

# Kubernetes Volume Options for VMware vSphere

Hitachi Vantara and Hitachi Ltd.,

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# Overview

This document introduces three different options on how to provision Kubernetes Persistent Volumes in VMware vSphere environment when Hitachi Virtual Storage Platform is used as storage.

Intended audience of this document is IT administrators, system architects, consultants, and sales engineers to assist in planning, designing, and implementing Hitachi storage with container solutions.

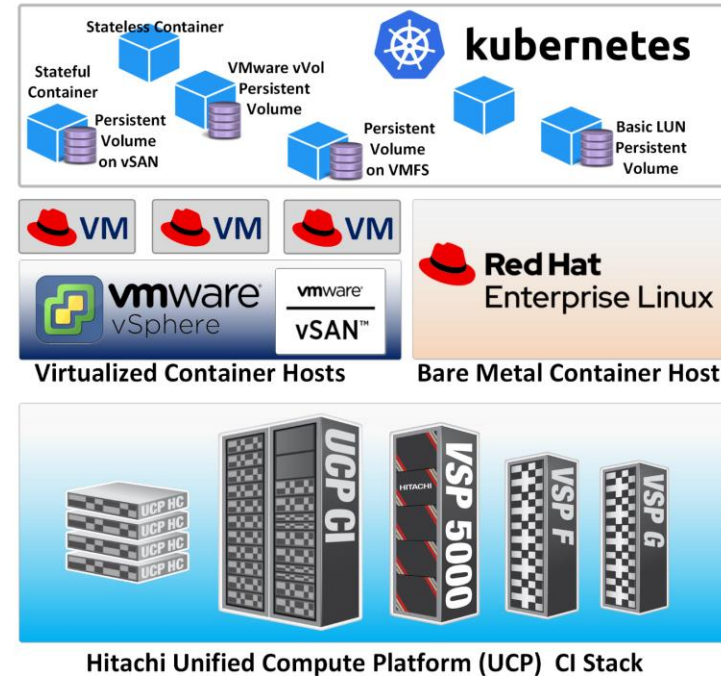
# Table of Contents

#	Title	Content
1	Use case summary	Describes brief summary of the use case for using Kubernetes on VMware vSphere.
2	Architecture	Architecture of each volume provisioning option.
3	Which Option to Choose	Comparison of the volume provisioning options.
4	Using Volume Features	Summary of features available with the volume provisioning options.
5	Best Practices	Describes step by step best practices for the use case.
6	Conclusion	Summary of the use case and best practice described in this document.
-	Related Links	Links to the related articles for reference.

# 1. Use case summary

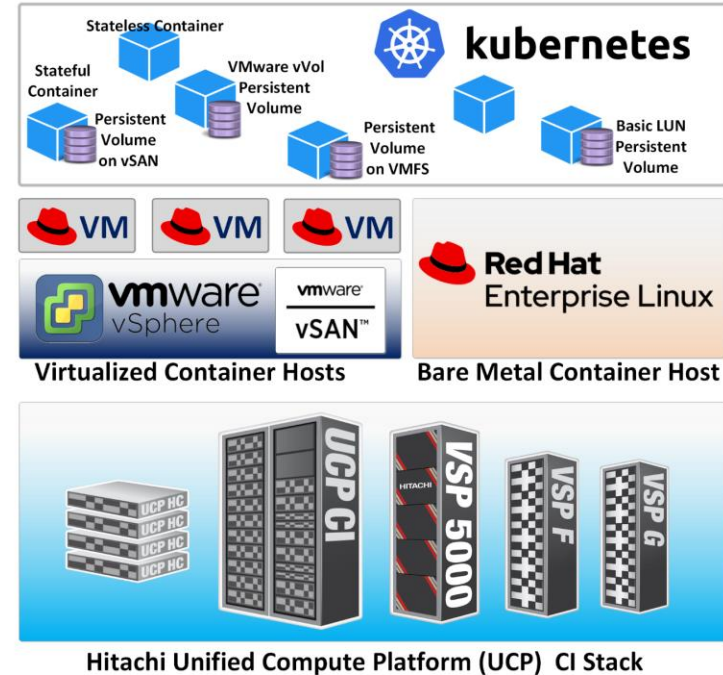
Kubernetes can be deployed on both bare metal hosts or virtual hosts. Depending on the deployment purposes and wide range of personas involved, different deployments can be used.

