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Optimize Hitachi Storage and Compute Platforms in VMware vSphere Environments

Best Practices Guide

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Feedback

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Revision History

Revision	Changes	Date
MK-SL-145-00	Initial release	March 26, 2019
MK-SL-145-01	Updates for new Hitachi Virtual Storage Platform models and new software	May 8, 2020
MK-SL-145-02	Updated with latest storage models/capabilities, vSphere 7, and added helpful blog references	May 15, 2020
MK-SL-145-03	Updated with latest storage models/capabilities, Ops Center naming changes, and other support updates	November, 2021

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Best Practices Guide

Hitachi Vantara LLC, a subsidiary of Hitachi, Ltd., provides various datacenter infrastructure components to enable IT environments to support a VMware ecosystem. This includes midrange and enterprise storage, converged, and hyperconverged infrastructure as well as a suite of software and software integrations to enable a robust automated operational environment.

This document outlines most of the best practices to implement in a VMware server virtualization, desktop, or cloud environment with Hitachi storage or a converged Hitachi Unified Compute Platform (UCP). This includes the associated software integrations into various VMware vCenter and vRealize management stacks. These aid in building a VMware environment that provides the performance, scalability, reliability, usability, resilience, and recoverability expected when paired with Hitachi products.

Hitachi is an Elite Partner in VMware's Technology Alliance Partner program, a participant in VMware Ready Partner programs for Storage Infrastructure Services, and a Global OEM partner. Together, Hitachi and VMware are committed to providing innovative, business-enabling technology, with end-to-end virtualization solutions for the datacenter.

These best practices cover the Hitachi storage and converged products listed in Table 1, "Hitachi Storage and Converged Systems," on page 2.

TABLE 1. HITACHI STORAGE AND CONVERGED SYSTEMS

Hardware	Product
Storage	Hitachi Virtual Storage Platform (VSP) 5000 series ▪ Virtual Storage Platform 5200 , 5600 ▪ Virtual Storage Platform 5100 , 5500 Hitachi Virtual Storage Platform E series ▪ Virtual Storage Platform E590, E790, E990 Hitachi Virtual Storage Platform F series ▪ Virtual Storage Platform F1500 ▪ Virtual Storage Platform F900, F900, F700, F370, F350 Hitachi Virtual Storage Platform G series ▪ Virtual Storage Platform G1500 ▪ Virtual Storage Platform G900, G700, G370, G350
Hyper Converged and Converged Systems	Hitachi Unified Compute Platform HC Hitachi Unified Compute Platform CI Hitachi Unified Compute Platform RS Cisco and Hitachi Adaptive Solutions for Converged Infrastructure Cisco and Hitachi Adaptive Solutions for SAP HANA Tailored Data Center Integration

Some of the Hitachi software products covered by these best practices are listed in Table 2, "Hitachi Software, Plugin, and Adapter Products," on page 3.

TABLE 2. HITACHI SOFTWARE, PLUGIN, AND ADAPTER PRODUCTS

Software	Product
Hitachi Adapters, Plugins and software for VMware Ecosystem	Hitachi Storage Provider for VMware vCenter (VASA) Hitachi Infrastructure Management Pack for VMware vRealize Operations (vROPS) Hitachi Storage Connector for VMware vRealize Orchestrator (vRO) Hitachi Storage Content Pack for VMware vRealize Log Insight (vRLI) Hitachi Storage Plug-in for VMware vCenter (vCenter) Hitachi Infrastructure Adapter for Windows PowerShell (PowerCLI) Hitachi Storage Replication Adapter (SRA) Ops Center Protector Adapter for VMware Site Recovery Manager (SRA) Ops Center Protector Connector for VMware vRealize Orchestrator (vRO) Hitachi Unified Compute Platform Advisor (UCP Advisor)
Hitachi Storage Software	Hitachi Storage Virtualization Operating System RF (SVOS RF): ▪ Hitachi Dynamic Provisioning (HDP) ▪ Hitachi Dynamic Tiering (HDT) ▪ Hitachi Thin Image (HTI) ▪ Hitachi ShadowImage ▪ Hitachi TrueCopy ▪ Hitachi Universal Replicator (HUR) ▪ Global-active device on Virtual Storage Platform ▪ Remote replication extended (for 3DC scenarios) ▪ Hitachi Ops Center Analyzer (formerly Hitachi Infrastructure Analytics Advisor) ▪ Hitachi Ops Center Automator (formerly Hitachi Automation Director) ▪ Hitachi Ops Center Protector (formerly Hitachi Data Instance Director

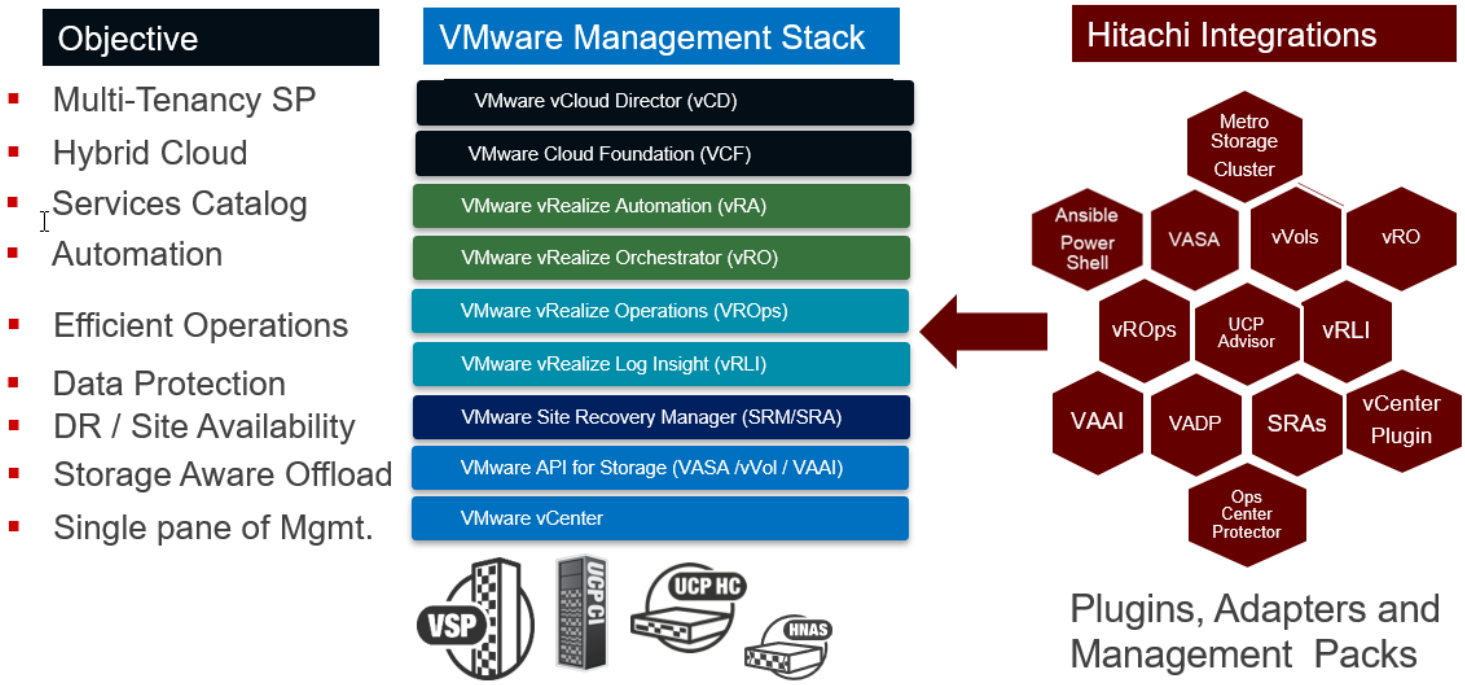
Note – Testing to develop these best practices was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

Hitachi Ecosystem Adapters for VMware Environments

The suite of Hitachi ecosystem adapters for VMware environments enables you to provision, manage, monitor, and operate Hitachi infrastructure within the single pane of glass experience provided by the VMware management stack. It is a best practice to leverage these integrations to simplify, automate and efficiently operate VMware virtualization or cloud environments that leverage Hitachi storage and Hitachi converged solutions.

Documentation on all of these Hitachi and VMware software integrations available on this VMware page from Hitachi Vantara Support. Download the integrations from VMware Adapters on Hitachi Vantara Support (user credentials required) or Hitachi Vantara on the VMware Solution Exchange (no credentials required).

The following figure illustrates enabling Native Cloud Management Experience.



A short summary of these integrations follows.

Hitachi Storage Provider for VMware vCenter (VASA and vVols)

Use Hitachi Storage Provider for VMware vCenter to enable storage-aware tagging services for VMFS and/or enable VMware vSphere Virtual Volumes (vVols) for a software-defined hardware-enabled Hitachi storage infrastructure. This enables efficient provisioning and usage of storage and VMDK resources based on application-specific data services, such as snapshot, encryption, replication, and so forth. Ultimately, reduce the operational burden shared by the virtual infrastructure administrator and the storage administrator with this storage provider.

For more information, see VMware vSphere Virtual Volumes (vVols) with Hitachi Virtual Storage Platform Quick Start and Reference Guide.

Hitachi Infrastructure Management Pack for VMware vRealize Operations

Hitachi Infrastructure Management Pack for VMware vRealize Operations (vROPS) (formerly Hitachi Storage Management Pack for VMware vRealize Operations) integrates metrics and alerts from physical and virtual layers to help you manage the health, capacity and performance of your Hitachi storage or converged infrastructure deployments in VMware environments. It significantly enables efficient resource utilization and proactive troubleshooting to reduce operational costs leveraging the provided dashboards, metrics, and correlated alerts. For more information, see the Infrastructure Management Pack for VMware vRealize Operations user guide.

Hitachi Storage Connector for VMware vRealize Orchestrator

Automate and orchestrate various workflow tasks on Hitachi storage supporting both block and file. Extend the capabilities of VMware vRealize Orchestrator with Hitachi Infrastructure Connector for VMware vRealize (formerly Storage Connector for VMware vRealize Orchestrator) by providing access to over 130 foundational Hitachi storage-specific workflows. For more information, see Storage Connector for VMware vRealize Orchestrator.

Hitachi Storage Content Pack for VMware vRealize Log Insight

Hitachi Infrastructure Content Pack for VMware vRealize Log Insight (formerly Storage Content Pack for VMware vRealize) delivers real-time log analysis and better troubleshooting across physical and virtual infrastructures. It simplifies searching for errors by collecting and grouping information to show important, relevant, and useful events. You are provided a comprehensive view into Hitachi storage systems, enabling spotting potential issues and keeping track of components that show departure from normal operations. For more information, see Hitachi Storage Content Pack for VMware vRealize Log Insight.

Hitachi Storage Plug-in for VMware vCenter

Using Hitachi Storage Plug-in for VMware vCenter integrates management of Hitachi Storage systems within the VMware vCenter console. This allows your VMware vCenter administrator to provision and manage datastores with essential configuration options from Hitachi Storage systems. Use this plug-in to provide visibility into mapping of datastores to Hitachi storage system resources. For more information, Hitachi Storage Plug-in for VMWare vCenter.

Hitachi Infrastructure Adapter for Microsoft Windows PowerShell

Hitachi Infrastructure Adapter for Microsoft Windows PowerShell provides an extensive range of cmdlets to automate many storage resource and data services options. Admins can use these cmdlets as part of PowerShell experience. For more information, see Storage Adapter for Microsoft Windows PowerShell.

