Hewlett Packard Enterprise

Deployment Guide

HPE Deployment Guide for Red Hat OpenShift Container Platform on HPE Synergy with HPE Nimble Storage and VMware Virtualization

Implementing a resilient on-premises Kubernetes and container solution

Contents

Overview

This document describes the steps required to create a Red Hat OpenShift Container Platform environment running on HPE Synergy and HPE Nimble Storage using VMware® vSphere® as the hypervisor and virtualization management layer. It is meant to be used in conjunction with files and Ansible playbooks found at https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/vsphere/nimble.

The OpenShift master, etcd, load balancer, and other solution management pieces are all deployed as virtual machines (VMs) to enable resource optimization and consolidation. Three HPE Synergy Compute Modules running on VMware ESXi ™ provide high availability (HA) resources and to support the management plane. Six HPE Synergy 480 Gen 10 Compute Modules provide compute capacity for either physical or virtual Red Hat OpenShift worker nodes.

Solution design

Figure 1 highlights the overview of the solution design from a storage perspective. Consult the master Deployment Guide found at https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/nimble for a detailed information on hardware implementation, cabling, and connectivity.

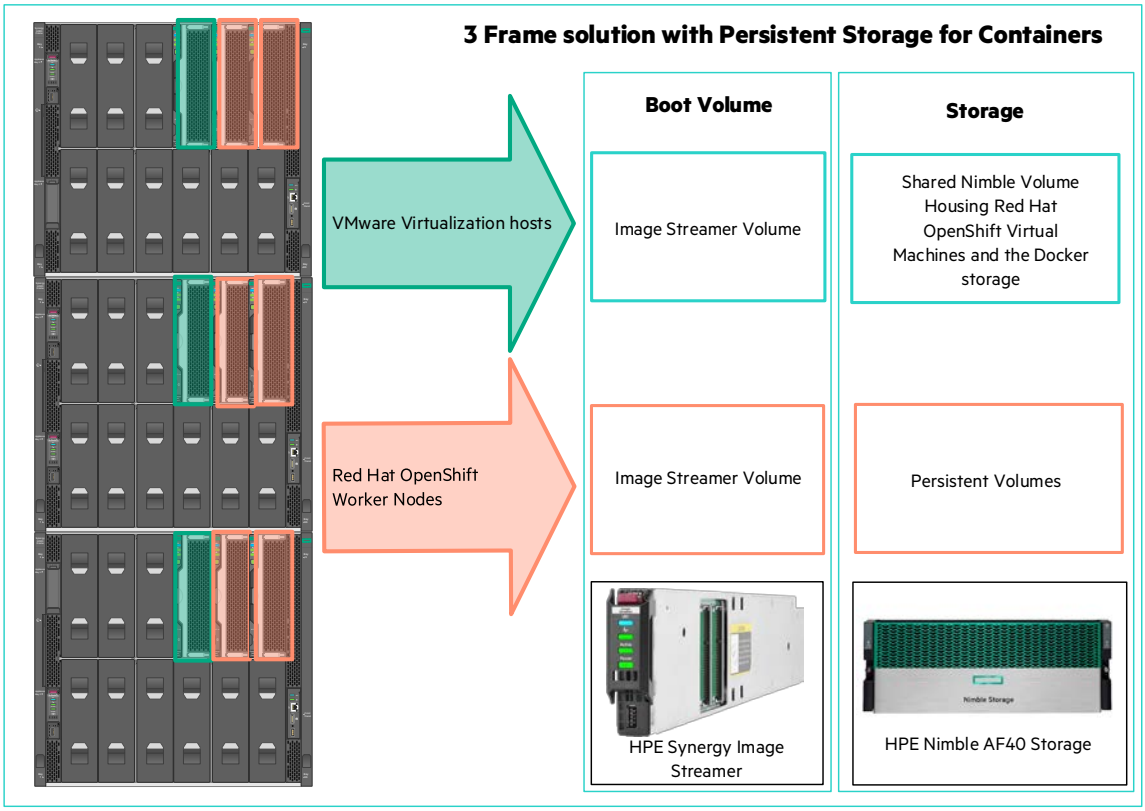

Figure 1. Solution design by function and storage type

Note

Containers and the images are stored in the Docker storage backend. This storage is ephemeral and separate from any persistent storage allocated to meet the needs of your applications. Docker storage in Figure 1 refers to this ephemeral storage.

