

Data Mobility for Kubernetes Persistent Volumes



Xing Yang, Principal Architect, Huawei

@2000Xyang

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

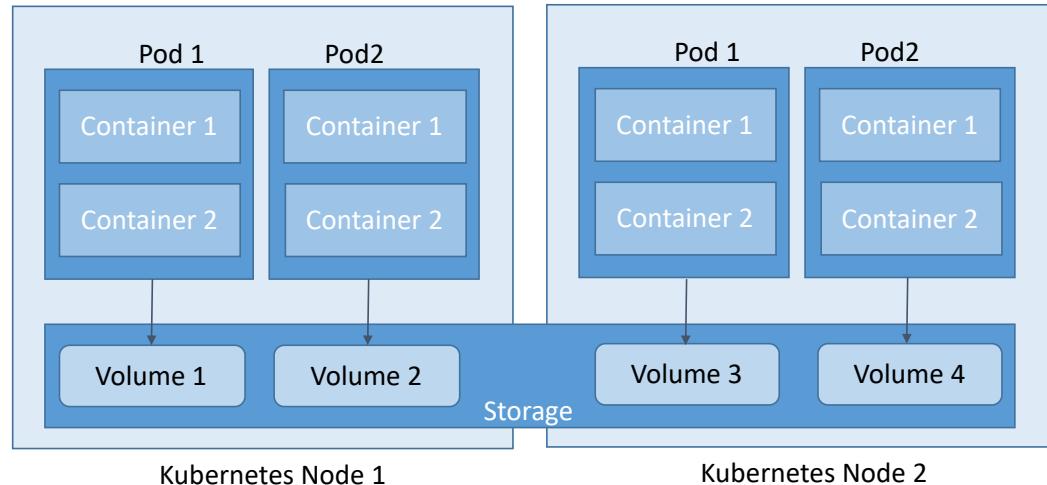


Kubernetes Persistent Volumes and Snapshots

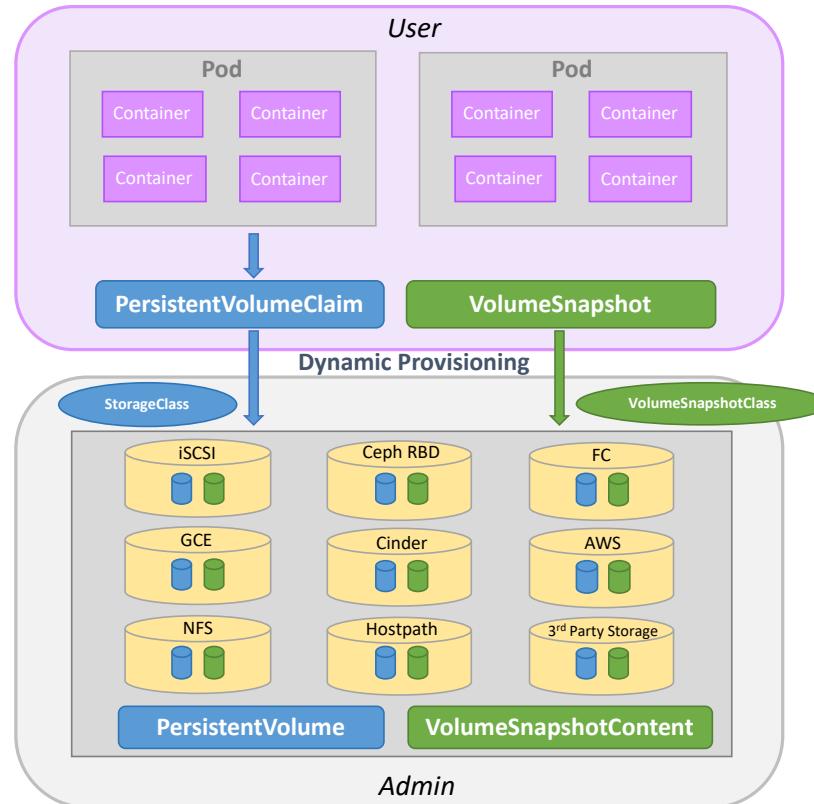


Kubernetes Persistent Volumes

