Building an Open Autonomous Data Platform

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@opensds_io

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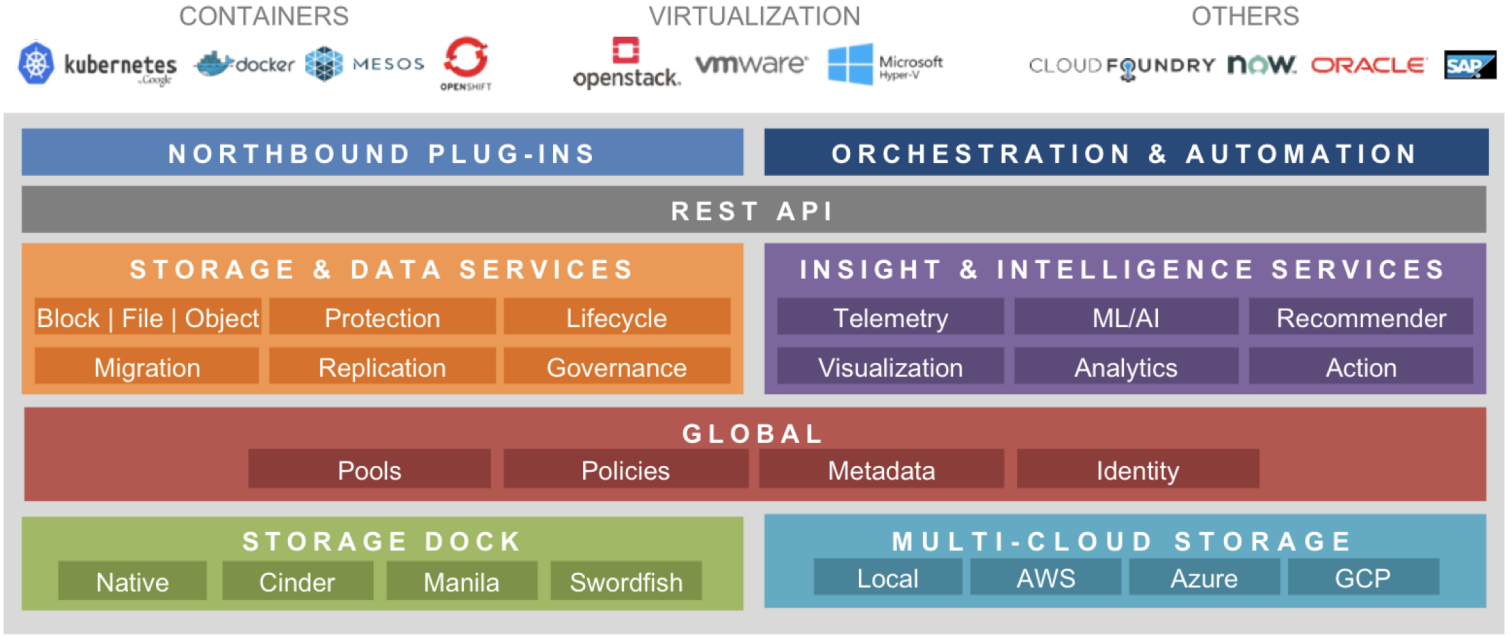
Agenda

- **Introduction to Open Autonomous Data Platform**
- Capri Features Update
  - Multi-Cloud Update and Object Lifecycle Management
  - FileShare Support
  - New Southbound Drivers
  - Telemetry
  - Anomaly Detection
  - Automation and Orchestration
- Demo
  - Automation and Orchestration
  - Object Lifecycle Management

The Open Autonomous Data Platform



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OpenSDS Roadmap

2017H2
ZEALAND

- Kubernetes FlexVolume
- Vol CRUD
- Standalone Cinder Integration
- CSI Support
- Ceph, LVM

2018H1
ARUBA

- OpenStack
- Replication
  Array-Based, Host-Based
- Dashboard
- Storage Profiles
- Enumeration
- Block Storage
  - Cinder Drivers
  - Ceph
  - LVM

2018H2
BALI

- S3 Object
- Multi-Cloud
  AWS, Azure, Ceph
- Multi-OpenStack
- CSI v1.0

2019H1
CAPRI*

- **Data Lifecycle**
- **Telemetry**
- **Anomaly Detection**
- **Orchestration & Automation**
- **File Share**
- **NVMeoF**
- **Multi-Cloud: GCS, IBM Cloud**
- **Storage**
  - **Fujitsu**
  - **HPE**

2019H2
DAITO*

- Data Protection

OpenSDS

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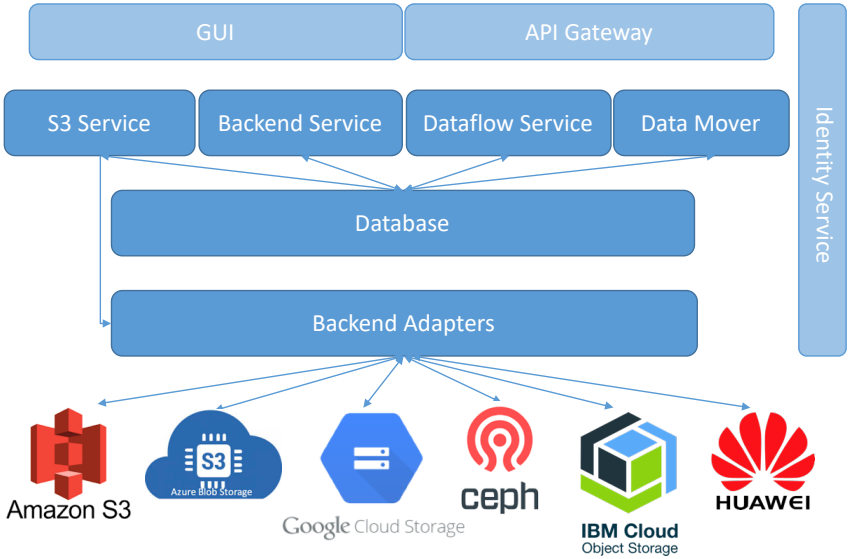
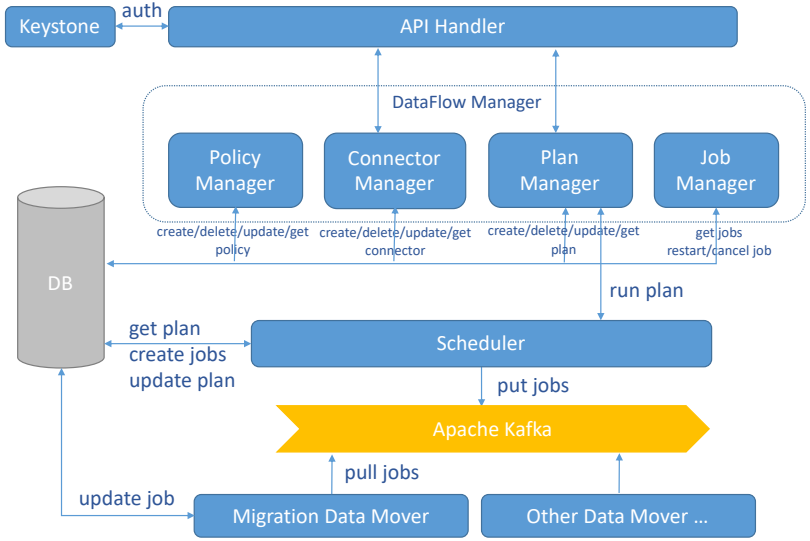
Multi-Cloud Data Control