Hitachi Storage Replication Adapter for VMware Site Recovery Manager

VMware vCenter Site Recovery Manager automates the disaster recovery and testing process using either host or storage-based replication. Hitachi Storage Replication Adapter (SRA) is the software interface that integrates Hitachi Storage systems and its replication software with VMware vCenter SRM processes. Used together, VMware vCenter SRM and Hitachi Storage and software provide an automated and seamless disaster recovery solution within the VMware vCenter infrastructure. See Block Storage Replication Adapter for VMware vCenter Site Recovery Manager.

Ops Center Protector Adapter for VMware Site Recovery Manager

Hitachi Data Instance Director Adapter for VMware Site Recover Manager provides a higher level of automation for configuration of local and remote replication relationships between primary and secondary systems. This adapter is like the adapter referenced above. This adapter is compatible with Hitachi Ops Center Protector environments that manage all the pausing, swapping, and resuming of the associated replication pairs that VMware vCenter Site Recovery Manager may require. Deploy this adapter independently from the adapter referenced above. For more information, see Data Instance Director Adapter for VMware Site Recovery Manager.

Ops Center Protector Connector for VMware vRealize Orchestrator

Hitachi Data Instance Director Connector for VMware vRealize Orchestrator enables you to include Hitachi Ops Center Protector storage hardware offload-based services such as virtual machine level backup, restore, and copy data management functionality in their vRealize Orchestrator workflows. The workflows currently supported include backup and restore of virtual machines, clone virtual machines from prior snapshots, and mount VMDKs from snapshots to any virtual machines. These vRealize Orchestrator operations can be performed from the VMware vCenter user interface using the packaged XML imported into vCenter. For more information, see Data Instance Director Connector for VMWare vRealize Orchestrator.

Hitachi United Compute Platform Advisor

Hitachi Unified Compute Platform Advisor (UCP Advisor) brings simplified IT administration to virtualized, converged, and hyperconverged systems from Hitachi. Unified Compute Platform Advisor supports guided life-cycle management to the server, network, and storage elements within supported Unified Compute Platform systems.

Unified Compute Platform Advisor is used to discover and provision servers initially, and later to manage the compute nodes:

- Identify Unified Compute Platform servers for remote management.
- Provision servers.
- Image the custom BIOS settings on the server
- Install the operating system.
- Upgrade the installed firmware,
- Power cycle a compute node remotely.
- Launch a remote console for a server.
- Provides remote access to general system information.

VMware vSphere Storage APIs – Array Integration

VMware vSphere Storage APIs – Array Integration (VAAI) allow VMware vSphere environments to use advanced features of Hitachi storage arrays. Using vSphere Storage APIs provide a way to use those advanced storage capabilities from within the VMware interface. Processing is directly on the storage infrastructure.

These performance enhancements move the I/O load from the dependent VMware vCenter host platform into the storage controller. By offloading storage related operations off to the storage subsystem, it speeds up the datastore and VMDK provisioning operations. This frees virtualization management for more critical tasks.

When used with VMware vSphere 5.x, 6.x, and 7.x, Hitachi storage supports the following API primitives:

- **Full copy** – This primitive enables the storage system to make full copies of data within the storage system without having the VMware ESXi host read and write the data.
- **Block zeroing** – This primitive enables storage systems to zero out many blocks to speed provisioning of virtual machines.

- **Hardware-assisted locking** – This primitive provides an alternative means to protect the metadata for VMFS cluster file systems, thereby improving the scalability of large VMware ESXi host farms sharing a datastore.
- **Thin provisioning stun** – This primitive enables the storage system to notify the VMware ESXi host when thin provisioned volumes reach certain capacity utilization threshold. When enabled, this allows the ESXi host to take preventive measures to maintain virtual machine integrity.
- **UNMAP** – This primitive enables a VMware ESXi host to inform the Hitachi storage array that space can be reclaimed that previously had been occupied by a virtual machine that has been migrated to another datastore or deleted.

Hitachi SAN and VMware Configuration Best Practices

A well-designed SAN must be reliable and scalable and recover quickly in the event of a single device failure. Also, a well-designed SAN grows easily as the demands of the infrastructure that it serves increases. The focus of this best practice guide is on environments that leverage SAN-based datastores. If you use Hitachi NFS datastores, consult Hitachi NAS Platform Best Practices Guide for NFS with VMware vSphere (MK-92HNAS028-01 or later, PDF).

Hitachi storage uses Hitachi Storage Virtualization Operating System RF (SVOS RF). Find general documents in Storage Virtualization Operating System covering volume management, security replication. Following are specific advice for VMware environments using Storage Virtualization Operating System. This guide covers VMware vSphere 6.x and 7.0 environments at time of publication.

Virtual Volumes (vVols)

Virtual Volumes (vVols) covered in detail in "Hitachi Storage (VASA) Provider Enabling Virtual Volumes (vVols)" on page 12. Follow the guidance covered in VMware vSphere Virtual Volumes (vVols) with Hitachi Virtual Storage Platform Quick Start and Reference Guide.

LUN and Datastore Provisioning Best Practices

These are best practices for general VMFS provisioning. Hitachi recommends that you always use the latest VMFS version. Always separate the VMware cluster workload from other workloads.

LUN Size

The following lists the current maximum LUN/datastore size for VMware vSphere and Hitachi Storage:

- The maximum LUN size for VMware vSphere 6.x or 7.x is 64 TB.
- The maximum LUN size for Hitachi Virtual Storage Platform F series or VSP G series is 256 TB with replication.
- The LUN must be within a dynamic provisioning pool.
- The maximum VMDK size is 62 TB (vVol-VMDK or RDM)

Using multiple smaller sized LUNs tend to provide higher aggregated I/O performance by reducing the concentration of a storage processor (MPB). It also reduces the recovery time in the event of a disaster. Take these points into consideration if using with larger LUNs. In some environments, the convenience of using larger LUNs might outweigh the relatively minor performance disadvantage.

Prior to Hitachi Virtual Storage Platform E series, VSP F series, and VSP G series systems, the maximum supported LUN size was limited to 4 TB because of storage replication capability. With current Hitachi Virtual Storage Platform, this limitation has been removed. Keep in mind that recovery is typically quicker with smaller LUNs. So, use the appropriate size that maximizes usage of MPB resources per LUN for workload. Use the VMware integrated adapters or plugins Hitachi Vantara provides, such as vSphere Plugin, Microsoft PowerShell cmdlets or VMware vRealize Orchestrator workflows to automate datastore and LUN management.

Thin-Provisioned VMDKs on a Thin-Provisioned LUNs from Dynamic ProvisioningPool

Thin provisioned VMDKs on thin provisioned LUNs have become a common storage provisioning configuration for virtualized environments. While EagerZeroThick VMDKs have typically seen better latency performance in older vSphere releases (that is, releases older than vSphere 5), the performance gap between thin VMDK and thick VMDK is now insignificant and you get added benefits with in-guest UNMAP for better space efficiency with thin. In vVols, thin provisioned VMDK (vVol) is the norm and it performs even better than thin VMDK on VMFS as no zeroing is required when allocating blocks (Thin vVols are the new EZT !). Generally, start with thin VMDK on VMFS or vVols datastores. The only exception where you might consider migrating to EZT disks is if you have performance sensitive heavy write VM/container workloads where you can potentially see low single digit % performance improvement for those initial writes that might not be noticeable to your app.

In the VSP storage array with Hitachi Dynamic Provisioning, it is also quite common to provision thin LUNs with less physical storage capacity (as opposed to fully allocated LUNs) However, monitor storage usage closely to avoid running out of physical storage capacity. The following are some storage management and monitoring recommendations:

- Hitachi Infrastructure Management Pack for VMware vRealize Operations provides dashboards and alerting capability for monitoring physical and logical storage capacity
- Enable automatic UNMAP with VMFS 6 (scripted UNMAP command with VMFS 5) to maintain higher capacity efficiency

RDMs and Command Devices

If presenting command devices as RDMs to virtual machines, ensure command devices have all attributes set before presenting it to VMware ESXi hosts.

LUN Distribution

The general recommendation is to distribute LUNs and workloads so that each host has 2-8 paths to each LDEV. This prevents workload pressure on a small set target ports to become a potential performance bottleneck.

It is prudent to isolate production, and critical systems to dedicated ports to avoid contention from other hosts workloads. However, presenting the same LUN to too many target ports could also introduce additional problems with slower error recovery.

Follow the practice below while try to achieve this goal.

- Each host bus adapter physical port (HBA) should only see one instance of each LUN
- The number of paths should typically not exceed the number of HBA ports for better reliability and recovery
- Two to four paths to each LUN provides the optimal performance for most workload environments
- See Recommended Multipath Settings for Hitachi Storage knowledge base article for more information about LUN instances.

HBA LUN Queue Depth

In a general VMware environment, increasing the HBA LUN queue depth will not solve a storage I/O performance issue. It may overload the storage processors on your storage systems. Hitachi recommends keeping queue depth values to the HBA vendor's default in most cases. See this VMware's KB article for more details.

In certain circumstances, increasing the queue depth value may increase overall I/O throughput. For example, a LUN hosting as a target for virtual machine backups might require higher throughput during the backup window. Make sure to monitor storage processor usage carefully for queue depth changes.

Slower hosts with read-intensive workloads may request more data than they can remove from the fabric in a timely manner. Lowering queue depth value can be an effective control mechanism to limit slower hosts.

For a VMware vSphere protocol endpoint (PE) configured to enable virtual volumes (vVols) from Hitachi storage, set a higher queue depth value, such as 128.

Host Group and Host Mode Options

To grant a host access to an LDEV, assign a logical unit number (LUN) within a host group. These are the settings and LUN mapping for host group configurations.

Fibre Channel Port Options

If connecting a Fibre Channel port using a SAN switch or director, you must change the following settings:

- **Port security** – Set the port security to **Enable**. This allows multiple host groups on the Fibre Channel port.
- **Fabric** – Set fabric to **ON**. This allows connection to a Fibre Channel switch or director.
- **Connection Type** – Set the connection type to **P-to-P**. This allows a point-to-point connection to a Fibre Channel switch or director. **Loop Attachment** is deprecated and no longer supported on 16 Gb/s and 32 Gb/s storage channel ports.

Hitachi recommends that you apply the same configuration to a port in cluster 1 as to a port in cluster 2 in the same location. For example, if you create a host group for a host on port CL1-A, also create a host group for that host on port CL2-A.

One Host Group per VMware ESXi Host Configuration

If you plan to deploy VMware ESXi hosts, each host's WWN can be in its own host group. This approach provides **granular control** over LUN presentation to ESXi hosts. This is the best practice for SAN boot environments, because ESXi hosts do not have access to other ESXi hosts' boot LUNs. Make sure to reserve LUN ID 0 for boot LUN for easier troubleshooting.

However, in a cluster environment, this approach can be an administrative challenge because keeping track of which WWNs for ESXi hosts are in a cluster can be difficult. When multiple ESXi hosts need to access the same LDEV for clustering purposes, the LDEV must be added to each host group.

One Host Group per Cluster, Cluster Host Configuration

VMware vSphere features such as vMotion, Distributed Resource Scheduler, High Availability, and Fault Tolerance require shared storage across the VMware ESXi hosts. Many of these features require that the same LUNs are presented to all ESXi hosts participating in these cluster functions.

For convenience and where granular control is not essential, create host groups with clustering in mind. Place all the WWNs for the clustered ESXi hosts in a single host group. This ensures that when adding LDEVs to the host group, all ESXi hosts see the same LUNs. This creates consistency with LUN presentation across all hosts.

