Hybrid Cloud with Provider-Managed Components

NetApp Solutions

NetApp
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NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

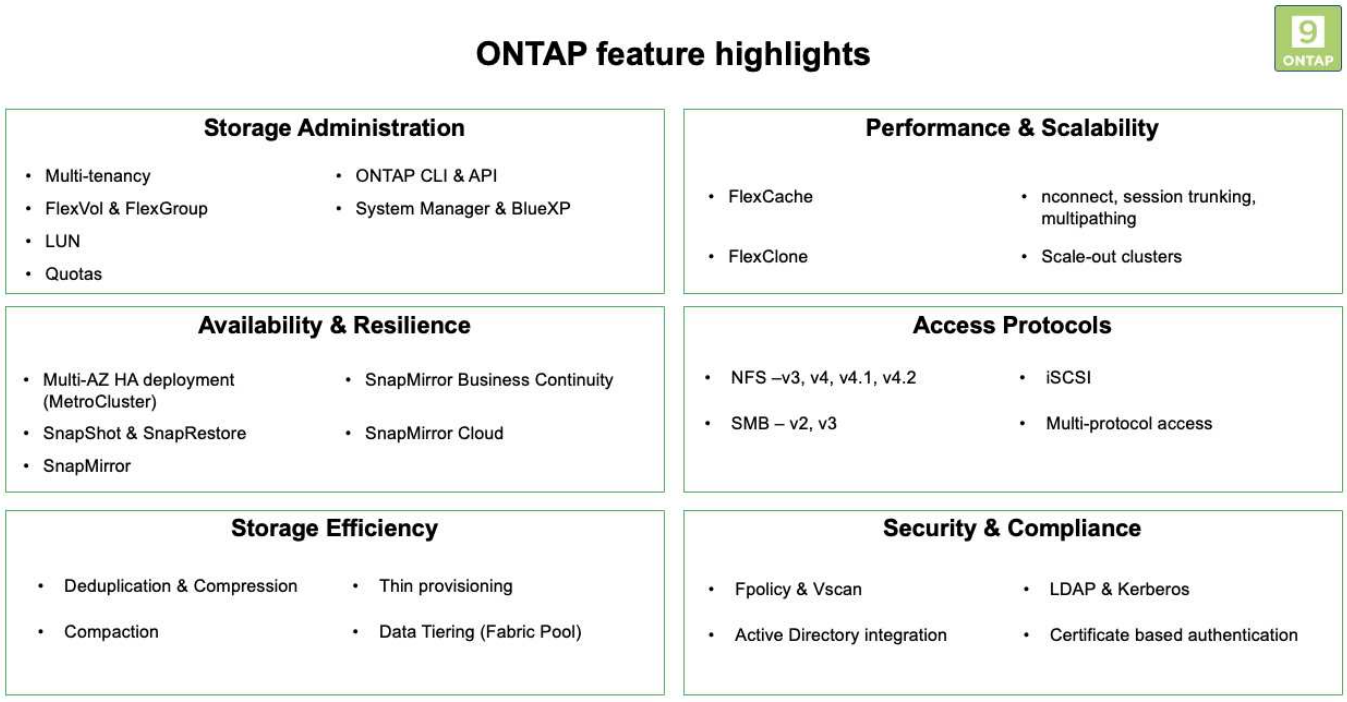
Overview

NetApp is seeing a significant increase in customers modernizing their legacy enterprise applications and building new applications using containers and orchestration platforms built around Kubernetes. Red Hat OpenShift Container Platform is one example that we see adopted by many of our customers.

As more and more customers begin adopting containers within their enterprises, NetApp is perfectly positioned to help serve the persistent storage needs of their stateful applications and classic data management needs such as data protection, data security, and data migration. However, these needs are met using different strategies, tools, and methods.

NetApp ONTAP based storage options listed below, deliver security, data protection, reliability, and flexibility for containers and Kubernetes deployments.