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

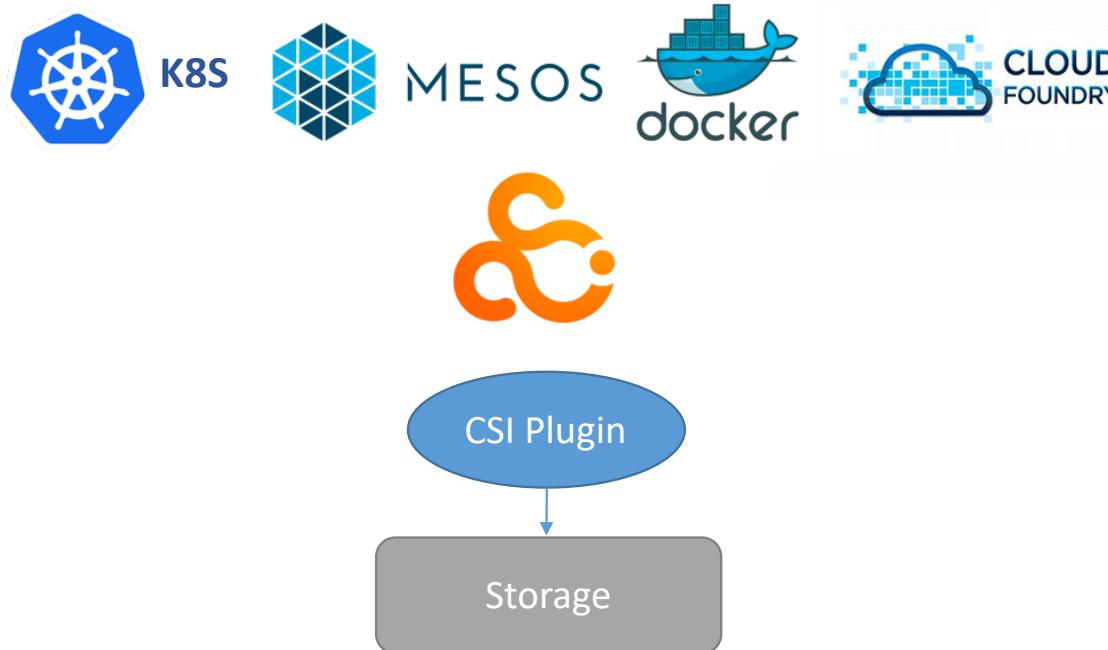


Kubernetes Volume Snapshots

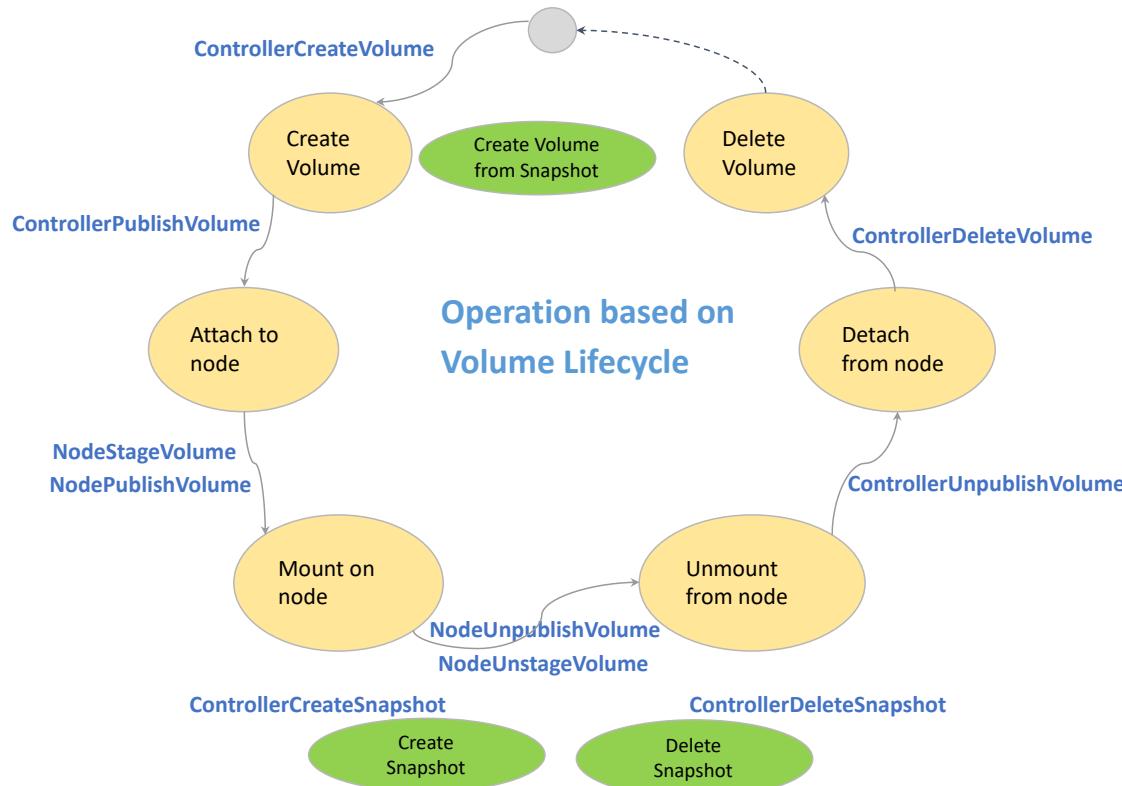


- Volume Snapshot
- Volume Snapshot Content
- Volume Snapshot Class
- Dynamic and Static Provisioning
- Supports CSI Drivers