Host Group Options

On Hitachi Virtual Storage Platform family storage, create host groups using Hitachi Storage Navigator. Change the following host mode and host mode options to enable VMware vSphere Storage APIs for Array Integration (VAAI):

- **Host Mode**
  - 21 [VMware Extension]
- **Host Mode Options**:
  - Enable 54-(VAAI) Support Option for the EXTENDED COPY command (redundancy optional).
  - Enable 63-(VAAI) Support option for vStorage APIs based on T10 standards (This includes extended copy via T10 which is why HMO 54 is now redundant or ignored for all SVOS releases).
  - Enable 114-(Auto-UNMAP) Automatic asynchronous reclamation on ESXi 6.5 or later (vSphere 7.0 U2 and later supports granular unmap greater than 1 MB so this host mode option is no longer needed with that release or higher).

When using VMware Virtual Volumes (vVols) environment on Hitachi storage, use the same options as above plus the following:

- Disable the custom Hitachi VAAI plugin claimrules on ESXi hosts, if present, so that VAAI T10 is exclusively used. Review the quick start guide for vVols, VMware vSphere Virtual Volumes (vVols) with Hitachi Virtual Storage Platform Quick Start and Reference Guide, on how to manage VAAI claimrules on ESXi hosts. This custom plugin claimrules are no longer being used and are being removed from future versions of VMware vSphere.

VMware vSphere Storage APIs Array Integration (VAAI) – Atomic Test and Set (ATS)

A change in the VMFS heartbeat update method was introduced in VMware VMFS 5, and this optimization results in a significant increase in the volume of ATS commands the ESXi kernel issues to the storage system and causes increased load on the storage system. Under certain circumstances, VMFS heartbeat using ATS may fail with false ATS miscompare events. This causes the ESXi kernel to verify again its access to VMFS datastores. This leads to "Lost access to datastore" messages.

The resolution of this issue is implemented in VMFS 6. The following setting is recommended for a VMware vSphere 6.5 environment.

- Set ATS heartbeat **OFF** for vSphere 6.0 or later with VMFS5.
- Keep default ATS heartbeat **ON** for vSphere 6.0 or later with VMFS6 **without** global-active device configured.
- Set ATS heartbeat **OFF** for vSphere 6.0 or later with VMFS6 **with** global-active device configured.

Refer to ESXi host loses connectivity to a VMFS3 and VMFS5 datastore (2113956) for more details and how to turn off ATS.

Zoning

Use zoning to enable access control in a SAN environment. Through zoning, a SAN administrator can configure which HBA WWPNs on the VMware ESXi host can connect to which WWPNs on the Hitachi storage processors.

The VMware ESXi host port in the Fibre Channel HBA is referred to as the initiator. The storage processor port in the Hitachi storage array is referred to as the target.

You can break zoning down into the following different configurations:

- **Single Initiator to Single Target (SI-ST) Zoning** – This configuration allows one initiator to be zoned to only one target. This configuration is the most resilient configuration, as traffic originating from another Initiator on the SAN will have less impact than the initiator in this zone.
- **Brocade Peer Zoning** – This configuration allows a single zone to provide a Principal–Pupil relationship where all pupils can communicate with the principal but no with each other. This provides the same zone-security as SI-ST zoning but with the administrative benefit of a reduction of number of zones. This is the preferred configuration in a Brocade fabric configuration.
- **Cisco Smart Zoning** – This implementation is preferred in a Cisco environment where NX-OS can eliminate initiator to initiator and target to target communication.
- **Single Initiator to Multiple Target (SI-MT) Zoning** – This configuration allows one initiator to be zoned to multiple targets in a single zone.
- **Multi Initiator Zoning** – **This configuration is never recommended.** This configuration allows multiple initiators to be zoned to multiple targets in a single zone. This exposes all initiators and targets to all traffic in the zone. Events such as a malfunctioning HBA could affect all initiators and targets in the zone and either negatively affect performance for all or bring down the Fibre Channel network completely.

Hitachi generally recommends the following:

- For utmost availability with slightly higher administrative cost, Hitachi recommends SI-ST zoning. Brocade Peer Zoning and Cisco Smart Zoning is supported to reduce admin burden.
- Each HBA port should only see one instance of each LUN. This is primarily based on years of experience with fabrics and to avoid potential availability issues where host HBA ports can be overrun leading to performance issues and error recovery with fabric path issues (transient or otherwise) is faster and less impactful to hosts.
- See Recommended Multipath Settings for Hitachi Storage knowledge base article for more information.

Optionally, do the following:

- Use SI-MT with Brocade Peer Zoning or Cisco Smart Zoning and follow same LUN presentation recommendation above.
- Regarding SI-MT, an example to use is provided within Cisco and Hitachi Adaptive Solutions for Converged Infrastructure and Cisco and Hitachi Adaptive Solutions for SAP HANA Tailored Data Center Integration.

Zoning is configured as SI-MT with Cisco Smart Zoning to optimize traffic intended to be specific to the initiator (Cisco UCS host vHBA) and the targets (Hitachi Virtual Storage Platform controller ports).

Using SI-MT zoning provides reduced administrative overhead versus configuring traditional SI-ST zoning, and results in the same SAN switching efficiency when configured with Smart Zoning. Refer to the Cisco and Hitachi Adaptive Solutions for Converged Infrastructure Design Guide for more details.

Multipathing

Multipathing allows a VMware ESXi host to use more than one physical path between the ESXi host and the storage array. Multipathing provides load balancing. This is the process of distributing I/O across multiple physical paths, to reduce or remove potential bottlenecks. Multipathing also provides redundancy and fault tolerance in case of a failure of any element in the SAN network, such as an adapter, switch, or cable. The ESXi host can switch to another physical path that does not use the failed component. This process of path switching to avoid failed components is known as path failover.

To support path switching with a Fibre Channel SAN, the ESXi host typically has two or more HBAs available from which the storage array can be reached. It also has full fault tolerance that uses two or more switches. Additionally, for full fault tolerance, two storage processors on Hitachi Storage arrays should be utilized so that the HBA can use a different path to reach the disk array.

Available multipathing policies supported by ESXi hosts are **Round Robin**, **Most Recently Used**, **Fixed**, and **Hitachi Dynamic Link Manager**.

Hitachi recommends using the **Round Robin Multipathing** PSP policy (VMW_PSP_RR) and use SATP default of active-active (VMW_SATP_DEFAULT_AA). In a global-active device configuration, **Round Robin Multipathing** PSP and using ALUA SATP (VMW_SATP_ALUA) are recommended options. This multipathing policy takes advantage of all available paths and bandwidth. Taking advantage of all available paths assures maximum performance from the SAN infrastructure. Note, With vSphere 6.7U1 and vSphere 6.5 P03 or later, the round robin multipathing policy became the default setting as part of the **SATP claimrules** for Hitachi Storage. See this blog post for more details.

In a global-active device configuration without ALUA configured, **Fixed** policy is preferred PSP to ensure writes are sent to preferred side.

As part of VMware ESXi Round Robin Path Selection Plug-in (PSP), there is an I/O quantity value when a path change is triggered that is known as the limit. After reaching that I/O limit, the PSP selects the next path in the list.

The default I/O limit is 1000 but can be adjusted if needed to improve performance. Specifically, it can be adjusted to reduce latency seen by the ESXi host when the storage system does not see latency.

The general recommendation for the PSP limit is to continue to use the default value of 1000 in typical VMware's mixed environment with multiple ESXi hosts with multiple datastores. It has been observed that a value of 20 provides potentially the optimum value for additional 3-5% latency improvement and potentially reducing path error detection. See this blog post for more details.

For reference, here is information on various multipath policies:

- **Round Robin (VMware)** – This policy sends a set number of I/O down the first available path, then sends the same set number of I/O down the next available path. This repeats through all available paths, and then starts over again and repeats. If a path becomes unavailable, it is skipped over until it becomes available again.
- **Most Recently Used (VMware)** – This policy uses the last successfully used path. If the last successfully used path is not available, then path failover occurs, and the next available path is used. This new path continues to be used until it is no longer available, even if the previously used path becomes available again.
- **Fixed (VMware)** – This policy has a preferred path that can be set by the VMware vCenter administrator. This path is used until it becomes unavailable. Then, it fails over to the next available path until it becomes unavailable. In which case, the path fails over to the next available path, or until the preferred path becomes available again. If the preferred path does become available again, then the system fails back to the preferred path.
- **Hitachi Dynamic Link Manager** – VMware ESXi also supports third party path selection policies. Hitachi Dynamic Link Manager is Hitachi's multipathing software that integrates with global-active device on Hitachi Virtual Storage Platform and Hitachi High Availability Manager to provide load balancing and path failover capabilities for servers.

Multiple Fibre Channel Fabrics

When designing and building a reliable and scalable SAN environment, multiple Fibre Channel fabrics are recommended. For example, with multiple switches, create two separate Fibre Channel fabrics such as Fabric-A and Fabric-B.

In a VMware vSphere environment, the ESXi hosts should have two or more HBA ports. Allocate at least one HBA port for each Fibre Channel fabric. Not only will this allow for greater I/O throughput on the SAN as more paths are available when using the round robin (VMware) multipathing policy, multiple HBAs also allow for redundancy and greater reliability in case of a component failure.

Each VMware ESXi host in a cluster should have an equal number of connections to each Fibre Chanel switch. Each Hitachi Storage array should have an equal number of connections from each storage processor to each switch. The example of this can be found in UCP CI for VMware vSphere Reference Architecture Guide. See "Configure Storage for Fibre Channel SAN" in that document.

This SAN Fibre Channel switch configuration ensures that a single switch failure will not leave an ESXi host unable to connect to a datastore, unable to continue running the virtual machines on those datastores.

It is recommended that the Fibre Channel switches not be up-linked to each other, creating separate Fibre Channel networks. This ensures that conditions on a Fibre Channel network do not affect traffic on another Fibre Channel network, such as would happen with a malfunctioning HBA. This helps ensure system reliability.

Hitachi Storage (VASA) Provider Enabling Virtual Volumes (vVols)

Use this information to enable VMware Virtual Volumes (vVols) on Hitachi storage.

VMware vSphere APIs for Storage Awareness (VASA)

VMware vSphere APIs for Storage Awareness (VASA) enables communication between VMware vCenter Server and the underlying storage. Through VASA, the storage entities can inform vCenter Server about their configurations, capabilities, storage health, and events.

In return, in certain environments, VASA can deliver virtual machine storage requirements from vCenter Server to a storage entity and ensure that the storage layer meets the requirements.

VMware vSphere Virtual Volumes (vVols)

VMware vSphere Virtual Volumes (vVols) is based on an integration and management framework between VMware vSphere and the storage system introduced in vSphere 6.0. With vVols-based environments, the virtual disk becomes the primary unit of data management at the storage system level. It now becomes possible to execute storage operations with granularity and to provision native storage-systems-based data services to individual virtual machines or virtual disks. The Hitachi Storage VASA Provider is the entity that enables vVols with Hitachi VSP Storage systems. The current release as of mid-2021 supports VASA 3.0 vVols 2.0 including placement and replication capabilities.