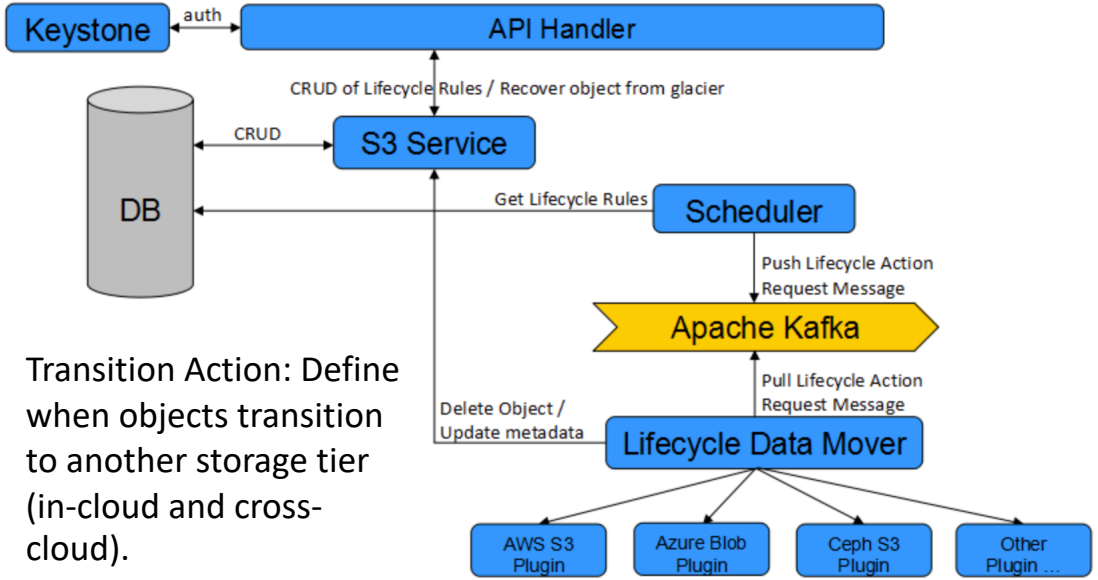




- Multi-Cloud Data Control allows data to migrate across multiple clouds.
- Support object store backends including AWS S3, Azure Blob, **Google Cloud Storage**, Ceph, **IBM Cloud**, Huawei OBS, and Fusion Storage. Supports S3 APIs.

Object Lifecycle Management

- Provide object lifecycle management mechanism that allows tenants to manage lifecycle configuration policies through APIs.
- Lifecycle rules are defined on the bucket, and OpenSDS manages the movement of objects according to those rules.

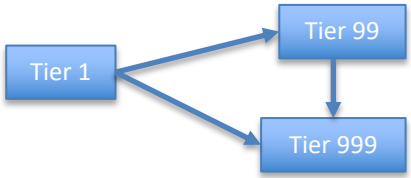


- Transition Action: Define when objects transition to another storage tier (in-cloud and cross-cloud).
- Expiration Action: Define when objects expire and get removed.

Storage Tiers and Migration Rules

OpenSDS S3	AWS S3	Azure (blob)	Google Cloud Storage	Huawei OBS	Ceph / Fusion Storage
Tier 1	Standard	Hot	Multi-Regional	Standard	Stardard
Tier 99	Standard_IA	Cool	--	Warm	--
Tier 999	Glacier	Archive	--	Cold	--

- Default OpenSDS storage tiers, Tier 1, Tier 99, and Tier 999, are mapped to AWS S3 storage classes and classes in other clouds. AWS S3 storage classes are supported at API level for S3 compatibility.
- Migration is allowed in one direction within the same cloud and across clouds.
- Support migration between on-premise object storage (Ceph or Fusion Storage) and cloud storage (AWS S3, Azure Blob, GCS, Huawei OBS)



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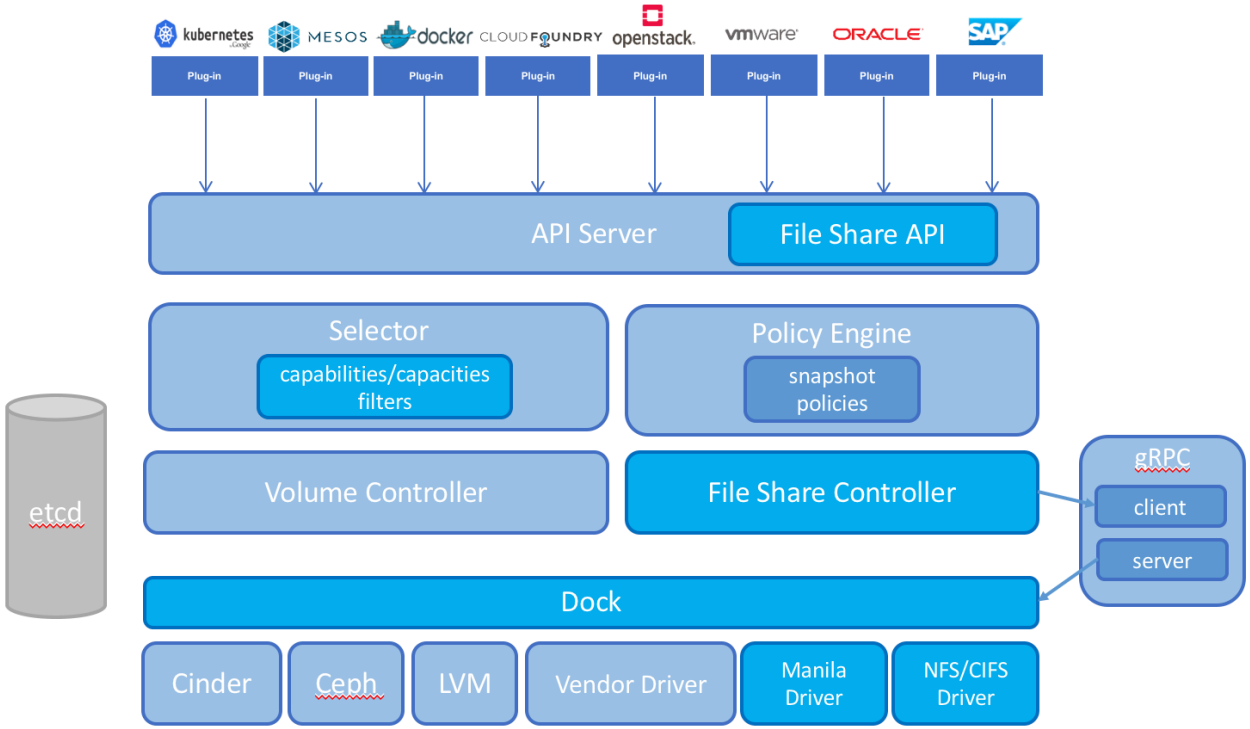
File Share Support



- Add File Share Service by providing APIs and a controller that supports file share provisioning and access control.
- Profiles design is based on Swordfish.
- File share drivers include NFS driver (LVM as backend), and Manila driver.
- CSI plugin support for shared file systems.