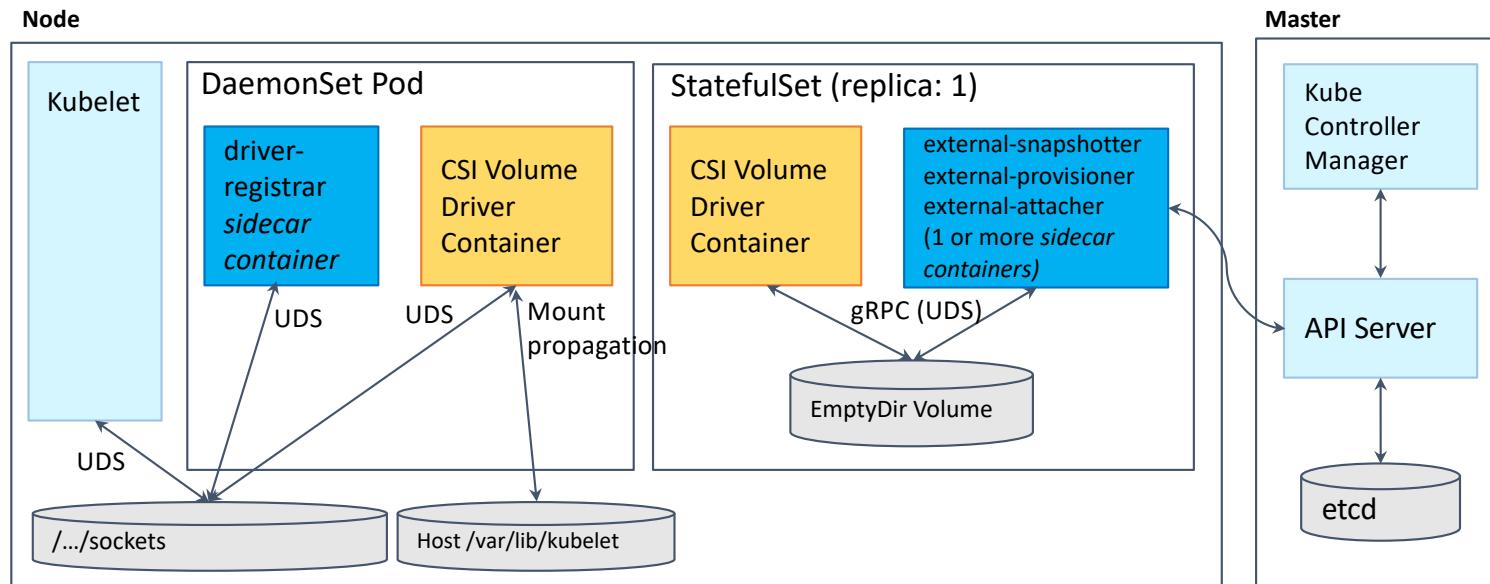
Container Storage Interface (CSI)



CSI Functions



Deploy CSI Plugin on Kubernetes



Source: <https://github.com/kubernetes/community/blob/master/contributors/design-proposals/storage/container-storage-interface.md>



Why Data Mobility

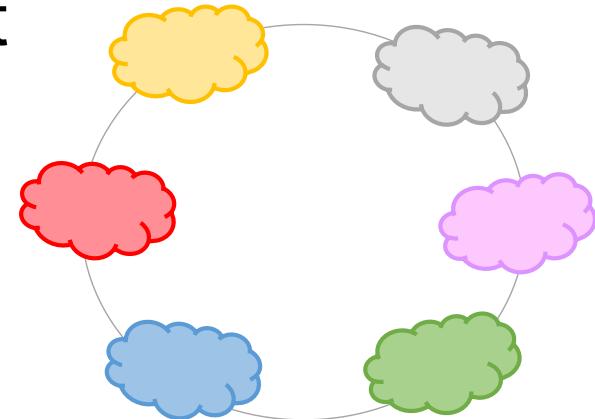


Why do we need Data Mobility

- 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
 -

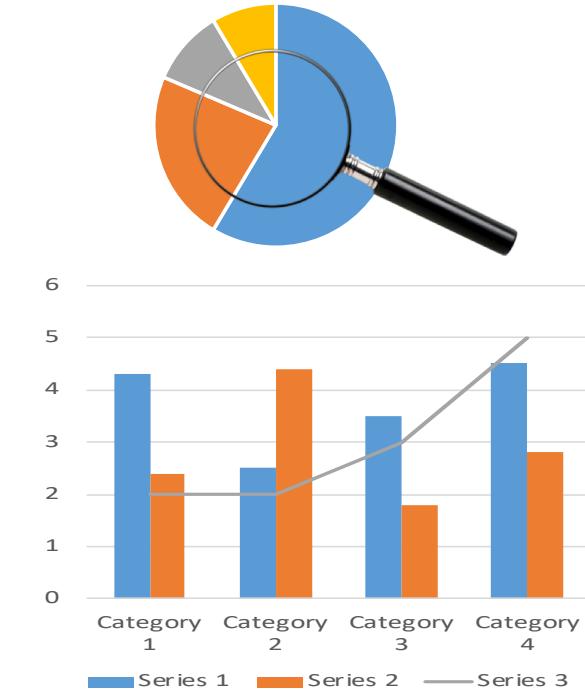
Use Case: High Availability

- Make data available at different geographic location.
- Make data available and accessible all the time without downtime.