Recommendations for a VMware vSphere Virtual Volume (vVols) Architecture

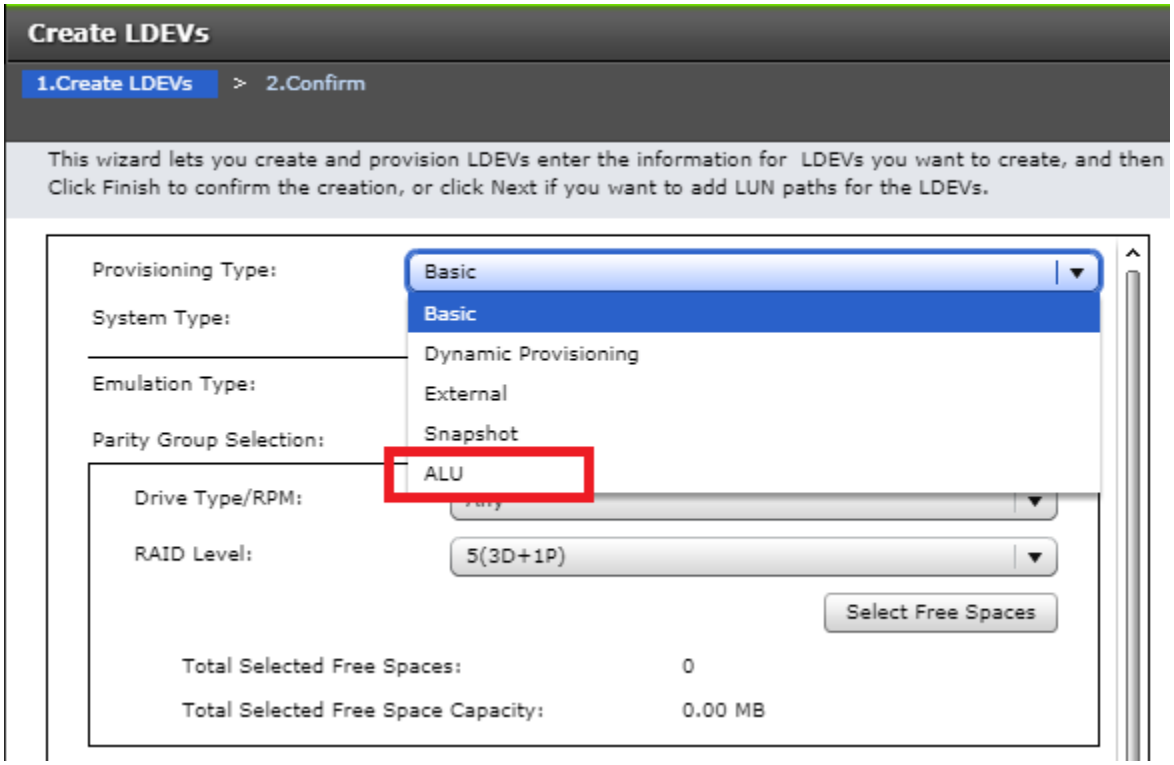
Hitachi Storage Provider for VMware vCenter is packaged and provided in an open virtual appliance (OVA) format.

- Read this first: VMware vSphere Virtual Volumes (vVols) with Hitachi Virtual Storage Platform Quick Start and Reference Guide to successfully enable a vVol environment on Hitachi storage.
- It can be downloaded here.

Some additional notes on a vVol architecture.

- On the Hitachi storage system, the protocol endpoint (PE) is an assigned logical unit (ALU). An ALU must be assigned to all VMware ESXi hosts in order to access vVols. A single ALU is all that is required for all ESXi hosts (up to a vSphere maximum of about 16,000 vVols per PE). This PE is mapped to 4 or more storage ports. Multiple ALUs can be deployed if required.

  The following figure shows the steps to create an ALU in Hitachi Storage Navigator. This is a necessary pre-requisite and best practice to create at least one ALU prior to VASA provider deployment.



- vVols can share an existing pool or pools and resource groups with VMFS datastores or have dedicated pools and resource groups. The best practice to date has been to create a separate resource group and pool which can share an underlying parity groups or use dedicated parity group if available
- Communication from the VASA provider to Hitachi storage for vVols operations is using the service processor (SVP). You can deploy the SVP as a preconfigured physical 1U node (or nodes) or installed as a virtual machine appliance. See System Management with SVP for more information about SVP installation options.
- To ensure the high availability of vVol out-of-band management operations, treat the VASA appliance like availability deployment modes used for vCenter appliance (VCSA) or NSX-T appliance. The VASA provider from Hitachi supports the following availability features:
  - VMware vSphere Fault Tolerance (FT)
  - VMware vSphere High Availability (HA)

  The VASA provider from VMware also supports monitoring of its application service level under the VMware vSphere High Availability configuration. By enabling the monitoring of the virtual machine and application option within VMware vSphere High Availability, the VASA provider will automatically restart if the VASA provider service stops.
- When Storage Provider for VMware vCenter or SVP becomes unavailable, only storage management control operations related to the virtual volume are affected, such as clone virtual machines, snapshot operations, and power on operations. This out-of-band communication does not affect virtual machine I/O, as the I/O flows through the fabric data path using protocol endpoints.

Multiple VMware vCenter Server Support and Multiple Storage Support

A **single** VASA provider from Hitachi for VMware vCenter can be registered with multiple VMware vCenter servers and can support multiple storage systems. This is unique to our implementation, improving configuration flexibility.

For example, the ability to have multiple vCenter servers that may be allocated for different groups or workloads to connect and use single or multiple shared storage array or arrays using a single managed VASA provider. When deployed with VMware Cloud Foundation, you typical deploy the VASA provider OVA from Hitachi in the management domain. Each workload domain vCenter can register to that single VASA Provider.

If you want to use the same storage system with multiple VASA providers (such as Production and Dev/Test environments with separate VASA providers), then best practice is you must create or use separate resource groups for each VASA provider to avoid any interaction overlap.

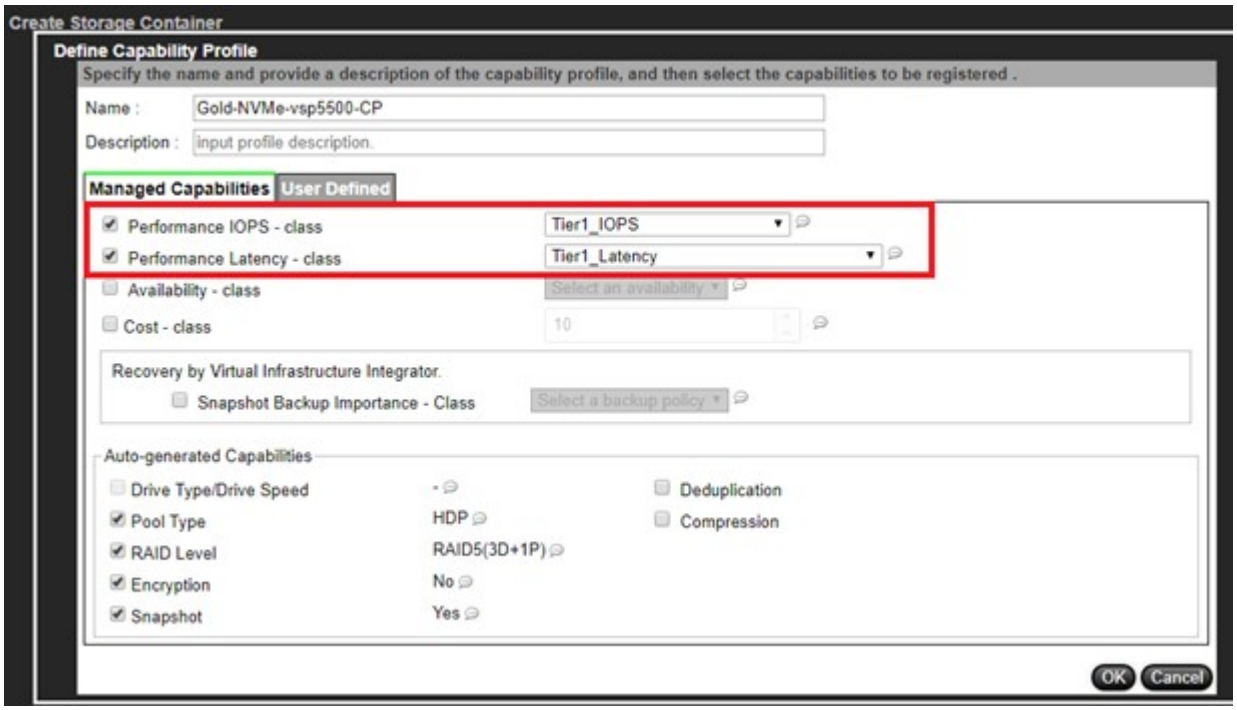
Hitachi's tag-based storage policy enablement can be used with only one vCenter server.

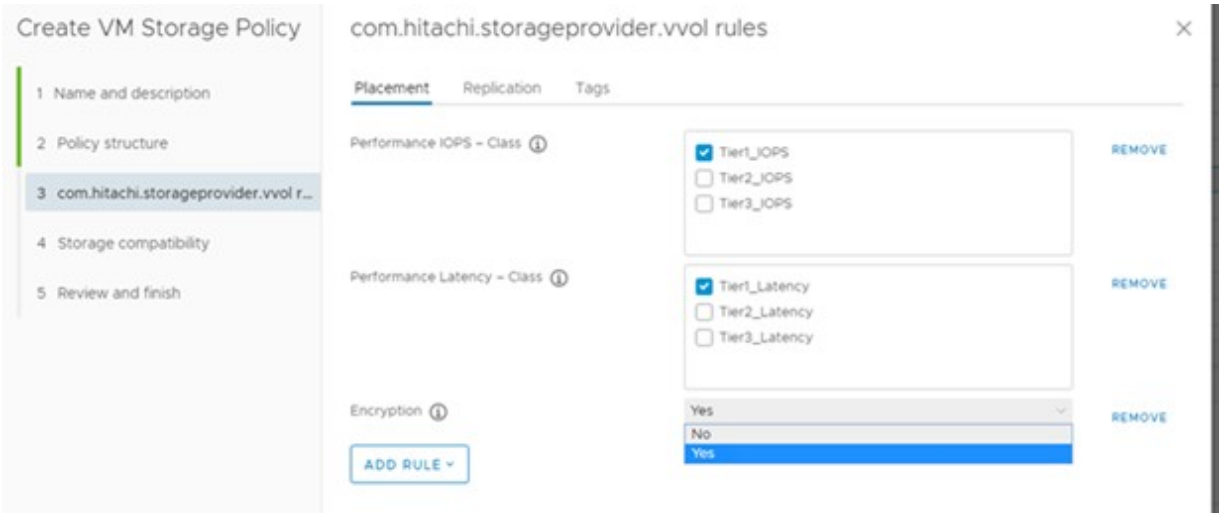
Hitachi Storage Capabilities Defined on Array-side and Advertised by VASA Scheme

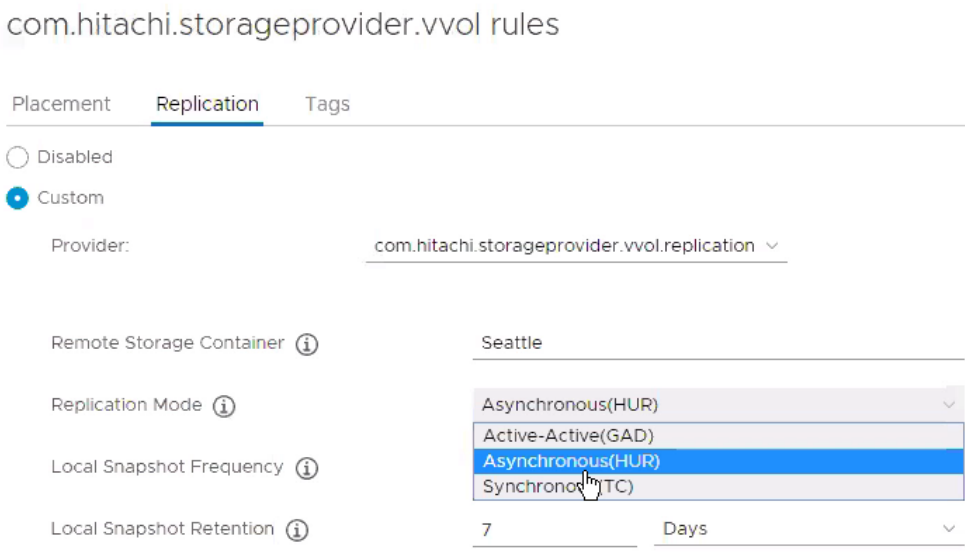
Storage administrators and virtual storage administrators work together to define the various capabilities required and provided for their Hitachi system prior to implementation and updated after deployment to fine tune usage. With VASA provider from Hitachi, you can define a profile for the pool of resources that are being provided as part of a storage container. When defining the profile, you assign the managed storage capabilities for the resource in question while the system also pre-assigns capabilities that it automatically detects on the storage resources.