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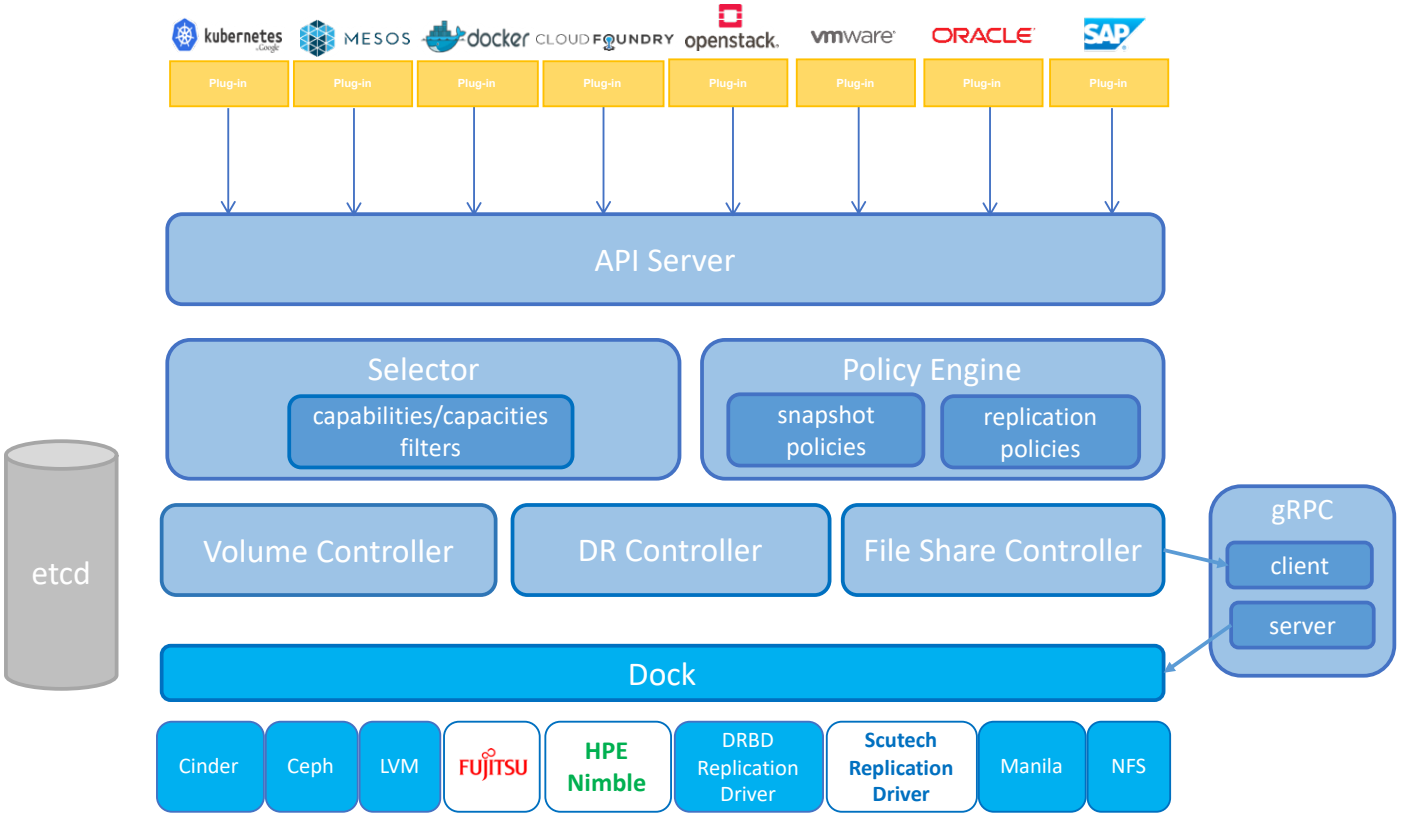
New Southbound Drivers



- HPE Nimble driver
  - Create/Delete/Extend/ Attach volumes, Create/Delete snapshots
- Fujitsu ETERNUS DX driver
  - **Evaluation purpose with limited support**
  - Create/Delete/Extend/ Attach volumes, Create/Delete snapshots
- Scutech Cloud Migration System (CMS) host-based replication driver
  - Create/Enable/Disable/ Delete replication
- NVMeoF driver (support LVM)

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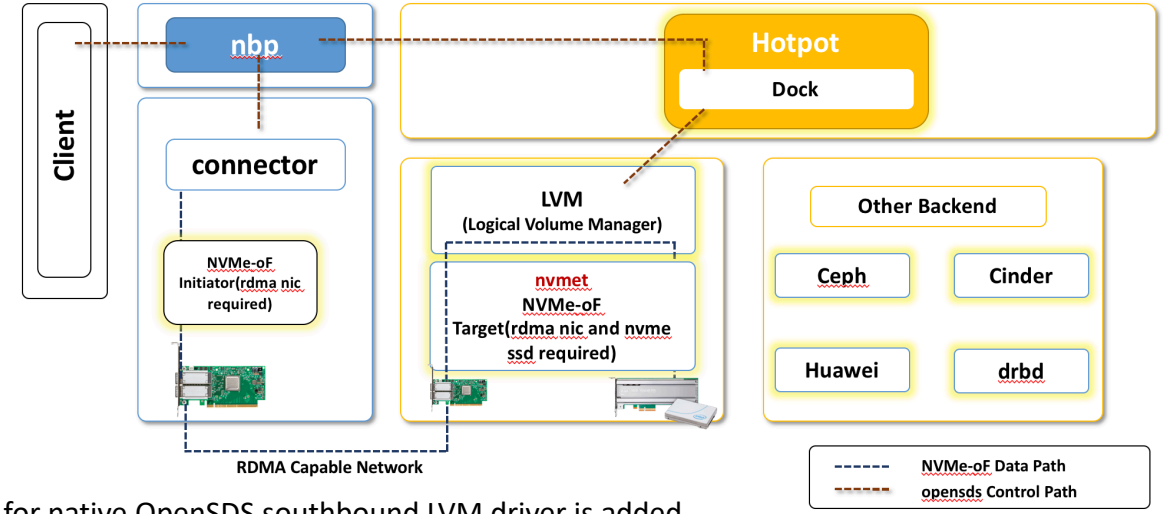
NVMeoF Driver