Figure 2 shows the logical design of the solution including where the volumes are attached.

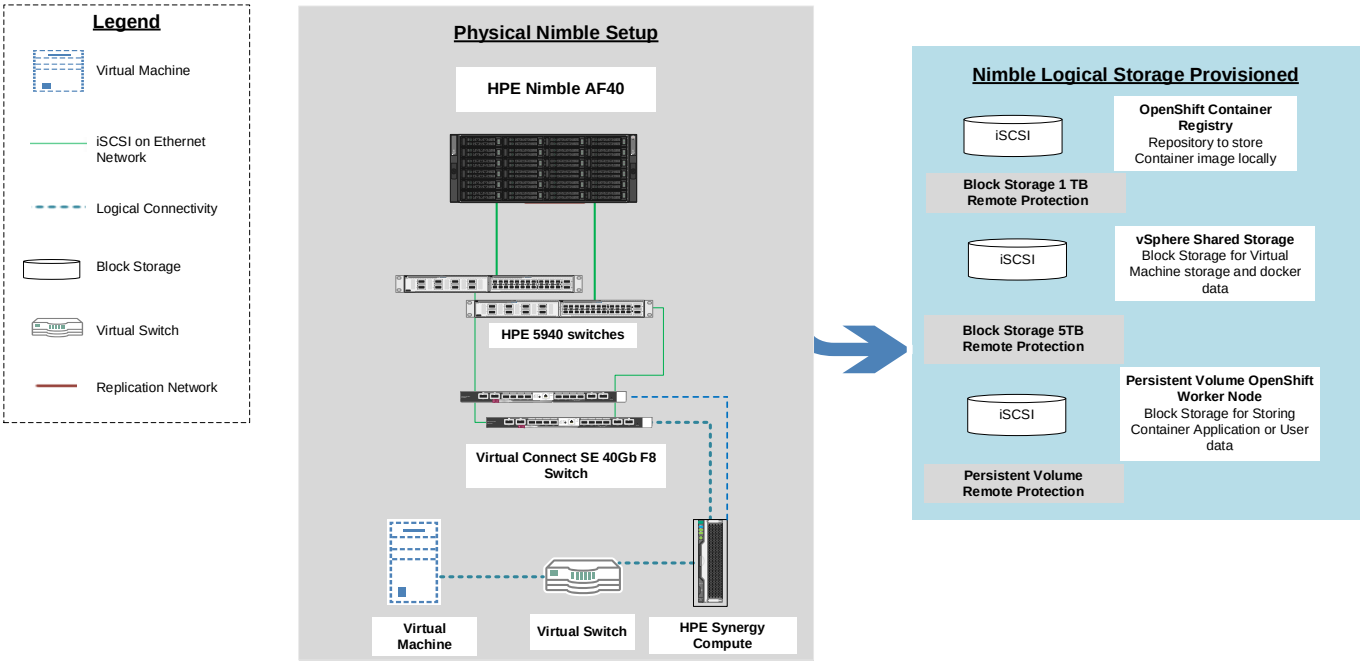

Figure 2. The logical layout of the solution stack

Note

The scripts described in this document and provided on the GitHub are sample scripts and are not supported by Hewlett Packard Enterprise or Red Hat. Hewlett Packard Enterprise plans to update this document over time with enhancements to deployment methodologies as well as new software versions, features, and functions. It is recommended that the installer review this document in its entirety and understand all prerequisites prior to begin with an installation.

Solution creation process

Figure 3 shows the flow of the installation process adopted in this document. For readability, a high-resolution copy of this image is located at https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/vsphere/nimble. It is recommended that installer personnel download and review the high-resolution image before proceeding.