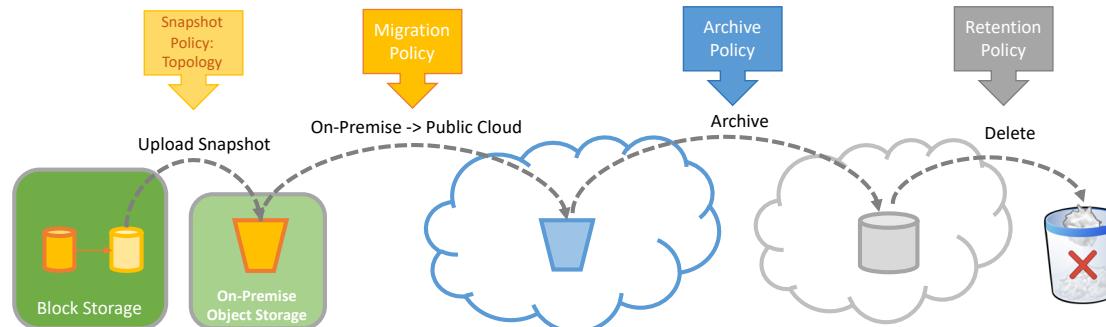
Use Case: Data Analytics

- 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

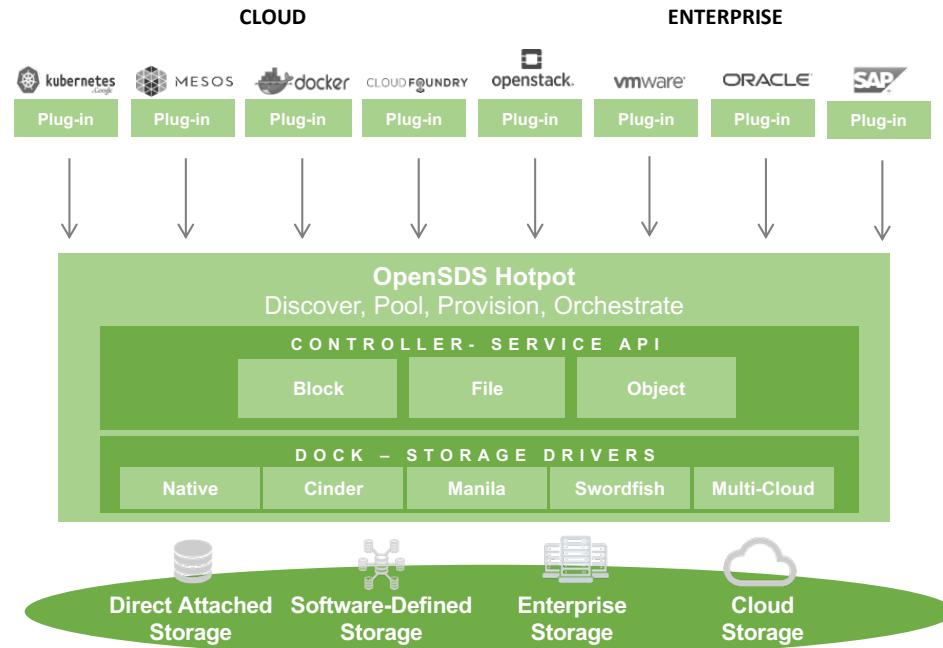
The Northbound Plug-ins Project

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