- NVMeoF support for native OpenSDS southbound LVM driver is added.
  - Supported transport: TCP/IP and RDMA.
  - Tested with Intel iWARP RDMA technology. Other RDMA technology, including InfiniBand and RoCE, will be tested in the future.
- Enabled NVMeoF support in CSI plugin.
  - NVMe TCP support is added
  - Support for other transport type, e.g., nvme-rdma, needs to be tested
- RDMA ethernet card is required for NVMeoF Initiator/Target environment. OpenSDS Ansible installer is updated to load the following modules to enable the RDMA feature in user space: nvmet, nvmet-rdma, nvme-rdma

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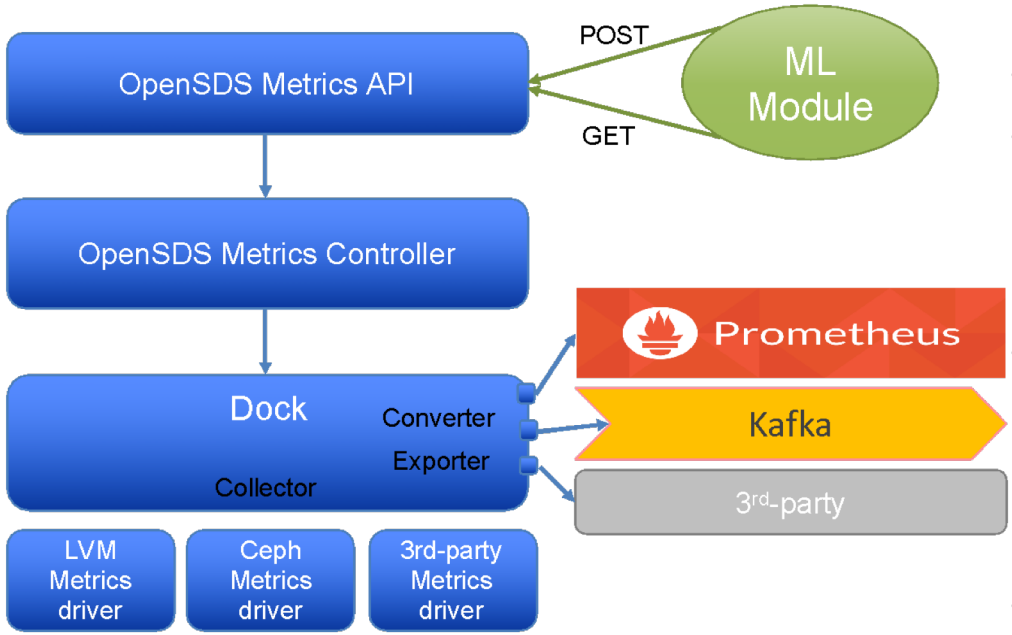
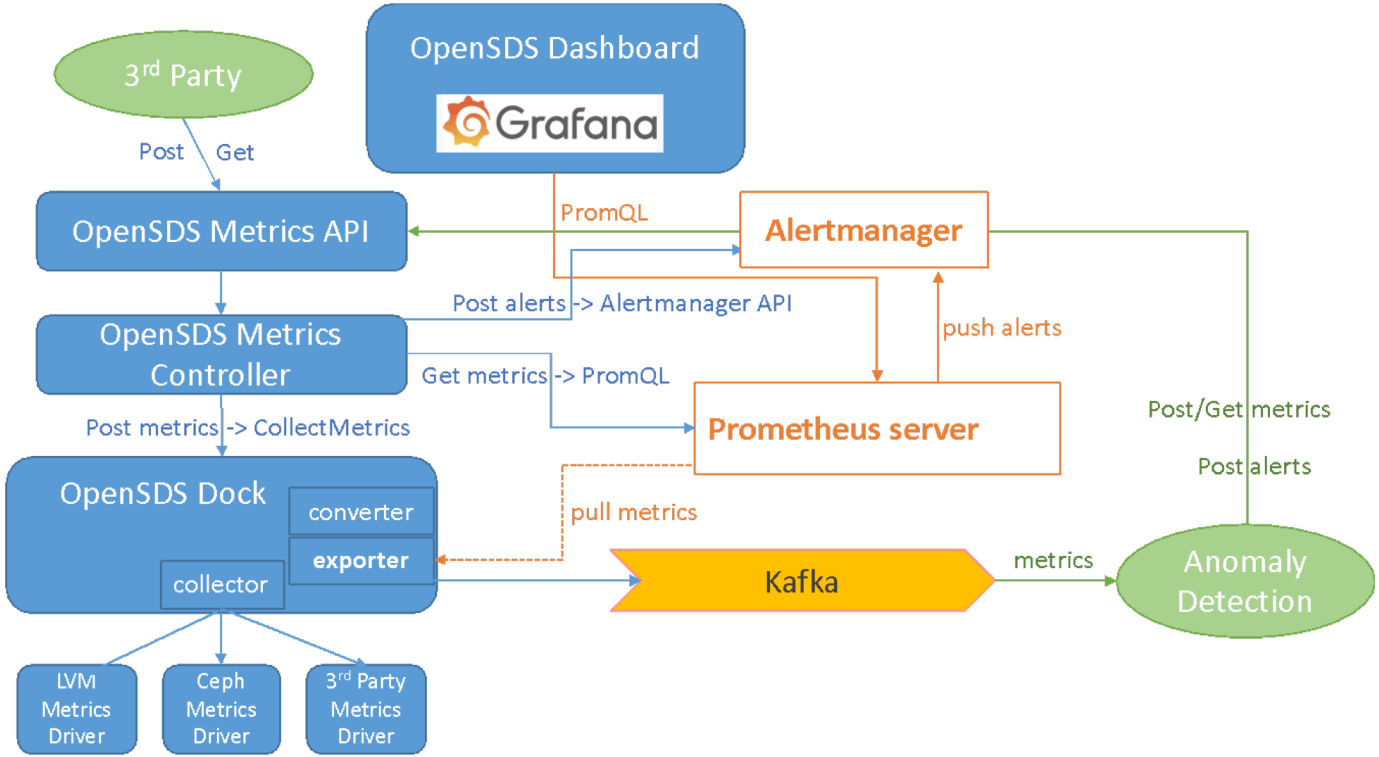
Telemetry

