OpenStack Cinder Tutorial

康佳峰 (K.K.)

CCMA/ ITRI

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Outline

• OpenStack
• Volume
• OpenStack Cinder
• Cinder driver status
• Contributions
• References
OpenStack (1/2)

- An IAAS cloud computing project and open source software under Apache License.

- Rackspace and NASA launched it in Jul. 2010, and OpenStack Foundation managed it since Sep. 2012.
  - ~200 companies or organizations have joined the project

- It consists of a series of interrelated project CODEs that control and provide the provision resources through a datacenter.
OpenStack (2/2)

• Adopted a six-month release schedule
  – Grizzly, Apr. 2013

• Primary released on Linux, Ubuntu LTS

• Cloud computing management layer that integrate existing Linux technologies

• Python implementation
Service Architecture
# OpenStack Code Names

<table>
<thead>
<tr>
<th>Service</th>
<th>Code name/Software Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>Nova</td>
</tr>
<tr>
<td>Image</td>
<td>Glance</td>
</tr>
<tr>
<td>Object Storage</td>
<td>Swift</td>
</tr>
<tr>
<td>Dashboard</td>
<td>Horizon</td>
</tr>
<tr>
<td>Identity</td>
<td>Keystone</td>
</tr>
<tr>
<td>Networking</td>
<td>Quantum</td>
</tr>
<tr>
<td>Volume</td>
<td>Cinder</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Technology Topologies

All network components interact through the Linux networking stack.
## Volume

<table>
<thead>
<tr>
<th>Physical Disk</th>
<th>Partition</th>
<th>Drive/Volume</th>
<th>Filesystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Disk 1</td>
<td>Partition 1</td>
<td>/dev/hda1</td>
<td>ext3</td>
</tr>
<tr>
<td></td>
<td>Partition 2</td>
<td>/dev/hda2</td>
<td>xfs</td>
</tr>
<tr>
<td>Hard Disk 2</td>
<td>Partition 1</td>
<td>C:</td>
<td>NTFS</td>
</tr>
<tr>
<td></td>
<td>Partition 2</td>
<td>D:</td>
<td>FAT32</td>
</tr>
</tbody>
</table>

A partition, physical drive, is a part of one physical hard drive.

A volume, logical drive, is a single accessible storage area with a single file system.
OpenStack Cinder

• Cinder allows you to give block level storage to your OpenStack Compute instances.
  – Extra block device or boot-from-volume device
  – Storage Access Network (SAN)
  – Amazon EBS

• The basic Cinder usage is iSCSI-exposed LVM volumes.
  – Two basic default components
    • lvm2
    • open-iscsi/iscsi-target

• https://wiki.openstack.org/wiki/CinderMeetings
  – Meets on a weekly basis in #openstack-meeting at 16:00 UTC on Wed.
Cinder History

  - Cinder

- **Folsom: 2012.2 (Oct. 2012)**
  - Nova (Compute)
    - Volume
  - Cinder

  - Nova (Compute)
    - Volume
  - …
Cinder Services

- **cinder-api**
  - Authenticates and routes requests throughout the block storage system.

- **cinder-scheduler**
  - Scheduling/routing volume create requests to the appropriate volume service.

- **cinder-volume**
  - Managing block storage devices, specifically the back-end devices themselves.
Cinder Interaction

Openstack Compute API

Openstack Volume API

Volume User

hypervisor
Libvirt, XenAPI, etc.
nova-scheduler
Queue

Volume Provider

cinder-db

cinder-scheduler

cinder-volume

cinder-api

nova-api

cinder-volume driver (iSCSI, etc.)

cinder-scheduler

nova-scheduler

nova-compute

Openstack Volume API

Openstack Compute API
Cinder Internal

- Cinder deployment
- Volume operations
- Volume stack
  - LVM/iSCSI
- Implementation
- Driver Status
Cinder Deployment

• Ubuntu 12.10

• Package
  – # apt-get install cinder-api cinder-scheduler cinder-volume open-iscsi python-
    cinderclient tgt

• Configuration file:
  – /etc/cinder/api-paste.ini, /etc/cinder/cinder.conf, /etc/nova/nova.conf,
    /etc/nova/nova-compute.conf

• Create storage space: (iSCSI-exposed LVM)
  – LVM partition with VG name = ‘cinder-volumes’

• Services
  – sudo service cinder-volume restart
  – sudo service cinder-api restart
  – sudo service cinder-scheduler restart
Volume Operations

- Create/Delete volume
- Create volume from snapshot
- Clone volume
- Create volume from image
- Copy image to volume
- Create/Delete snapshot

