Overview

NetApp Solutions

NetApp
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NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

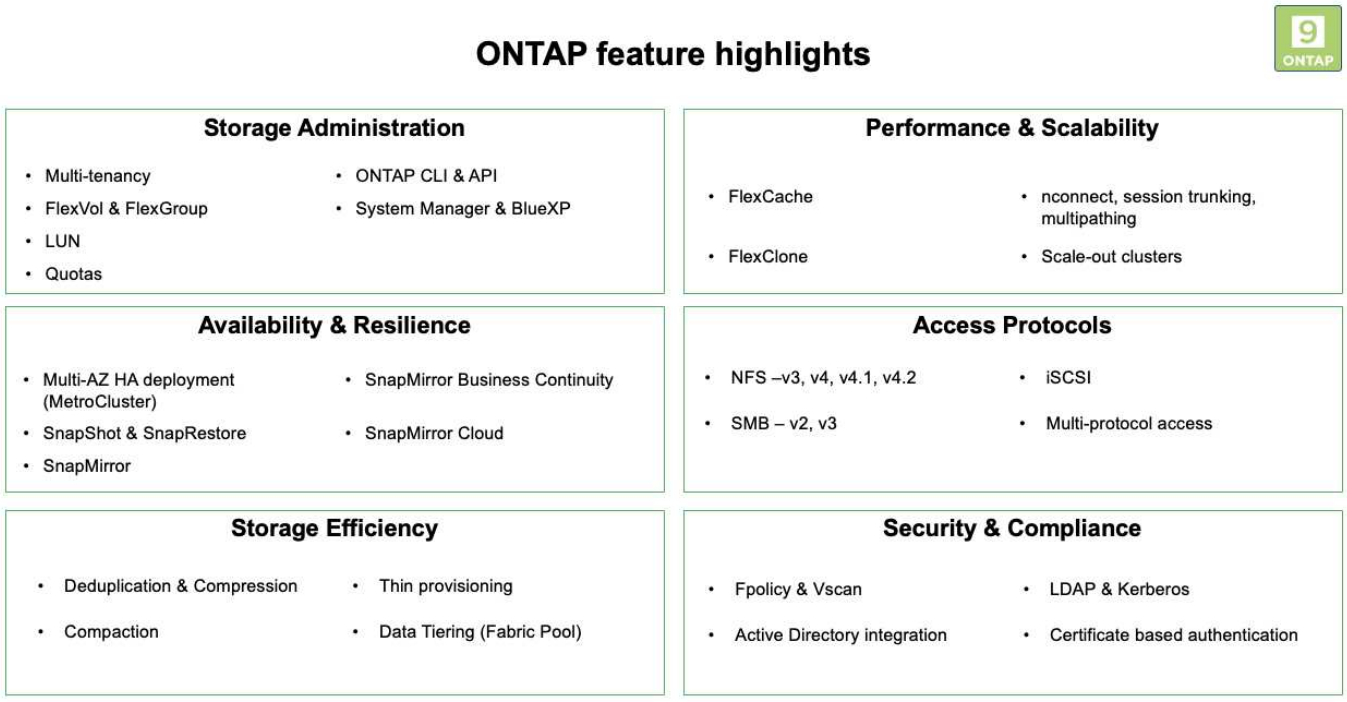
Overview

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.