In an all virtualized deployment, Kubernetes master controller nodes and worker nodes are all deployed on RHEL VM hosted on VMware vSphere hosts. A virtualized Kubernetes deployment is highly flexible and dynamic. Due to vSphere's ability to deploy VMs quickly, new virtual worker nodes can be added to the Kubernetes cluster quickly.



# 1. Use case summary

No physical deployment in the datacenter is required to have a functional Kubernetes node. A new set of RHEL VMs can also be deployed quickly to deploy another Kubernetes cluster if there's a need to separate Kubernetes tenants into their own cluster. VMware vSphere can also help consolidate the Kubernetes nodes, reducing the rack space footprint. VMware's CPU scheduling ability and memory overcommit can further consolidate nodes. VMware's HA/DRS can also help protect the Kubernetes nodes and enforce the SLA.



## 2. Architecture

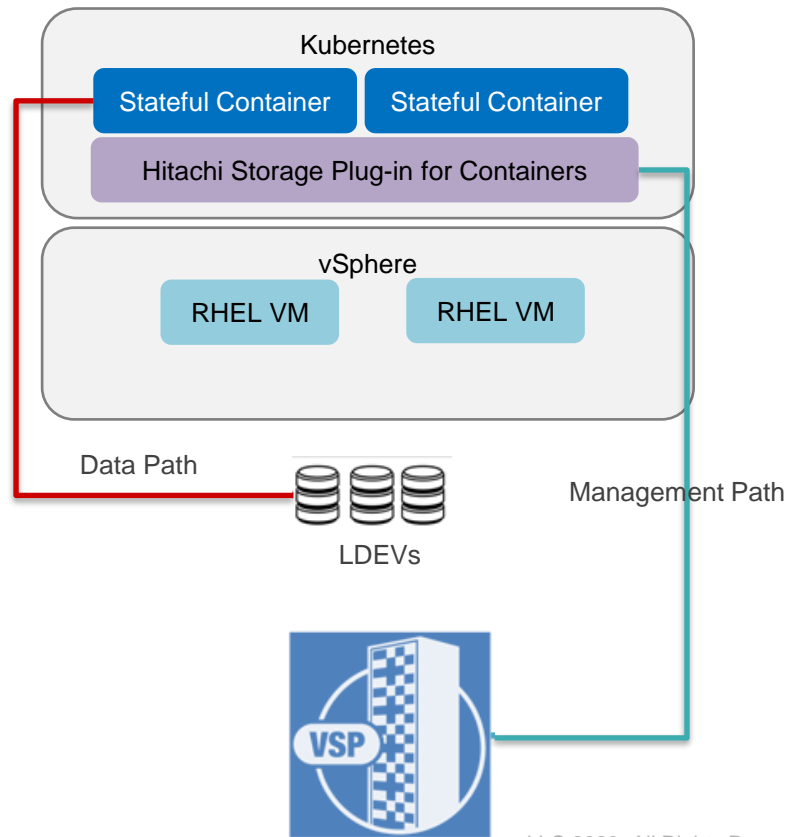
Virtualized RHEL container hosts (VMs) run in VMware vSphere environment. Kubernetes master controller nodes and the worker nodes are running on vSphere ESXi hosts. The following persistent volume options are available for this configuration:

- ☐ Use Hitachi Storage Plug-in for Containers (HSPC) to provision persistent volumes (PVs) directly from Hitachi storage.
- ☐ Use VMware Virtual Volumes (vVols) to provision persistent volumes directly from Hitachi storage.
- ☐ Create persistent volumes from regular VMFS datastores.

# HSPC Volume

Hitachi VSP provides a REST API for Hitachi Storage Plug-in for Containers (HSPC) to provision persistent volumes. HSPC is deployed within the Kubernetes cluster in the respective master controller nodes and worker nodes. Containers can access the persistent volumes through a local point inside the worker node VM.