- Attach/Detach volume
### Usage by Example

```bash
# cinder create --display_name test 1

# cinder list

<table>
<thead>
<tr>
<th>ID</th>
<th>Status</th>
<th>Display Name</th>
<th>Size</th>
<th>Volume Type</th>
<th>Attached to</th>
</tr>
</thead>
<tbody>
<tr>
<td>81c8c61c-4889-423e-a9f4-05663b1e4b48</td>
<td>available</td>
<td>test</td>
<td>1</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

# nova volume-attach vml 81c8c61c-4889-423e-a9f4-05663b1e4b48 /dev/vdb

# nova volume-detach vml 81c8c61c-4889-423e-a9f4-05663b1e4b48

# cinder delete 81c8c61c-4889-423e-a9f4-05663b1e4b48
```
LVM/iSCSI Volume Stack

**Cinder** (volume server)
- Cinder.API
- Cinder.Scheduler
- VolumeManager
  - LVMVolumeDriver
    - LVMISCSIDriver
    - iscsi.TargetAdmin
    - TgtAdm
- <Driver>
- Utils

**Nova** (Volume client)
- Compute.API
- Compute.Scheduler
- ComputeManager
- virt.connection
- ComputeDriver(nova.virt.driver)
- XenAPIConnection
- LibvirtConnection
- LibVirtVolumeDriver
  - <libvirtDriver>
- utils
- LibvirtNetVolumeDriver
- LibvirtISCSIVolumeDriver
- LibvirtConnection
- Utils
Implementation (1/2)

• Create volume
  – User: POST http://volume1.server.itri:8776/v1/{tenant_id}/volumes
  – Cinder-API: CALL cinder.volume.API().create()
  – Cinder.volume.API: RPC CAST cinder.volume.create_volume()
  – Cinder.volume.manager: CALL cinder.volume.driver.create_volume()
  – Cinder.volume.manager: CALL cinder.volume.driver.create_export()
Implementation (2/2)

• Attach volume
  – Nova-API: **CAST** Nova.compute.API.attach_volume()
  – Nova.compute.api(): **RPC CAST** NOVA.compute.manager.attach_volume()
    – Nova.compute.manager. attach_volume: **RPC CALL** cinder.volume.initialize_connection()
    – Nova.compute.manager.attach_volume: **RPC CALL** virt volume driver attach_volume()
      • E.g. libvirt.driver.attach_volume() → volume_driver.connect_volume()
    – Nova.compute.manager.attach_volume: **RPC CALL** cinder.volume.attach()
Cinder Driver Status

- SAN
  - LVM based IET or TGT
  - SAN ISCSI
  - EMC SMI-S
  - HP 3PAR/LeftHand
  - Huawei
  - IBM StorwizeSVC/XIV
  - NetApp iSCSI
  - Nextenta NexentarStor
  - Windows
  - SolidFire
  - Coraid
  - Solaris
  - Sheepdog
  - Zadara
  - …

- NFS
  - GlusterFS
  - NetApp NFS
  - XenAPI
  - Coraid
  - Scality SOFS
  - …

- Object
  - Ceph RBD

https://wiki.openstack.org/wiki/CinderSupportMatrix
Contributions (1/2)

• Add Cinder driver and Nova virt driver to promote your storage solution.

• Add Cinder scheduler to enhance different cinder drivers
Contributions (2/2)

• Cinder driver
  – create_volume()
  – create_export()
  – delete_volume()
  – delete_export()
  – ensure_export()
  – initialize_connection()
  – terminate_connection()
  – create_volume_from_snapshot()
  – create_snapshot()
  – delete_snapshot()
  – copy_image_to_volume()
  – copy_volume_to_image()
  – clone_image()

• Nova driver
  – attach_volume() /
    connect_volume()
  – detach_volume() /
    disconnect_volume()

• Cinder scheduler
  – schedule_create_volume()
Conclusions

• OpenStack Cinder defines a set of common methods to model block storage solutions for virtual machine

• Storage providers can easily integrate storage solution into Cinder for customer usage

• Storage customer can easily adopt different storage product via Cinder
Q&A

- 康佳峰 (K.K.)
- E-mail: joseph.cfk@gmail.com
References

• [https://wiki.openstack.org/wiki/Cinder](https://wiki.openstack.org/wiki/Cinder)
• [http://docs.openstack.org/trunk/openstack-compute/admin/content/](http://docs.openstack.org/trunk/openstack-compute/admin/content/)
• [https://launchpad.net/openstack](https://launchpad.net/openstack) – [https://launchpad.net/nova](https://launchpad.net/nova)
  – [https://launchpad.net/cinder](https://launchpad.net/cinder)