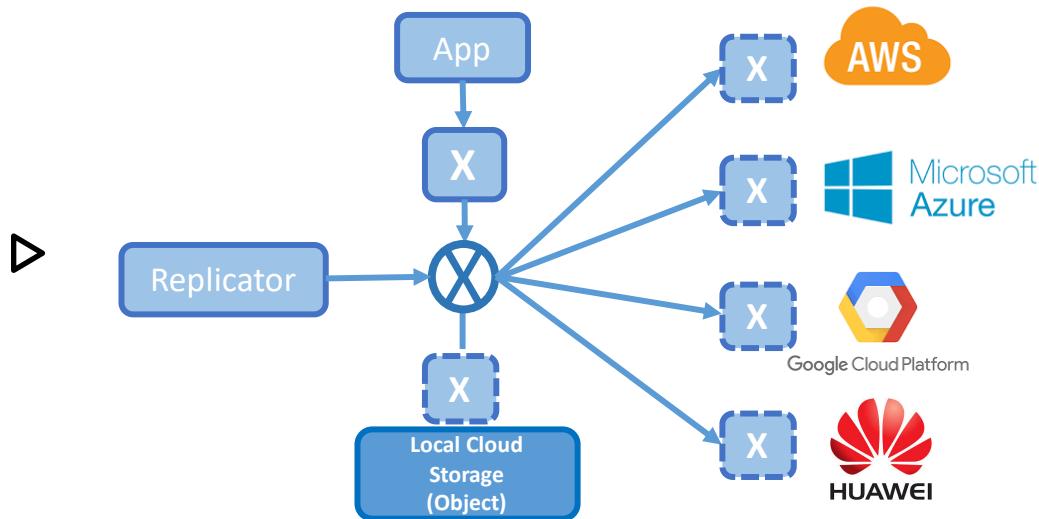


OpenSDS Project - Gelato

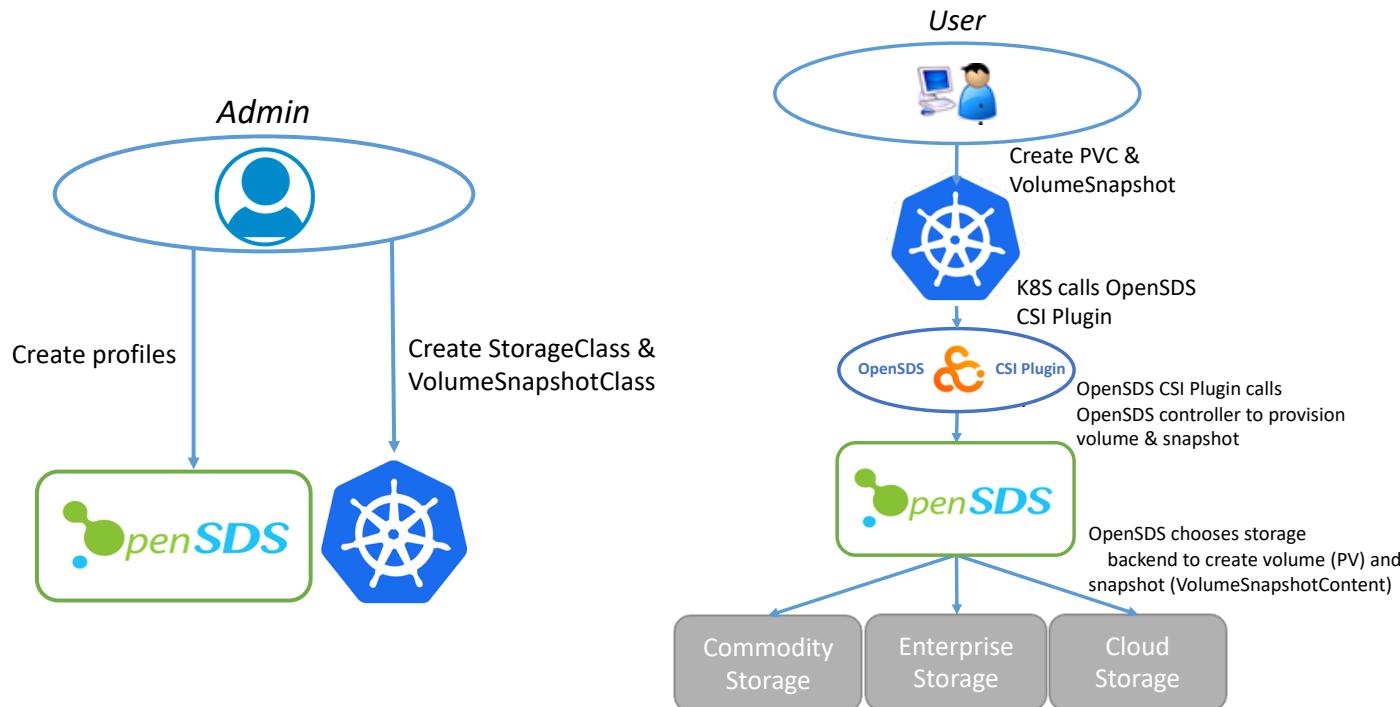
Gelato

The Multi-Cloud Project

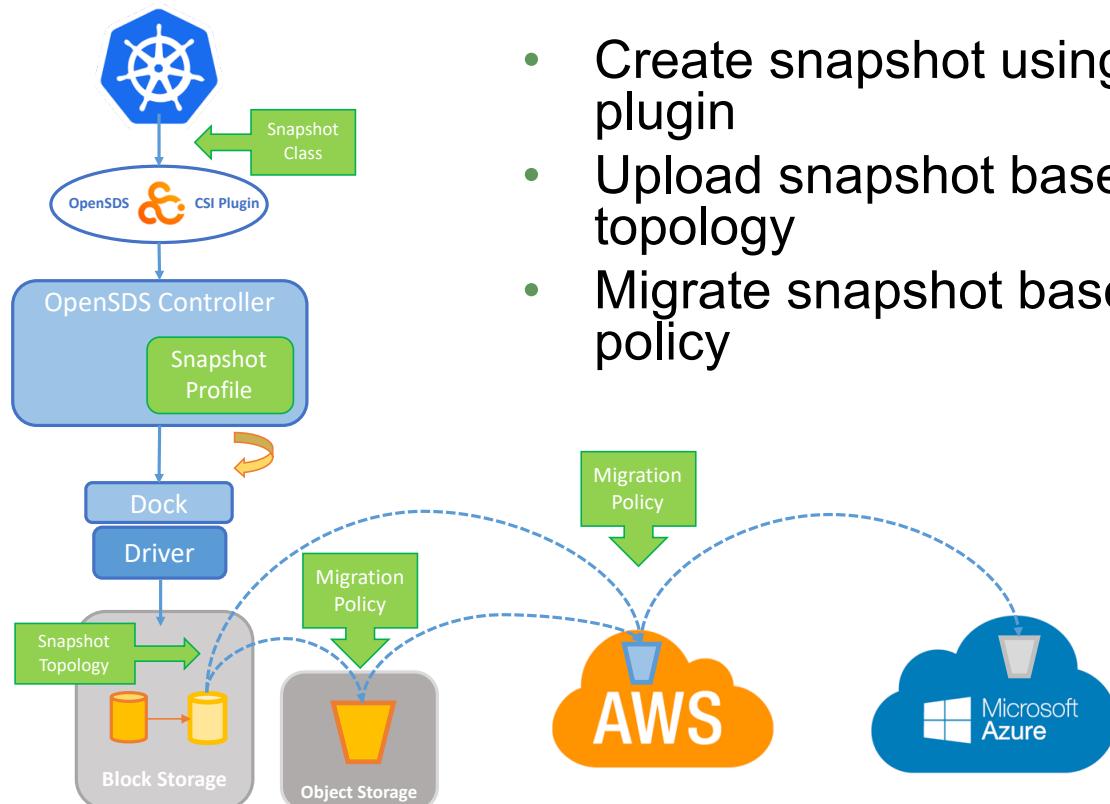
Policy based multi-cloud data control
to enable data mobility across clouds