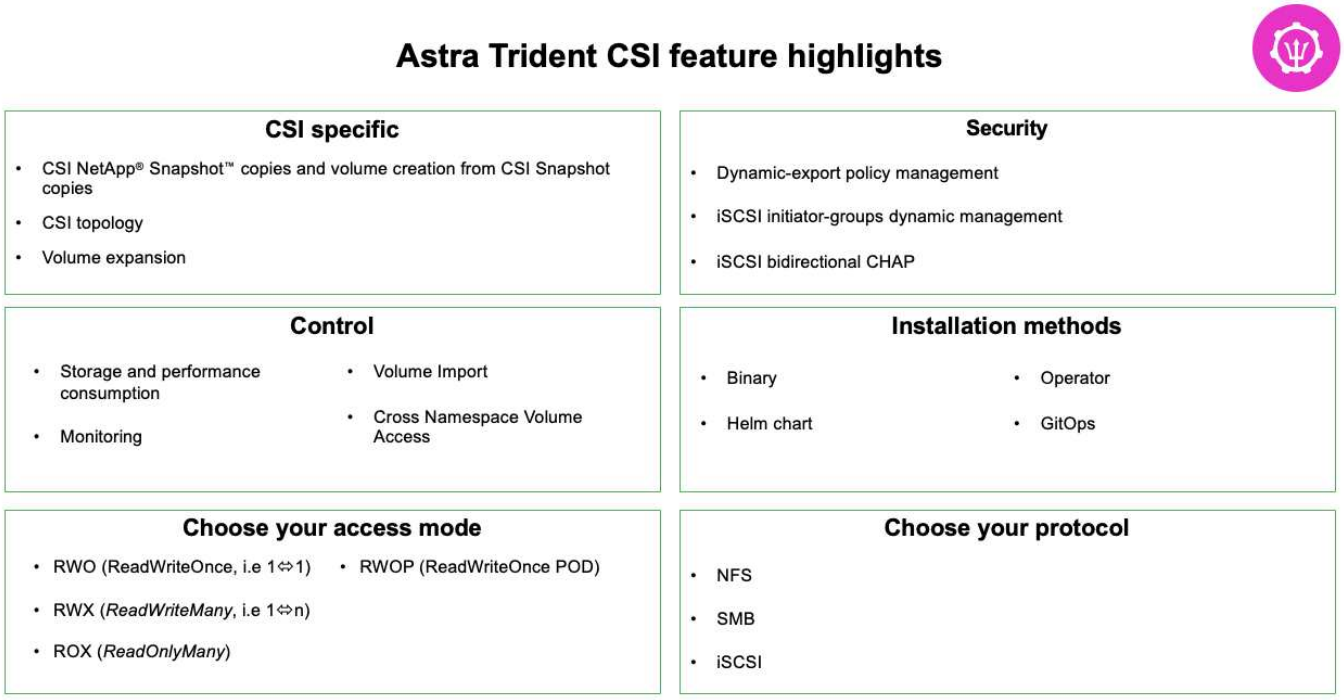
- Self-managed storage in on-premises:
  - NetApp Fabric Attached Storage (FAS), NetApp All Flash FAS Arrays (AFF), NetApp All SAN Array (ASA) and ONTAP Select
- Provider-managed storage in on-premises:
  - NetApp Keystone provides Storage as a Service (STaaS)
- Self-managed storage in the cloud:
  - 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.

Value propositions of NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

Most customers do not just start out building Kubernetes based environments without any existing infrastructure. Perhaps they are a traditional IT shop running most of their enterprise applications on virtual machines (in large VMware environments for example). Then they start building small container-based environments to satisfy the needs of their modern application development teams. These initiatives usually start small and begin to become more pervasive as the teams learn these new technologies and skills, and begin to recognize the many benefits of adopting them.
The good news for customers is that NetApp can serve the needs of both environments. This set of solutions for hybrid multicloud with Red Hat OpenShift will empower NetApp customers to adopt modern cloud technologies and services without having to overhaul their entire infrastructure and organization. Whether customer applications and data are hosted on-premises, in cloud, run on virtual machines, or on containers, NetApp can provide consistent data management, protection, security, and portability. With these new solutions, the same value NetApp has delivered in on-premises data center environments for decades will be available across the enterprise entire data horizon, without requiring significant investment to retool, acquire new skills, or build new teams. NetApp is positioned well to help customers solve these business challenges regardless of what phase of their cloud journey they are in.

NetApp Hybrid Multi-Cloud with Red Hat Openshift:

- Gives customers validated designs and practices which demonstrate the best ways for customers to manage, protect, secure, and migrate their data and applications when using Red Hat OpenShift with NetApp based storage solutions.
- Present best practices for customers running Red Hat OpenShift with NetApp storage in VMware environments, bare metal infrastructure, or a combination of both.
- Demonstrate strategies and options for both on-prem and cloud environments, as well as hybrid environments where both are used.

Supported Solutions of NetApp Hybrid Multicloud for Red Hat OpenShift Container workloads

The solution tests and validates Migration & Centralized Data Protection with OpenShift container platform (OCP), OpenShift Advanced Cluster Manager (ACM), NetApp ONTAP, NetApp BlueXP and NetApp Astra Control Center (ACC).