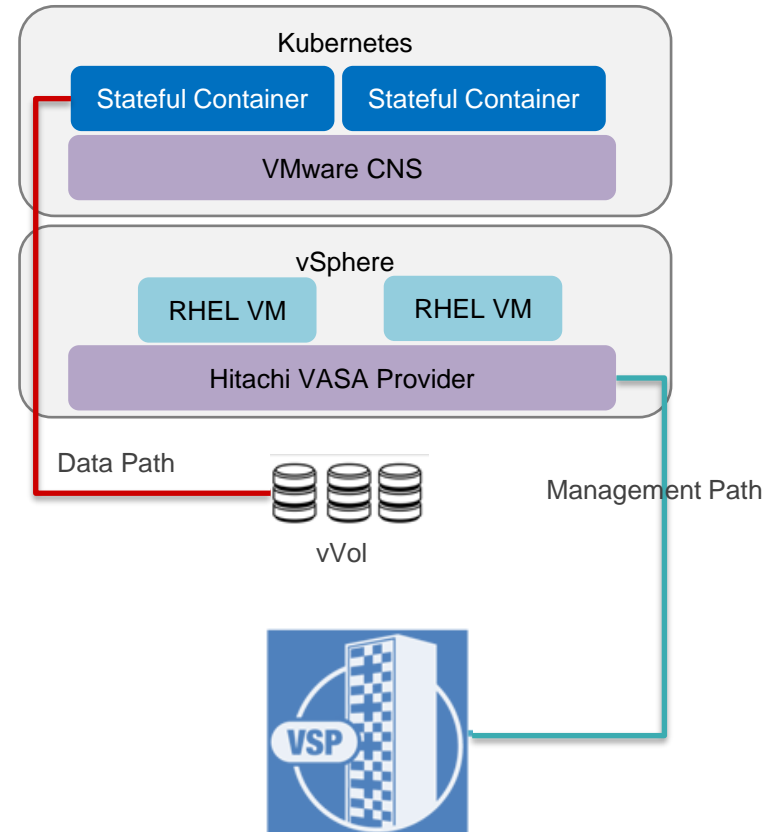
The persistent volumes are provided by Hitachi VSP LDEVs/LUNs through block protocol to the worker node VMs.



# vVol

Hitachi VASA Provider for VMware vCenter provides Hitachi VSP storage capabilities awareness to VMware vCenter where it can be used with VMware Storage Policy Based Management (SPBM). VMware Cloud Native Storage (CNS) provides the persistent storage provisioning capabilities utilizing the VMware storage stack.

Containers can access the persistent volumes through a local point inside the worker node VMs.



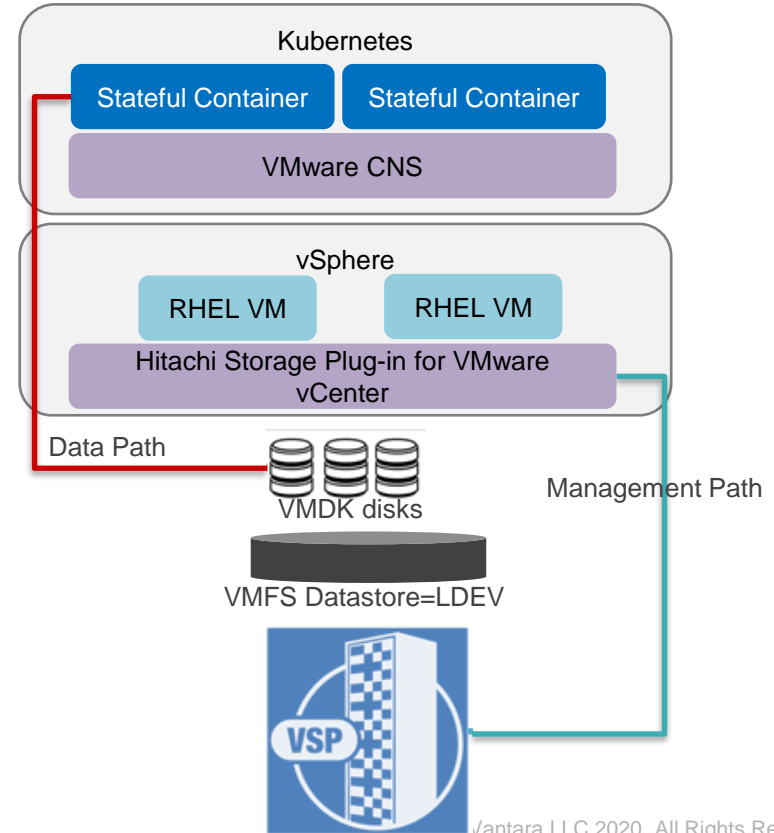


# VMFS

Hitachi Storage Plug-in for VMware vCenter (vCenter Plug-in) provisions VMFS datastore.