Profiles and StorageClass/VolumeSnapshotClass



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

Volume Snapshot Example

```
apiVersion: snapshot.storage.k8s.io/v1alpha1
kind: VolumeSnapshotClass
metadata:
  name: csi-opensds-snapclass
snapshotter: csi-opensdsplugin
parameters:
  profile: upload-snapshot-to-cloud
```

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

```
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
```

Create Snapshot

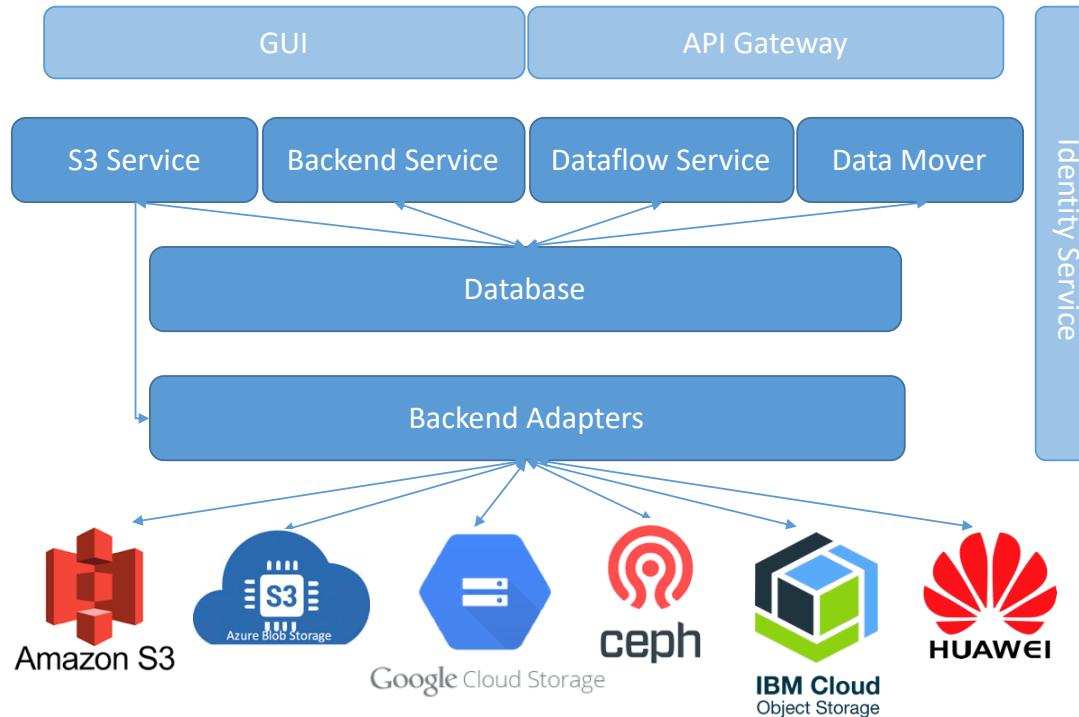




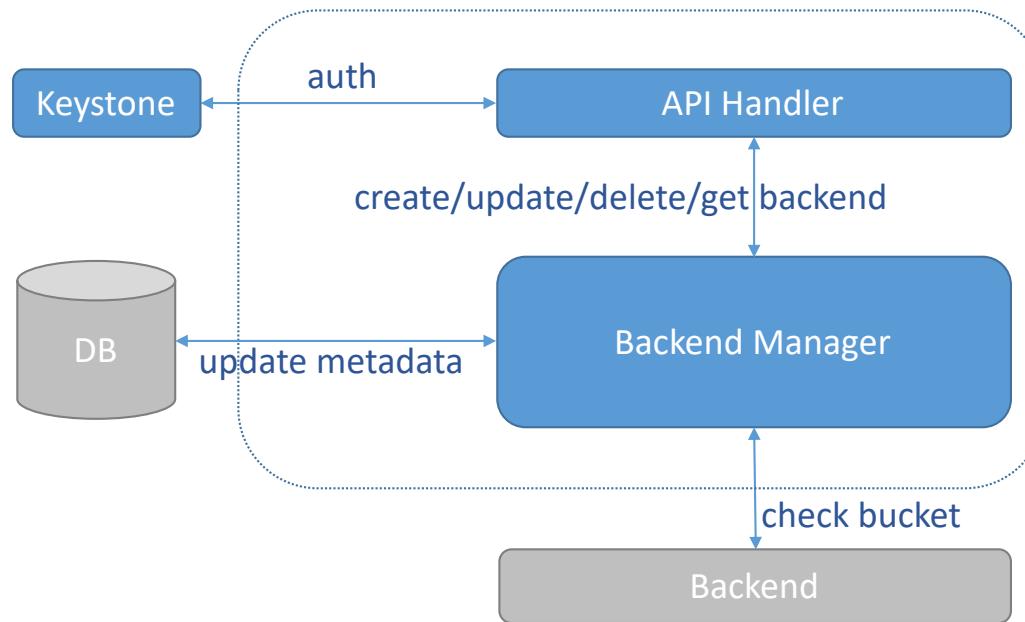
Multi-Cloud Data Control Architecture



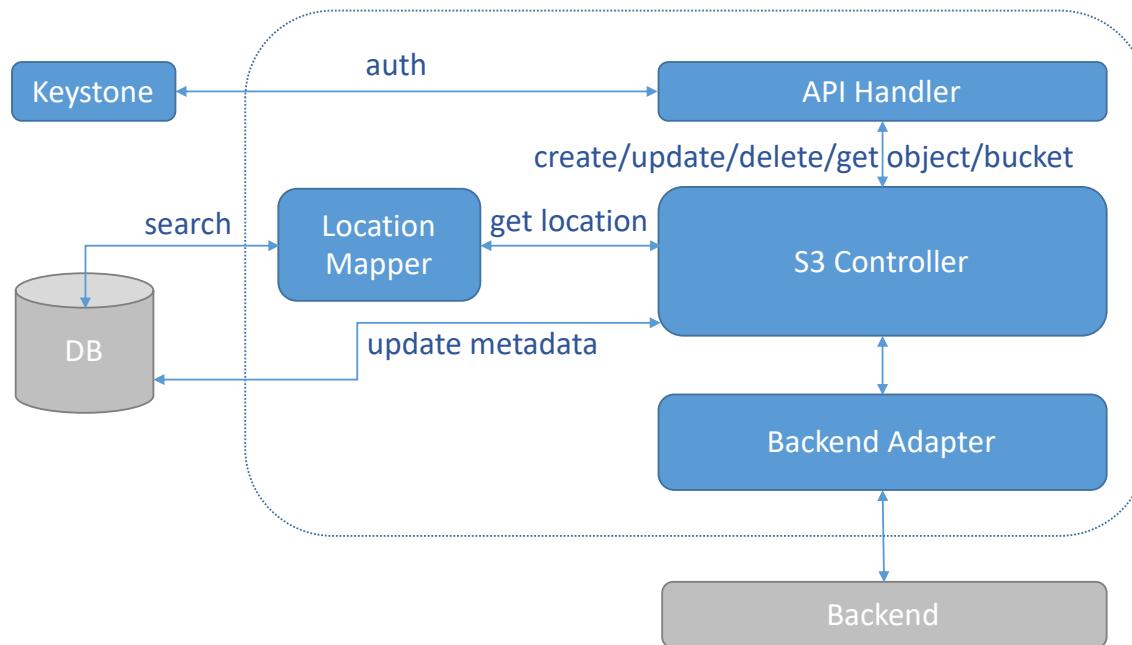
Multi-Cloud Data Control Architecture



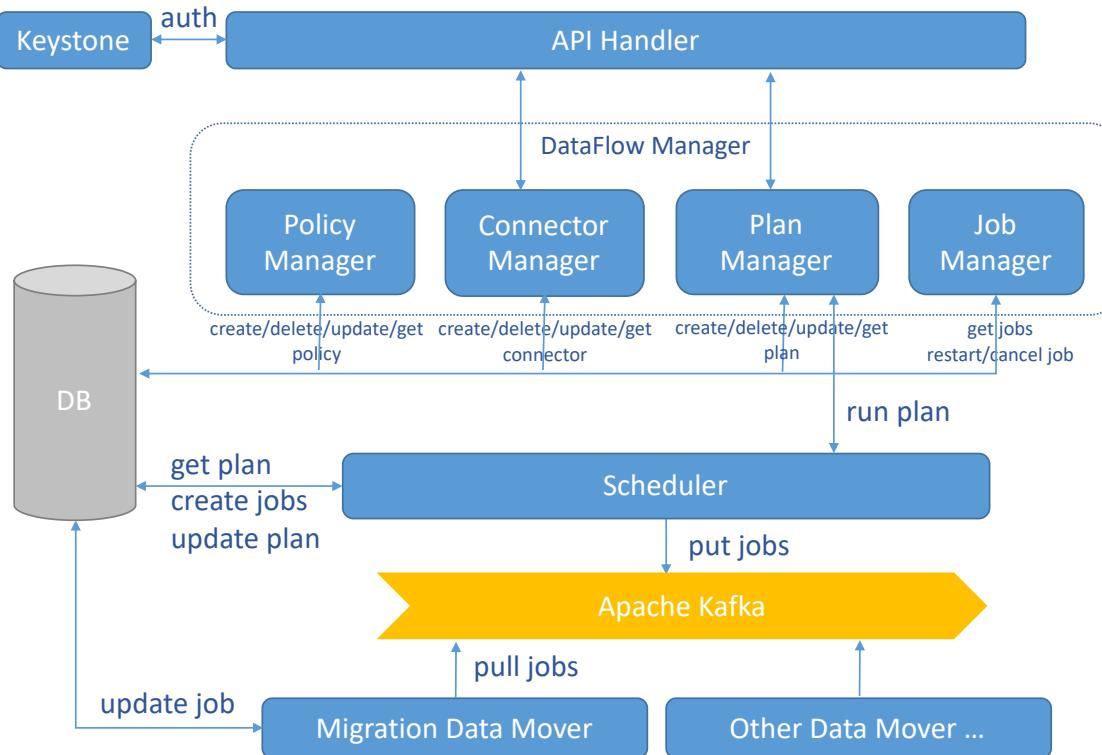
Multi-Cloud Backend Service



Multi-Cloud S3 Service



Multi-Cloud Dataflow Service



Multi-Cloud Dashboard

The screenshot displays a multi-cloud dashboard interface with a dark blue background. On the left, a sidebar lists navigation options: Home, Resource, Dataflow, Profile, Infrastructure, and Identity. The main area features a central node labeled "OpenSDS" connected to three cloud icons: AWS (with 2 resources), Ruijie Cloud (with 1 migration), and Huawei (with 2 resources). Below this, three cards provide summary data:

- Resource**: Volumes (5), Buckets (2), Filesystems (0)
- Dataflow Capacity**: A line chart showing capacity increasing from 0 to approximately 22 over time.
- Dataflow Quantity**: Migrations (0), Replications (1)



Multi-Cloud Dashboard – Register Backend