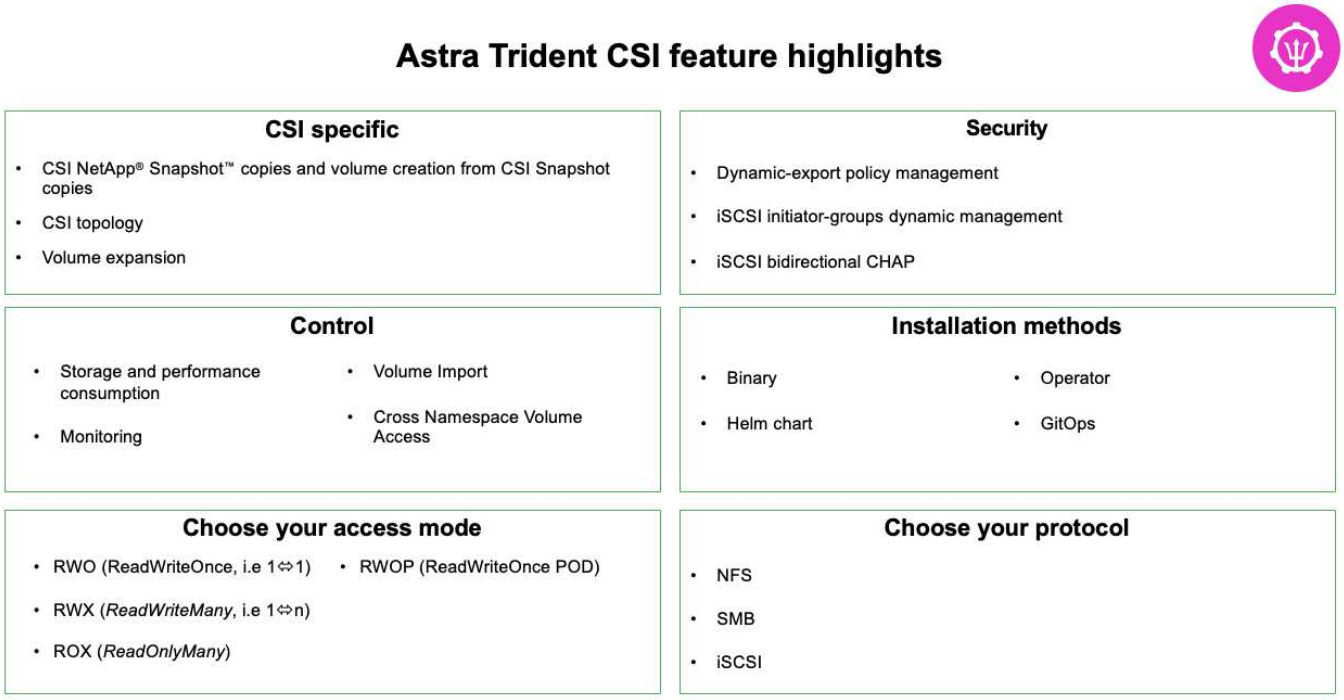
- Self-managed storage in on-premises:
  - NetApp Fabric Attached Storage (FAS), NetApp All Flash FAS Arrays (AFF), NetApp All SAN Array (ASA) and ONTAP Select
- Provider-managed storage in on-premises:
  - NetApp Keystone provides Storage as a Service (STaaS)
- Self-managed storage in the cloud:
  - NetApp Cloud Volumes ONTAP(CVO) provide self managed storage in the hyperscalers
- Provider-managed storage in the cloud:
  - Cloud Volumes Service for Google Cloud (CVS), Azure NetApp Files (ANF), Amazon FSx for NetApp ONTAP offer fully managed storage in the hyperscalers



NetApp BlueXP enables you to manage all of your storage and data assets from a single control plane/interface.

You can use BlueXP to create and administer cloud storage (for example, Cloud Volumes ONTAP and Azure NetApp Files), to move, protect, and analyze data, and to control many on-prem and edge storage devices.

NetApp Astra Trident is a CSI Compliant Storage Orchestrator that enable quick and easy consumption of persistent storage backed by a variety of the above-mentioned NetApp storage options. It is an open-source software maintained and supported by NetApp.