VMware Cloud Native Storage (CNS) provisions persistent volumes (VMDK disks) on the VMFS datastore, utilizing the VMware storage stack.

The VMFS datastores are provided by Hitachi VSP LDEVs/LUNs through block protocol to the worker node VMs.



### 3. Which Option to Choose

#### HSPC Volume

- Values
  - Good to use when containers are running on a VM + bare metal mixed environment.
  - Users can migrate containers between bare metal and VM nodes without doing any volume operations.
- Notes
  - Can be used only with iSCSI on virtualized worker nodes. (HSPC supports FC/iSCSI. However, FC is not supported for VMware VM environment.)

#### vVol

- Values
  - Good to use when users prefer to use SPBM function.
    - Users can choose volumes based on storage policies defined in VASA.
- Notes
  - Architecture requires additional initial configuration and involvement with operation team.

#### VMFS

- Values
  - Good to use when users are running mix of containers and traditional apps (non-containers) in the same vSphere environment.
    - Users can re-mount volumes between containers and non-containers.
- Notes
  - Less granularity. Storage functions can only be used per datastore.

# Comparison

Below is a Provisioning Capability Overview for each provisioning option.

	HSPC Volume	vVol	VMFS
Clone/Snapshot	Tech Preview (via CSI)	To be Supported (via CSI / vSphere vVol management)*	To be Supported (via CSI / vSphere VMDK management)*
Online Expansion	Tech Preview (via CSI)	Not supported (via CSI)	Not supported (via CSI)
Storage Policy Based Management	Via Storage Class	Via VMware SPBM	Via VMware SPBM
Scalability	Good 256 vols/VM	Good 256 vols/VM	Good 256 vols/VM
Interoperability	Good FC + iSCSI (iSCSI only for vSphere nodes)	Good FC + iSCSI	Good FC + iSCSI

\*Best practice procedure to be addressed in future whitepaper.

For support schedule, contact VMware.

<https://blogs.vmware.com/virtualblocks/2020/06/17/using-vvols-with-cns/>

## 4. Using Volume Features

HSPC provides tech-preview of CSI features (clone/snapshot/expansion). Users can manage PVs from kubectl.

CNS supports CSI for provisioning volumes. However, it does not implement various CSI features yet (except for Offline Volume Expansion). Users need to manage the underlying volumes (vVol/VMDK) from vSphere interface.

PVs created by HSPC and CNS-vVol are equivalent to LDEVs on Hitachi storage, and volume operations are off-loaded to the backend storage. This allows users to gain the performance and functionality of enterprise storage in container environment.

PVs created by CNS-VMFS are VMDKs running on VMFS datastore. The volume operations are handled by vSphere.

\* As of December, 2020.

## Setting up environment for HSPC

The following describes the prerequisites for using HSPC.

1. Enable VSP Program Product Licenses (P.P.)
  - Hitachi Dynamic Provisioning Software (HDP)
  - [Hitachi Thin Image Software \(HTI\)](#)

2. Install HSPC

For installation method, refer to the section “Install Storage Plug-in for Containers for Kubernetes CSI” in HSPC's Quick Reference Guide from [Containers - Hitachi Vantara Knowledge](#).

[Note] StorageClass and Secret needs to be configured, respectively.

# Prerequisite

## Setting up environment for vVol

The following describes the prerequisites for using vVol.

