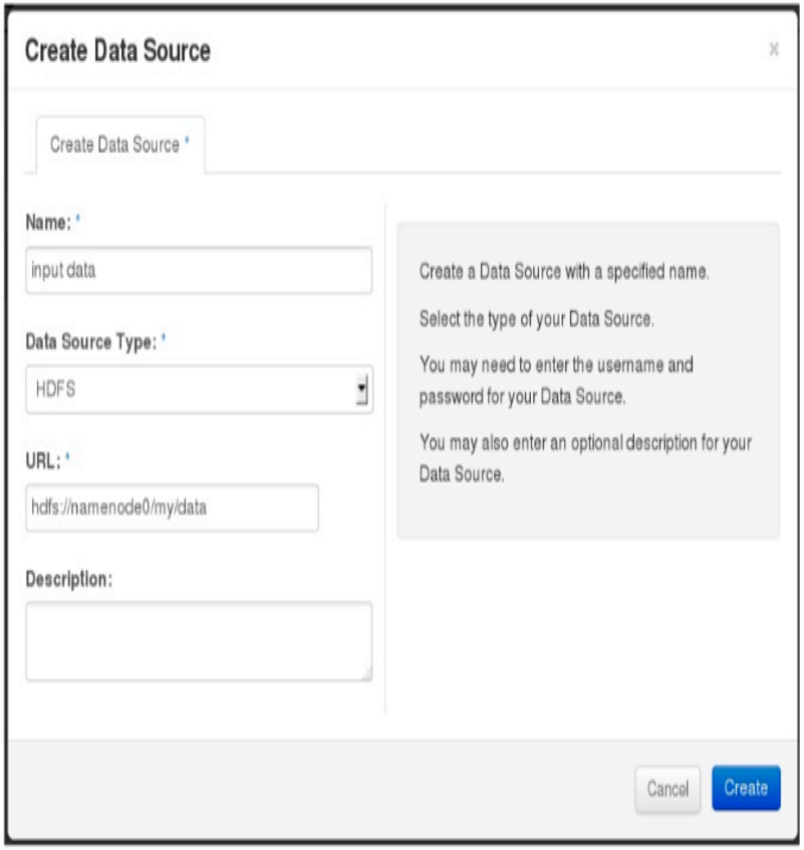
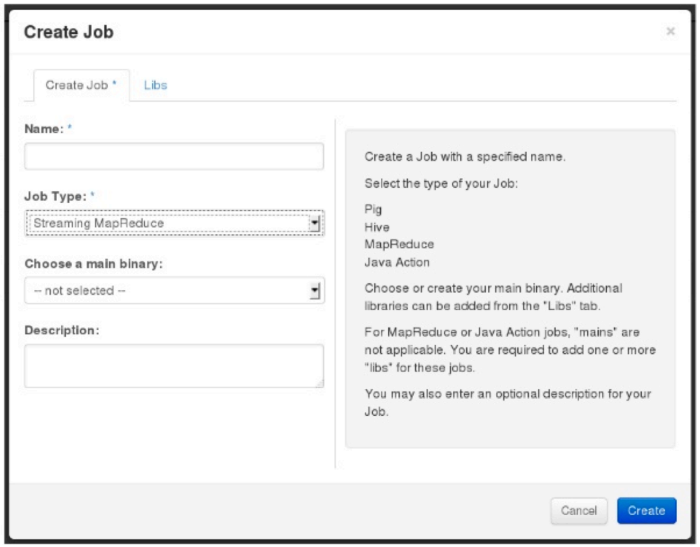
- Support for external HDFS;



Elastic Data Processing

- Job Type selection;



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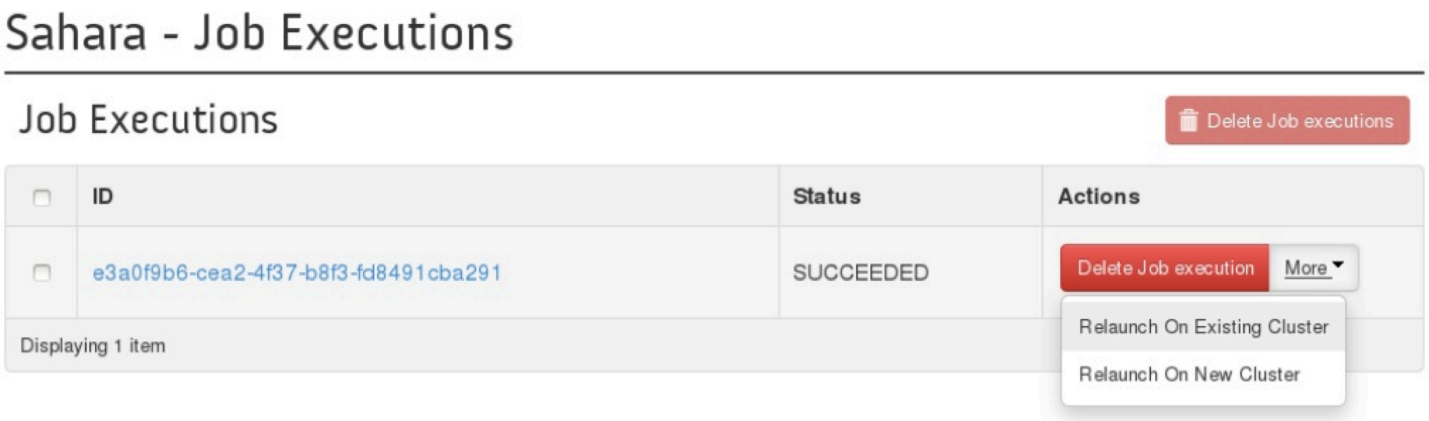
Job re-launch, with new data and parameters



EDP – Command line interface

Image Management

```
$ sahara
...
Positional arguments:
  <subcommand>
    image-add-tag    Add a tag to an image.
    image-list       Print a list of available images.
    image-register   Register an image from the Image index.
    image-remove-tag Remove a tag from an image.
    image-show       Show details of an image.
    image-unregister Unregister an image.
```

EDP – Command line interface

Node group, cluster and job templates

```
$ sahara
   node-group-template-create   Create a node group...
   node-group-template-delete   Delete a node group...
   node-group-template-list     Print a list of available...
   node-group-template-show     Show details of a node...
   cluster-template-create      Create a cluster template.
   cluster-template-delete      Delete a cluster template.
   cluster-template-list        Print a list of available...
   cluster-template-show        Show details of a cluster...
   job-template-create          Create a job template.
   job-template-delete          Delete a job template.
   job-template-list            Print a list of job...
   job-template-show            Show details of a job...
```

EDP – Command line interface

Data sources and job binaries

```
$ sahara
...
  <subcommand>
   data-source-create  Create a data source that provides
                       job input receives job output.
   data-source-delete  Delete a data source.
   data-source-list    Print a list of available data...
   data-source-show    Show details of a data source.
   job-binary-create   Record a job binary.
   job-binary-delete   Delete a job binary.
   job-binary-list     Print a list of job binaries.
   job-binary-show     Show details of a job binary.
```

EDP - Command line interface

Clusters and jobs

```
$ sahara
...
  <subcommand>
    cluster-create   Create a cluster.
    cluster-delete   Delete a cluster.
    cluster-list     Print a list of available clusters.
    cluster-show     Show details of a cluster.
    job-create
    job-delete       Delete a job.
    job-list         Print a list of jobs.
    job-show         Show details of a job.
```

Thank you.