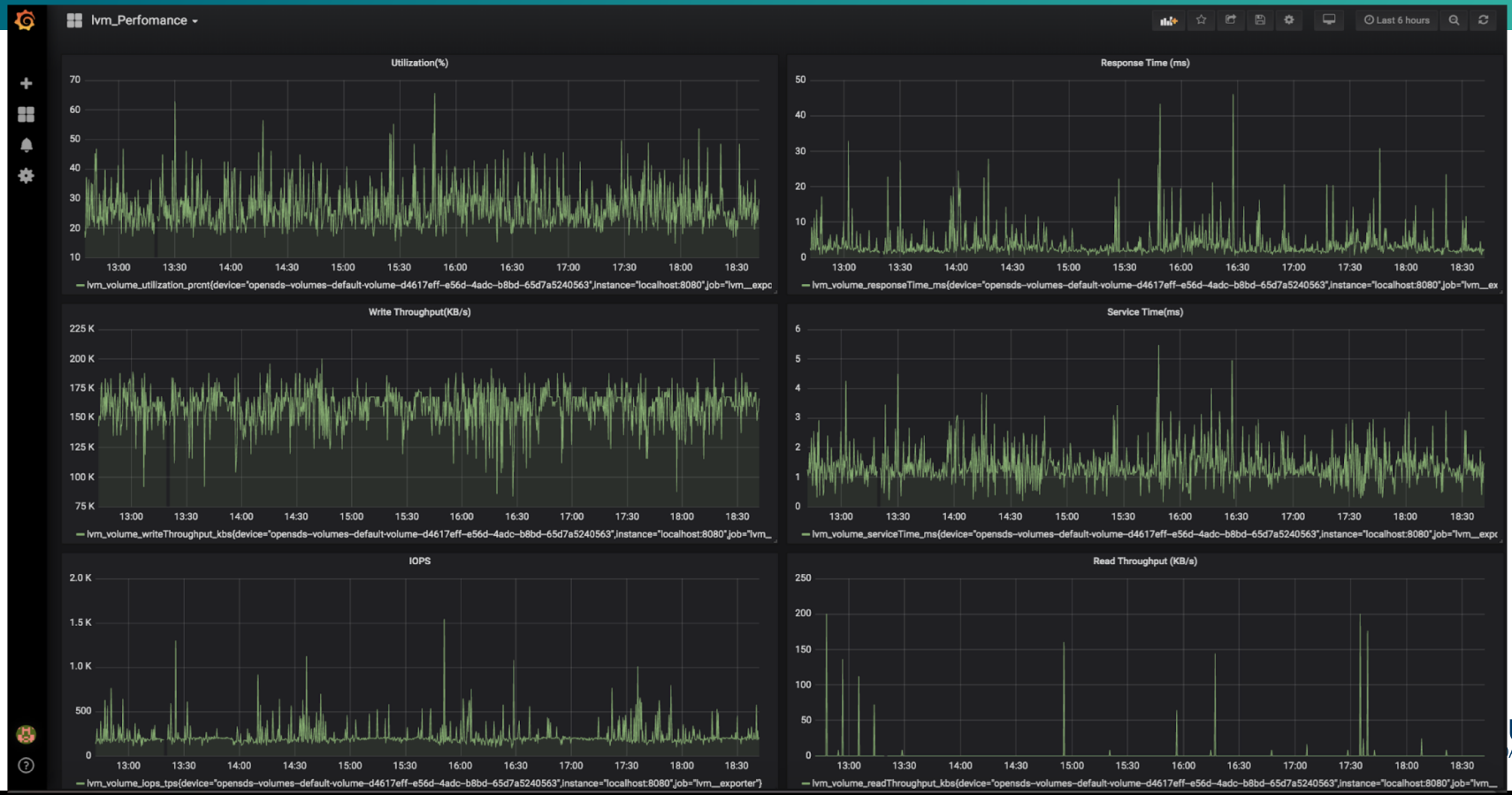


- ML module sends requests using Metrics API that generates data.
- Collector collects metrics from metrics drivers.
- Adapter includes a Converter that converts data to a proper format that can be understood by the receiving end, e.g., Prometheus, and an Exporter that sends(emits) the data to the intended destination.
- Collected metrics include IOPs, bandwidth, latency, average CPU usage, etc. for various resources such as storage controller, pools, volumes, disks, etc. For Ceph, an existing Prometheus Ceph exporter will be used. Prometheus Node exporter will also be used to collect node metrics.
- ML module receives data through Kafka. ML module also retrieves additional data using Metrics API which gets data from Prometheus.

Metrics to Prometheus and Kafka



LVM Metrics in Grafana



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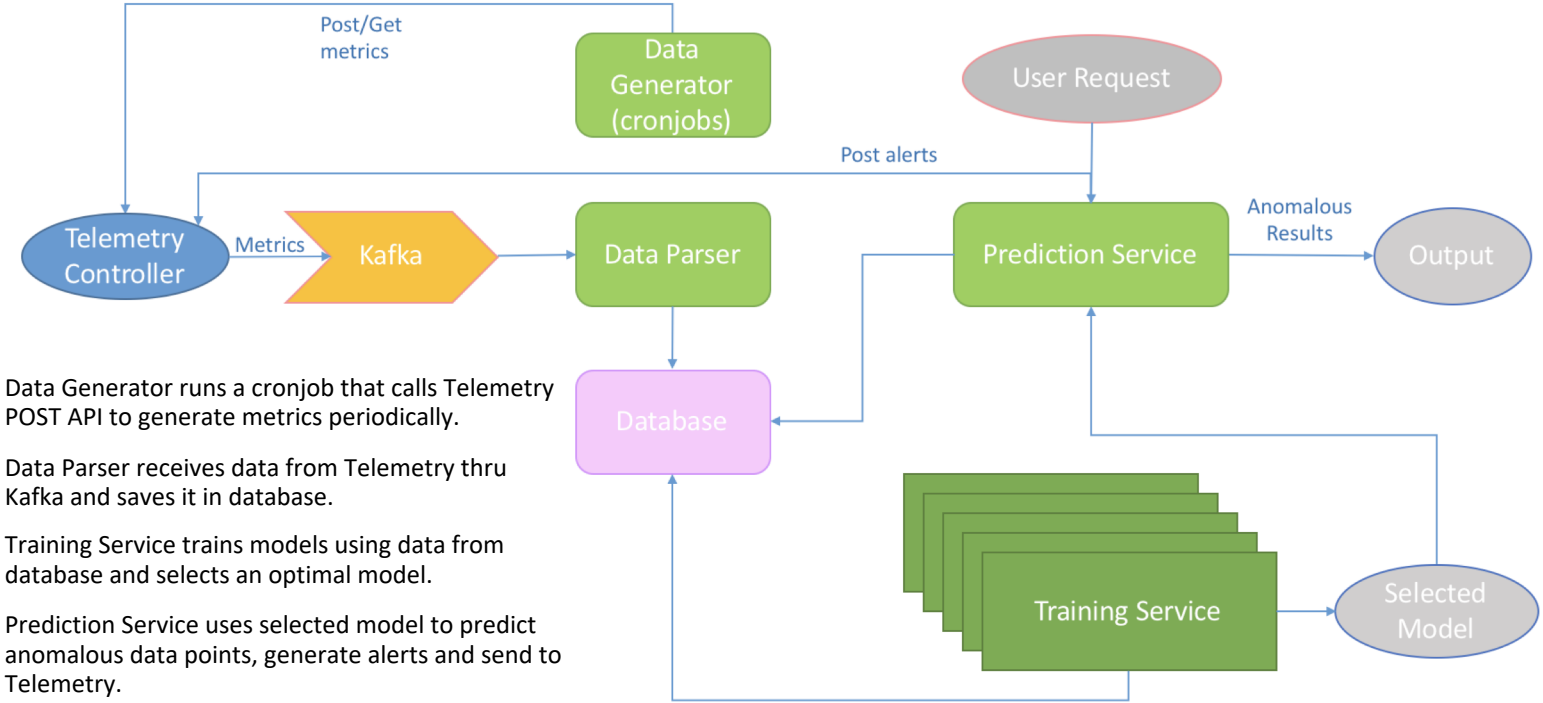
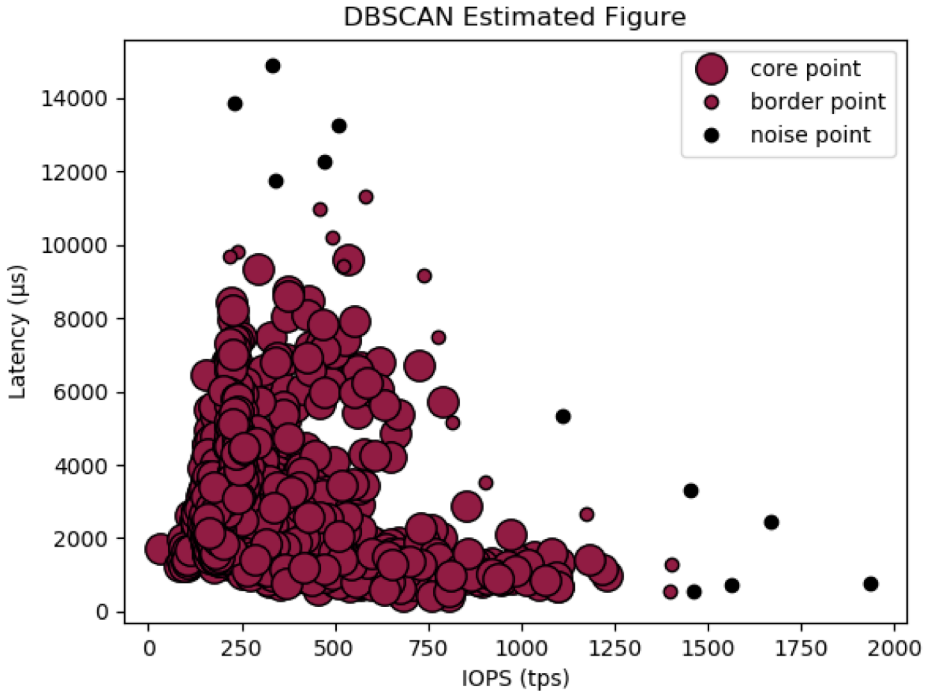
Anomaly Detection Architecture