1. Install Hitachi VASA Provider (Storage Provider for VMware vCenter)  
In order to use VMware vVol with Hitachi storage, Hitachi Storage Provider for VMware vCenter needs to be installed. The deployment guide can be found at the following link:  
[Storage Provider for VMware vCenter \(VASA\)](#)
2. Setup virtualized Kubernetes cluster with VMware Cloud Native Storage  
See the following link for procedures:  
[About Getting Started with VMware Cloud Native Storage](#)  
[Deploying a Kubernetes Cluster on vSphere with CSI and CPI](#)

# 5. Best Practices

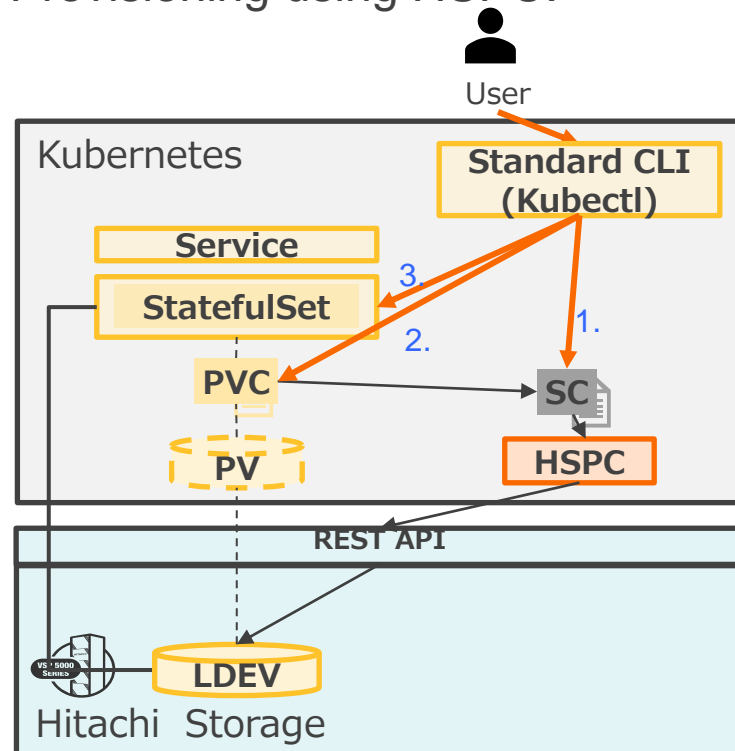
## Volume Provisioning with HSPC

Below is the overview of best practices for Volume Provisioning using HSPC.

The procedure below are all done through Kubectl.

1. Create Storage Class using YAML file.
2. Create a Persistent Volume Claim (PVC).
3. Create a StatefulSet using the PVC.

For details, refer to [Deploy WordPress and MySQL in Kubernetes using HSPC](#)



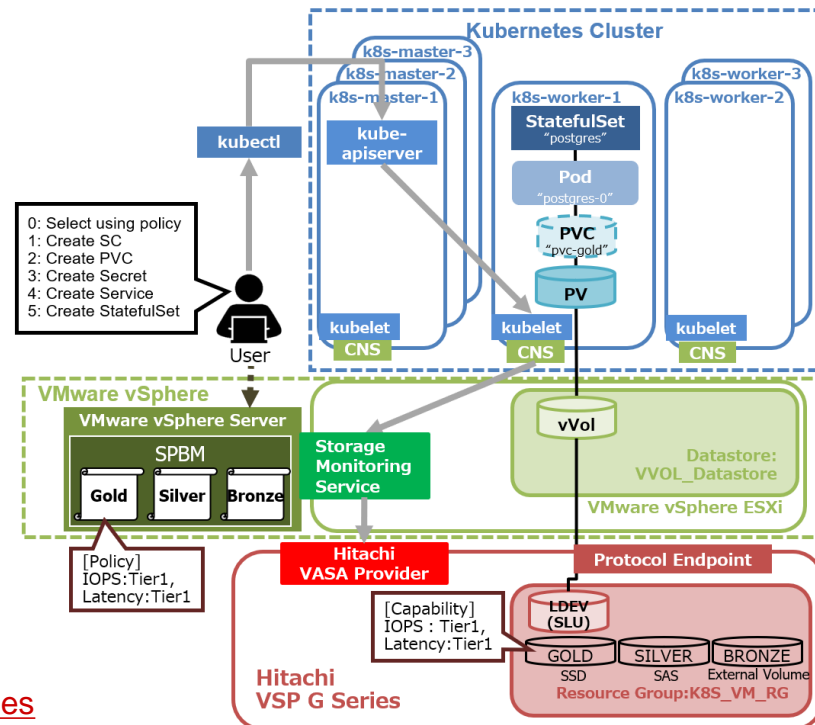
# 5. Best Practices

## Volume Provisioning with vVol

Below is the overview of best practices for Volume Provisioning using vVol.