For this solution, the following scenarios are tested and validated by NetApp. The solution is separated into multiple scenarios based on the following characteristics:

- on-premises
- cloud

- self-managed OpenShift clusters and self-managed NetApp storage
- provider-managed OpenShift clusters and provider-managed NetApp storage

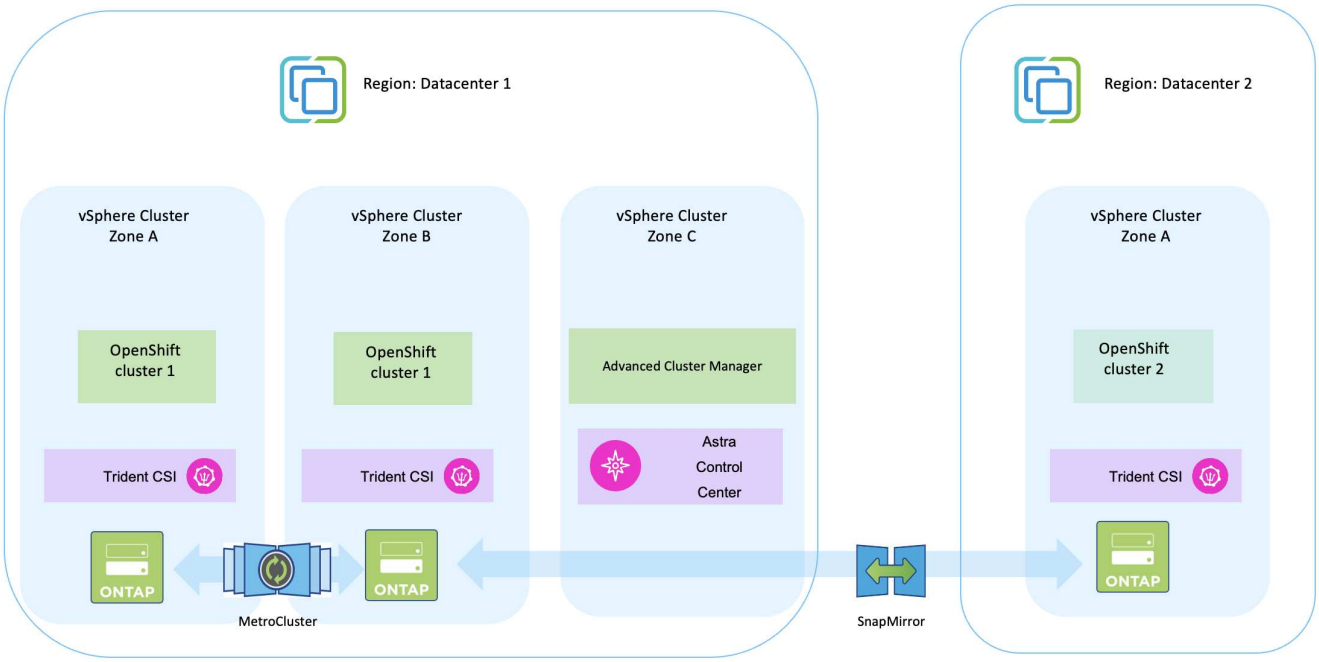
We will be building out additional solutions and use cases in the future.

Scenario 1: Data protection and migration within the on-premises environment using ACC

On-premises: self-managed OpenShift clusters and self-managed NetApp storage

- Using ACC, create Snapshot copies, backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.