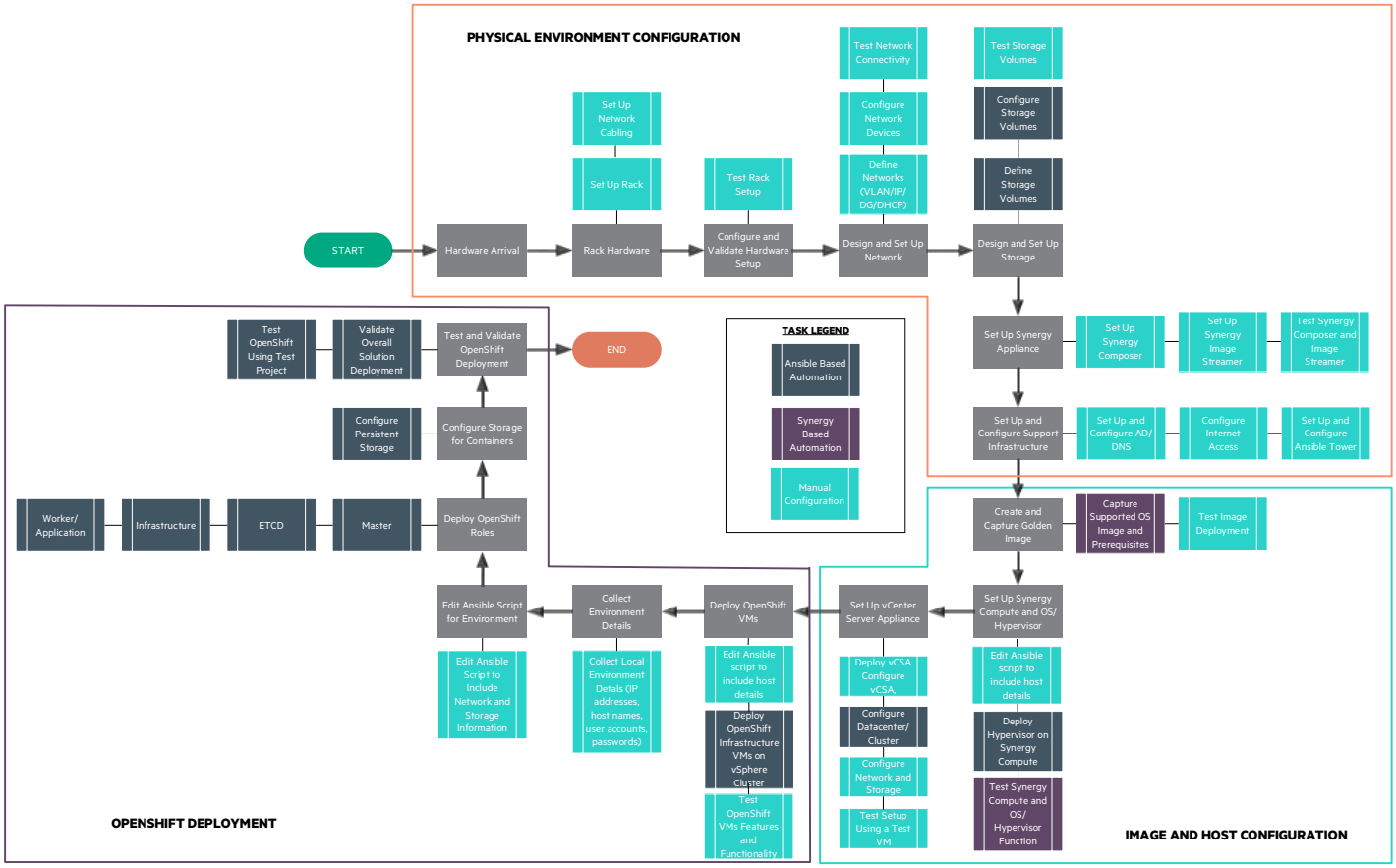

Figure 3. Solution creation flow diagram

Prerequisites

Software Versions

Table 1 describes the versions of important software utilized in the creation of this solution. The installer should download or ensure access to this software, and have appropriate licensing and subscriptions in place, for use within the planned timeframe.

Table 1. Major software versions used in solution creation

Component	Version
Red Hat Enterprise Linux Server	7.6
VMware ESXi	6.7
VMware vCenter Server Appliance	6.7
Red Hat OpenShift Container Platform	3.11
HPE Nimble Storage Linux Toolkit	2.4
HPE Nimble Storage Kube Storage Controller	2.4

Deployment environment

This document is built with the assumptions that the required services and networks are available within the implementation environment. This section discusses those assumptions and, where applicable, provides details on how they should be configured. If a service is optional, it is noted in the description.

Services

Table 2 lists the services utilized in the creation of this solution and provides a high-level explanation of their function and whether or not they are required.