- Data Generator runs a cronjob that calls Telemetry POST API to generate metrics periodically.
- Data Parser receives data from Telemetry thru Kafka and saves it in database.
- Training Service trains models using data from database and selects an optimal model.
- Prediction Service uses selected model to predict anomalous data points, generate alerts and send to Telemetry.

DBSCAN Graph – LVM

- Volume level metrics
  - IOPs
  - Latency
- Data generation: used dd for random writes and bonnie++ for heavy workloads
- Data processing: 6000 data points collected in 2 days, removing zeros
- epsilon: 1.40
- minPts: 11
- adjusted_rand_score: 0.69



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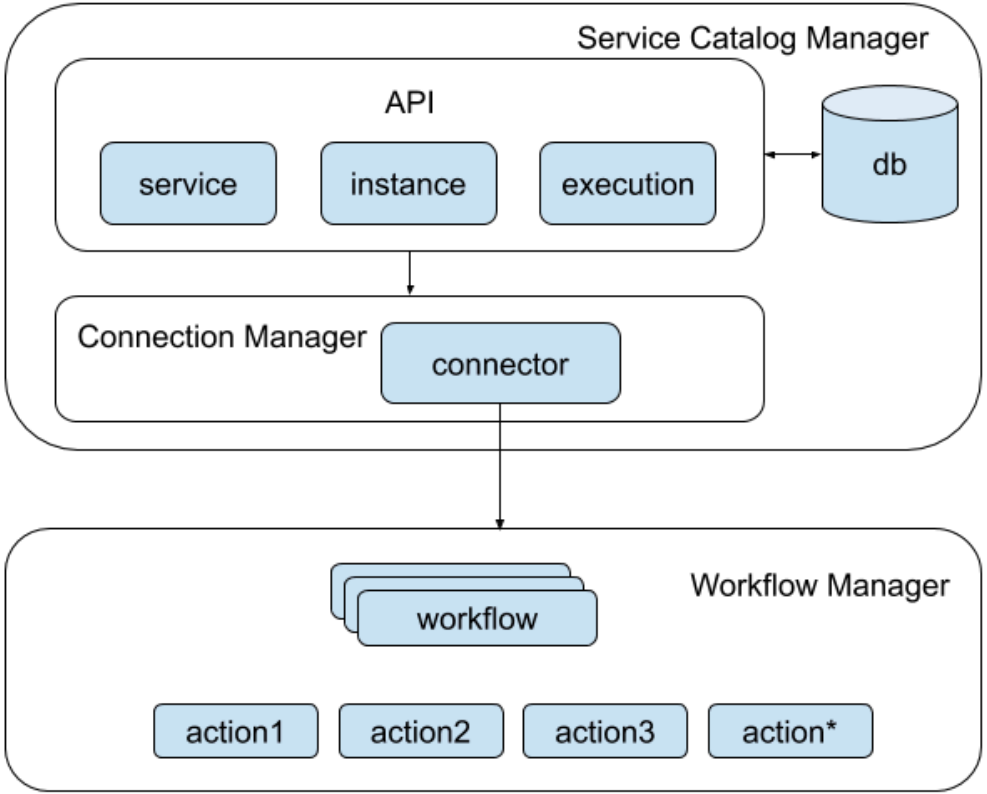
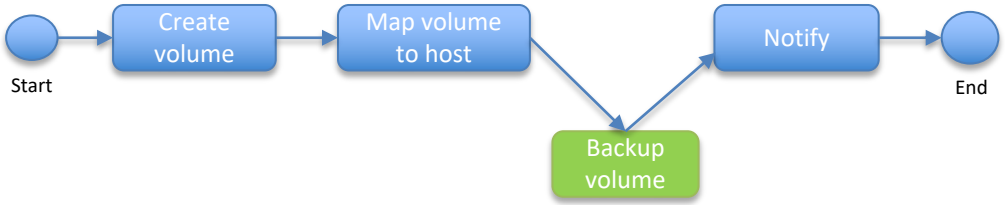
Automation and Orchestration



- Define actions as part of a workflow.
- Integrate with workflow manager such as StackStorm.
- Define generic services based on specific use cases.
- Use cases include automation of volume provisioning, data migration, big data analysis, autoscaling, etc.
- Allow users to customize services and insert multiple custom actions in the beginning, middle, and end of a workflow.