Scenario 1

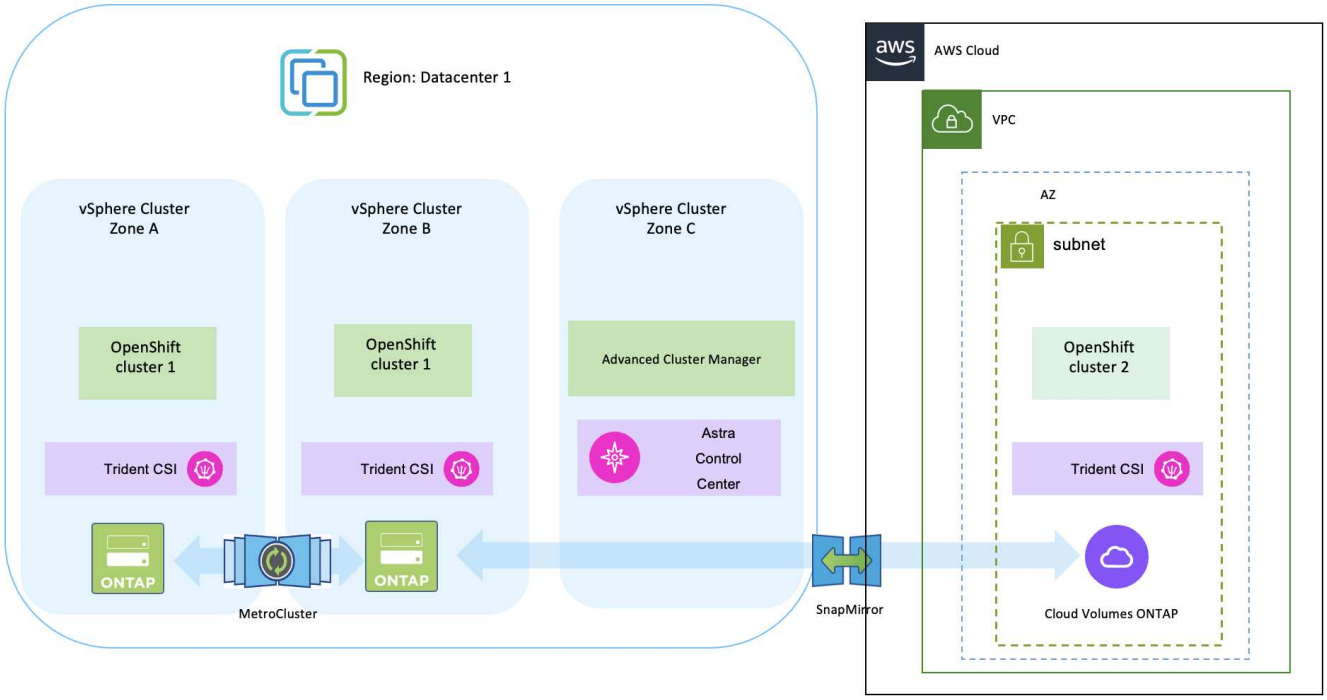


Scenario 2: Data protection and migration from the on-premises environment to AWS environment using ACC:

On-premises: Self-managed OpenShift cluster and self-managed storage
AWS Cloud: Self-managed OpenShift cluster and self-managed storage

- Using ACC, perform backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.