\*The user interface used is indicated in square brackets “[]”.

1. [Hitachi VASA Provider] Add the storage pools to VASA.
2. [vCenter] Create VM Storage Policies.
3. [Kubectl] Create Storage Class using YAML file, referring to the VM Storage Policies.
4. [Kubectl] Create a Persistent Volume Claim (PVC).
5. [Kubectl] Create a StatefulSet using the PVC.



For details, refer to [Deployment Options for Kubernetes Container Applications on Unified Compute Platform CI with Hitachi VSP Series](#)



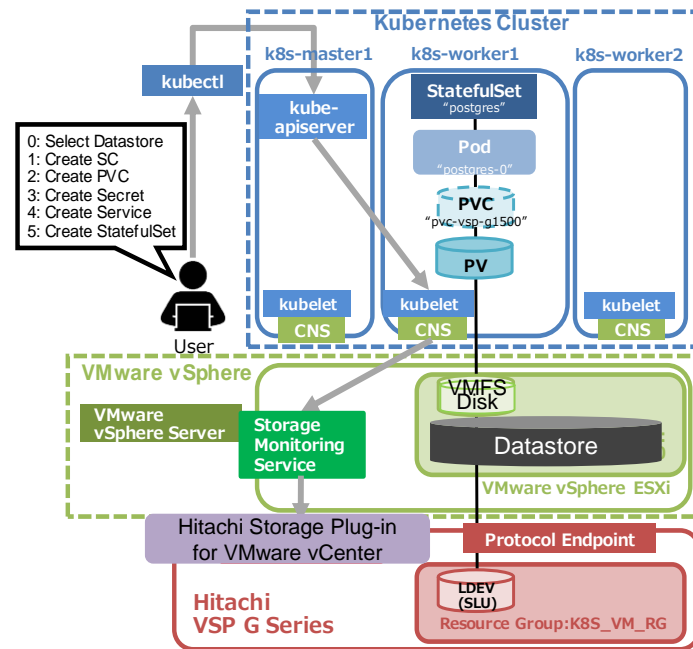
# 5. Best Practices

## Volume Provisioning with VMFS

Below is the overview of best practices for Volume Provisioning using VMFS.

1. [vCenter Plug-in] Create a VMFS datastore from LDEV.
2. [vCenter] Create a tag-based VM Storage Policy.
3. [Kubectl] Create Storage Class using YAML file, referring to the VM Storage Policy.
4. [Kubectl] Create a Persistent Volume Claim (PVC).
5. [Kubectl] Create a StatefulSet using the PVC.

For details, refer to [Deployment Options for Kubernetes Container Applications on Unified Compute Platform CI with Hitachi VSP Series](#)



# 5. Best Practices

## Volume Cloning/Snapshot with HSPC

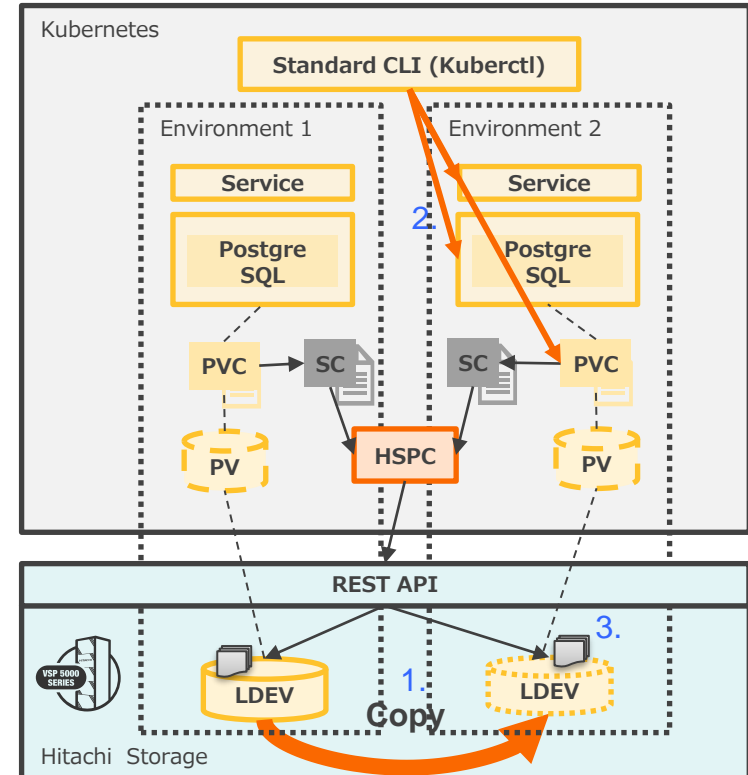
Below is the overview of best practices for Volume Cloning/Snapshot using HSPC.