Volume Provisioning Automation

- User registers a service, e.g. volume provisioning service, by defining a template in YAML or JSON.
  - Workflow can be customized, e.g., a “backup-volume” task can be added after “map-volume-to-host” in “provisioning-workflow” to backup the volume periodically to some 3rd-party backup device. New workflows can be created by users.
- Once the service is registered, user can consume the service by creating a service instance which can be executed immediately or delayed. Service catalog manager will read parameters from the instance, and initiate and execute a specific workflow.



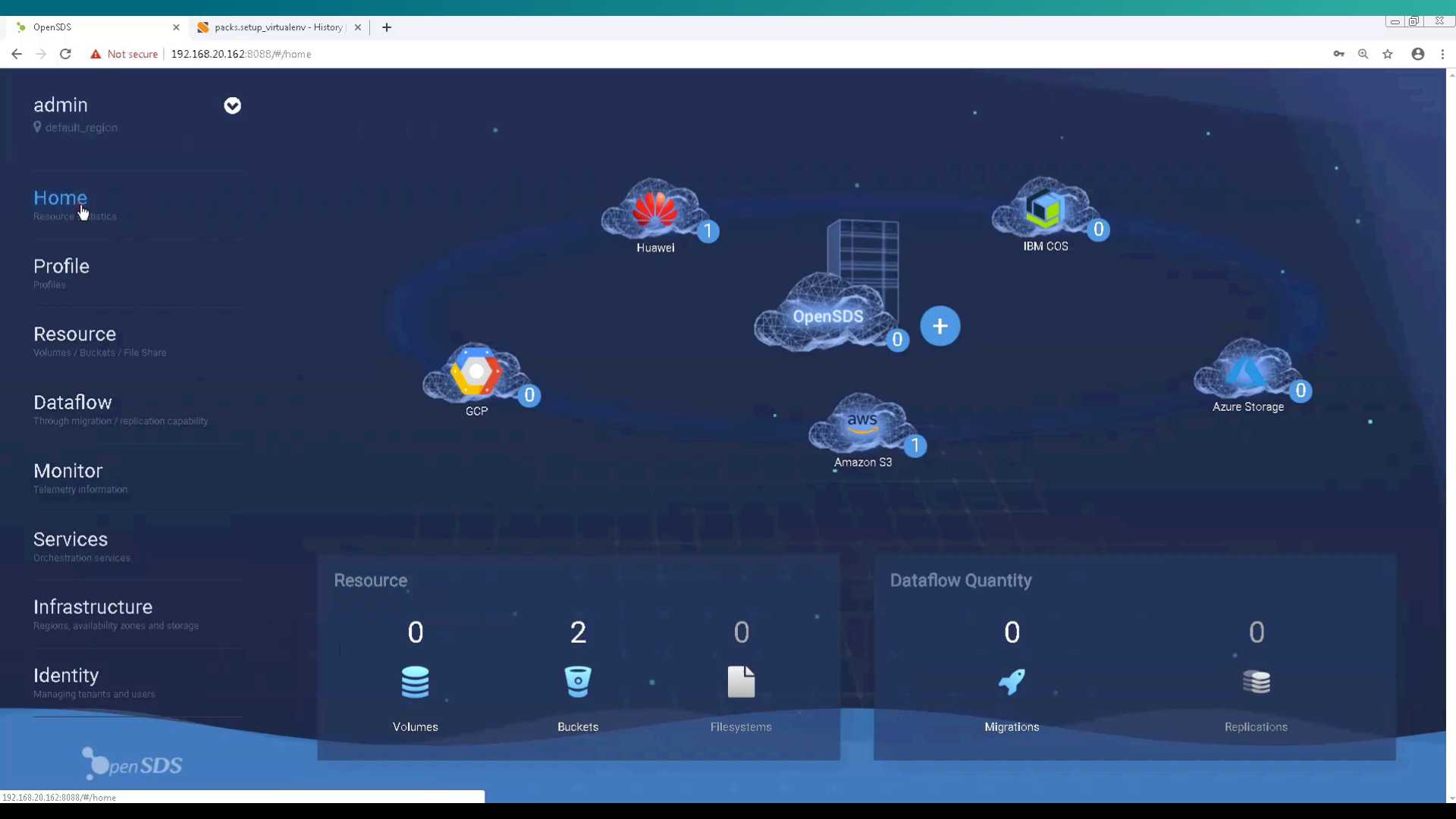

```yaml
---
version: 1.0
name: “Provisioning service”
description: “Provisioning a volume for a host”
parameters:
  “volume_name”:
    type: “string”
    description: “Name of the volume to be provisioned”
    constraints":
      allowed_pattern: "[A-Z]+[a-zA-Z0-9]*"
  “profile”:
    type: “string”
    default: “default”
    description: “Profile ID or name”
  “volume_size”:
    type: “integer”
    “default”: 1
  “host”:
    type: “string”
    description: “Name or IP address of the host”
workflows:
  “provisioning-workflow”:
    description: “This is the workflow for provisioning a volume”
    input: [“volume_name”, “profile”, “volume_size”, “host”]
    output: <json>
    tasks:
      “create-volume”:
        action: “opensds.create-volume”
          on-success:
            - “mapping-volume-to-host”
      "mapping-volume-to-host":
        action: "opensds.attach-volume"
          on-success:
            - ”notify”
      “notify”:
        action: “opensds.notify”
        "input":
              "cmd: "printf 'volume <% $.volume_id %> was attached to host
successfully'"
```

Capri Features

- Telemetry
  - Integrate with Prometheus and Grafana, and collecting metrics from storage backends.
  - Metrics driver for LVM, Ceph, and OceanStor V3/V5.
- Anomaly detection
  - Detect anomalous data points based on metrics collected from Telemetry.
  - Limitations: Alert generation is not done.
- Automation and orchestration
  - Design orchestration workflow using StackStorm
  - Supported workflows include volume provisioning, bucket migration, and user defined workflows.
- Multi-cloud
  - New object store backends
    - Google Cloud Storage (GCS) backend
    - IBM Cloud object store backend
  - Signature identification with AK/SK
- Object lifecycle management
  - Provide object lifecycle management mechanism that allows tenants to manage lifecycle configuration policies through APIs.
  - Support migration between on-premise object storage (Ceph or Fusion Storage) and cloud storage (AWS S3, Azure Blob, GCS).
  - Support default OpenSDS storage tiers.
  - Limitations:
    - User defined rules is not supported in Capri.
    - Restore for Glacier is not supported.
    - Support non-versioned bucket only in Capri.
- File share support
  - Profiles design based on Swordfish
  - File share drivers: NFS driver, Manila driver
- Volume Drivers
  - NVMeoF driver (support LVM)
    - Supported transport: TCP/IP and RDMA.
    - Tested with Intel iWARP RDMA technology. Other RDMA technology, including InfiniBand and RoCE, will be tested in the future.
  - HPE Nimble driver
  - Fujitsu ETERNUS DX driver (Evaluation purpose with limited support)
  - Scutech CMS host-based replication driver
- CSI 1.1.0 support
  - Raw block support
  - Topology support
  - Multi-attach support
  - NVMe TCP support
    - Support for other transport type, e.g., nvme-rdma, needs to be tested
  - CSI plugin support for shared file systems (through file share APIs)
- Installer
  - Enable multi-dock/multi-node and multi-backend installation with Ansible
  - Helm installation with Ceph
  - Salt installer
- Thin OpenSDS (Experimental)
  - A light-weight OpenSDS to serve Cloud Native environment