The screenshot displays the Multi-Cloud Dashboard interface. On the left, a sidebar menu includes: Home, Resource (Volumes / Buckets), Dataflow (Through migration / replication capability), Profile (Block profiles), Infrastructure (Regions, availability zones and storage), and Identity (Managing tenants and users). The main dashboard features three cloud icons: AWS (2 resources), OpenSDS (1 resource, highlighted with a blue plus sign), and Huawei (2 resources). Below these are two cards: 'Resource' (5 Volumes, 2 Buckets, 0 Filesystems) and 'Dataflow Capacity' (a line graph showing capacity increasing from 0 to approximately 22 over time). A central modal window titled 'Register Storage Backend' is open, showing fields for Name, Type (Object selected), Region, Endpoint, Bucket, Access Key, and Secret Key. At the bottom right of the dashboard, there are buttons for 'Migrations', 'Replications', and 'Exports'.

admin
default_region

Home
Resource statistics

Resource
Volumes / Buckets

Dataflow
Through migration / replication capability

Profile
Block profiles

Infrastructure
Regions, availability zones and storage

Identity
Managing tenants and users

Resource

5 Volumes

2 Buckets

0 Filesystems

aws 2

OpenSDS +

Huawei 2

Dataflow Capacity

Migrations Replications Exports

Register Storage Backend

Object File Block

Name :

Type : Please select

Region : Please select

Endpoint :

Bucket : Bucket name

Access Key :

Secret Key :

Multi-Cloud Dashboard - Migration

The screenshot displays the Multi-Cloud Dashboard interface, specifically the Migration section. On the left sidebar, under the Dataflow category, there is a 'Migration' section showing 'Migrations(0)' and 'Replications(1)'. A 'Create' button is available to start a new migration task. A modal window titled 'Migrate' is open, prompting for basic information: Plan Name (empty), Source Bucket (dropdown menu 'Please select'), Destination Bucket (dropdown menu 'Please select'), and Execution Time (checkbox 'Immediately' checked). Below this, a 'Rule' section states: 'Without a rule, all objects in the source bucket will be migrated; otherwise only objects selected based on the rule will be migrated.' It includes two optional checkboxes: 'Config Data analysis' and 'Delete the source objects after the migration is completed.' At the bottom of the modal are 'OK' and 'Cancel' buttons. The background shows a network diagram with three clouds representing different cloud providers: AWS (labeled 'aws'), AliCloud (labeled 'AliCloud'), and Huawei Cloud (labeled 'Huawei'). Arrows indicate data flow between these clouds. The overall theme is multi-cloud integration and data 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

ZEALAND

**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
- NVMeoF 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
- NVMeoF
- 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>



THE LINUX FOUNDATION OPEN SOURCE SUMMIT EUROPE