Business critical container workloads need more than just persistent volumes. Their data management requirements require protection and migration of the application kubernetes objects as well.

Application data includes kubernetes objects in addition to the user data: Some examples are as follows:
- kubernetes objects such as pods specs, PVCs, deployments, services
- custom config objects such as config maps and secrets
- persistent data such as Snapshot copies, backups, clones
- custom resources such as CRs and CRDs

NetApp Astra Control, available as both fully-managed and self-managed software, provides orchestration for robust application data management. Refer to the Astra documentation for additional details on the Astra family of products.

This reference documentation provides validation of migration and protection of container-based applications, deployed on RedHat OpenShift container platform, using NetApp Astra Control Center. In addition, the solution provides high-level details for the deployment and the use of Red Hat Advanced Cluster Management (ACM) for managing the container platforms. The document also highlights the details for the integration of NetApp storage with Red Hat OpenShift container platforms using Astra Trident CSI provisioner. Astra Control Center is deployed on the hub cluster and is used to manage the container applications and their persistent storage lifecycle. Finally, it provides a solution for replication and failover and fail-back for container workloads on managed Red Hat OpenShift clusters in AWS (ROSA) using Amazon FSx for NetApp ONTAP (FSxN) as

persistent storage.

NetApp Solution with Managed Red Hat OpenShift Container platform workloads on AWS

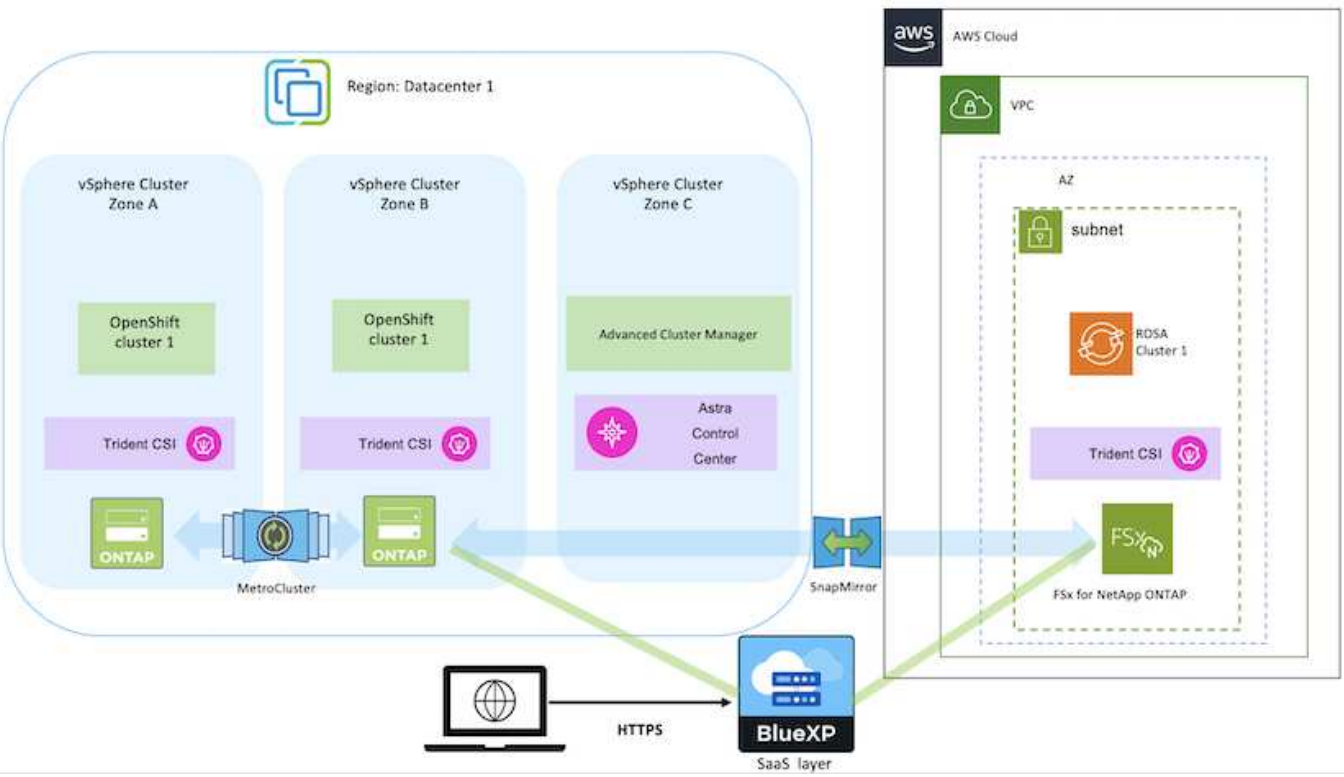
Customers may be "born in the cloud" or may be at a point in their modernization journey when they are ready to move some select workloads or all workloads from their data centers to the cloud. They may choose to use provider-managed OpenShift containers and provider-managed NetApp storage in the cloud for running their workloads. They should plan and deploy the Managed Red Hat OpenShift container clusters (ROSA) in the cloud for a successful production-ready environment for their container workloads. When they are in AWS cloud, they could also deploy FSx for NetApp ONTAP for the storage needs.