Table 2. Services used in the creation of this solution

Service	Required/Optional	Description/Notes
DNS	Required	Provides name resolution on management and data center networks, optionally on iSCSI networks.
DHCP	Required	Provides IP address leases on PXE, management and usually for data center networks. Optionally used to provide addresses on iSCSI networks.
NTP	Required	Required to ensure consistent time across the solution stack.
Active Directory/LDAP	Optional	May be used for authentication functions on various networks. This solution utilizes local authentication.

DNS

The Domain Name System (DNS) services must be in place for management and data center networks. Once a host is active, ensure that both forward and reverse lookups work on the management and the data center networks.

DHCP

The Dynamic Host Configuration Protocol (DHCP) services must be in place for the management networks. DHCP services are generally in place on data center networks. It may also be useful to have them in place on iSCSI networks because Virtual Connect exposes the MAC address of the network interfaces before installation has begun, it is easy to create address reservations for the hosts. A reservation is required for a single adapter on the management network of each physical server. This facilitates post-deployment configuration over SSH as well as a secure communication channel for running Ansible scripts. If DHCP services are present on the iSCSI networks, reservations can simplify the post-deployment configuration of the host on those networks.

NTP

A Network Time Protocol (NTP) server should be available to hosts within the solution environment.

Installer laptop

A laptop system that can connect to various components within the solution stack is required.

Ansible Engine

This document is built on the assumption that Ansible Engine exists within the deployment environment and is accessible to the installer. Hewlett Packard Enterprise built this solution using Ansible version 2.7.9. The following repositories should be enabled on the Ansible Engine host:

- rhel-7-server-extras-rpms
- rhel-7-server-rpms
- rhel-7-server-ose-3.11-rpms
- rhel-7-server-ansible-2.7-rpms
- rhel-7-rhv-4-mgmt-agent-rpms

The following modules should be installed on the Ansible Engine host:

- Python 2.7.9 or higher
- Python module for HPE OneView

  - hpOneView is the Python Software Development Kit (SDK) for the OneView Application Programming Interface (API) that allows managing OneView functionalities.
  - Download the python repository found at https://github.com/HewlettPackard/python-hpOneView to the Ansible Engine and follow the instructions in its Readme section to install the repository.
- Ansible module for HPE OneView
  - oneview-ansible is the Ansible module for HPE OneView, which utilizes the hpOneView Python SDK to enable infrastructure-as-a-code.
  - Download the Ansible repository found at https://github.com/HewlettPackard/oneview-ansible/ to the Ansible Engine and follow the instructions in its Readme section to install the repository.
- Python SDK for the VMware vSphere APIs
  - PyVmomi is the Python SDK for the VMware® vSphere® API that allows managing ESX, ESXi, and vCenter®.
  - Execute the following command in the Ansible Engine to install PyVmomi.

```
# pip install PyVmomi
```

Physical environment configuration

The configuration deployed for this solution is described in this section. Figure 4 describes the various components involved in the solution. At a high level, Hewlett Packard Enterprise and Red Hat deployed the following hardware as described in Table 3.

Table 3. Components utilized in the creation of this solution

Component	QTY	Description
HPE Synergy 12000 Frame	3	Three (3) HPE Synergy 12000 Frames house the infrastructure used for the solution
HPE Virtual Connect 40Gb SE F8 Module	2	A total of two (2) HPE Virtual Connect 40Gb SE F8 Modules provide network connectivity into and out of the frames
HPE Synergy 480 Gen10 Compute Module	9	Three (3) virtualized management hosts and six (6) bare metal or virtualized hosts for worker nodes
HPE FlexFabric 2-Slot Switch	2	Each switch contains one (1) each of the HPE 5930 modules listed below
HPE 5930 24p SFP+ and 2p QSFP+ Module	2	One module per HPE FlexFabric 2-Slot Switch
HPE 5930 8-port QSFP+ Module	2	One module per HPE FlexFabric 2-Slot Switch
HPE Nimble Storage AF40	1	One array for virtual machines, Docker storage and persistent volumes
HPE Synergy Image Streamer	2	Provides OS volumes to OpenShift worker nodes
HPE Synergy Composer	2	Core configuration and lifecycle management for the Synergy components

This configuration was built on HPE Converged System 750, which offers an improved time to deployment and tested firmware recipe. The baseline can be retrieved at http://h17007.www1.hpe.com/us/en/enterprise/integrated-systems/info-library/index.aspx?cat=convergedsystems&subcat=cs750#.XQpIV4gzY2w. The user also has the flexibility of customizing the HPE components throughout this stack per their unique IT and workload requirements or building with individual components.