Scenario 2

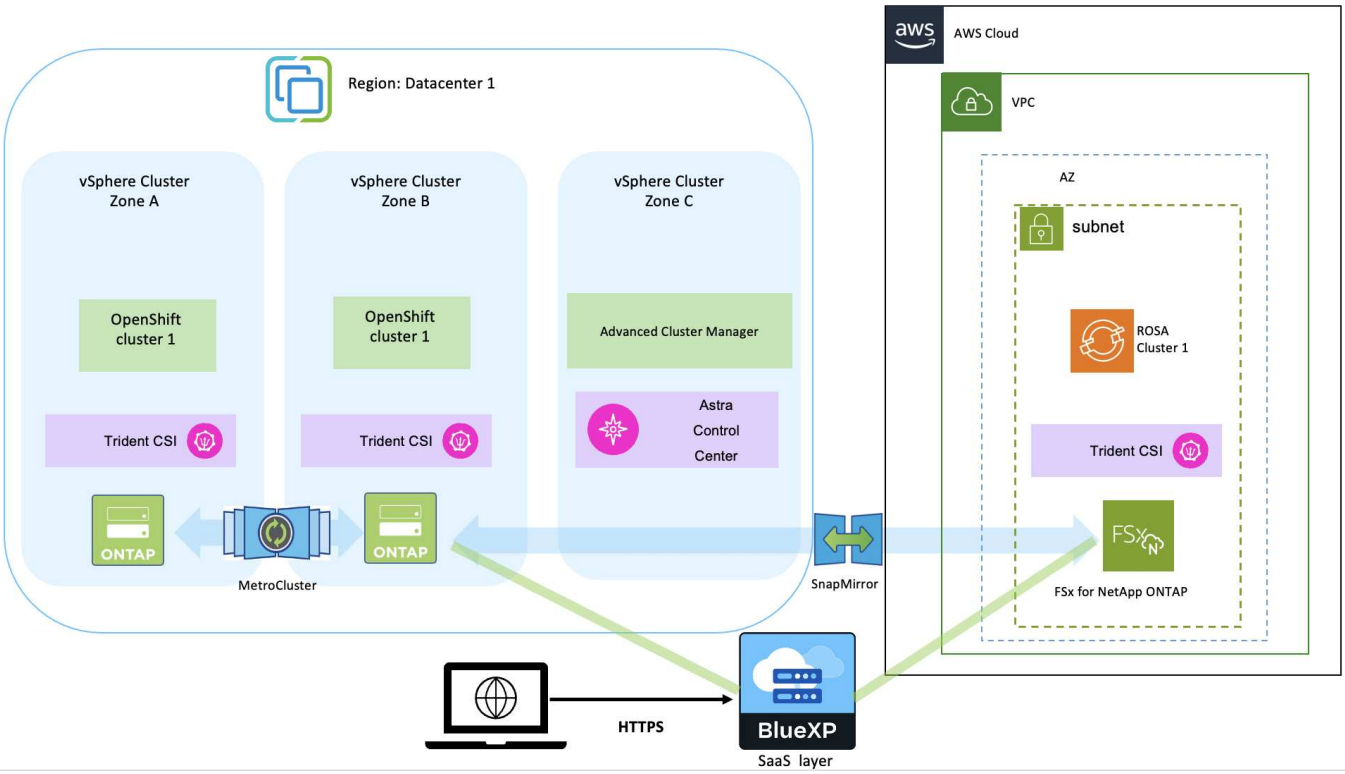


Scenario 3: Data protection and migration from the on-premises environment to AWS environment:

On-premises: Self-managed OpenShift cluster and self-managed storage
AWS Cloud: Provider-managed OpenShift cluster (ROSA) and provider-managed storage (FSxN)

- Using BlueXP, perform replication of persistent volumes (FSxN).
- Using OpenShift GitOps, recreate application metadata.

Scenario 3



For considerations when using ONTAP in a MetroCluster configuration, refer here.

Versions of various components used in the solution validation

The solution tests and validates Migration & Centralized Data Protection with OpenShift container platform, OpenShift Advanced Cluster Manager, NetApp ONTAP, and NetApp Astra Control Center.

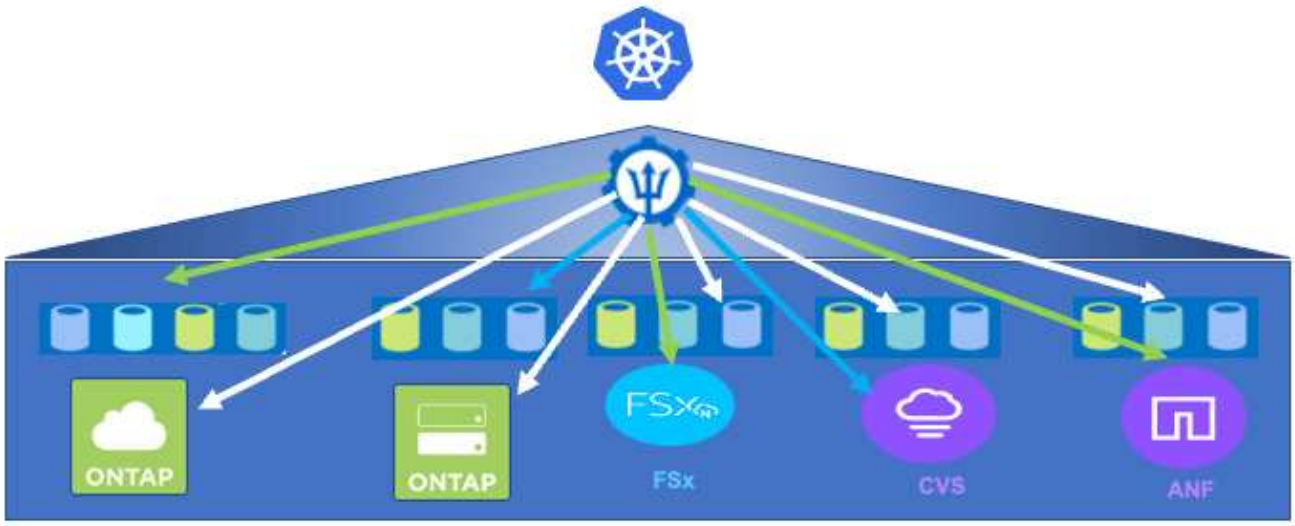
Various scenarios of the solution were validated using the versions as shown in the table below:

Component	Version
VMware	vSphere Client version 8.0.0.10200 VMware ESXi, 8.0.0, 20842819
Hub Cluster	OpenShift 4.11.34
Source and Destination Clusters	OpenShift 4.12.9 on-premises and in AWS
NetApp Astra Trident	Trident Server and Client 23.04.0
NetApp Astra Control Center	ACC 22.11.0-82
NetApp ONTAP	ONTAP 9.12.1
AWS FSx for NetApp ONTAP	Single AZ