FSx for NetApp ONTAP delivers data protection, reliability, and flexibility for container deployments in AWS. Astra Trident serves as the dynamic storage provisioner to consume the persistent FSxN storage for customers' stateful applications.

As ROSA can be deployed in HA mode with control plane nodes spread across multiple availability zones, FSx ONTAP can also be provisioned with Multi-AZ option which provides high availability and protect against AZ failures.

There are no data transfer charges when accessing an Amazon FSx file system from the file system's preferred Availability Zone (AZ). For more info on pricing, refer here.

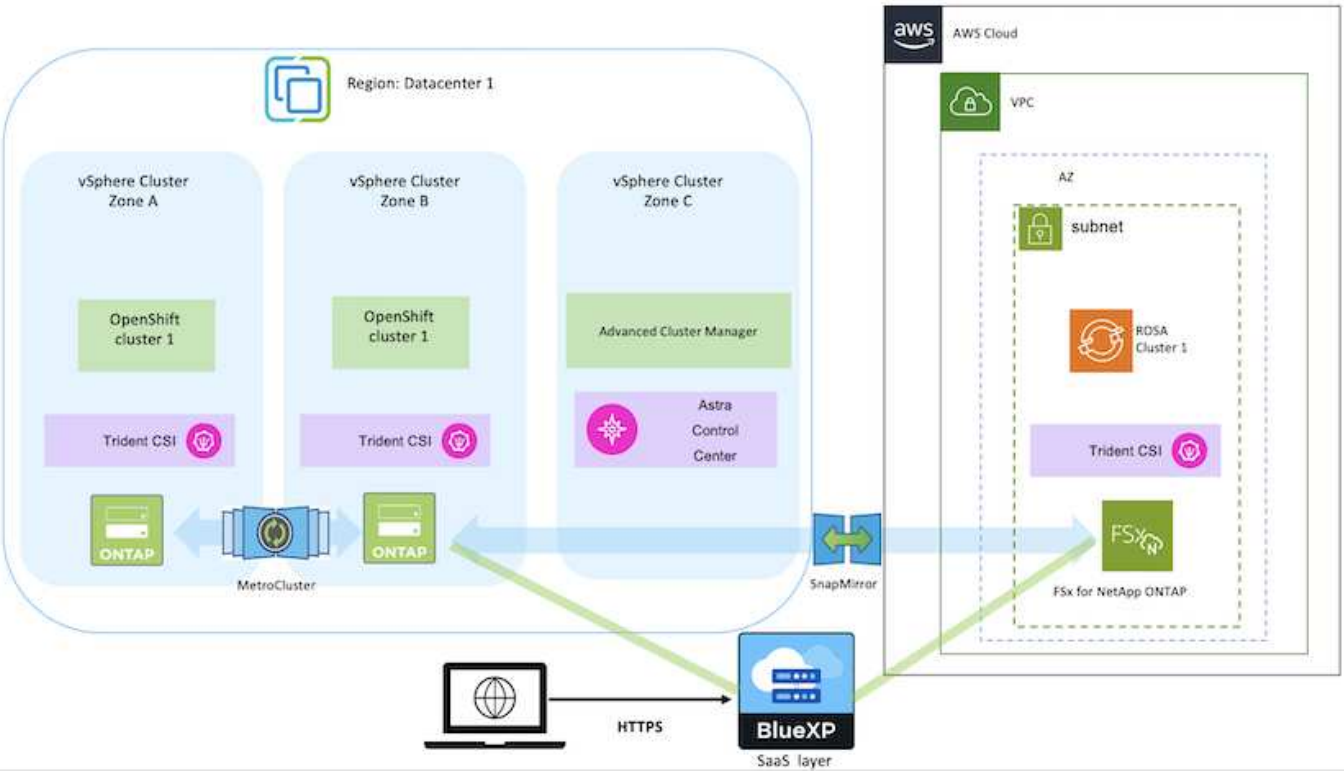
Data protection and migration solution for OpenShift Container workloads