Figure 4 shows the physical configuration of the racks used in this solution.

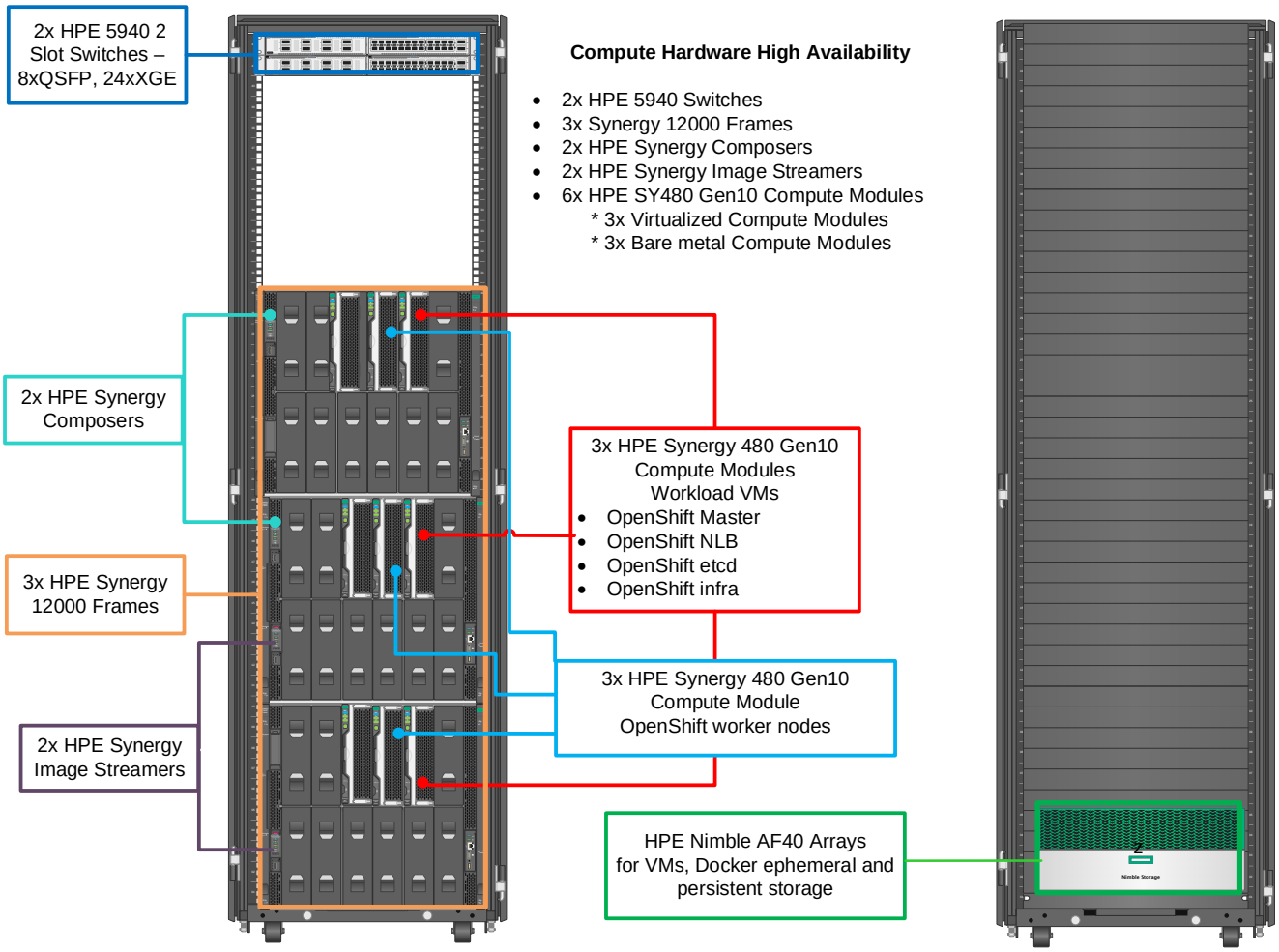

Figure 4. The physical layout of the compute within the solution

As noted in the overview, firmware recipes for the individual components adhere to HPE Converged Solution 750 specifications which can be found at https://support.hpe.com/hpsc/doc/public/display?sp4ts.oid=null&docLocale=en_US&docId=emr_na-a00051226en_us. It is recommended that the installer utilize the latest available matrix.