Supported NetApp Storage integrations with Red Hat Open Shift Containers

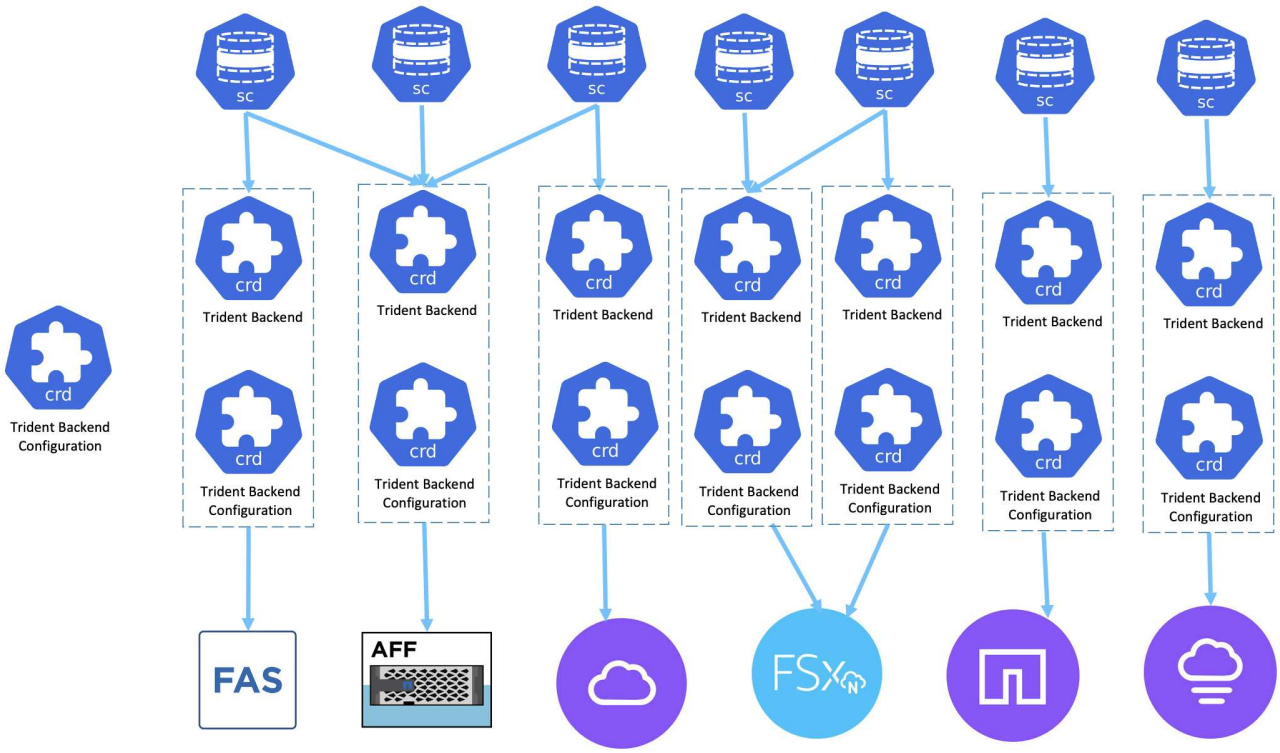
Whether the Red Hat Open Shift containers are running on VMware or in the hyperscalers, NetApp Astra Trident can be used as the CSI provisioner for the various types of backend NetApp storage that it supports.

The following diagram depicts the various backend NetApp storage that can be integrated with OpenShift clusters using NetApp Astra Trident.