1. [Kubectl] Create clone volume.
2. [Kubectl] Deploy application StatefulSet with the cloned Persistent Volume (PV) attached.
3. [psql] Check that the data is copied to the target application environment.

For details, refer to:

[Kubernetes Volume Clone using HSPC](#)

[Kubernetes Volume Snapshot using HSPC](#)



# 5. Best Practices

## Online Volume Expansion with HSPC

Below is the overview of best practices for Volume Expansion using HSPC.

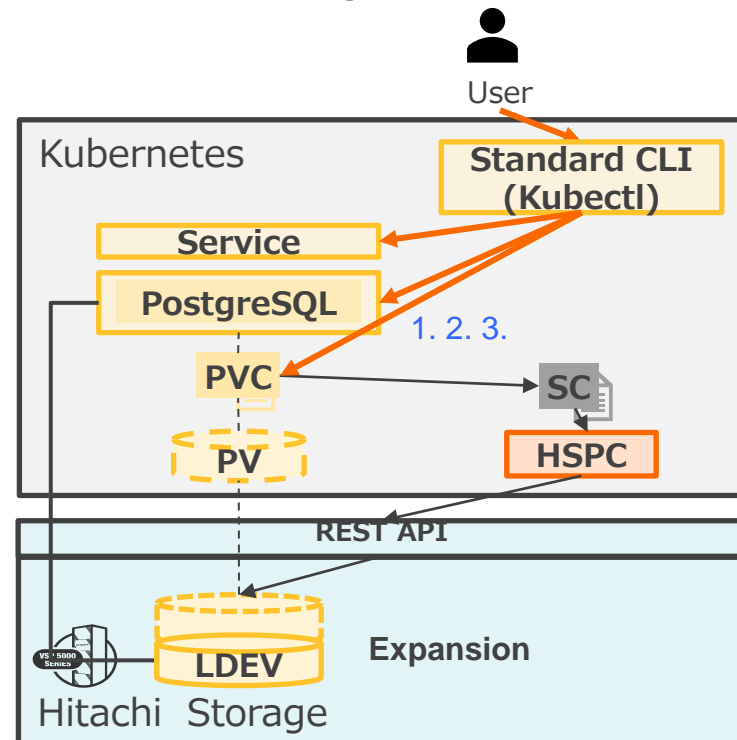
HSPC supports both “Online expansion” and “Offline expansion”.

The procedure below are all done through Kubectl.

1. Check the size of PVC and filesystem.
2. Change the size of PVC.
3. Check the size of PVC and filesystem.

For details, refer to:

[Kubernetes CSI Volume Expansion using HSPC](#)



## 6. Conclusion

In this document, you have learned three different options on how to provision Kubernetes Persistent Volumes in VMware vSphere environment when Hitachi Virtual Storage Platform is used as storage.

HSPC is simple and easy to use from Kubernetes, while vVol and VMFS are suited for using vSphere features.

- [Deployment Options for Kubernetes Container Applications on Unified Compute Platform CI with Hitachi VSP Series](#)
- [Deployment Options for Red Hat OpenShift on Hitachi Unified Compute Platform CI with Hitachi Virtual Storage Platform Family](#)
- [Container Storage Interface \(CSI\) Driver for Hitachi Virtual Storage Platform Series](#)
- [Deploy WordPress and MySQL in Kubernetes using HSPC](#)
- [Kubernetes Volume Clone using HSPC](#)
- [Kubernetes CSI Volume Expansion using HSPC](#)
- [Kubernetes Raw Block Volume using HSPC](#)
- [Kubernetes Volume Snapshot using HSPC](#)
- [Storage Provider for VMware vCenter \(VASA\)](#)

# Thank You

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