Data Mobility for Kubernetes
Persistent Volumes

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Agenda

- Kubernetes Persistent Volumes and Snapshots
- Container Storage Interface (CSI)
- Why Data Mobility - Use Cases
- Policy Based Data Mobility using OpenSDS
- Multi-Cloud Data Control Architecture
- Demo
- OpenSDS Community
- OpenSDS Roadmap
- Getting Involved
Kubernetes Persistent Volumes and Snapshots
Kubernetes Persistent Volumes

- Persistent Volume
- Persistent Volume Claim
- Storage Class
- Dynamic and Static Provisioning
Kubernetes Volume Snapshots

- Volume Snapshot
- Volume Snapshot Content
- Volume Snapshot Class
- Dynamic and Static Provisioning
- Supports CSI Drivers
Container Storage Interface (CSI)
CSI Functions

Operation based on Volume Lifecycle

Create Volume
Create Volume from Snapshot
Attach to node
Mount on node

Delete Volume
Detach from node
Unmount from node
Attach to node

ControllerCreateVolume
ControllerPublishVolume
NodePublishVolume
NodeStageVolume
NodeUnpublishVolume
NodeUnstageVolume
ControllerDeleteVolume
ControllerUnpublishVolume
ControllerCreateSnapshot
ControllerDeleteSnapshot
Deploy CSI Plugin on Kubernetes

Source: https://github.com/kubernetes/community/blob/master/contributors/design-proposals/storage/container-storage-interface.md
Why Data Mobility
Why do we need Data Mobility

- Data mobility allows data to be accessible any time, any where, on premise or in the cloud.
- Use cases for data mobility by OpenSDS multi-cloud data control
  - High availability
  - Data analytics
  - Data lifecycle management
  - ....
Use Case: High Availability

• Make data available at different geographic location.
• Make data available and accessible all the time without downtime.
Use Case: Data Analytics

• Upload datasets to public cloud for data analytics.
• Utilize compute resources in public cloud to do CPU intensive work.
Use Case: Data Lifecycle Management

- Frequently accessed data stored on-premise.
- Data not accessed for a long time can be stored in archival storage in public cloud.
- Data can be moved to different location depending on usage, age, access frequency.
- Data can be deleted automatically based on policy.
Policy-based Data Mobility using OpenSDS
OpenSDS Projects – Sushi and Hotpot

**SUSHI**
The Northbound Plug-ins Project

Common plug-ins to enable OpenSDS storage services for cloud and application frameworks

**HOTPOT**
The Storage Controller Project

Single control for block, file, and object services across storage on premise and in clouds
Gelato
The Multi-Cloud Project
Policy based multi-cloud data control to enable data mobility across clouds
Profiles and StorageClass/VolumeSnapshotClass

Admin

Create profiles

Create StorageClass & VolumeSnapshotClass

OpenSDS

User

Create PVC & VolumeSnapshot

K8S calls OpenSDS CSI Plugin

OpenSDS CSI Plugin calls
OpenSDS controller to provision volume & snapshot

OpenSDS chooses storage backend to create volume (PV) and snapshot (VolumeSnapshotContent)

Commodity Storage
Enterprise Storage
Cloud Storage

Admin
CSI Plugin and Policy-based Data Mobility

- Create snapshot using OpenSDS CSI plugin
- Upload snapshot based on snapshot topology
- Migrate snapshot based on migration policy
apiVersion: snapshot.storage.k8s.io/v1alpha1
kind: VolumeSnapshot
metadata:
  name: new-snapshot-demo
  namespace: demo-namespace
spec:
  snapshotClassName: csi-opensds-snapclass
  source:
    name: opensdspvc
    kind: PersistentVolumeClaim

Note: Profile can be uuid or name of the profile in OpenSDS.

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Multi-Cloud Data Control Architecture
Multi-Cloud Data Control Architecture

- GUI
- API Gateway
- S3 Service
- Backend Service
- Dataflow Service
- Data Mover
- Database
- Backend Adapters

- Amazon S3
- Acronis Cloud Storage
- Google Cloud Storage
- IBM Cloud Object Storage
- Huawei
Multi-Cloud Backend Service

Keystone

auth

API Handler

create/update/delete/get backend

Backend Manager

DB

update metadata

Backend

check bucket
Multi-Cloud S3 Service

Keystone

Location Mapper

DB

API Handler

S3 Controller

Backend Adapter

Backend

auth

create/update/delete/get object/bucket

get location

update metadata

search
Multi-Cloud Dashboard
Multi-Cloud Dashboard – Register Backend
Multi-Cloud Dashboard - Migration
Demo

- Take snapshot using OpenSDS CSI plugin
- Snapshot uploaded to AWS S3
- Migrate data from AWS S3 to Huawei Cloud object store
OpenSDS Roadmap

**2017H2**
**ZEA LAND**
*Storage For Kubernetes*
- Kubernetes FlexVolume
- Vol CRUD
- Standalone Cinder Integration
- CSI Support
- Ceph, LVM

**2018H1**
**ARUBA**
*Storage Orchestration*
- OpenStack
- Replication
  - Array-Based, Host-Based
- Dashboard
- Virtual Pools
- Storage Profiles
- NVMMeoF preview
- Enumeration
- Block Storage
  - Ceph
  - LVM
  - IBM: XIV, Storwize, SVC
  - Huawei: Dorado

**2018H2**
**BALI**
*Storage Multi-Cloud*
- Data Migration
  - Offline, Online*
- Monitoring
- Multi-OpenStack
- S3 Object
- Multi-Cloud Control
- NVMMeoF
- Storage Groups
  - Snapshots, Replication
- CSI
  - Mesos*, Docker*
- Swordfish
  - Dell-EMC, NetApp

**2019H1**
**CAPRI**
*Storage Intelligence*
- Analytics
- Lifecycle
- Data Protection
- File Share

**2019H2++**
- Performance
- Optimization
- Tiering
- Security
- Sharing
- Networking
- SCM
OpenSDS Community

**Technical Steering Committee**
- **Steven Tan, Chairman**
  Huawei, VP & CTO Cloud Storage Solution
- **Rakesh Jain, Vice-Chair**
  IBM, Research Engineer and Architect
- **Allen Samuels**
  Western Digital, R&D Engineering Fellow
- **Anjaneya "Reddy" Chagam**
  Intel, Chief SDS Architect
- **Jay Bryant**
  Lenovo, Cloud Storage Lead

**End-User Advisory Committee**
- **Cosimo Rossetti**
  Vodafone, Lead Storage Architect
- **Yusuke Sato**
  Yahoo Japan, Infrastructure Lead
- **Kei Kusunoki**
  NTT Communications, Storage Architect
- **Yuji Yazawa**
  Toyota ITC, Group Lead
- **Wim Jacobs**
  KPN, Senior Architect
Getting Involved

- Repos: https://github.com/opensds
- Slack: https://opensds.slack.com
- Mailing list: https://lists.opensds.io
- Weekly meetings: https://github.com/opensds/design-specs/blob/master/README.md#opensds-technical-meetings