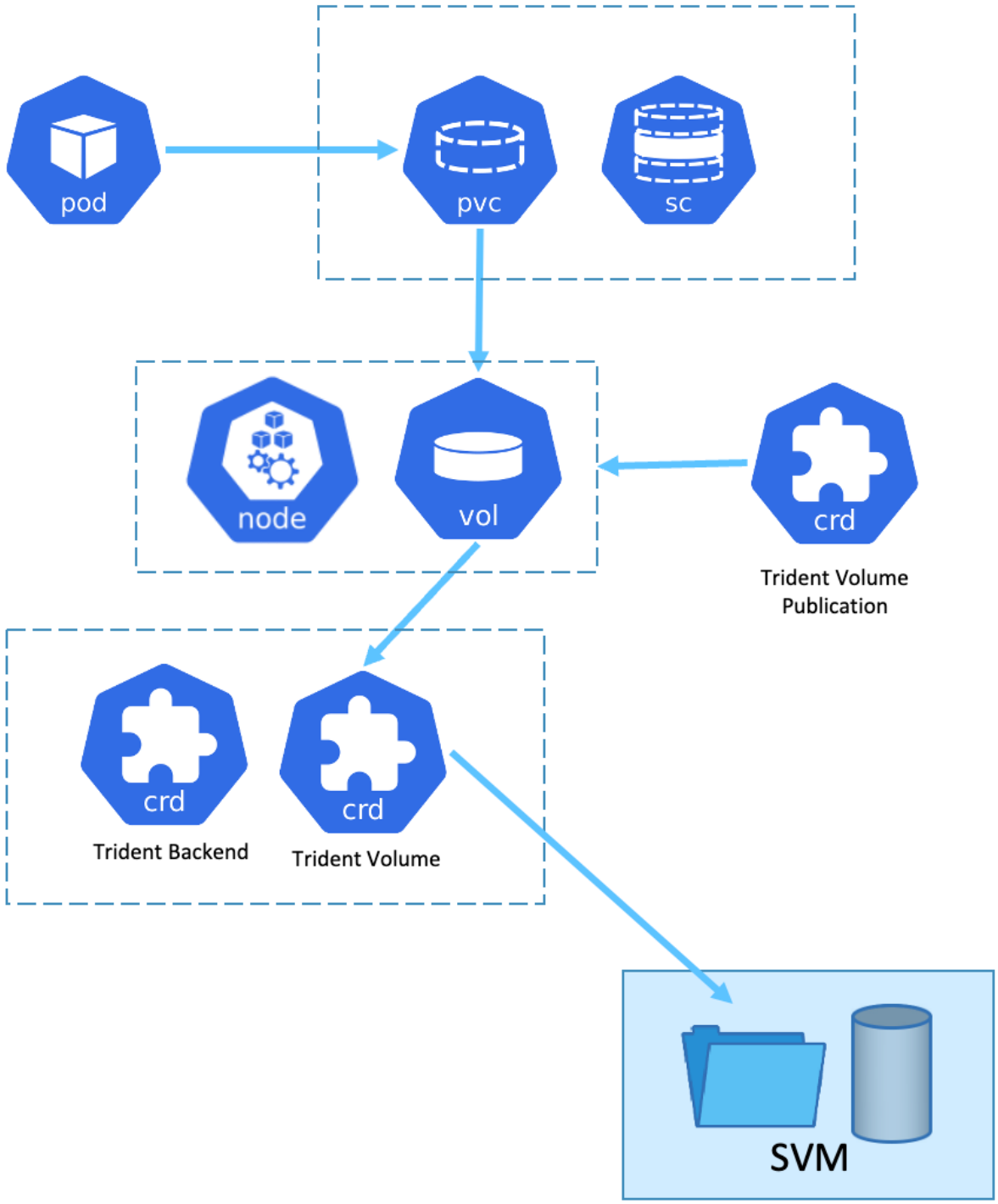


ONTAP Storage Virtual Machine (SVM) provides secure multi-tenancy. A Single OpenShift cluster can connect to single SVM or multiple SVMs or even to multiple ONTAP clusters. Storage class filters the backend storage based on parameters or by labels. Storage administrators define the parameters to connect to storage system using trident backend configuration. On successful connection establishment, it creates the trident backend and populates the information which the storage class can filter.

The relationship between the storageclass and backend is shown below.



Application owner requests persistent volume using storage class. The storage class filters the backend storage.
The relationship between the pod and backend storage is shown below.



Container Storage Interface (CSI) Options

On vSphere environments, customers can pick VMware CSI driver and/or Astra Trident CSI to integrate with ONTAP. With VMware CSI, the persistent volumes are consumed as local SCSI disks, whereas with Trident, it is consumed with network.

As VMware CSI does not support RWX access modes with ONTAP, applications need to use Trident CSI if RWX mode is required. With FC based deployments, VMware CSI is preferred and SnapMirror Business Continuity (SMBC) provides zone level high availability.

