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# IMPLEMENTING VMWARE VSAN ON HPE PROLIANT SERVERS WITH VMWARE VSPHERE

Best practices and general build information for deploying and configuring VMware vSAN with vSphere 7.0 on the HPE ProLiant platform

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# INTRODUCTION

VMware vSAN™ provides a software-defined storage solution that supports the storage needs of virtual machines in a VMware vSphere® cluster and provides support for key vSphere capabilities such as VMware vSphere® vMotion®, VMware vSphere® High Availability (vSphere HA), and VMware vSphere® Distributed Resource Scheduler™ (DRS). vSAN aggregates the local server storage of multiple HPE ProLiant servers within a vSphere cluster into a shared storage pool that is available to all hosts within that vSphere cluster. Hard disk drives (HDDs) and flash-based storage, such as solid-state drives (SSDs), PCIe accelerators, and NVMe storage from servers in a vSAN-enabled vSphere cluster contribute to the performance and capacity of the vSAN solution.

**NOTE**
For the remainder of this paper, flash-based storage will be generalized and referred to as SSDs.

This paper focuses on the requirements for a successful vSAN implementation on HPE ProLiant servers with vSphere 7.0. For earlier versions of vSAN, please refer to this white paper. When planning a vSAN implementation, consider the configuration and support restrictions discussed in this paper. Additionally, this paper assumes that you are familiar with vSphere and HPE ProLiant servers.

# VMWARE VSAN OVERVIEW

VMware vSAN, as its name implies, provides an alternative to traditional shared storage solutions, such as iSCSI, Fibre Channel, and

Fibre Channel over Ethernet (FCoE), by utilizing the local storage available to each HPE ProLiant server in the vSphere cluster. vSAN enables you to seamlessly extend virtualization to storage, creating a hyperconverged solution that simply works with your existing tools, skillsets, software solutions, and hardware platforms. Operations become easier with fewer tasks and intelligent automation that can be managed through one tool and a unified team, allowing you to respond to business demands faster and more intelligently. vSAN also helps enterprises prepare for tomorrow's IT demands—whether expanding to the public cloud or rapidly deploying the latest flash and server technologies.

## High availability

vSAN high availability is addressed by replicating the data to one or more additional hosts within the vSAN-enabled cluster. In addition to acting as read/write cache, the SSDs in the caching layer also support the vSAN replication activities by acting as the initial write copy target for the replicated data.

vSAN provides the ability for an administrator to define the number of complete mirror copies of data, referred to as replicas, within the vSAN cluster. The administrator defines the desired number of replicas on a per-VM basis, which provides the flexibility to adjust the desired level of protection based on the criticality of the VM data.

## Data access

When configuring vSAN, vSphere administrators define disk groups in the vSphere Client. Up to five disk groups can be configured on a VMware ESXi™ host in a vSAN cluster with each disk group being comprised of one caching tier SSD and up to seven-capacity tier HDD/SSD. Each disk group contributes to a vSAN shared datastore, which are utilized to store virtual machine objects such as virtual disks, configuration files, and snapshots.

The data on a vSAN datastore is accessed in one of two methods. If the requested data is local to the host, then the I/O is serviced directly from the local disks. However, if the data is remote, then the data is read from or written to the remote host over the Ethernet network.

In a hybrid configuration, the SSDs in the caching tier form a caching layer with 70% dedicated for read cache and 30% for write buffer. In an all-flash configuration, the caching tier only serves as a write buffer while the capacity tier is used for reading cache and storing data. The read cache keeps a list of commonly accessed disk blocks in order to reduce I/O read latency. If the requested block is not in cache, it is retrieved directly from the capacity layer. Important to note is that a host can access the read cache of any of the hosts in the same cluster. vSAN maintains a directory of cached blocks that can be referenced to find the requested block and then retrieved over the vSAN network.

Write operations go into the write buffer first and later de-staged to the disks in the capacity layer. When a write is initiated, it is sent to the local cache on the host and additionally to the write cache on one or more remote hosts. In the event of a failure, this ensures a copy of the data is available. Once those writes land on both hosts, the write operation is acknowledged back to the application. The data then is de-staged to the capacity layer at regular intervals.

### Scale-out storage

As new HPE ProLiant servers are added into a vSAN cluster, the potential capacity of existing shared datastores is increased. Up to 32 nodes can be added into the cluster in vSAN 5.5, which matches the number of hosts supported in a vSphere cluster. vSAN 6.0 onward supports up to 64 nodes per cluster.

In addition to extending existing shared datastores, scaling is possible by creating new datastores through the addition of new hosts into the cluster, by adding additional disks into existing members of the cluster, or by performing a combination of those two options. Depending on the vSphere administrator preference, the configuration and addition of the new storage can be performed automatically by VMware vCenter Server® or manually by the administrator.

### Limitations

As discussed previously, vSAN supports shared datastores and key vSphere capabilities such as VMware vSphere vMotion, vSphere High Availability (vSphere HA), and vSphere Distributed Resource Scheduler. However, there are some limitations that should be considered, when determining the appropriate storage solution for your environment. The following list describes key limitations:

- vSAN does not support Distributed Power Management (DPM).
- Based on the cluster size, disk group, and disk count restrictions, there is a physical limit to the capacity support of a vSAN configuration.
- vSAN and VMware NSX® can co-exist on the same vSphere infrastructure but NSX does not support vSAN network traffic.
- vSAN requires a minimum of three vSphere hosts in each standard vSAN cluster, or 2 hosts and a witness appliance in a 2-node vSAN cluster.
- vSAN storage is only available to the hosts within the vSAN cluster.
- Up to 100 VMs per host in vSAN 5.5. Up to 200 VMs per host vSAN on 6.0 onward (Refer VMware vSphere Configuration Maximums page).
- Blade systems with direct attached storage systems are supported on vSAN 6.0 onward. This support does not exist in vSAN 5.5.

## VSAN ENABLEMENT PROCESS

vSAN enablement process (Figure 1) provides an overview of the process for successfully enabling a vSAN cluster. These steps provide a high-level overview of the planning and implementation process. It is highly recommended to review the VMware® technical white paper, "What's New with vSAN 7."

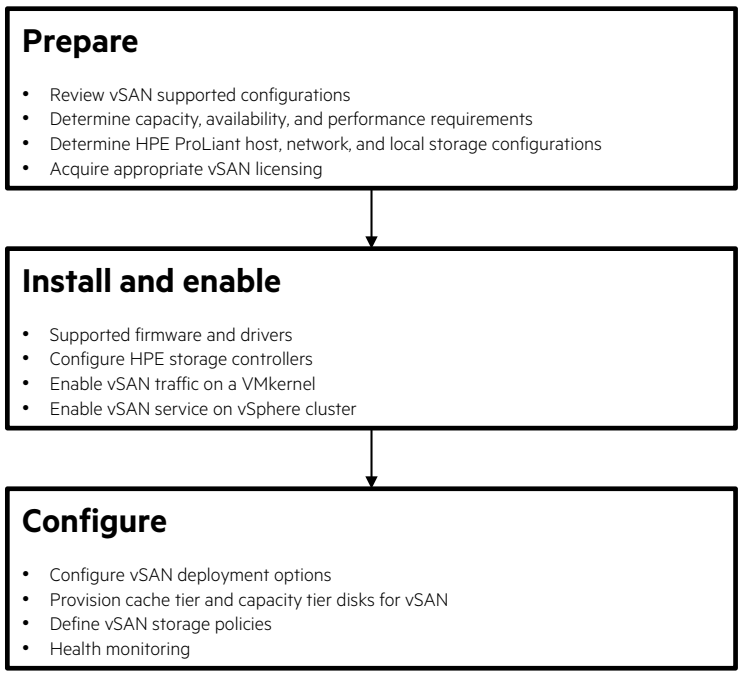


**FIGURE 1.** vSAN enablement process

## Prepare

Determining the hardware components and physical configuration for a vSAN implementation is not a trivial task. Many factors need to be considered. This section provides an overview of the planning steps required to implement a supported vSAN configuration, highlights unique factors to consider for HPE solutions, and provides references to additional resources.

The following steps define a rough outline and recommended steps to successfully implement a vSAN configuration. It will become clear as the administrator performs the steps that the factors and requirements discussed in each step have multiple interdependencies that influence each other. In most cases, it will be an iterative process to finalize the configuration.

1. **Review possible options for building a supported configuration:** To implement a fully supported vSAN configuration, a vSAN ReadyNode configuration can be implemented. Or a custom configuration (Build Your Own based on Certified Components) can be defined if the following requirements are met:
   - HPE ProLiant server is listed on the VMware Compatibility Guide for Systems/Servers with support for the targeted ESXi release.
   - HPE ProLiant server supports the targeted storage controller and drives. This can be determined by working with an HPE sales representative.
   - Storage controllers, HDDs, and SSDs are listed on the VMware vSAN Compatibility Guide. The VMware Compatibility Guide

   (VCG) has specific hardware listed along with their supported firmware and drivers. VMware is emphasizing the importance of following the VCG to avoid issues stemming from unsupported configurations.

### vSAN-certified solutions

HPE has certified several vSAN ReadyNode configurations. HPE vSAN ReadyNodes are certified combinations of HPE ProLiant servers,

RAID/Storage controllers, NICs, and drives specific for vSAN usage. These configurations are categorized into ReadyNode Profiles based on VMware vSAN Hardware Quick Reference Guide. This guide provides a reference for selecting the right ReadyNode server for your environment.

To build your own server configuration, HPE server components have been certified and listed on the VMware Compatibility Guide. See the “Build Your Own based on Certified Components” section of the VCG.

Refer to the VMware vSAN Compatibility Guide to get the latest list of vSAN certified offerings.

2. **Size and define the characteristics of the vSphere cluster:** Initially, the traditional planning exercises required to define the compute, memory, and networking requirements of a vSphere cluster should be completed. At the end of this step, a rough number of ESXi hosts, their CPU and memory configuration, and the physical and virtual networking should be defined. In addition, the virtual machines/application storage capacity and storage performance requirements along with their I/O profile should be well understood. The configuration defined in this step should be viewed as a starting point, which will likely be altered when the vSAN requirements and needs are considered. See VMware TCO Comparison Calculator.
   - A minimum of three hosts are required for standard vSAN cluster, although in a 2-node cluster you can have two hosts with an external witness. A vSAN Witness Host is a dedicated ESXi host (may be a physical ESXi host or vSAN Witness Appliance), whose purpose is to host the Witness component of vSAN objects. Refer to VMware’s 2 node cluster guide for more information. This minimum configuration only allows for a single host failure. HPE recommends having four or more hosts for additional availability options (failures, maintenance, and so on).
   - The minimum memory requirement for a host can be calculated by referring to this article.
   - vSAN supports 1 Gb, 10 Gb, 25 Gb, 40 Gb, and 100 Gb NICs. For hybrid configurations, a 1 Gb network is supported when dedicated for vSAN traffic but HPE recommends at least 10 Gb. For all flash configurations, only 10 Gb or higher network is supported due to the increase in network traffic.
   - Load balancing is not supported for vSAN network traffic. However, it is recommended to include more than one adapter and to use NIC teaming to provide redundancy. This means configuring physical NICs in an active/standby configuration.
   - vSAN requires multicast traffic be enabled on the Layer 2 network between ESXi hosts in a cluster. Layer 3 multicast is not required.
   - USB and SD devices are supported as ESXi boot devices in vSAN but must be paired with another disk for OS data. Please refer to ESXi’s boot device requirements here.