Policy based management is premised on the fact that storage exposes a set of capabilities. That is, a resource that provides Tier 1 IOPS and encryption and remote replication services. Virtual machine administrators define virtual machine storage policies policy for virtual machine producers selecting one or more of these capabilities and values that are exposed by the VASA provider. When a virtual machine is provisioned and assigned a virtual machine storage policy, vCenter asks the VASA provider to create that virtual machine and its VMDKs in storage resources or services that match that virtual machine storage policy.

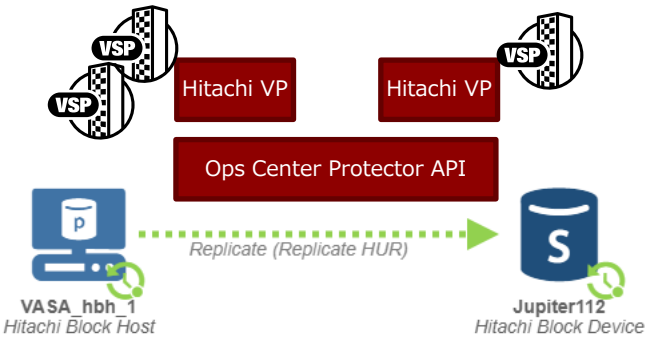
The following figures show an example of a storage capability profile definition by VASA provider in the web user interface, an example virtual machine storage policy definition by VMware vSphere Web Client for both placement and replication capabilities, and the visibility of those vVols and their associated storage policy assignment.







Note that replication services for Hitachi VASA Provider are enabled with Ops Center Protector



Quality of Service and Virtualizing Legacy Storage

Hitachi Virtual Storage Platform can non-disruptively front-end virtualize non-NVMe or legacy storage, including 3rd-party storage, to allow for life extension or non-disruptive migration enablement while gaining the following benefits of VSP:

- NVMe, all flash, or hybrid performance
- Resiliency
- Capacity

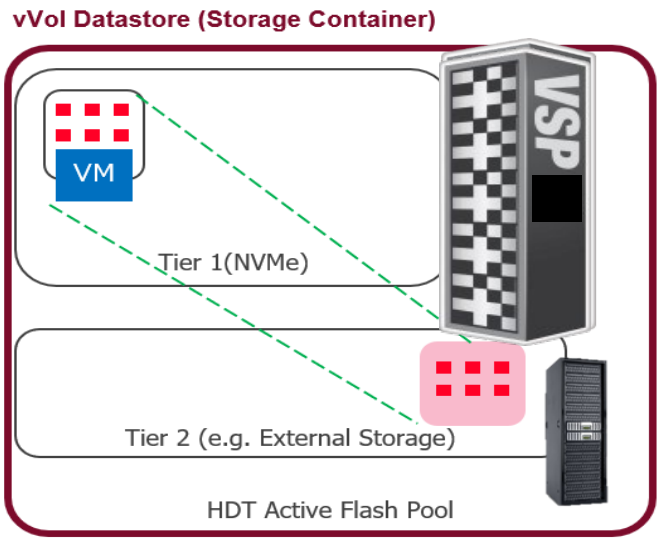
When you implement VMware vSphere Virtual Volumes (vVols), the legacy systems inherit the benefits of storage policy based management (SPBM) and VASA or vVol implementation**.**

To enable data tiering between the system to enable use cases where virtual machines or data will age in importance over time, this is best practice:

1. Create **one** vVol datastore (storage container) that abstracts the two or multiple storage systems into one vVol datastore using Hitachi Data Tiering (HDT) pooling capabilities.
2. Create a VMware vCenter virtual machine storage policy with capabilities of Tier 3 IOPS+latency for these virtual machine services.
3. Review the capability schema in the VASA web user interface to see how VASA maps storage policies to tiers created with Hitachi Dynamic Tiering.

When you assign this policy to these aging or less relevant virtual machines, the VASA provider will detect that policy change and automatically tier those warm or cold virtual machines or VMDKs to the lowest legacy tier in this configuration. This frees up that tier 1 for the next revenue generating app.

VM Policy	Data	HDT
Tier1 Latency and Tier1 IOPS	Tier 1	Level 1
	Tier 2	
Tier3 Latency and Tier3 IOPS	Tier 1	Level 5
	Tier 2	
Other/No Policy	Tier 1	Any
	Tier 2	

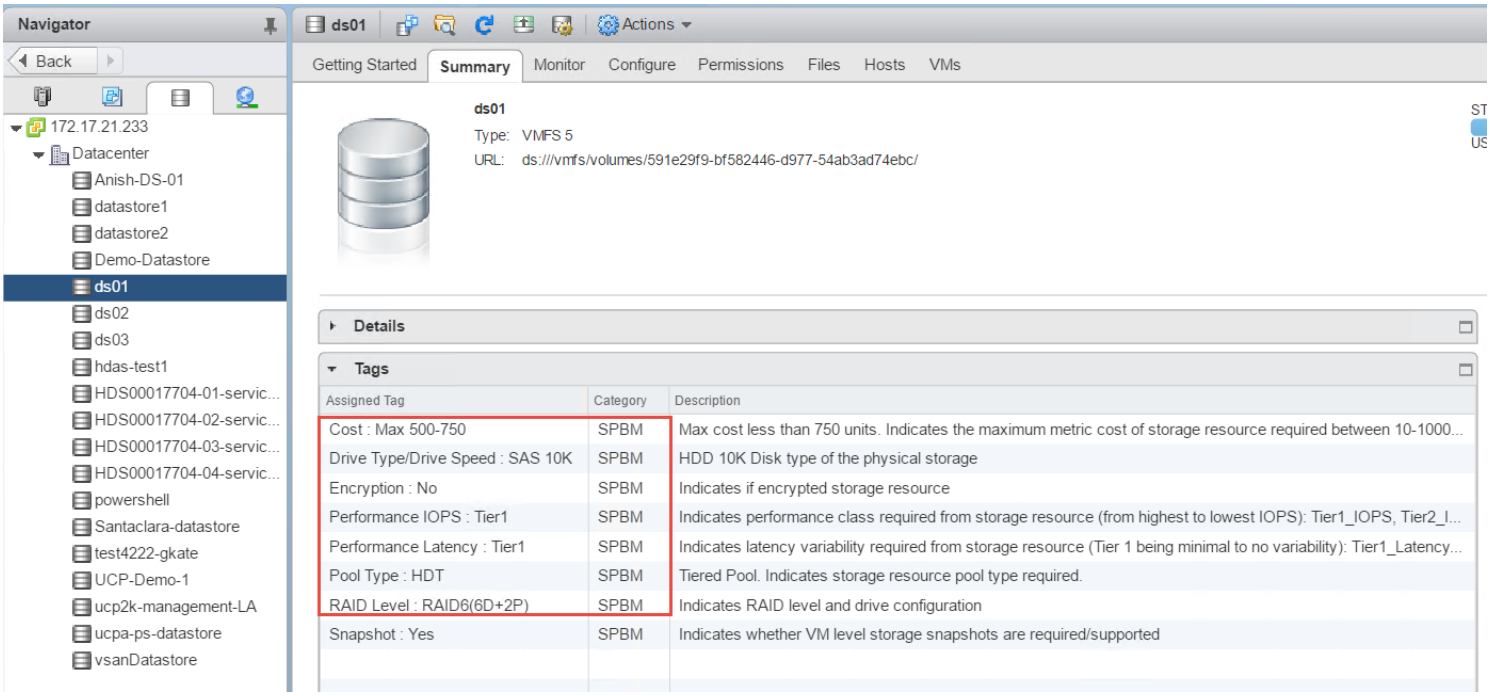


Hitachi Storage (VASA) Provider Enabling Tag-based Storage Policy for VMFS Datastores

The tag-based storage policy provides similar outcome for VMFS datastores as storage policy-based management (SPBM) does for VMware Virtual Volumes.

You can set a storage capability profile on the pool that is serving the VMFS datastores or you can customize the storage capability profile of an individual LUN. Hitachi Virtual Storage Platform automatically tags the datastores in VMware vCenter for existing and new datastores and these will appear in vCenter as tags.

Like SPBM for VMware vVols, you can create a virtual machine storage policy using tags to allow virtual machine producers to find the right datastore that matches their requirements. It also allows you to create custom capabilities (such as rack location, availability zone) to augment the base capabilities provided.



Clustered VMDK with vSphere 7.0+

For details on setting up and using Clustered VMDK (or Shared VMDK) with Hitachi Virtual Storage Platform, see our detailed blog at https://community.hitachivantara.com/s/article/Setting-up-Windows-Server-Failover-Cluster-on-vSphere-7-with-Hitachi-VSP.

iSCSI

This section describes volume provisioning using iSCSI.

iSCSI Provisioning

iSCSI initiators and targets use TCP to create relationships called sessions. The initiator sees one logical connection to the target. An iSCSI session might also contain multiple logical connections.

From a VMware vSphere host perspective, these sessions might also be thought of in term of paths between the initiator and target. Having multiple connections per session enables bandwidth aggregation and can also provide load balancing.

Although vSphere does not support multiple connections per session, by configuring multiple sessions, you can configure load balancing and ensure path redundancy. See VMware vSphere Storage Guide 6.7 (PDF) for more details.

Multipathing with iSCSI

With software iSCSI, you can use multiple NICs that provide failover and load balancing capabilities for iSCSI connections between your host and storage systems.

Multipathing plug-ins do not have direct access to physical NICs on your host. So, for this setup, you first need to connect each physical NIC to a separate VMkernel port. You then associate all VMkernel ports with the software iSCSI initiator using a port binding technique. As a result, each VMkernel port connected to a separate NIC becomes a different path that the iSCSI storage stack and its storage-aware multipathing plug-ins can use. Refer to Best Practices For Running VMware vSphere On iSCSI for more information.

VMware vSphere Storage Optimizations and Capacity Management

VMware vSphere provides several features to address datastore capacity management and virtual machine performance and help with administrative tasks around storage, such as UNMAP, vSphere Storage DRS, and vSphere Storage I/O control.

UNMAP

In VMware vSphere 6.5, automatic UNMAP was introduced. It automatically issues the **UNMAP** command to release free storage space in background on thin-provisioned storage arrays that support UNMAP operations.

The main requirements to take advantage of Auto-UNMAP are listed below:

- Use Thin provisioned VMDKs backed with thin provisioned LDEVs/LUs or vVols datastore
- VMFS 6 datastores
- In-Guest UNMAP support:
  - Linux guest OS with hardware version 13 or later to present SCSI-4
  - Windows 2012R2 OS with hardware version 11 or later
  - In-Guest automated UNMAP also supported for VMware vVol datastores.
- vSphere ESXi 6.5 P1 or U1 or later (VMware ESXi 6.5.0 build-4564106 used internally)
- Storage: VSP E series, VSP G series, VSP F series, or VSP 5000 series (GA Microcode Minimum: SVOS 7.3.1 83-05-02-20/00)
- Ensure Host Mode Options (HMO) 63 and HMO 114 set to ON.

See the blog at https://community.hitachivantara.com/s/article/Dealing-with-VMware-Datastore-space-management-on-VSP-Storage-part-2 for additional details.