Figure 5 describes the logical storage layout used in the solution. Image Streamer is used for installing the operating system on the virtualized hosts. HPE Nimble Storage AF40 provides dedicated and shared volumes as outlined below.

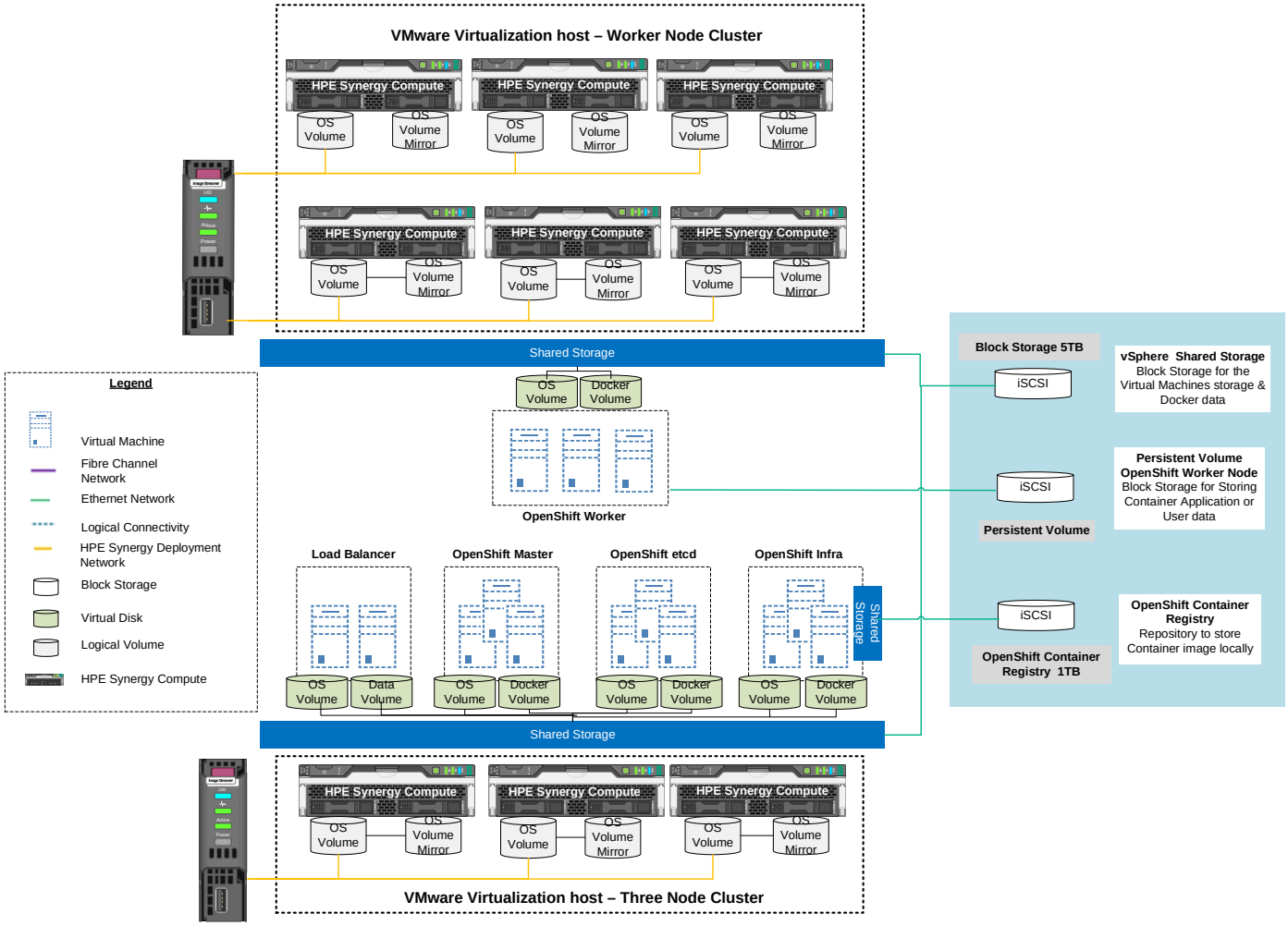

Figure 5. iSCSI physical layout

Information about storage volumes/disks is described in Table 3. The installer may choose to manually create and present these volumes or use the Ansible resources as specified in Table 4.