3. **Size and define the characteristics of the vSAN configuration:** Capacity, performance, and availability requirements for storage, VMs, and networking are the primary factors to consider in this step. The VMware vSAN Design and Sizing Guide provides a detailed analysis of each of the factors and provides formulas to assist in the planning process.

   Information to take into account during the planning exercises in this step:

   - If ESXi will be installed on a local disk, that disk cannot be utilized for a vSAN disk group. Any RAID level supported by the storage controller can be used on the install disk(s).
   - It is not required for all ESXi hosts in the cluster to contribute storage to the vSAN cluster; however, a minimum of three hosts must contribute storage in a standard vSAN cluster.
   - Achieving optimal performance depends on the I/O load. VMware recommends ensuring that the storage controllers have a queue depth of at least 256.
   - vSAN supports storage controllers in two modes: either pass-through mode or RAID 0 mode. Pass-through mode is also commonly referred to as HBA mode.
   - vSAN supports multiple HPE controllers on a single host. This allows for disk configurations beyond the limit of a single controller.
   - HPE SAS expanders are supported with vSAN with maximum of 26 drives.
   - HPE recommends having the cache size of the vSAN datastore be at least 10% of the anticipated consumed capacity. This ratio should be calculated before the number of failures to tolerate setting is considered. This applies to both hybrid and all-flash configurations.
   - Up to five disk groups can be configured on an ESXi host in a vSAN cluster with each disk group being comprised of one caching tier SSD and up to seven-capacity tier HDD/SSD.
   - With the limitation of one caching tier SSD per disk group, HPE recommends having multiple disk groups to improve performance and to protect against failure.
   - SSDs are categorized by their endurance and performance classes. HPE offers a variety of vSAN certified SSDs (SAS, SATA, NVMe, and PCIe). See VMware's VCG here.

   At the end of this step, the questions below should be answered, and the initial design adjusted accordingly:

   - How many shared datastores are required and what are the minimum raw capacity requirements for each of those?
   - What is the desired caching-to-capacity disk ratio?
   - How many VMs can be supported by the cluster and per host?
   - What is the expected host CPU and memory overhead for vSAN processing?
   - What are the networking requirements for vSAN?
   - What is the minimum number of ESXi hosts required?

4. **Define the hardware configuration:** In this step, the ESXi host compute, memory, and storage requirements should be mapped to hardware. As mentioned in step 1, the VMware Compatibility Guide should be referenced to determine the supported hardware with vSAN. Keep in mind that depending on the HPE ProLiant server and drive tray configuration, the number of physical disks that can be supported by each system will vary. See VMware vSAN Hardware Quick Reference Guide for more information. HPE supports vSAN configurations with both HPE Smart Array controllers and Smart Host Bus Adapters (HBAs).
5. **Procure appropriate vSAN licensing:** vSAN licenses have a per CPU socket capacity. When a license is applied to a cluster, the total number of CPUs in the participating hosts count toward that license capacity. See VMware's vSAN Licensing Guide for additional information.

## Install and enable

Firmware and drivers: To ensure you are running a supported vSAN configuration, update the drivers and firmware on the storage controllers, SSDs and/or HDDs to match the supported versions listed on the VMware vSAN Compatibility Guide.

See HPE white paper on Deploying and updating VMware vSphere on HPE ProLiant Servers.

Storage controllers: Before enabling vSAN, the storage controllers must be configured in either pass-through or RAID 0 mode. VMware recommends running in pass-through mode when possible so that the hypervisor is given direct access to the physical disks. vSAN can then set up a distributed configuration across all hosts in a cluster. In RAID 0 mode, single disk RAID 0 sets will need to be configured for each disk using HPE Smart Storage Administrator. In this case, vSAN will not manage hot-plug operations (instead relying on the storage controller's software to manage that), and local SSDs will need to be tagged as SSD before they can be claimed in vSAN. HPE SSA can be used to configure the RAID 0 sets. HPE Smart Storage Administrator CLI is also supported and can be used:

Create a single disk RAID 0 set:

```
# esxcli ssacli cmd -q "ctrl slot=<slotnumber> create type=ld drives=<driveaddress> raid=0"
```

For more information about SSACLI, see the HPE VMware Utilities User Guide.

Additionally, in RAID 0 mode, it is recommended to configure the storage controller cache for 100% read cache.

```
# esxcli ssacli cmd -q "ctrl slot=<slotnumber> modify cacheratio=100/0"
```

This effectively disables write caching to minimize conflicts with vSAN's caching layer. In RAID 0 mode, there are two supported vSAN Smart Array configurations that can be configured using SSACLI commands:

1. Lower q-depth writes—generally Smart Array default (disables drive write cache):

```
# esxcli ssacli cmd -q "ctrl slot=<slotnumber> modify dwc=disable"
```

2. High q-depth writes (enables drive write cache):

```
# esxcli ssacli cmd -q "ctrl slot=<slotnumber> modify dwc=enable"
```

**Networking:** The vSAN service must be enabled on a VMkernel port for each host. HPE recommends dedicating a VMkernel to vSAN traffic and separating it from the management traffic. This happens automatically if the vSAN toggle is checked when creating a new cluster.

If vMotion, Storage vMotion, or HA is desired on the cluster, an additional VMkernel port is needed. vSAN traffic requires a 10 Gb or faster network, and standard switches are supported but VMware vSphere® Distributed Switch™ are recommended.

**Enable vSAN on a cluster:** When creating a new cluster in vSphere, check the vSAN radio button.

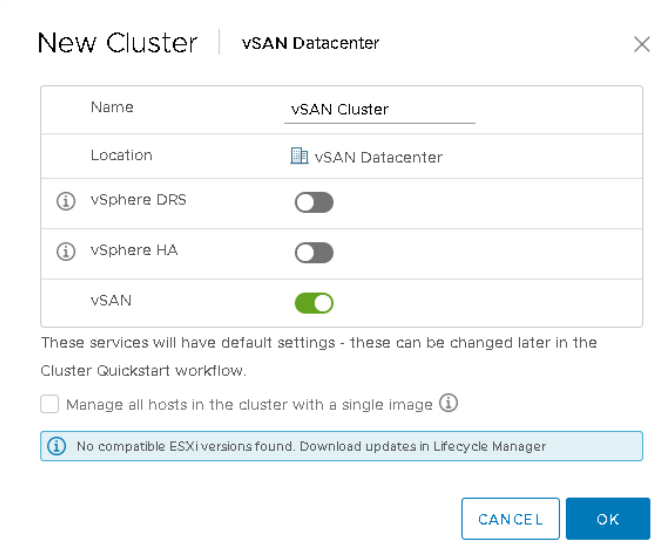


**FIGURE 2.** Creating a new cluster with vSAN enabled

Next, add ESXi hosts (by hostname or IP) that are going to be a part of the vSAN datastore to the cluster. Once the hosts are added, the vSAN configuration wizard will open.

## Configure

1. The first step is to configure a distributed switch. There is an option to create a new distributed switch or use an existing one. A new port group will be created on each host in the cluster using selected distributed switch. A new VMkernel port with the vSAN service enabled will also be automatically created on each host within the cluster to facilitate the flow of vSAN related traffic.

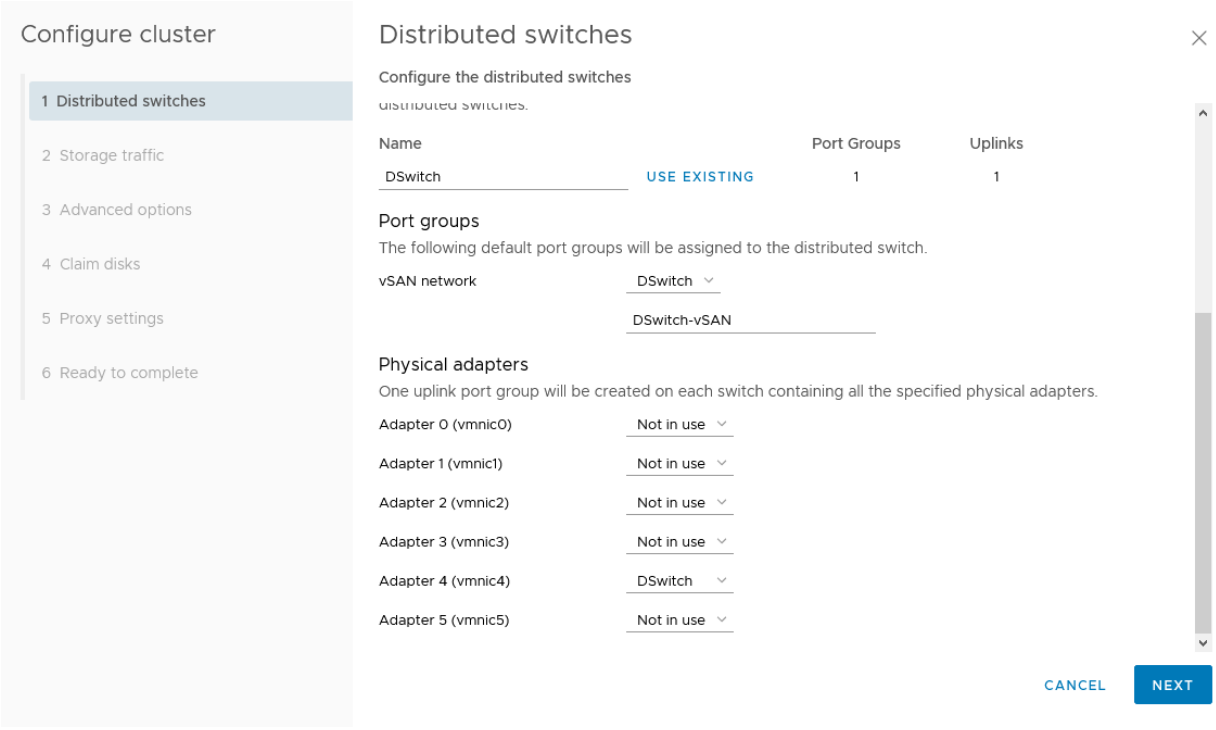


**FIGURE 3.** Configuring distributed switches

2. On the **Storage traffic** screen, check the VLAN box and specify the VLAN ID to use a separate VLAN for vSAN traffic. Otherwise, leave the box unchecked. For protocol, select IPv4 (default) and select DHCP as the IP type in IPv4 configuration and click Next.