Demo 1: Automation & Orchestration

- Volume provisioning
- Bucket migration


OpenSDS
packs.setup_virtualenv - History
Not secure
192.168.20.162:8088/#/home
admin
default_region
Home
Resource statistics
Profile
Profiles
Resource
Volumes / Buckets / File Share
Dataflow
Through migration / replication capability
Monitor
Telemetry information
Services
Orchestration services
Infrastructure
Regions, availability zones and storage
Identity
Managing tenants and users
Huawei
1
IBM COS
0
OpenSDS
0
GCP
0
Azure Storage
0
aws
Amazon S3
1
Resource
0
2
0
Volumes
Buckets
Filesystems
Dataflow Quantity
0
0
Migrations
Replications
openSDS
192.168.20.162:8088/#/home

Demo 2: Object Lifecycle Management

- In-cloud transition
- Cross-cloud transition
- Expiration


admin
default_region
Home
Resource statistics
Resource
Volumes / Buckets
Dataflow
Through migration / replication capability
Profile
Profiles
Infrastructure
Regions, availability zones and storage
Identity
Managing tenants and users
Huawei
2
IBM COS
0
OpenSDS
1
GCP
0
Azure Storage
1
aws
Amazon S3
1
Resource
0
3
0
Volumes
Buckets
Filesystems
Dataflow Quantity
2
0
Migrations
Replications
OpenSDS
0K/s
0K/s
ENG
19:19
2019/5/17

The Road to Open Autonomous Data Platform

CAPRI 2019H1

Assisted: Policy-Based

- Anomaly Detection
- Telemetry
- Automation
- Object Lifecycle
- File Share
- NVMeoF
- Multi-Cloud: GCS, IBM Clouds
- CSI - raw block
- HPE, Fujitsu storage

DAITO 2019H2

Minor Autonomous

- Anomaly Handling
- Data Lifecycle - File
- Data Protection

E* 2020H1

Partial Autonomous

- Scaling
- Load Balancing
- Adaptive Data Protection
- Data Governance

F* 2020H2

Semi Autonomous

- Optimization
- Adaptive Data Governance

Beyond 2020

Towards Fully Autonomous

- Self Healing
- Self Scaling
- Self LB
- Self Optimization
- Self Protection
- Self Lifecycle
- Self Governance

SODA

The Open Autonomous Data Project

To build an open autonomous data storage platform with **self-driving protection, availability, security and optimization** capabilities for real world uses; to provide a neutral platform for **open source data storage projects collaboration**, and to **build a multi-vendor ecosystem** of products, solutions and services

PROJECT REBRANDING

THANK YOU

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Accepting New Members

Vendors And End Users Welcome

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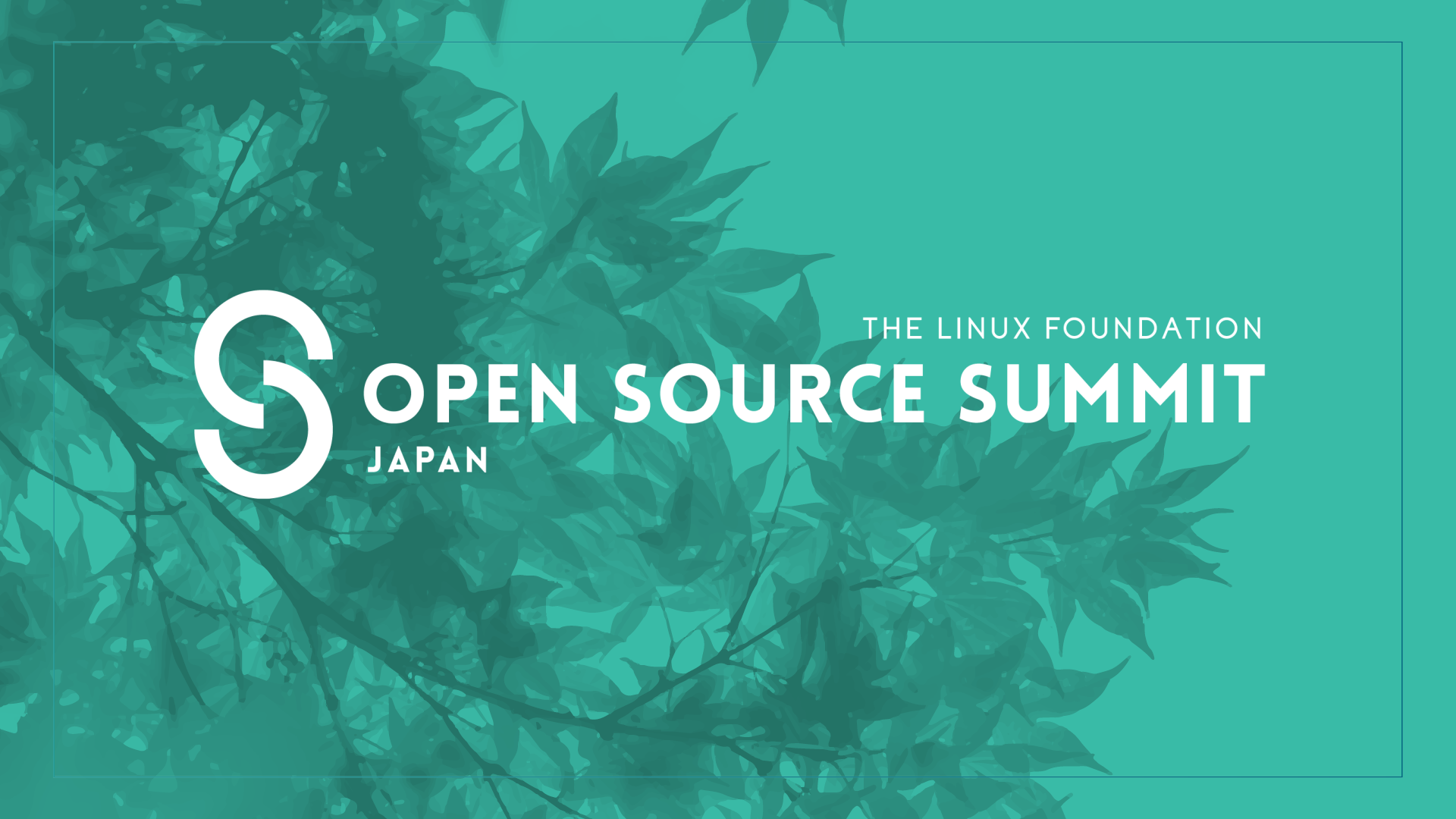
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