VMware CSI supports

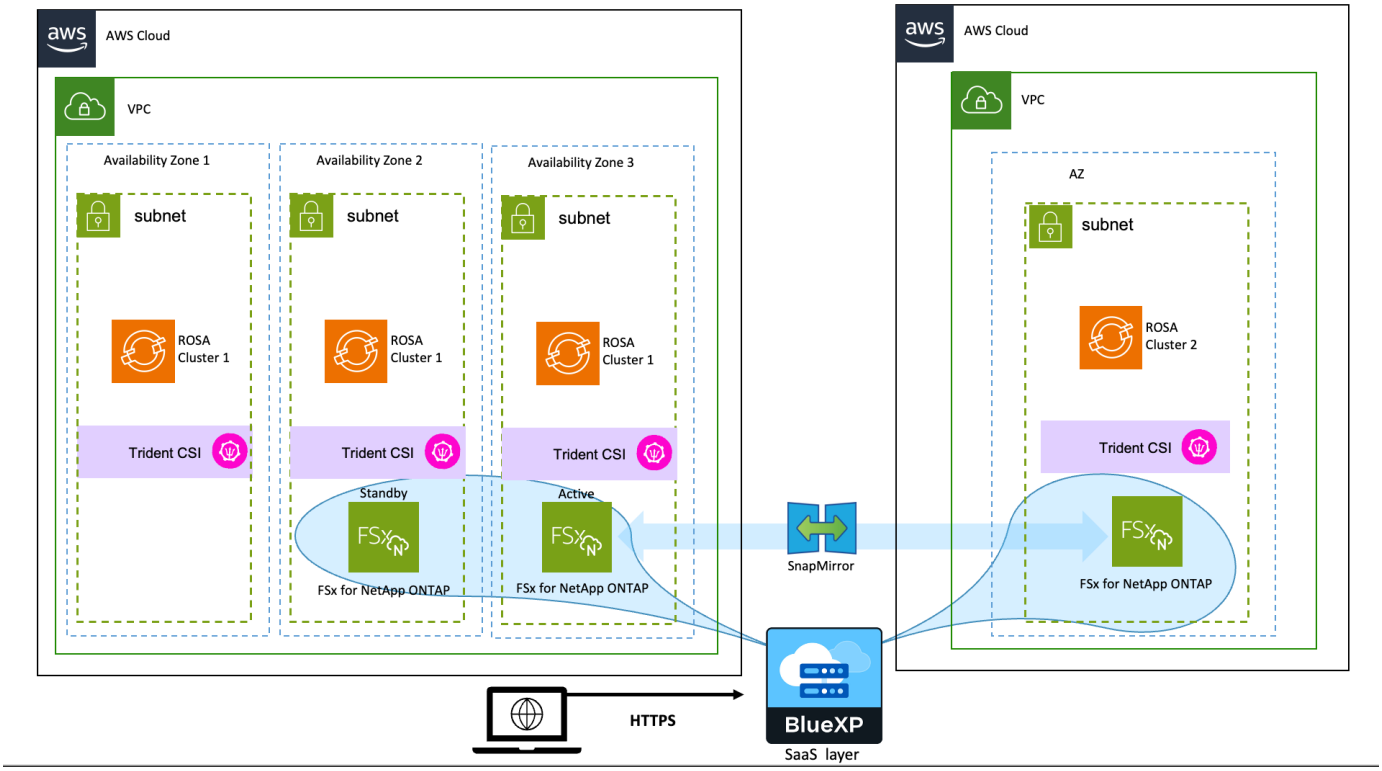
- Core Block based datastores (FC, FCoE, iSCSI, NVMeoF)
- Core File based datastores (NFS v3, v4)
- vVol datastores (block and file)

Trident has following drivers to support ONTAP

- ontap-san (dedicated volume)
- ontap-san-economy (shared volume)
- ontap-nas (dedicated volume)
- ontap-nas-economy (shared volume)
- ontap-nas-flexgroup (dedicated large scale volume)

For both VMware CSI and Astra Trident CSI, ONTAP supports nconnect, session trunking, kerberos, etc. for NFS and multipathing, chap authentication, etc. for block protocols.

In AWS, FSx for NetApp ONTAP (FSxN) can be deployed in single Availability Zone (AZ) or in Multi AZ. For production workloads that requires high availability, multi-AZ provides zonal level fault tolerance and has better NVMe read cache compared to single AZ. For more info, check AWS performance guidelines.
To save cost on disaster recovery site, single AZ FSx ONTAP can be utilized.



For number of SVMs that are supported by FSx ONTAP, refer managing FSx ONTAP storage virtual machine

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