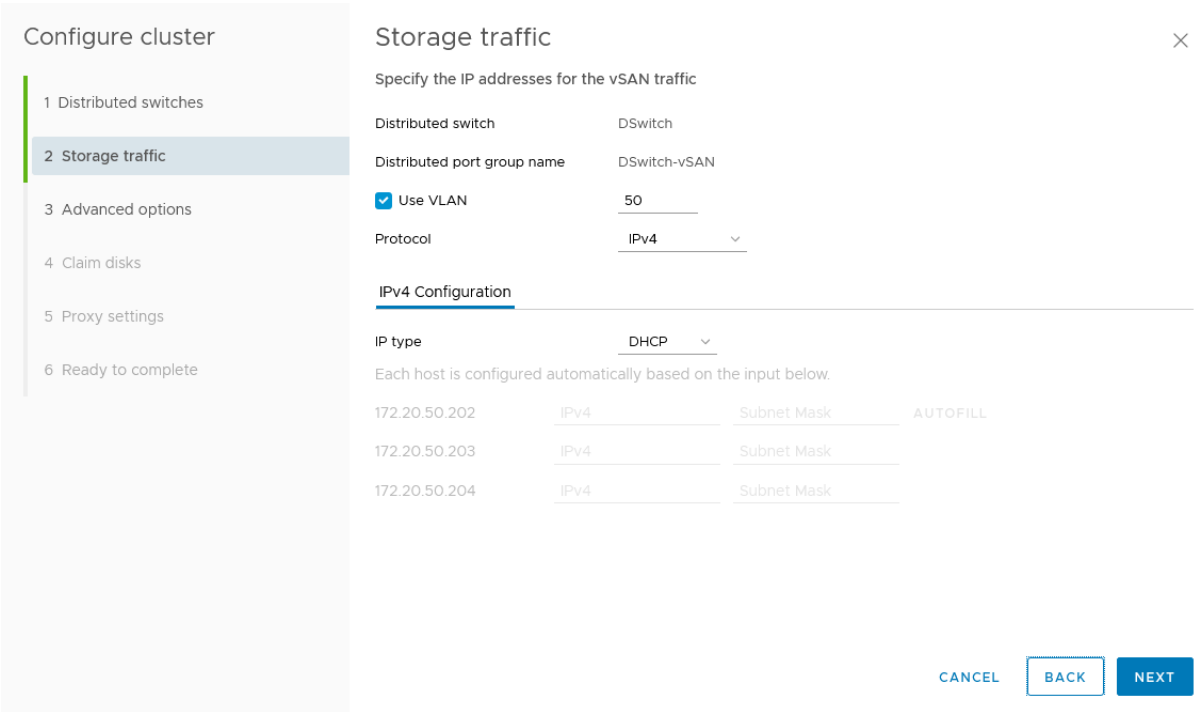


**FIGURE 4.** Configuring storage traffic

3. The **Advanced Options** screen allows customization of vSAN options, host options, and has a toggle for Enhanced vMotion compatibility. In vSAN options, select a deployment type (single site, stretched, and so on) based on the structure of the deployment.

Deduplication and compression are available on vSAN 6.2 onward. These two space efficiency techniques are only available for all-flash configurations. They are enabled together at the cluster level and cannot be enabled individually. Deduplication occurs when data is de-staged from the caching tier to the capacity tier and is performed within each disk group. Redundant blocks across multiple disk groups will not be deduplicated. Compression is then applied after the deduplication has occurred but before the data is written to the capacity tier. For more information, see VMware's vSAN 6.2 Space Efficiency white paper.

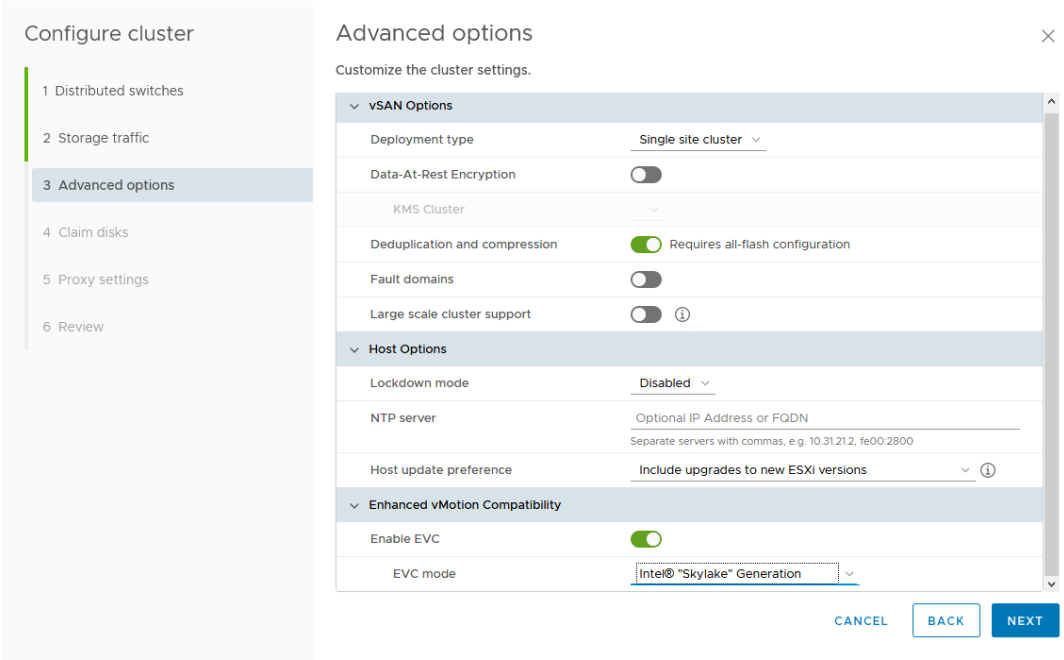


**FIGURE 5.** Configuring advanced options

4. On the **Claim disks** screen, claim the available disks as cache or capacity tier. To avoid warnings and errors, ensure that each host has a balanced configuration consisting of a cache tier and one or more capacity tier disks. If there is more than one disk model, choose the high speed, write intensive disks for cache tier. Once the disks are claimed correctly, a "Configuration correct" dialog box will be displayed at the bottom of the screen. When satisfied with the configuration, click Next.

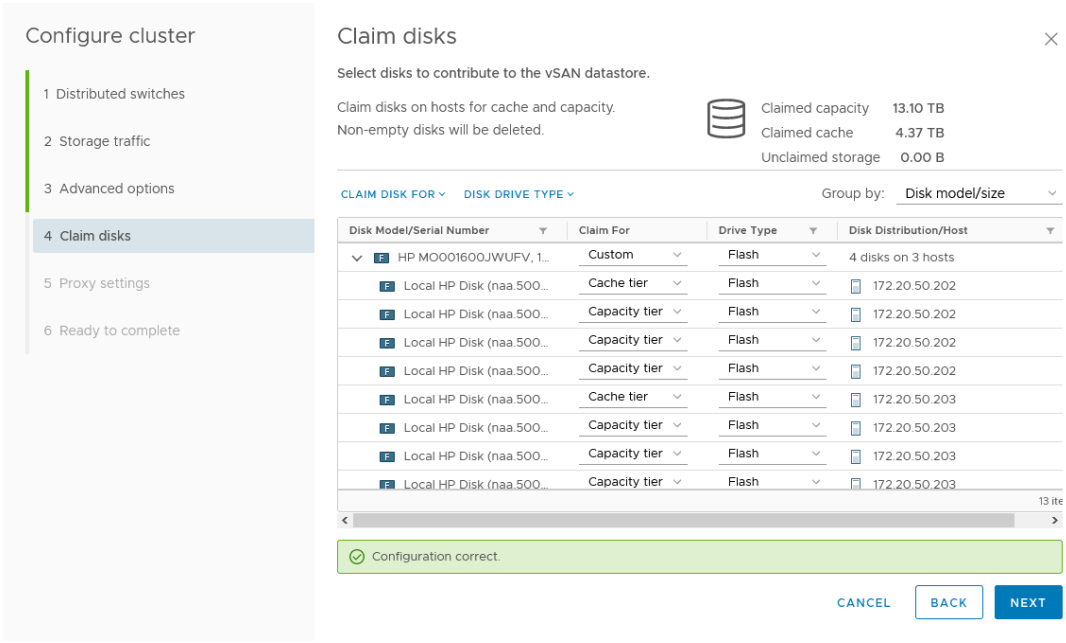


**FIGURE 6.** Claiming disks

5. On the Proxy settings screen, enter requisite details pertaining to the proxy server used in the environment, if any, and click Next.

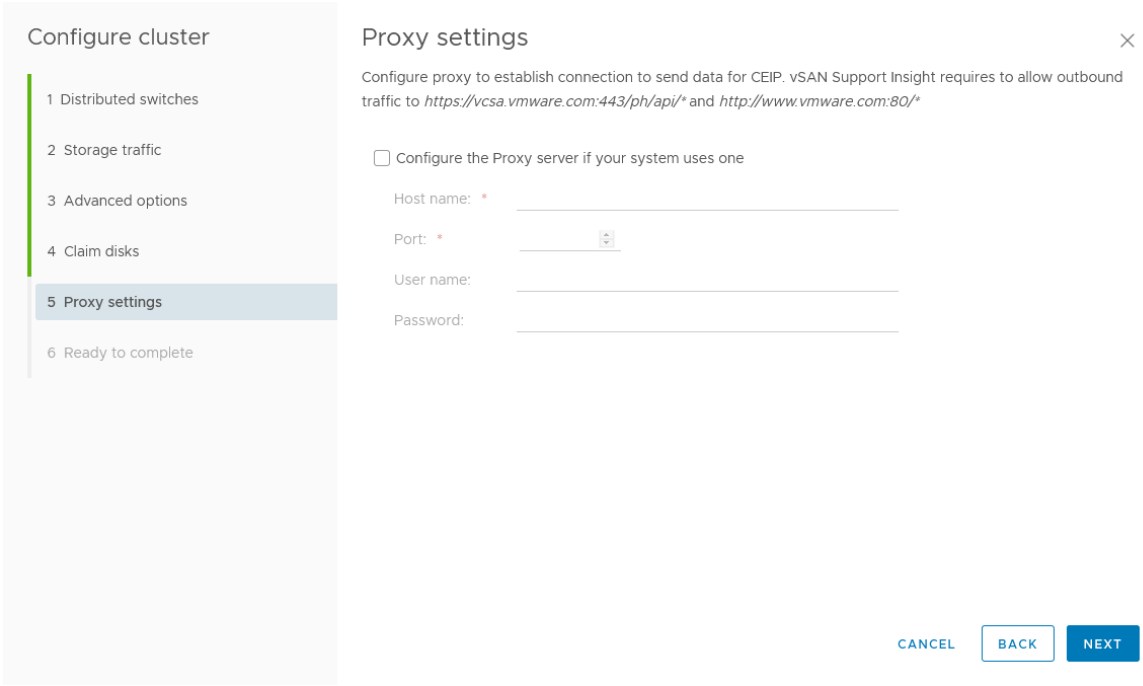


**FIGURE 7.** Proxy settings

6. On the **Review** screen, review the specified options and click Finish to apply the specified configuration settings.