In vSphere 6.7 and later, VMware enabled additional performance parameters (low, medium, high, and fixed) to determine the UNMAP throughput that arrays would receive. Setting automatic space reclamation settings to a fixed rate at 100 MB/secprovides a reasonable combination of UNMAP rate and storage processor (MPU) utilization. Always monitor MPU usage before and after changing the UNMAP rate.

For VMFS 5, manual UNMAP is still supported with following command:

```
esxcli storage vmfs unmap -l <datastore-name>
```

VMware vSphere Storage DRS

A datastore cluster is a collection of datastores with shared resources and a shared management interface. When you create a datastore cluster, you can use VMware vSphere Storage DRS to manage storage resources.

Storage DRS generates recommendations or performs Storage vMotion migrations to balance space use across the datastore cluster. It also distributes I/O within the datastore cluster and helps alleviate high I/O load on certain datastores.

- **Trigger** – This happens when space use on a datastore exceeds a threshold, or I/O latency on a datastore exceeds a threshold.
- **Time** – Storage DRS is invoked at the configured frequency which is, by default, every eight hours. It can also be invoked when one or more datastores in a datastore cluster exceeds the user-configurable space utilization thresholds.
- **Granularity** – VMware vCenter Server uses Storage vMotion to migrate virtual machine disks to other datastores in the datastore cluster to balance resources.

When deciding which datastores to group into a datastore cluster, try to choose datastores that are as homogeneous as possible in terms of the following:

- Host interface protocol, such as FCP, iSCSI, and NFS
- RAID level
- Performance characteristics

VMware recommends not mixing SSD and hard disks in the same datastore cluster. However, this does not apply to the datastores provisioned from a Hitachi Dynamic Tiering pool.

The following are recommendations for VMware vSphere Storage DRS with Hitachi Storage:

- Enable only **Space** metrics when a datastore cluster contains multiple datastores that are provisioned the same dynamic provisioning pool with or without Hitachi Dynamic Tiering.
  - Moving a noisy neighbor within the same dynamic provisioning pool does not improve performance.
- Enable **Space** and **I/O** metrics when a datastore cluster contains multiple datastores that are provisioned from different dynamic provisioning pools.
  - Moving a noisy neighbor to the other dynamic provisioning pool balances out performance.

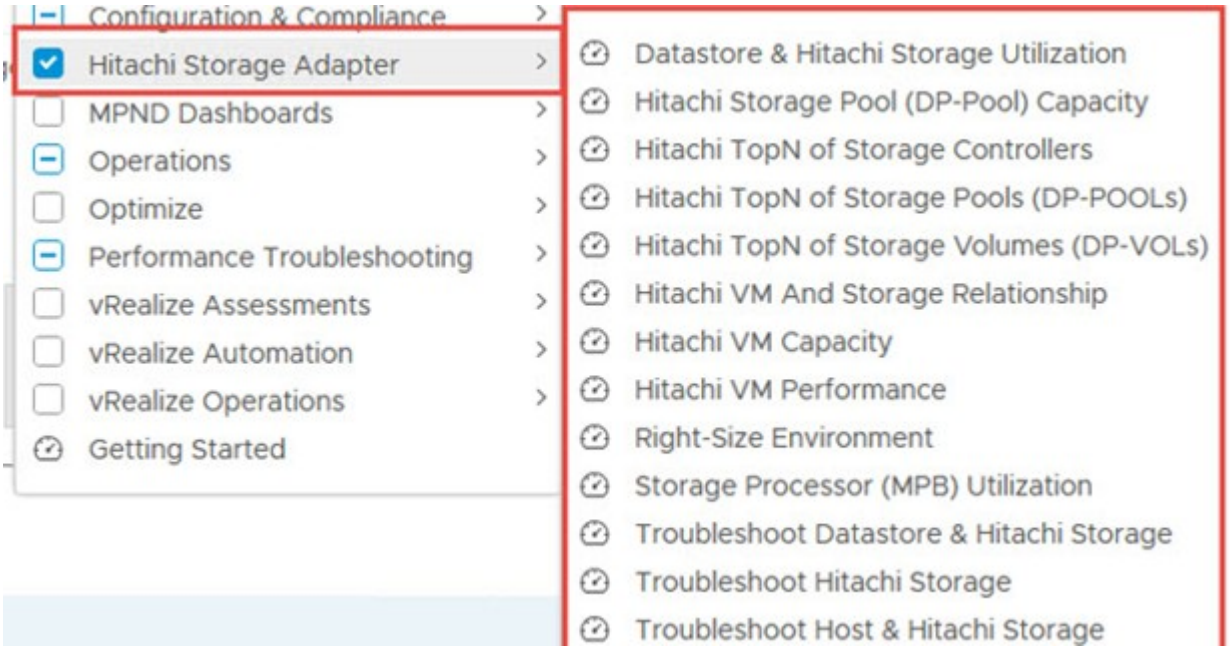
VMware vSphere Storage I/O Control (SIOC)

Hitachi has no specific recommendation regarding VMware vSphere Storage I/O Control (SIOC). SIOC extends the constructs of shares and limits to handle storage I/O resources. You can control the amount of storage I/O that is allocated to virtual machines during periods of I/O congestion, which ensures that more important virtual machines get preference over less important virtual machines for I/O resource allocation.

- **Trigger (Time)** – This happens when device latency exceeds a threshold.
- **Granularity** – Each virtual machine (or virtual disk) that accesses that datastore is allocated I/O resources in proportion to its shares.

VMware vRealize Operations

VMware vRealize Operations helps visualize all the resources associated with a virtual machine in a single plane of glass. It bridges the gaps between virtual and physical object to identify where the problem takes place. Hitachi Infrastructure Management Pack for VMware vRealize Operations extends the functionality of vRealize Operations by providing simplified management capabilities for Hitachi Storage components, improving performance and operational efficiency. It provides better visibility into performance and storage capacity planning for your end-to-end virtual infrastructure environment. Refer to Infrastructure Management Pack for VMware vRealize Operations for more information. Use the following set of dashboards to manage capacity and performance of Hitachi Storage as shown.



Hitachi Storage Resource Management

Hitachi storage provides storage-aware functionalities, such as Hitachi Dynamic Tiering and active flash to address similar issues. It is important to grasp the differences between them and what VMware vSphere and Hitachi storage each resolve with their functionality.

Hitachi Dynamic Tiering and Active Flash

Using Hitachi Dynamic Tiering, you can configure a storage system with multiple storage tiers using different types of data drives. This includes the following:

- FMD
- SSD
- SAS
- SATA
- External volumes

This helps improve the speed, capacity, and cost of performance. Dynamic Tiering improves underlying storage resources with following conditions.

- **Trigger** – Monitor the I/O load per page and relocate the page to the optimal tier
- **Time** – Define a user-specified period of at least 30 minutes
  - Real-time with the active flash
- **Granularity** – Relocate the storage tier with a page size of 42 MB

In addition, active flash monitors a page's access frequency level in real time to promote pages that suddenly became busy from a slower media to high-performance flash media.

In a VMware environment, many workloads tend to be highly random with smaller block size. This may not be suitable for deduplication and compression, even with an all flash configuration. Hitachi Dynamic Tiering with active flash may a good option to improve capacity and cost by efficiently using the flash tier minimally.

Capacity Savings, Deduplication, and Compression with Hitachi Storage

Hitachi Storage Virtualization Operating System RF (SVOS RF) delivers superior adaptive data reduction (ADR) and operational efficiency, covering a broad range of efficiency services including thin provisioning, snapshots and linked clones, compression, deduplication, and cloud connect. SVOS RF adaptive data reduction intelligence is optimized for highest system throughput and response time consistency. Virtual Storage Platform all-flash and NVMe storage systems deliver inline, drive-based accelerated compression to provide system-level storage efficiency savings.

The key factor affecting accommodation on a flash device is not performance, but capacity. So, this makes the high raw capacity that the flash device has and the saving ratio that comes from deduplication and compression functionalities key factors. See Data Reduction for more details.

Capacity Saving with Deduplication and Compression Options

Regarding deduplication and compression, the Hitachi Virtual Storage Platform family has two main types for providing adaptive data reduction (ADR)

- Hitachi Storage Virtualization Operation System RF provides controller-based deduplication and/or compression

  This capacity saving is processed at the dynamic pool or dynamic tiering level.

- FMD DC2 hardware-based compression with inline processing

  This compression is processed at the FMD DC2 drive level.

- When you use FMD DC2 hardware-based compression, requires enabling the accelerated compression option on all parity groups of FMD DC2 drives.
- You can use either controller-based or hardware-based deduplication and compression, or a combination of both. With a combination of both options, controller-based deduplication and hardware-based compression are used.

Compression Recommendation and Considerations

Regarding the compression option, using FMD DC2 hardware-based compression is recommended if FMDs are deployed.

Use Hitachi Storage Virtualizing Operating System v9.x with controller-based compression for all systems, including NVMe based systems.

When using FMD DC2, consider the following:

- No performance degradation appears due to the truly hardware offloaded in-line or real-time accelerated compression.
- Regarding the compression saving ratio, the differences between software-based and hardware-based are insignificant.
- Inline processing-based compression provides you with reduction of initial capacity and cost.

Deduplication Recommendations and Considerations

Deduplication is highly effective in the virtualization environment, which tends to have duplicated data. This includes data such as the same operating system images, templates, and backups.

Hitachi Storage Virtualization Operating System RF v9.x has changed how ADR is implemented to provide controller-based deduplication by combining a mix of inline and post processing deduplication. Check the latest capabilities in Storage Virtualization Operating System

- From lab validation results at Hitachi, enabling deduplication achieved a 60-70% capacity saving for a datastore where 8 virtual machines with an operating system VMDK resides running Microsoft® Windows Server® 2012 R2.
- Enabling FMD DC2 hardware accelerated compression enhances deduplication with more than a 20% capacity saving. This combination of deduplication and compression achieved more than 80-90% capacity savings in total.
- A main concern related to deduplication is performance degradation. This comes from mainly the following two factors:
- It consumes extra storage compute resources to perform deduplication and metadata management.
- The garbage collection running as a background task also requires processing overhead. This task may increase storage CPU (MP) usage from 2% to 15%.
- The following are some of the considerations with regards to controller-based deduplication:
- It may impact I/O performance. Verify the performance by utilizing best practices or the cache optimization tool (COT) tool before using the capacity saving function.
- Because approximately 10% of the capacity is used for metadata and garbage data, the capacity saving function should be applied only when the saving is expected to be 20% or higher.
- In deduplication and compression, processing is performed per 8 KB. Therefore, if the block size of the file system is an integral multiple of 8 KB, then the capacity saving is likely to be effective.
- The capacity saving function is not a good fit for high-write workloads. If the write workload rate is higher than garbage collection throughput, then the storage cache write-pending increases, causing performance degradation.

The capacity saving effect vary depends on your application and workload. You need to know your application workload and suitability before enabling a capacity saving feature. Table 3, "Deduplication Consideration for General Use Cases," on page 23 lists the possible use cases for capacity savings.

TABLE 3. DEDUPLICATION CONSIDERATION FOR GENERAL USE CASES

Use Case	Description
Microsoft Office®	Because there are many identical file copies, deduplication is effective.
VDI	Deduplication is very effective because of operation system area cloning.
Database (TPC-H)	Deduplication is not effective because the database has unique information for each block.
Database (TPC-C)	For a database that has many data updates, garbage data is increased, so it is not suitable.
Image/video	Compressed by application.
Backup/archive	Deduplication is effective between backups.

Flash Module Drive DC2 Configurations and Recommendations

As mentioned in See "Deduplication Recommendations and Considerations" on page 22., the key factor affecting accommodation on a flash device is not performance, but capacity. The required flash memory drive (FMD) DC2 capacity can vary, whether there is dedupeable or compressible data.