Deploy and configure the Managed Red Hat OpenShift Container platform on AWS

This section describes a high-level workflow of setting up the Managed Red Hat OpenShift clusters on AWS(ROSA). It shows the use of Managed FSx for NetApp ONTAP (FSxN) as the storage backend by Astra Trident to provide persistent volumes. Details are provided about the deployment of FSxN on AWS using BlueXP. Also, details are provided about the use of BlueXP and OpenShift GitOps (Argo CD) to perform data protection and migration activities for the stateful applications on ROSA clusters.

Here is a diagram that depicts the ROSA clusters deployed on AWS and using FSxN as the backend storage.



This solution was verified by using two ROSA clusters in two VPCs in AWS. Each ROSA cluster was integrated with FSxN using Astra Trident. There are several ways of deploying ROSA clusters and FSxN in AWS. This high-level description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

The setup process can be broken down into the following steps:

Install ROSA clusters

- Create two VPCs and set up VPC peering connectivity between the VPCs.
- Refer here for instructions to install ROSA clusters.

Install FSxN

- Install FSxN on the VPCs from BlueXP.
  Refer here for BlueXP account creation and to get started.
  Refer here for installing FSxN.
  Refer here for creating a connector in AWS to manage the FSxN.
- Deploy FSxN using AWS.
  Refer here for deployment using AWS console.

Install Trident on ROSA clusters (using Helm chart)

- Use Helm chart to install Trident on ROSA clusters.
  url for the Helm chart: https://netapp.github.io/trident-helm-chart

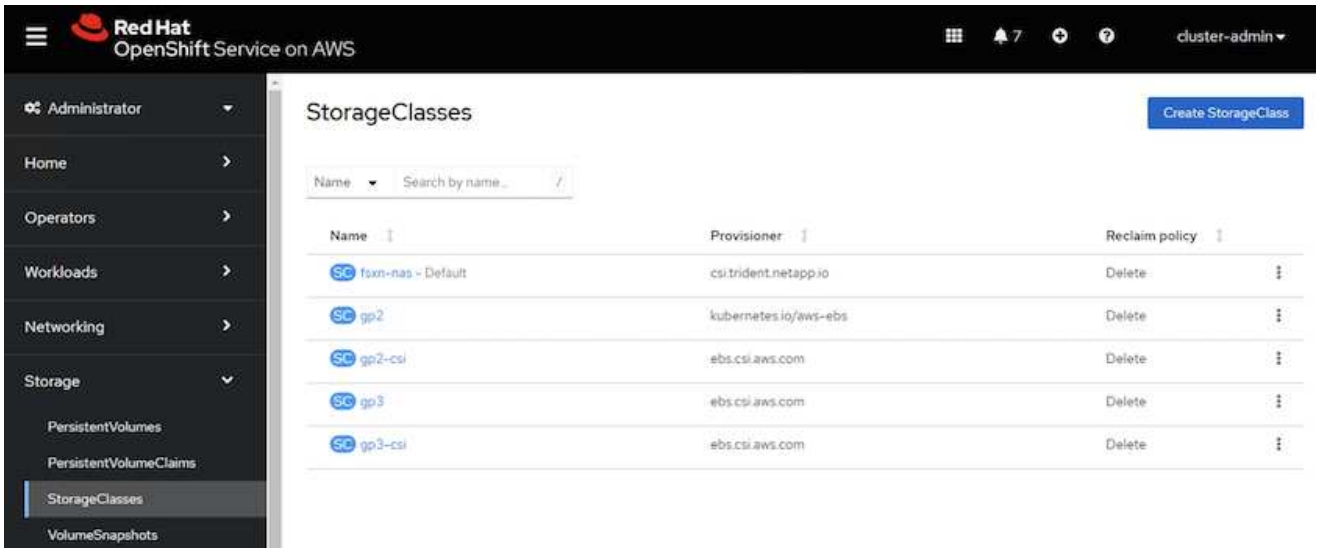
Integration of FSxN with Astra Trident for ROSA clusters