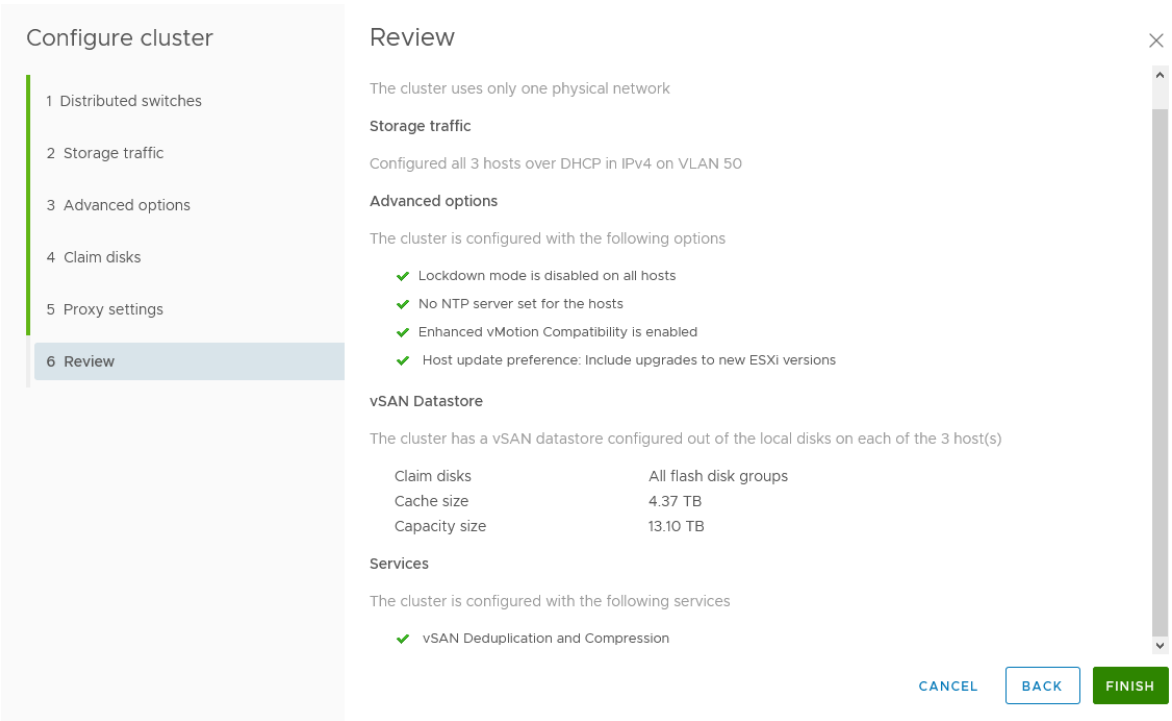


**FIGURE 8.** Cluster configuration review

## STORAGE POLICIES

vSAN relies on storage policies to define Virtual Machine storage requirements. Define the storage policies based on VM

performance and availability requirements. When you enable vSAN on a cluster, a default vSAN policy is created and applied to the aggregate datastore. There are several settings that can be defined within a policy including the number of failures to tolerate, which allows a virtual machine to survive a few hardware failures in a cluster.

To add a new storage policy, Go to Menu > Policies and Profiles > Create VM Storage Policy. This will open a new Storage Policy Wizard.

1. On the Name and description screen, select an instance of vCenter Server and add a name and description for the storage policy.

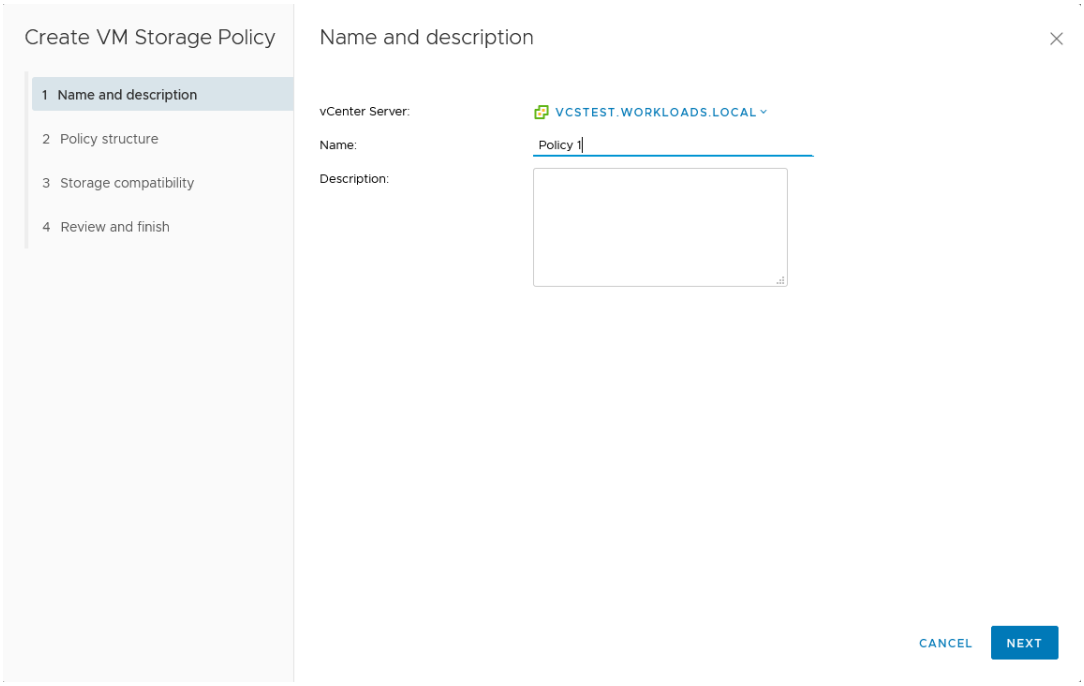


**FIGURE 9.** VM Storage Policy: Name and description

2. On the Policy structure screen, enable Host based rules and rules for vSAN storage.

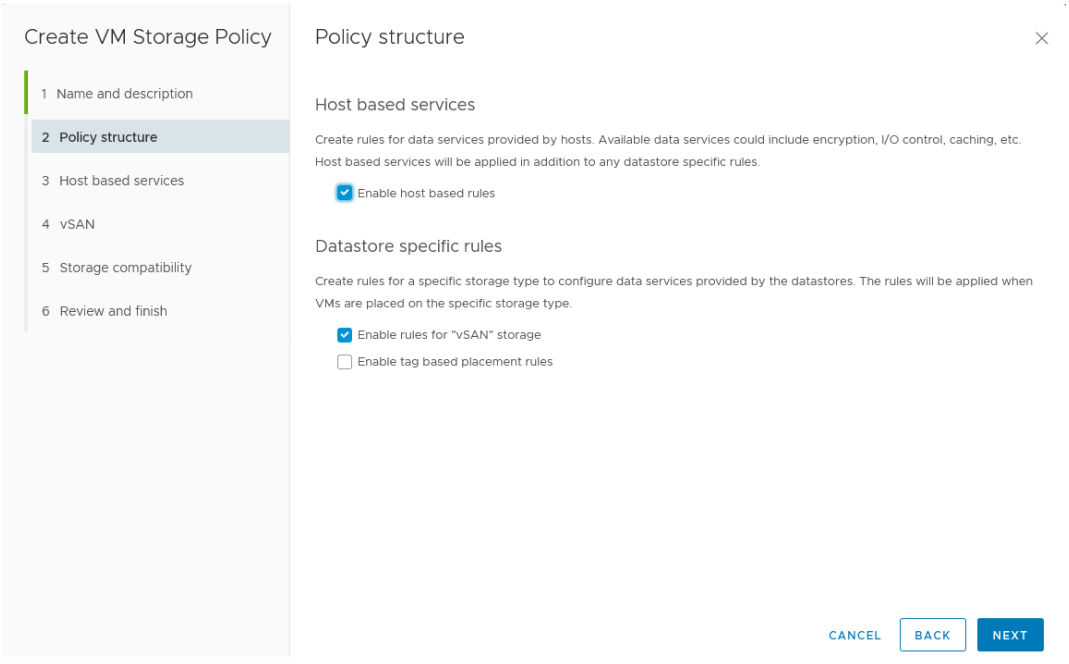


**FIGURE 10.** VM Storage Policy: Structure

3. On the Host based services screen, under Encryption, set use storage policy component to Default Encryption Properties.

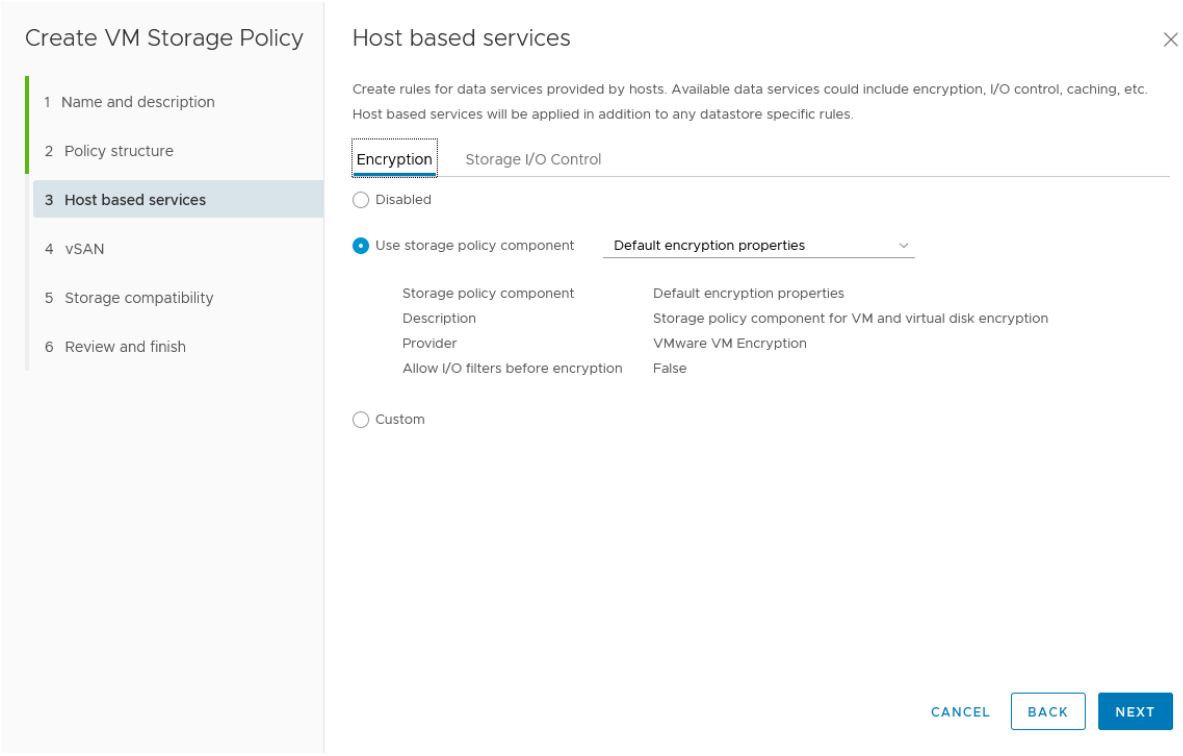


**FIGURE 11.** VM Storage Policy: Host based services

4. On the vSAN screen, the Availability tab offers options for Site disaster tolerance and Failures to tolerate. Set these according to requirements.