The following are some recommendations for FMD DC2:

- If your application requires high IOPS and low latency, and if your data is compressible, FMD DC2 accelerated compression (without dedupe) might be an option.
- RAID-6 is the recommended RAID level for pool-VOLs, especially for a pool where recovery time from a pool failure due to a drive failure is not acceptable.
- Configure a parity group across the drive-boxes to maximize the performance by increasing the number of back-end paths.

VMware Site Recovery Manager Best Practices

These are the best practices for VMware Site Recovery Manager (SRM). Hitachi has two versions of the site recovery adapter.

Standard Storage SRM and Stretched Storage SRM with Global-active Device Best Practices

VMware vCenter Site Recovery Manager integrates tightly with Hitachi Storage arrays using either Hitachi Storage Replication Adapter or Hitachi Ops Center Protector. This provides centralized management of recovery plans. Tight integration between storage systems, VMware vCenter, VMware vCenter Site Recovery Manager, and Hitachi storage replication adapters ensures a coordinated recovery for large, business critical environments.

Remote data replication is a key function in building out stable and reliable disaster recovery environments. Replicating data to a remote secondary site represents the most effective insurance policy against a catastrophic failure. Although you can perform data replication at the server level, you can perform data replication more effectively within the storage infrastructure.

The following are two types of underlying storage configurations supported by VMware Site Recovery Manager:

- Standard storage (active-standby solution) leveraging Hitachi True Copy or Hitachi Universal Replicator
- Stretched storage (active-active solution) leveraging global-active device on Hitachi Virtual Storage Platform

Table 4 lists the differences between two types of storage.

TABLE 4. COMPARISON BETWEEN STANDARD STORAGE AND STRETCHED STORAGE

Type	Site Recovery Manager with Standard Storage	Site Recovery Manager with Stretched Storage
Business continuity	Site failover is required with down time even though planned migration such as site maintenance is being conducted.	During planned migration such as site maintenance, no disruption and down time occurs by using Cross-vCenter vMotion with Stretched storage is made up by global-active device and Hitachi Storage Replication Adapter.
Storage availability	Site failover is required due to primary storage failure. It costs application downtime.	When primary storage failure occurs, no site failover is required by using the cross path to remote site storage which is virtualized as a single stretched storage and volume across the sites powered by global-active device technology.
Simplicity	Simple because traditional disaster recovery configuration consists of primary storage and secondary storage.	In addition to traditional disaster recovery configuration, there is a need to consider quorum storage and additional paths between sites as cross-paths, and so forth. It tends to be more complex and larger.

You may decide, depending on required RPO, which results in which replication type you choose.

For more information on the SRAs, see the following:

- Hitachi Block Storage Replication Adapter for VMware vCenter Site Recovery Manager (SRM) – Deployment Guide
- Hitachi Data Instance Director Adapter for VMware Site Recovery Manager (SRA)

VMware vSphere Metro Storage Cluster with Global-Active Device Best Practices

A VMware vSphere Metro Storage Cluster architecture on Hitachi Storage platforms provides an ideal solution for maximizing availability and uptime by clustering physical datacenters within metro distances. The metro storage cluster solution from Hitachi consists of storage systems presenting replicated storage as a single LUN from different geographically distributed sites. This design enables high availability of services by allowing virtual machine migration between sites with no downtime. See the KB article for metro storage cluster support with Hitachi VSP.

Changes in Multipathing and Path Configuration Best Practice

These are changes in multipathing and patch configuration best practices in a VMware vSphere Metro Storage Cluster environment.

Global-Active Device with Native Multi-Pathing with ALUA

For a VMware Metro Storage Cluster configuration, global-active device with VMware native multi-pathing (NMP) with ALUA is supported with micro code 83-03-01-x0/00 and later. This feature allows you to present I/O to the remote site storage across long distances path that cause high response time by specifying it as non-optimized path. This minimizes response time and the cost of WAN traffic. It is recommended to turn on this feature with site distances greater than 20 miles (32 km).

Here is an example of enabling ALUA mode and specifying non-optimized path on Hitachi Storage:

raidcom modify ldev -ldev_id XXXXXX -alua enable

raidcom modify lun -port CLX-C-X -lun_id all -asymmetric_access_state non_optimized

Here is an example of enabling a SATP rule set as ALUA for Hitachi devices and selecting PSP as round robin on the VMware ESXi side:

Esxcli storage nmp satp rule add -V HITACHI -M "OPEN-V" -P VMW_PSP_RR -s VMW_SATP_ALUA -c tpgs_on

- Hitachi recommends using RR (round robin) instead of MRU (most recently used).
- With VMware vSphere 6.7U1 and vSphere 6.5 P03 or later, this ALUA SATP rule is set by default. See VMware Native Multipathing rules for Hitachi VSP now enabled by default in vSphere builds for more details.

Uniform and Non-Uniform Host Access

While the Hitachi Storage Cluster for VMware vSphere solution supports uniform and non-uniform host access topology, Hitachi recommends uniform host access deployment where feasible for utmost high availability requirements.

- **Uniform host access configuration** – This is when VMware ESXi hosts from both sites are all connected to a storage node in the storage cluster across all sites. Paths presented to ESXi hosts are stretched across this distance.
- **Non-uniform host access configuration** – This is when VMware ESXi hosts in each site are connected only to storage node or nodes in the same site. Paths presented to ESXi hosts from storage nodes are limited to the local site.

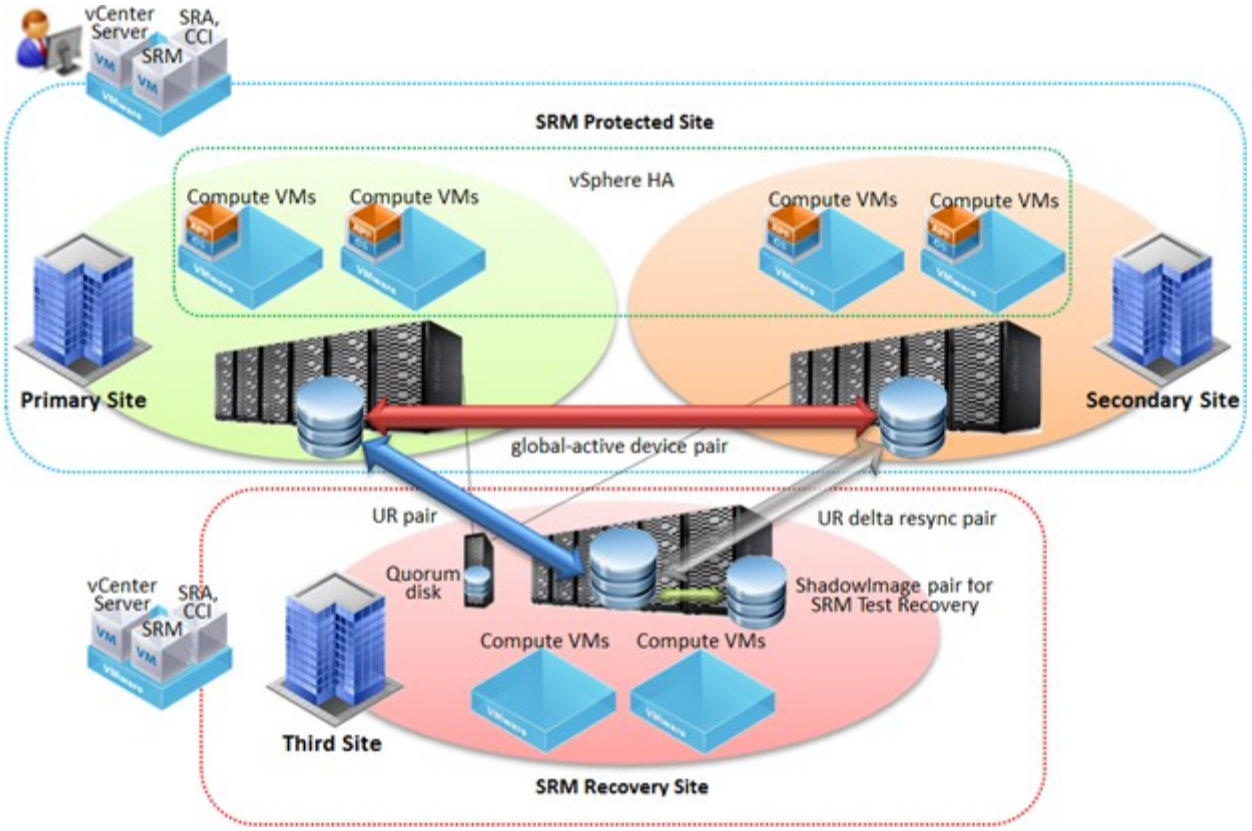
Refer to Implement vSphere Metro Storage Cluster with Hitachi Virtual Storage Platform (VSP) (2145375) for more information regarding to this topic.

3 Data Center (3DC) with VMware Site Recovery Manager Best Practices

The 3DC solution consists of clustered primary and secondary datacenters leveraging global-active device in Hitachi Virtual Storage Platform, and the third data center which is replicated from the others as a disaster recovery site leveraging Hitachi Universal Replicator with delta resync functionality.

Hitachi Universal Replicator with delta resync functionality establishes storage remote replication from the primary data center to the third data center and from the secondary data center to the third datacenter, respectively. This is called the global-active device 3DC delta resync environment, as shown.

To maintain adequate service level agreements, ensure journals are adequately sized to avoid any throttling of IOPS to maintain replication SLAs if Hitachi Universal Replicator inflow control is set to **enabled**. If Universal Replicator inflow control is set to **disabled**, host I/O is prioritized and the Universal Replicator relationship is suspended.



Installing VMware Site Recovery Manager in this 3DC environment gives you the orchestrated and repeatable planned or unplanned migration or disaster recovery operations using a tested and proven recovery plan. This enables end-to-end virtual machine protection across 3 datacenters. As a normal state, VMware SRM protects the virtual machine between the primary and the third data center.

This solution is based on VMware Metro Storage Cluster, which clusters the primary and the secondary data centers within a single VMware vCenter data center object and uses stretched storage cluster powered by global-active device.

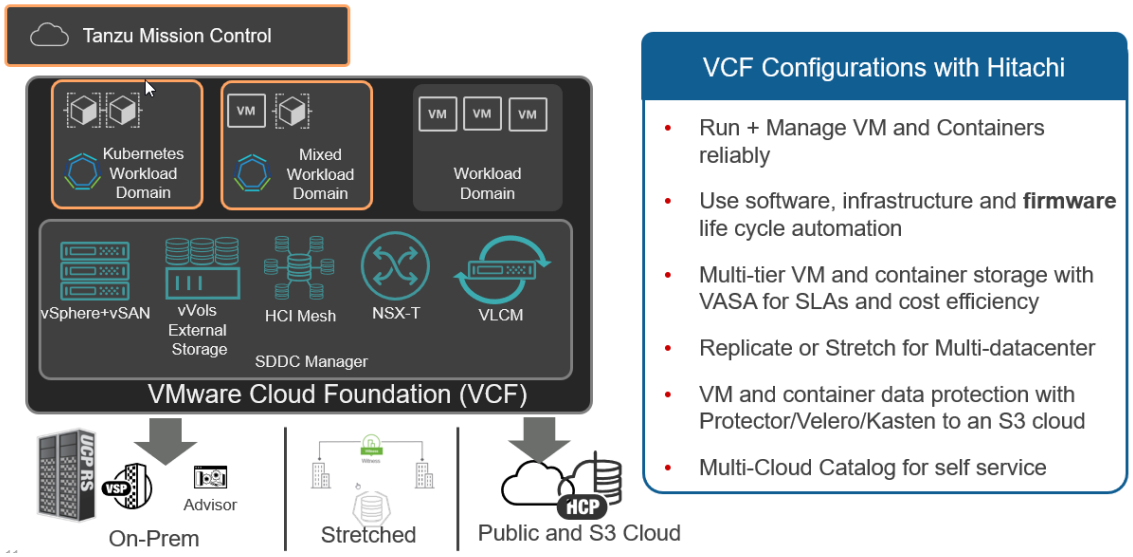
When the primary datacenter goes down, the virtual machine can be restarted on the secondary data center, leveraging VMware vSphere High Availability fail over functionality as a VMware Metro Storage configuration. During failover from the primary to secondary datacenter, storage remote replication established from the primary to the third data center is also automatically failed over to the other one established from the secondary to the third data center by leveraging delta resync functionality.