OpenShift GitOps can be utilized to deploy Astra Trident CSI to all managed clusters as they get registered to ArgoCD using ApplicationSet.

```
apiVersion: argoproj.io/v1alpha1
kind: ApplicationSet
metadata:
  name: trident-operator
spec:
  generators:
  - clusters: {}
    # selector:
    #   matchLabels:
    #     tridentversion: '23.04.0'
  template:
    metadata:
      name: '{{nameNormalized}}-trident'
    spec:
      destination:
        namespace: trident
        server: '{{server}}'
      source:
        repoURL: 'https://netapp.github.io/trident-helm-chart'
        targetRevision: 23.04.0
        chart: trident-operator
      project: default
      syncPolicy:
        syncOptions:
          - CreateNamespace=true
```

Create backend and storage classes using Trident (for FSxN)

- Refer here for details about creating backend and storage class.
- Make the storage class created for FsxN with Trident CSI as default from OpenShift Console. See screenshot below:



Deploy an application using OpenShift GitOps (Argo CD)

- Install OpenShift GitOps operator on the cluster. Refer to instructions here.
- SetUp a new Argo CD instance for the cluster. Refer to instructions here.

Open the console of Argo CD and deploy an app.
As an example, you can deploy a Jenkins App using Argo CD with a Helm Chart.
When creating the application, the following details were provided:
Project: default
cluster: https://kubernetes.default.svc
Namespace: Jenkins
The url for the Helm Chart: https://charts.bitnami.com/bitnami

Helm Parameters:
global.storageClass: fsxn-nas

Data protection

This page shows the data protection options for Managed Red Hat OpenShift on AWS (ROSA) using Astra Control Service.

FSx NetApp ONTAP for Red Hat OpenShift Service on AWS (ROSA)

The following video shows the backup of a ROSA application running in one region and restoring to another region.

FSx NetApp ONTAP for Red Hat OpenShift Service on AWS

Data migration

This page shows the data migration options for container workloads on Managed Red Hat OpenShift clusters using FSx for NetApp ONTAP for persistent storage.

Data Migration

Red Hat OpenShift service on AWS as well as FSx for NetApp ONTAP (FSxN) are part of their service portfolio by AWS. FSxN is available on Single AZ or Multi-AZ options.
Multi-Az option provides data protection from availability zone failure.
FSxN can be integrated with Astra Trident to provide persistent storage for applications on ROSA clusters.

Integration of FSxN with Trident using Helm chart

ROSA Cluster Integration with Amazon FSx for ONTAP

The migration of container applications involves:

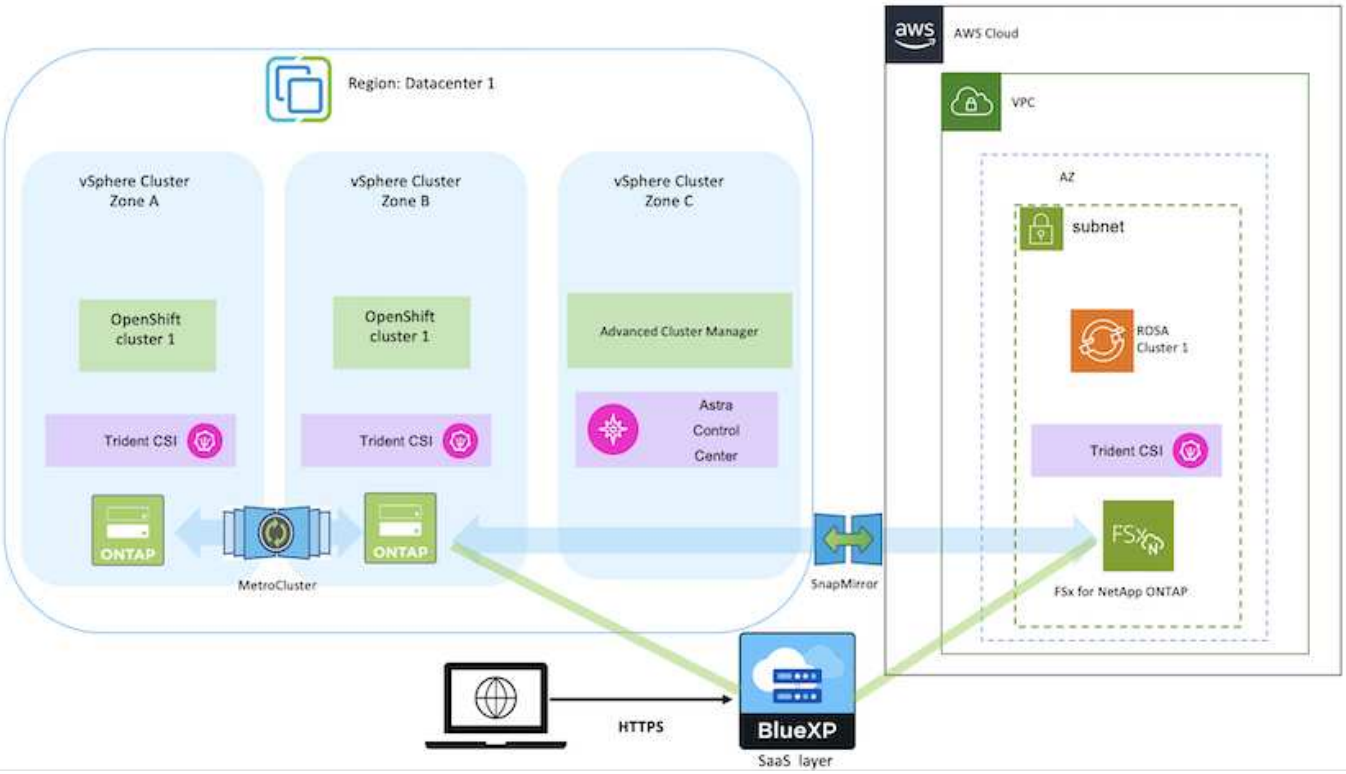
- Persistent volumes: this can be accomplished using BlueXP.
  Another option is to use Astra Control Center to handle container application migrations from on-premises to the cloud environment. Automation can be used for the same purpose.
- Application metadata: this can be accomplished using OpenShift GitOps (Argo CD).

Failover and Fail-back of applications on ROSA cluster using FSxN for persistent storage

The following video is a demonstration of application failover and fail-back scenarios using BlueXP and Argo CD.

Failover and Fail-back of applications on ROSA cluster

Data protection and migration solution for OpenShift Container workloads


Region: Datacenter 1
vSphere Cluster
Zone A
vSphere Cluster
Zone B
vSphere Cluster
Zone C
OpenShift
cluster 1
OpenShift
cluster 1
Advanced Cluster Manager
Trident CSI
Trident CSI
Astra
Control
Center
ONTAP
ONTAP
MetroCluster
SnapMirror
aws
AWS Cloud
VPC
AZ
subnet
ROSA
Cluster 1
Trident CSI
FSx
FSx for NetApp ONTAP
HTTPS
BlueXP
SaaS layer

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