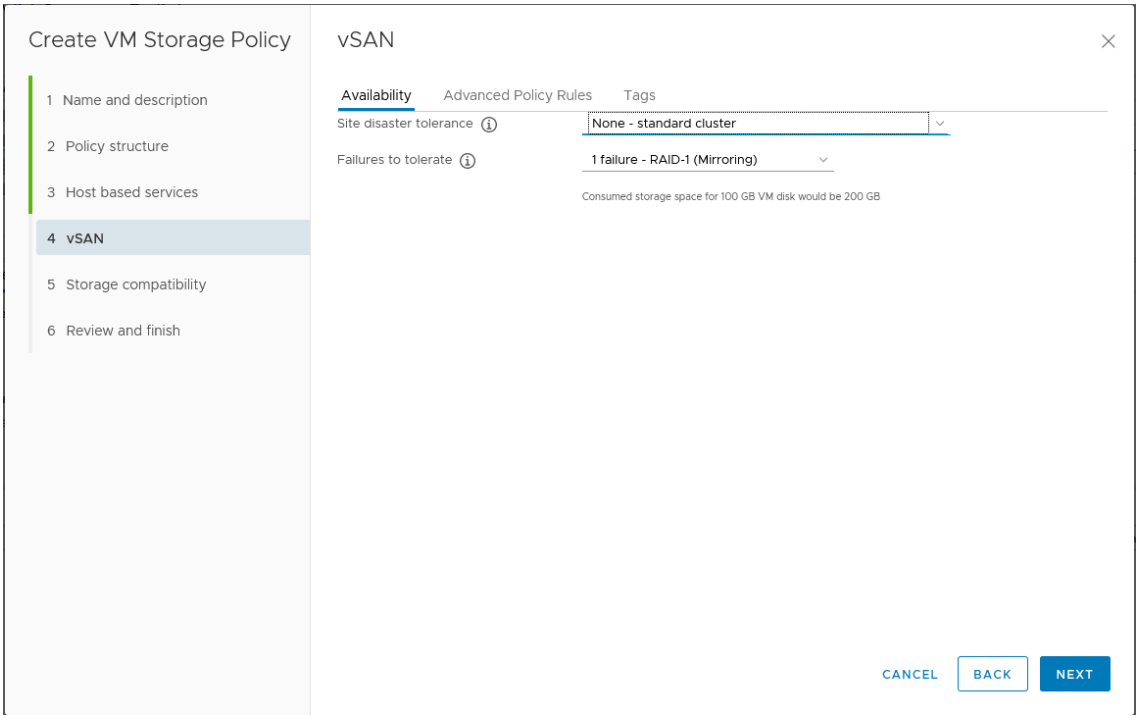


**FIGURE 12.** VM Storage Policy: vSAN Availability options

5. On the vSAN screen under the Advanced Policy Rules tab provides configuration options for advanced settings like Number of disk stripes per object, IOPS limit, and so on. There are toggles to enable Force provisioning, which will allow the provisioning of virtual machines with a policy that cannot be met by the current vSAN cluster resources and to disable object checksum. Configure these policies as required by the deployment.

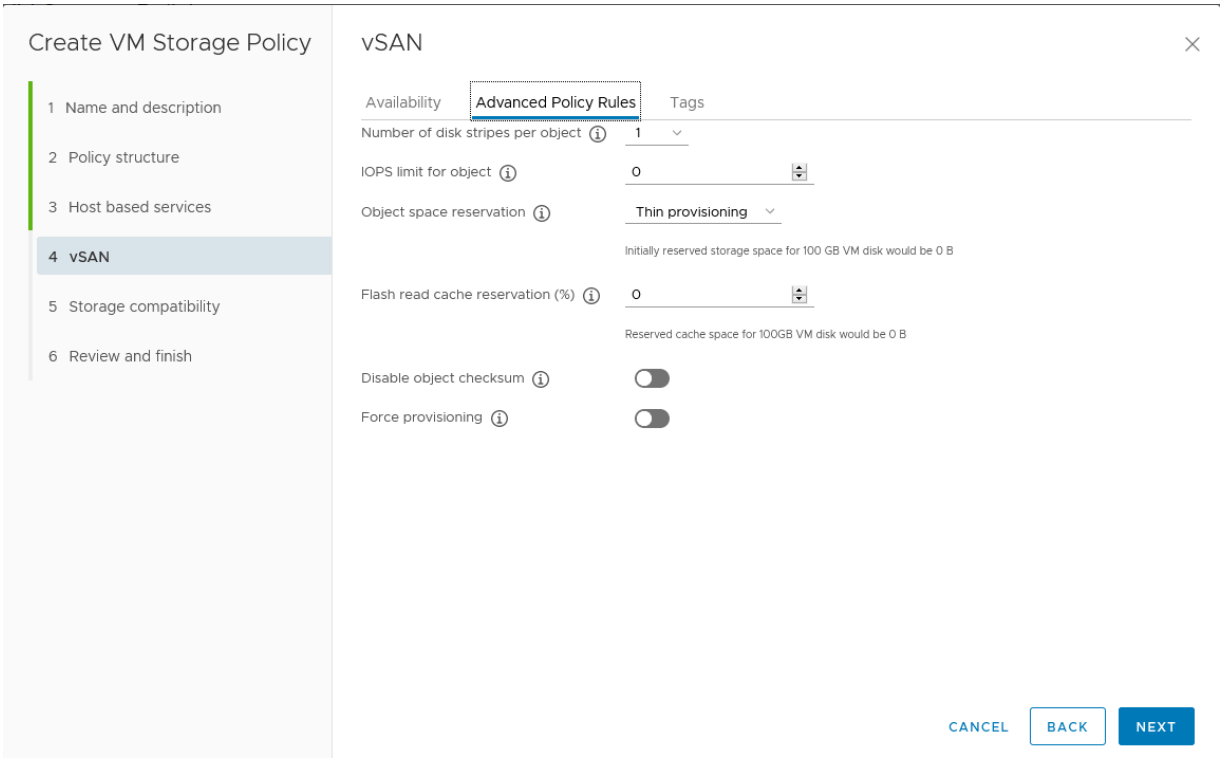


**FIGURE 13.** VM Storage Policy: vSAN Advanced policy rules

6. The Storage compatibility screen will list all vSAN Datastores that are compatible with the settings chosen in the new vSAN policy.

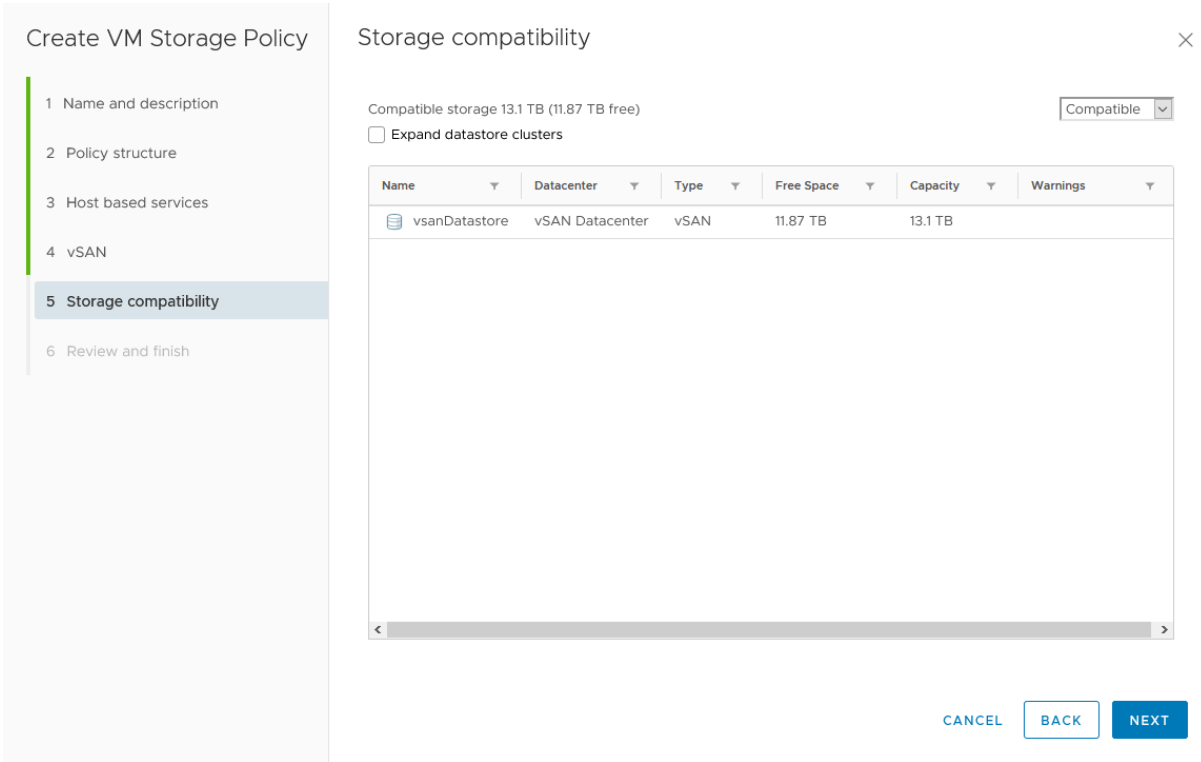


**FIGURE 14.** VM Storage Policy: Storage compatibility

7. Review the policy settings on the Review and finish screen and click Finish to create the policy.

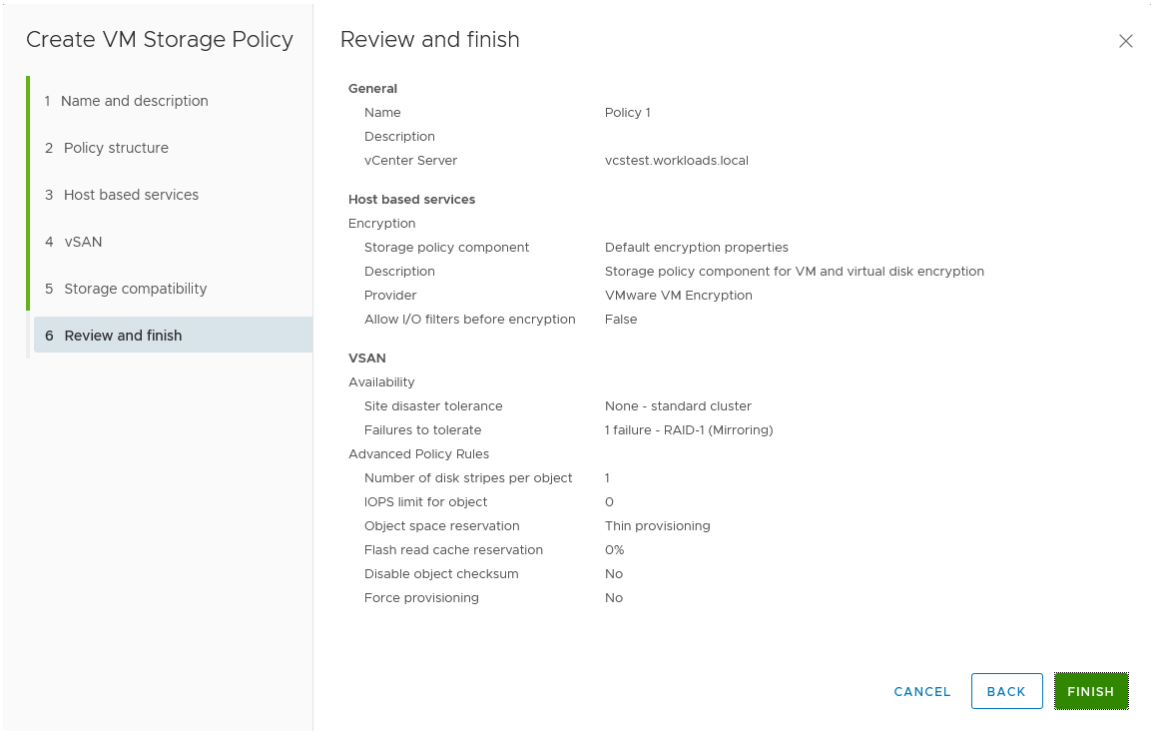


**FIGURE 15.** VM Storage Policy: vSAN review and finish

Once defined, policies can be applied when a VM is being created within the cluster. Alternatively, virtual machines can be assigned to the policy by editing their settings. If no policy is specified, the default policy will be applied with the following key parameters:

- Number of failures to tolerate = 1
- Number of disk stripes per object = 1
- Flash-read cache reservation = 0%
- Object space reservation = Not used
- Force provisioning = Disabled

## Health monitoring

VMware has introduced the ability to monitor the health of a vSAN cluster since vSAN 6.0. It runs several checks on the networking configuration, physical disks, and the vSAN cluster configuration.

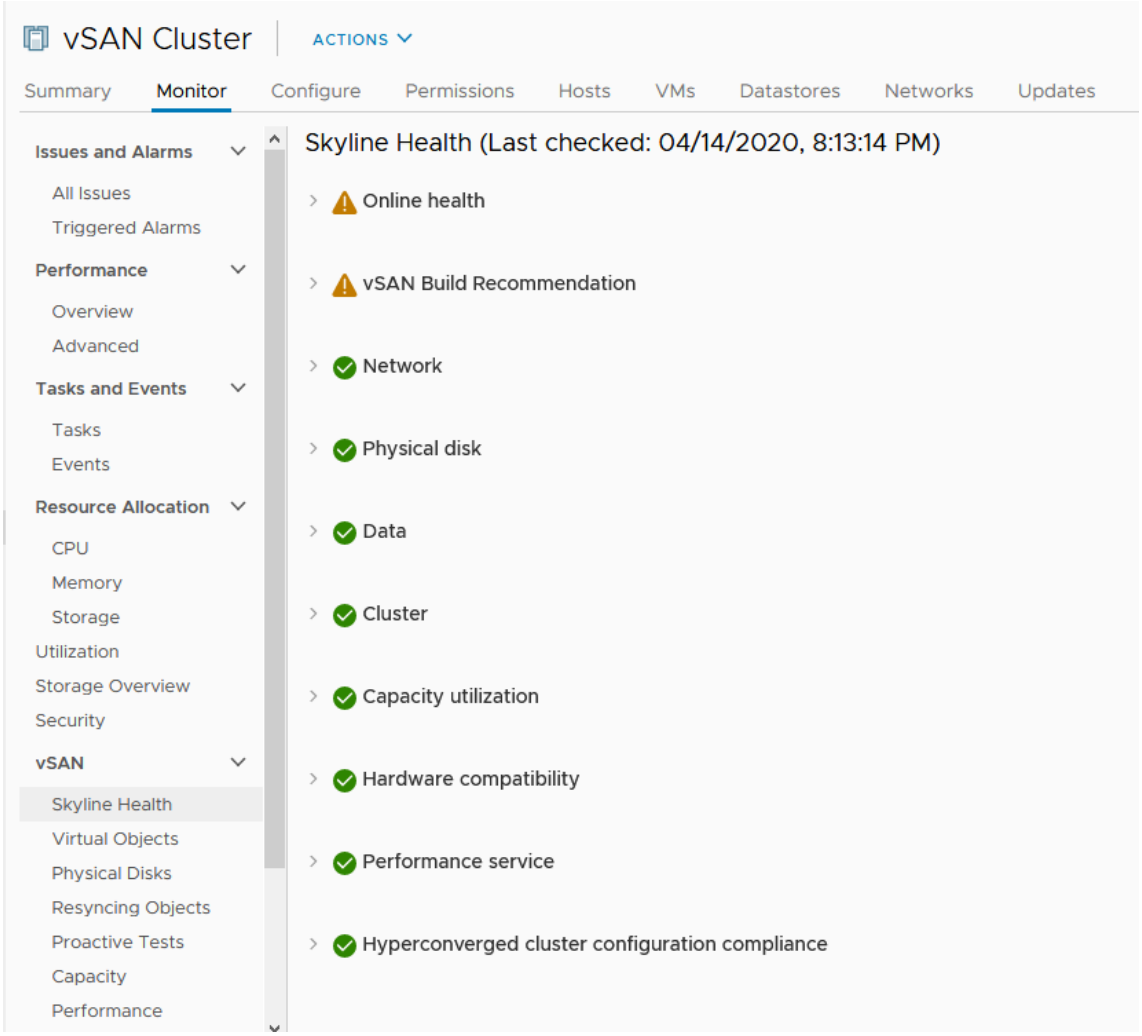


**FIGURE 16.** vSAN cluster health monitoring

One of the most useful aspects of this feature is the ability to ensure the hardware configuration is supported. The hardware can be checked against the VMware vSAN Compatibility Guide (either online or via uploading a copy of the VCG database). After the initial scan, the health monitoring service will continue monitoring the cluster on an ongoing basis and will highlight any issues found in the cluster.

## Lifecycle management with vLCM

vSphere Lifecycle Manager is the next version of Update Manager that enables centralized, automated patch and version management for VMware vSphere. It offers support for VMware ESXi hosts, virtual machines, and virtual appliances. With vSphere Lifecycle Manager, a user can upgrade and patch ESXi, and update third-party software on hosts. vSphere Lifecycle Manager can also perform firmware updates on hosts in addition to OS, drivers, and software updates.

The HPE Hardware Support Manager (HSM) plug-in for VMware vSphere Lifecycle Manager integrates with HPE iLO Amplifier Pack and allows users to update server firmware and drivers in the same maintenance window as the ESXi server Operating System updates, with a single reboot if possible.

## DEPLOY AND CONFIGURE THE HPE HSM PLUG-IN (HPE ILO AMPLIFIER PACK)

The first step is to install and configure the HPE HSM in VMware vCenter®

1. Download and deploy the HPE iLO Amplifier Pack and power on.
2. Log into the HPE HSM.
3. On the left menu select vLCM HSM Registration.
4. Click Add vCenter and input your vCenter server information.

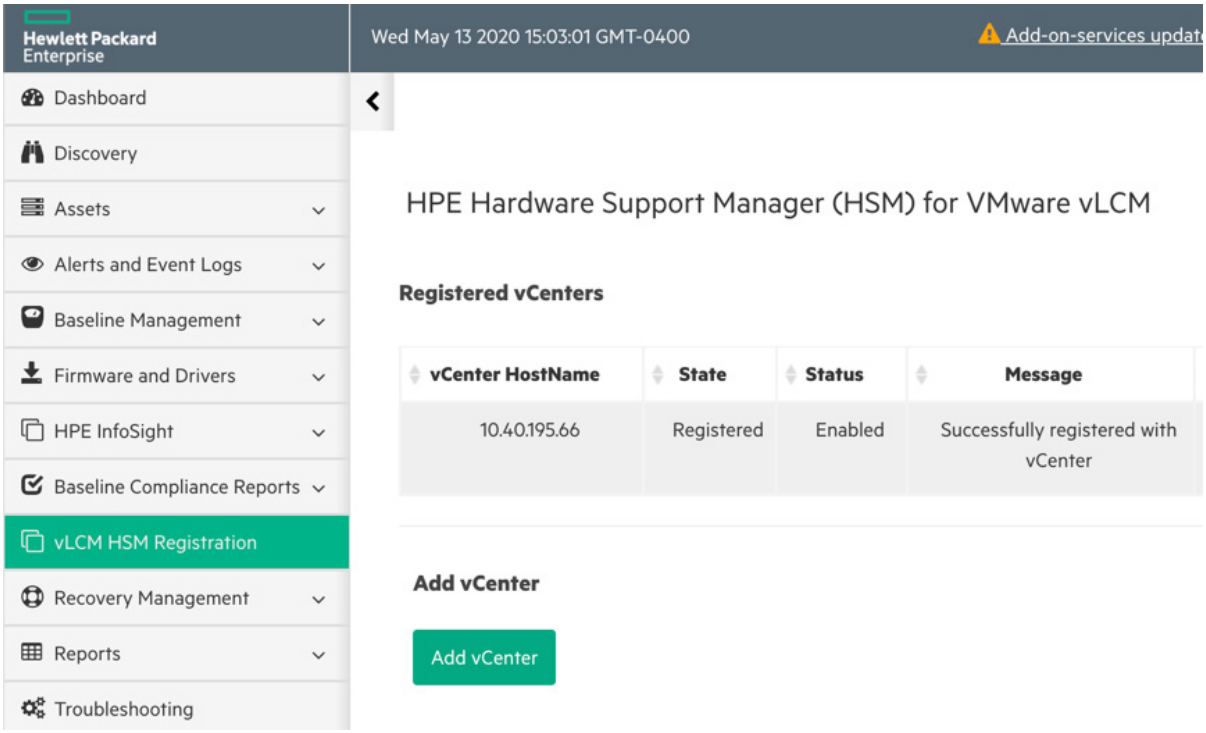


**FIGURE 17.** Deploying and configuring HPE HSM

### Import a Baseline

1. From the left menu select Baseline Management then Firmware Baseline.
2. Click Import Baseline.
3. Click to select Network Share (NFS), HTTP/HTTPS, or File Upload from the Import Type menu.
4. Do one of the following:
   - For Network Share (NFS), enter the IPv4 or IPv6 address, mount path, and storage path.
   - For HTTP/HTTPS, enter the HTTP or HTTPS URL to the ISO image. This URL can be an IPv4 or IPv6 address.
   - For File Upload, click Choose File to open the file explorer and choose the baseline stored on your local drive.
5. Click Import to import the ISO image or click Cancel to return to the Firmware Baseline page.
6. The import progress can be seen on the Jobs Status page.
7. Once the import completes, the baseline is listed on the Firmware Baseline page, along with the following information:
   - Filename of the .ISO file
   - Name of the baseline
   - Version
   - Status of the import
   - File size in MB