For a global-active device 3DC delta resync environment solution, the virtual machine protected by VMware SRM can follow this datacenter failover movement and re-protect the virtual machine between the secondary and third datacenter with minimal effort.

Note – As a normal state, VMware SRM protects the virtual machine between the primary and third datacenter. When the primary datacenter goes down, storage remote replication can automatically failover though, the re-protection of virtual machines by SRM requires some manual operation to switch the source and target datacenter. To do this, switching the command control interface configuration file and restarting the Hitachi Open Remote Control Manager daemon is required.

VMware Cloud Foundation (VCF) and External Storage

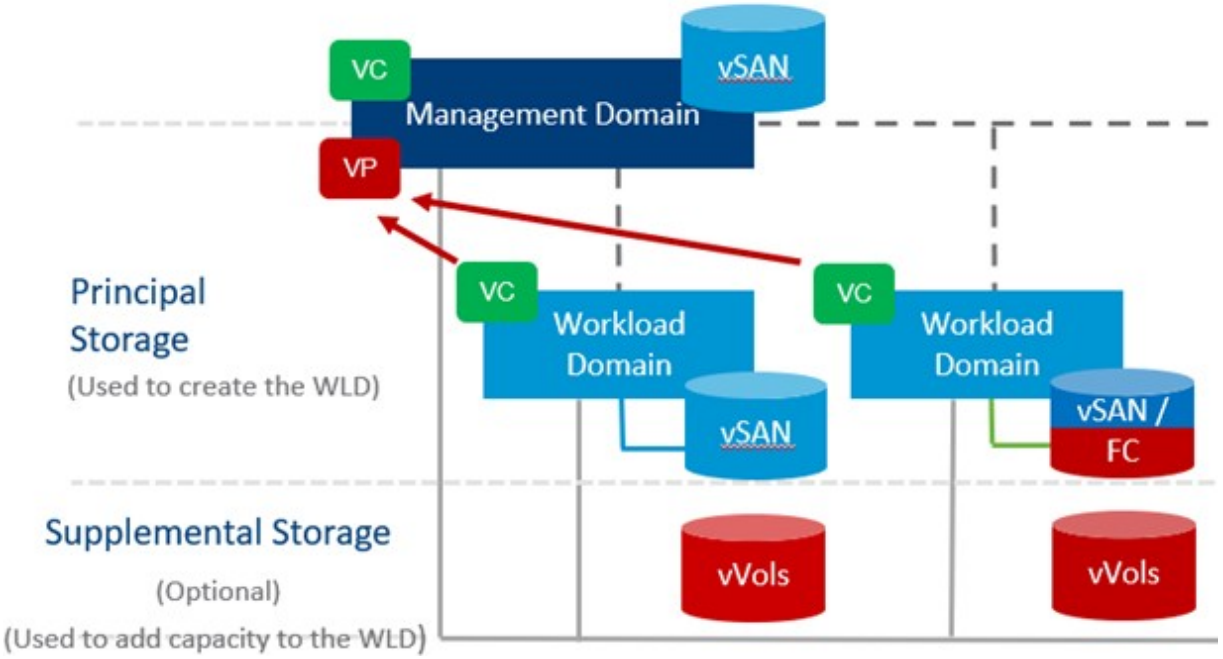
VMware Cloud Foundation (VCF) provides a compelling hybrid cloud platform for customers to run VM and container workloads effectively including lifecycle management for the software stack. Hitachi augments that solution by adding key elements such as external storage as additional principal or supplemental storage to meet various use cases, a UCP RS platform to run VCF, HCP for content storage, and UCP Advisor to add integrated hardware lifecycle management.



VMware Cloud Foundation (VCF) supports Hitachi SAN storage (VMFS and vVols) used as principal or supplemental storage. The use cases vary by customer, ranging from flexibility to scale storage footprint, mission critical applications with stringent RPO/RTO requirements, to simply matching business outcomes to suitable tier of storage.

VCF 4.x+ expanded their external storage offerings for principal or supplemental storage with support for vVols and VMFS to augment native vSAN datastores. The best practice is to deploy the VASA provider OVA from Hitachi in the VCF management domain and each VCF workload domain VMware vCenter can register to that single VASA provider.

VMware Cloud Foundation 4.0
Principal & Supplemental Storage

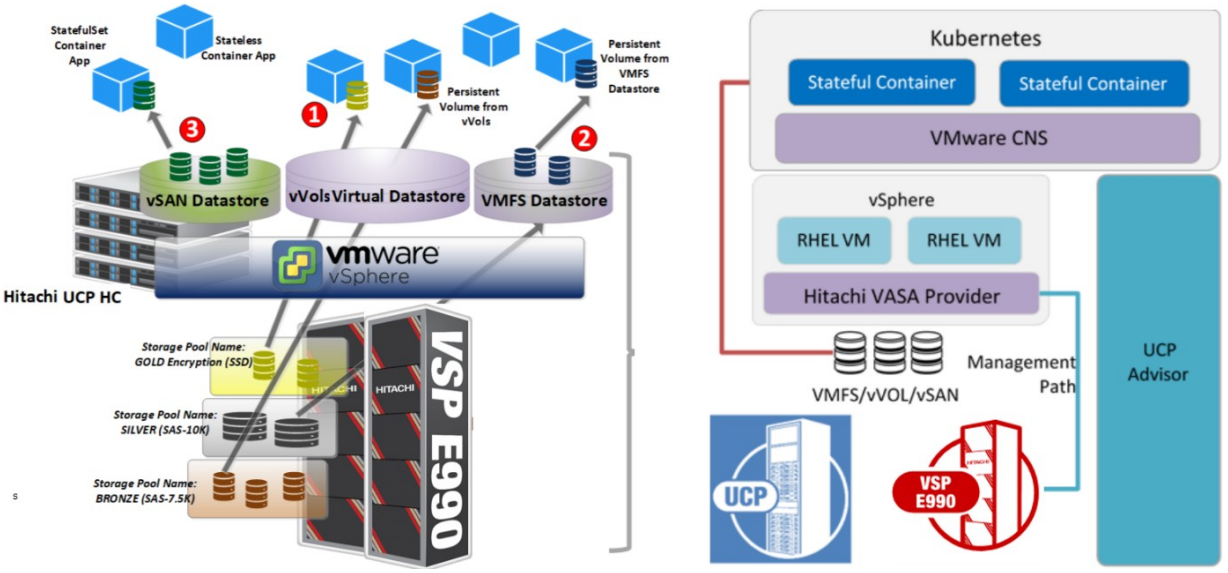


Kubernetes and Persistent storage Options with Hitachi VSP and UCP

Review the recently published multi-cloud container reference architecture which walks you through how to deliver and manage a VMware Tanzu-based container workload platforms as part of your evolving infrastructure. This paper demonstrates combining VMware VCF, TKGs, TMC, and vVols on VSP, vSAN, Velero, Hitachi UCP, and HCP to manage/protect on-premises Kubernetes clusters and workloads including persistent storage workloads. Previous to this, there was a good paper which covered Deployment Options for Kubernetes Container Applications on Unified Compute Platform CI with Hitachi VSP Series Reference Architecture Guide (PDF) for using persistent cloud native storage (CNS) for containers (vSAN, vVols, VMFS, and bare metal).

With the growth in containers, there will be the need for persistent storage for PostgreSQL databases as targets for those container services. These services will access their 'persistent data' through shared but probably sharded databases instances. Hitachi storage can provide persistent storage for these container services.

Additionally, you can take advantage of the additional work done to provide storage policy management for persistent storage for Kubernetes clusters, including Tanzu Kubernetes guest clusters, running on top of VMware vSphere to deliver the requested storage class capabilities at the vmdk level.



Referenced Infrastructure Products

These are the infrastructure products referenced in this guide from Hitachi Vantara.

Hitachi Virtual Storage Platform

Use Hitachi Virtual Storage Platform 5000 series, VSP E series, and VSP F series storage for an all NVMe or all flash-powered cloud platform for your mission critical applications. This storage meets demanding performance and uptime business needs.

Hitachi Virtual Storage Platform G series storage provides a hybrid media powered platform. It has a broad range of efficiency technologies that deliver maximum value while making ongoing costs more predictable. You can focus on strategic projects and consolidate more workloads while using a wide range of media choices.

Hitachi Storage Virtualization Operating System RF is at the heart of the Virtual Storage Platform F and VSP G series family. It provides storage virtualization, high availability, flash optimized performance, quality of service controls, and advanced data protection. This proven, mature software provides common features, management, and interoperability across the Hitachi portfolio. This means you can reduce migration efforts, consolidate assets, reclaim space, and extend product life.

Hitachi Unified Compute Platform

Hitachi Unified Compute Platform (UCP) is a converged system that provides the foundation for business transformation and IT modernization. It allows you to build a modern IT infrastructure than can host any application, at any scale, and at any location.

The Unified Compute Platform architecture consists of modular building blocks including VMware vSAN and external storage-based converged systems. Its components scale independently to provide you with greater configurability, flexibility, and agility. The solution may be configured to support traditional "systems of record" as well as cloud-native applications.

Hitachi Unified Compute Platform Advisor

Hitachi Unified Compute Platform Advisor (UCP Advisor) brings simplified IT administration to storage, converged, and hyperconverged systems and supports guided lifecycle management for the server, network, and storage elements within supported Unified Compute Platform systems.

it provides operational workflows for end-to-end provisioning of VMware ESXi hosts, bare metal hosts, datastores, and networking orchestration.

Hitachi Ops Center Protector (formerly Hitachi Data Instance Director)

Hitachi Ops Center Protector provides enterprise copy data management capabilities for VMware environments and uses automated intelligence to provide a layered SLA-driven modern data protection schema. It provides a managed snapshot offload-based solution for granular virtual machine backup, cloning and recovery, and automated management of multi-datacenter replications and supports VADP-based backup. It integrates with VMware vSphere tags to provide tag-controlled backup and copy data management capabilities.

Hitachi Ops Center Automator (formerly Hitachi Automation Director)

Hitachi Ops Center Automator provides configurable best-practice-based service templates for simple, application-specific provisioning of datacenter resources to databases, applications, and VDI environments. Built-in support for role-based access control means that, once established, these templates can be used to move to self-service provisioning.

For More Information

Hitachi Vantara Global Services offers experienced storage consultants, proven methodologies and a comprehensive services portfolio to assist you in implementing Hitachi products and solutions in your environment. For more information, see the Services website.

Demonstrations and other resources are available for many Hitachi products. To schedule a live demonstration, contact a sales representative or partner. To view on-line informational resources, see the Resources website.

Hitachi Academy is your education destination to acquire valuable knowledge and skills on Hitachi products and solutions. Our Hitachi Certified Professional program establishes your credibility and increases your value in the IT marketplace. For more information, see the Hitachi Vantara Training and Certification website.

For more information about Hitachi products and services, contact your sales representative, partner, or visit the Hitachi Vantara website.

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