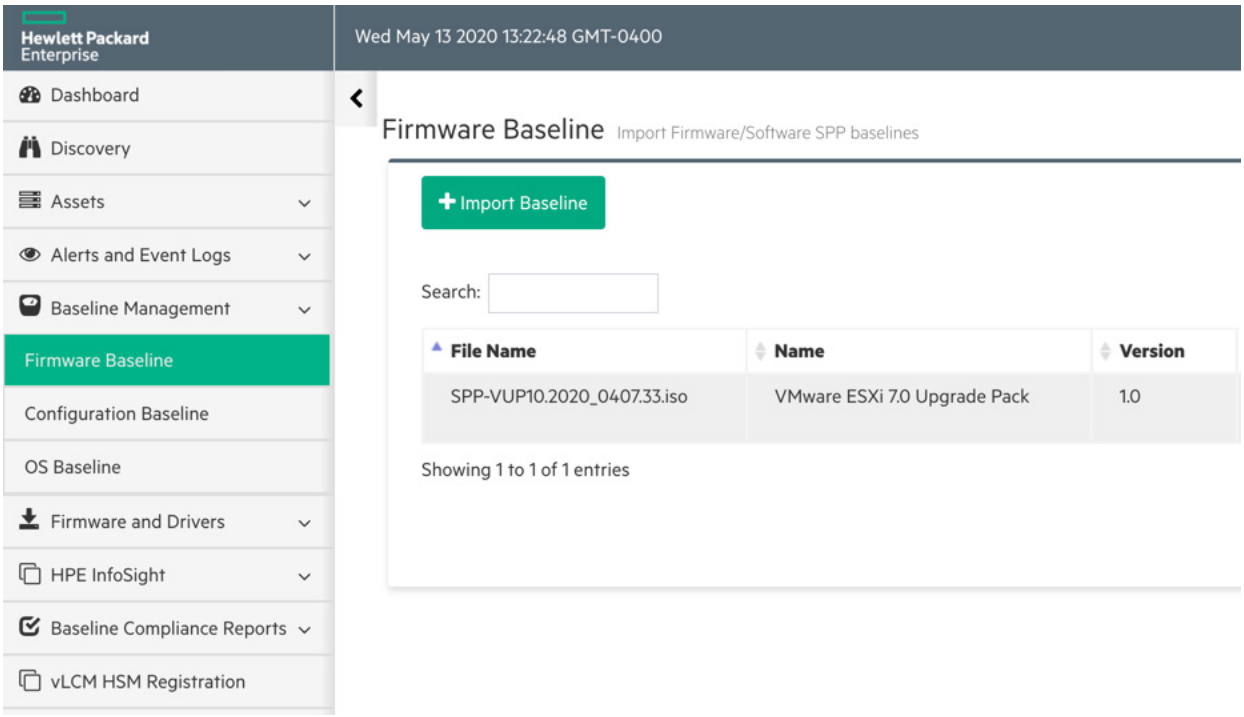


**FIGURE 18.** Importing a Baseline

## Configure vCenter to use vLCM

Upon new cluster creation you will be given an option to Manage all hosts in the cluster with a single image. Check the box and select ESXi version 7 as well as the Vendor Add-on.

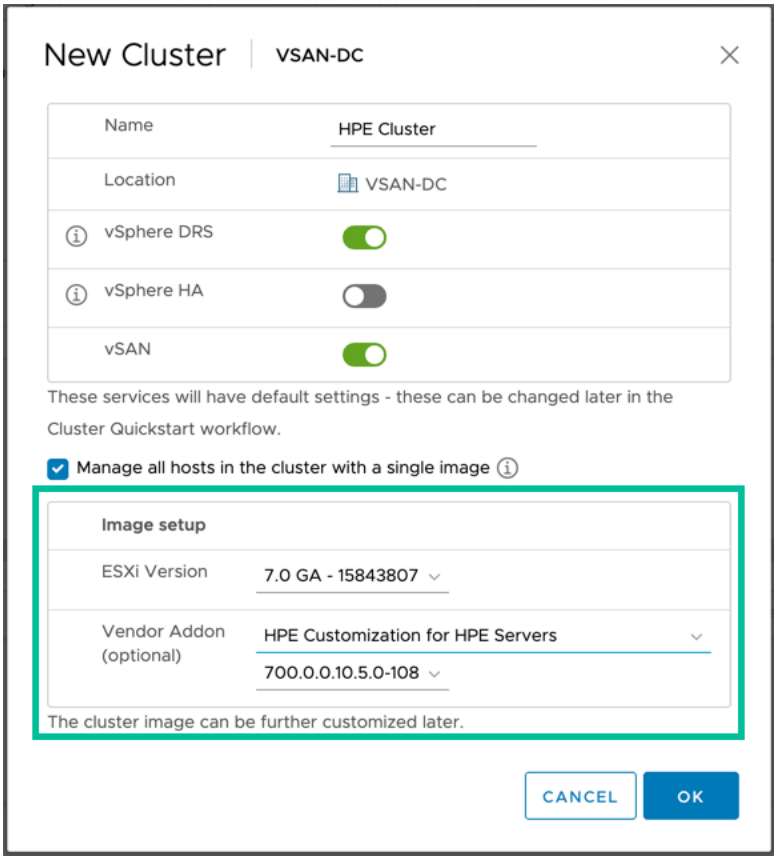


**FIGURE 19.** Configuring vCenter to use vLCM

If your cluster has already been configured, you can still manage with vLCM by doing the following:

1. Select your cluster in vCenter and click on the **Updates** tab.
2. Click MANAGE WITH A SINGLE IMAGE in the top right corner. If you do not see this button you have already enabled vLCM.

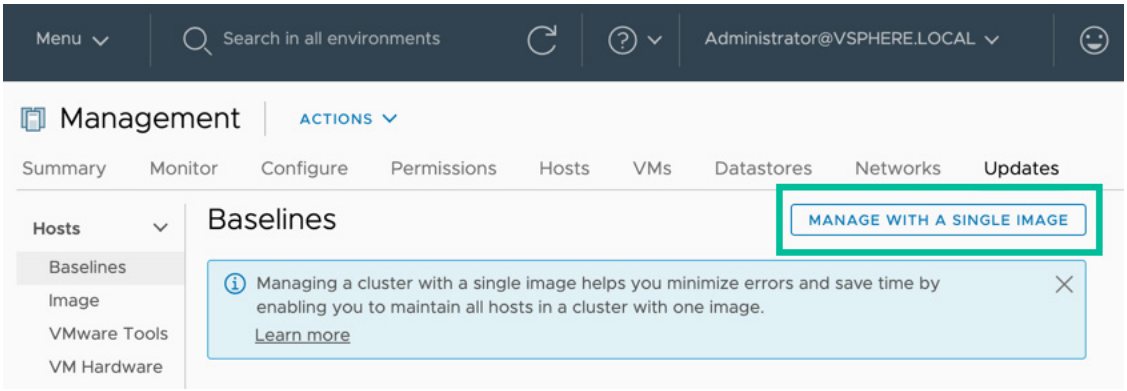


**FIGURE 20.** Managing configured cluster with a single image

Provide HPE iLO information to hosts:

1. From each host click the configure button on the top menu.
2. At the very bottom of the list select **HPE Hardware Support Manager**.
3. Click Edit and add the IP and credentials for each host.

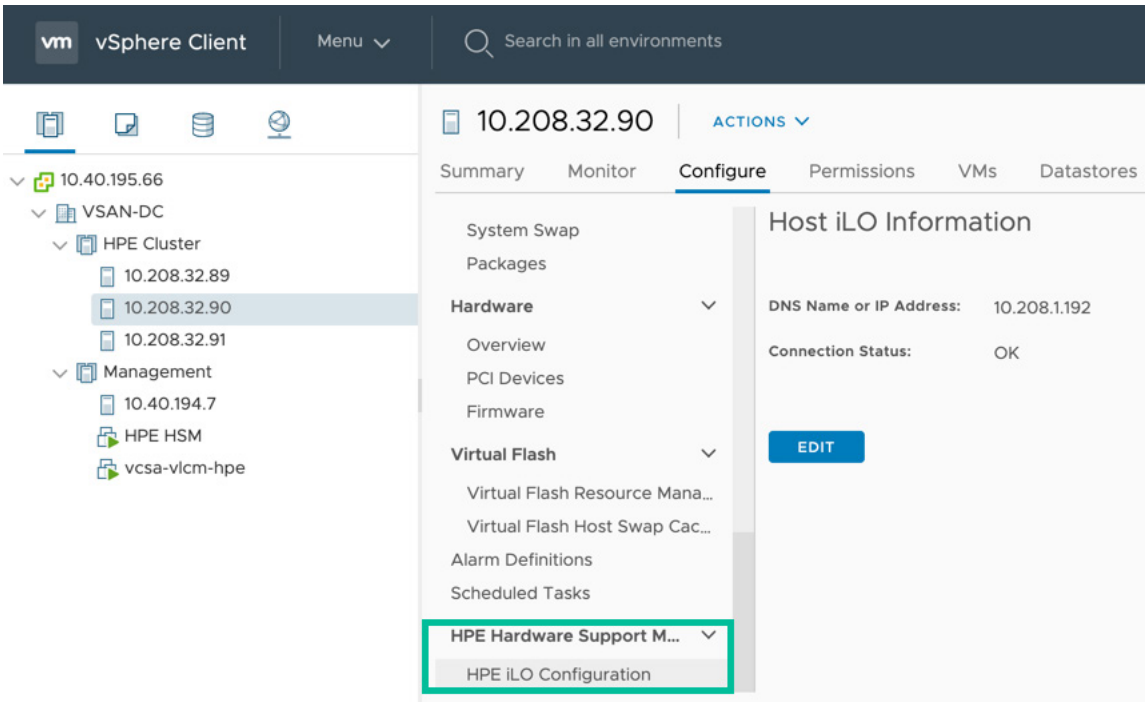


**FIGURE 21.** Providing Host HPE iLO Information

## CONFIGURE A DESIRED STATE IMAGE

If you have selected to manage hosts with a single image the HPE Vendor Add-on as explained above, you should see the following information in the updates tab at the cluster level. At this point the baseline that manages all your hosts is only checking the ESXi version and the software in the Vendor add-on. It's time to add the firmware and drivers.

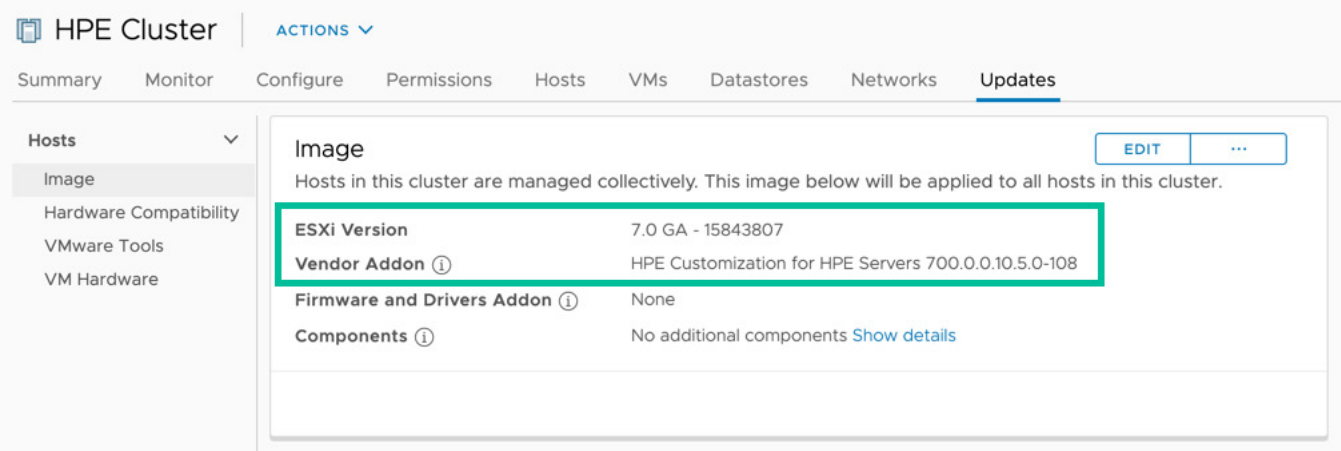


**FIGURE 22.** Configuring a desired state image

1. From the Updates tab, click **Edit**.
2. Under Firmware and Drivers click **Select**.
3. Choose the **HPE Hardware Support Manager** and the add-on listed below and click Select.
4. Click **Save**.

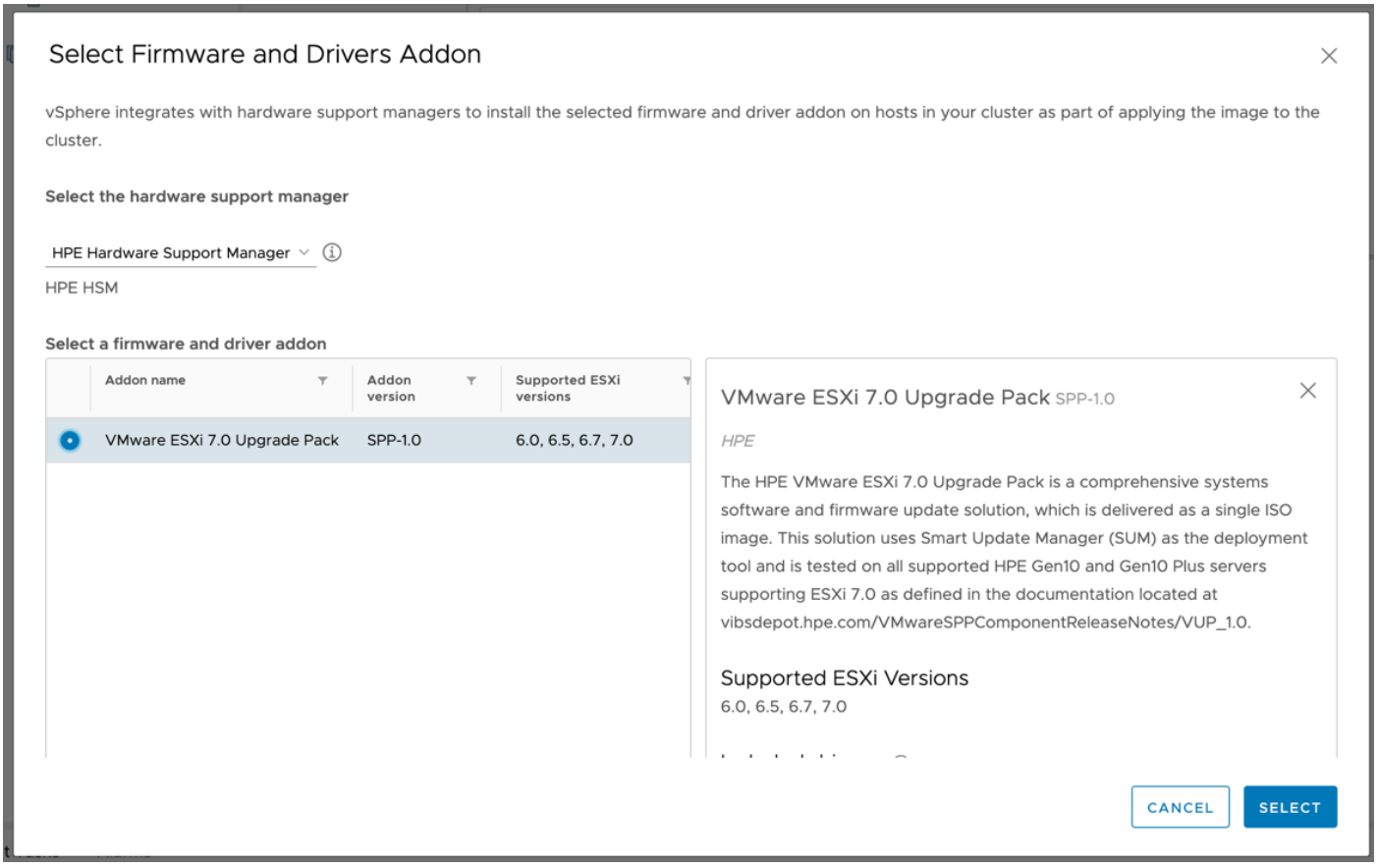


**FIGURE 23.** Firmware and Driver Add-ons for desired state image

Once you have successfully configured your baseline image with the Firmware and Drivers Add-on, vLCM will check compliance on the hosts in your cluster, and provide a detailed report comparing the software, firmware, and drivers on the hosts, what is on the desired state image (baseline). It should look similar to the following image.

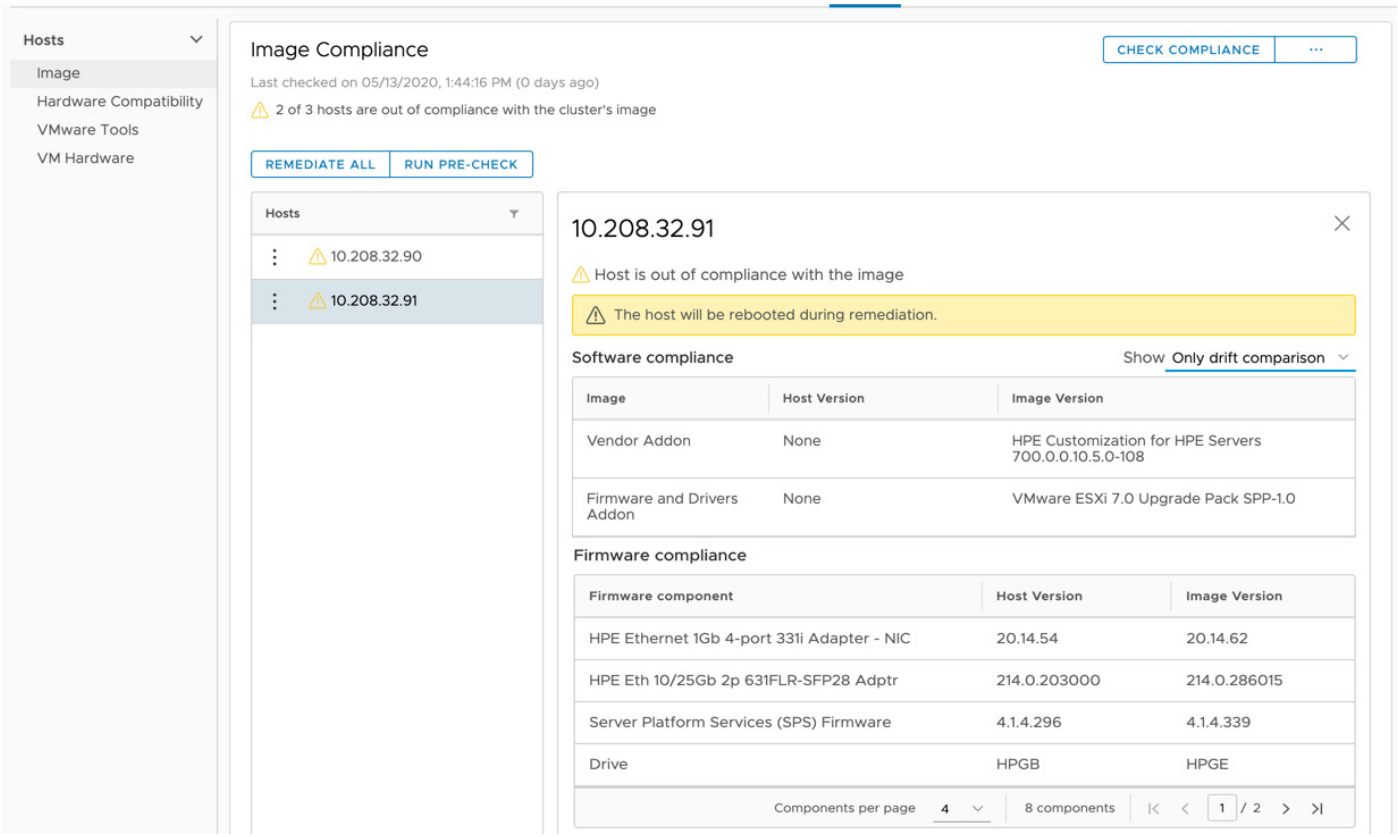


**FIGURE 24.** Checking compliance of hosts to the desired state image

## REMEDIATE SERVERS

When vLCM detects hosts have drifted from the desired state configuration, you will be given the opportunity to remediate individual hosts (right click the host and select remediate) or remediating all hosts simultaneously by clicking Remediate All. When you remediate, vLCM will do the following:

- Migrate workload to other hosts
- Enter host into maintenance mode
- Restart host
- Install drivers and firmware listed on the baseline image
- Restart the host
- Check the host for compliance against the baseline image
- Return the workload
- Exit maintenance mode
- If Remediate All was selected, vLCM will continue in a rolling upgrade fashion

## ADDITIONAL RECOMMENDATIONS

- For optimal performance, enable Jumbo Frames. The benefits will need to be weighed against the added complexity involved in deploying it throughout the switching infrastructure and NICs.
- Ensure SSD or HDD are empty and not preformatted before adding them to the cluster.
- For better performance, create multiple smaller disk groups instead of larger disk groups. The increase in cache drives could boost performance.
- While disparate hardware configurations are supported, it is recommended to use similar (if not identical) hardware configurations (number of disks, capacity, types of disk, and so on.).
- In an all-flash configuration, prefer RAID 5/6 for redundancy to save space and increase usable disk capacity instead of using RAID 1, unless RAID 1 is strictly required for the use case.
- Refer to the VMware vSAN Monitoring and Troubleshooting Guide for further help with troubleshooting.

**Resources**

HPE ProLiant Servers

HPE Custom ESXi Images

HPE ProLiant server and option firmware and driver support recipe for VMware

HPE Service Pack for ProLiant

VMware's technical papers portal

VMware vSAN Planning and Deployment Guide

vSAN ReadyNode Sizer

VMware vSAN Compatibility Guide

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