Table 4. Volumes and sources used in this solution

Volume/Disk Function	Qty	Size	Source	Hosts	Shared/Dedicated
Hypervisor	9	15GB+	HPE Image Streamer	ESXi hosts	Streamed
Virtual Machine Hosting and Docker Data	1	5TB	HPE Nimble Storage	ESXi hosts	Shared
Persistent Application Data	N	App Specific	HPE Nimble Storage	OpenShift worker nodes	Dedicated
OpenShift Container Registry	1	1TB	HPE Nimble Storage	Infrastructure node	Shared

Prior to defining these volumes, you must initialize and configure the HPE Nimble Storage. Hewlett Packard Enterprise has provided resources to automate the initialization and configuration of the HPE Nimble Storage. For more details, refer Appendix B of the master Deployment Guide at https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/nimble.

Executing the Ansible playbooks

Prior to configuring the compute modules, the installer should retrieve the required Ansible plays and files from GitHub by running the following command on the Ansible Engine server:

```
# cd /etc/ansible
# git clone https://github.com/HewlettPackard/hpe-solutions-openshift.git
```

Host configuration

This section describes the configuration of the hosts. It is divided into topics that disseminate universal configuration parameters, options for virtualized hosts. Required configuration steps are outlined. These may be in the form of pointers to code or command line options. It is up to the installer to decide how to reach the desired end state.

Warning

During host deployment, ensure that adapter names and functions are accurately recorded for the installation environment, as variations in install procedures may result in different adapter functions than what is represented in the following sections. This will result in the failure of automated configuration steps.

Compute Module configuration

This section describes the configuration of the compute modules and required configuration steps. These may be in the form of HPE OneView, HPE Image Streamer instructions or command line options. If customizations are required, it is up to the installer to decide how to reach the desired end state within their compute environment.

A Server Profile allows a set of configuration parameters, including firmware recipe, network, and SAN connectivity, BIOS tuning, boot order configuration, local storage configuration and more to be templated. These templates are key to delivering the “infrastructure-as-code” capabilities of the HPE Synergy platform. For the purpose of this solution, a template was used to define virtualized management nodes.

Management nodes

The management nodes will be deployed and customized using HPE Synergy Image Streamer while ensuring that the required storage volumes are created and attached. This section outlines the steps required to install the host. At a high level, these steps can be described as:

1. Download the artifacts for HPE Synergy Image Streamer from the HPE GitHub site.
2. Add the artifact bundles to HPE Synergy Image Streamer.
3. Create a server profile with an empty volume.
4. Install the VMware ESXi hypervisor.
5. Capture the VMware ESXi base golden image.
6. Delete server profile with the empty volume.
7. Add the ESXi golden image to the deployment plan.
8. Deploy the ESXi hosts using the golden image.
9. Utilize the virtualized hosts.

Download the artifacts for HPE Synergy Image Streamer

VMware ESXi 6.7 artifact bundle for HPE Image Streamer 4.2 is **HPE - ESXi 6.7-2018-08-02-v4.2.zip.** It can be downloaded at https://github.com/HewlettPackard/image-streamer-esxi/tree/v4.2/artifact-bundles. Sample foundation artifact bundles can be downloaded from https://github.com/HewlettPackard/image-streamer-esxi/tree/v4.2/artifact-bundles.

Add the artifact bundles to HPE Synergy Image Streamer

1. From the HPE Synergy Image Streamer interface, navigate to the **artifact bundles** page.
2. From the **Actions** menu, click **Add** to add the downloaded VMware ESXi artifact bundle. If not already present, add the sample foundation bundle.
3. From the **Actions** menu, click **Extract** to extract the artifacts from each downloaded bundle.

Create a Server Profile with an empty volume

HPE Synergy Image Streamer deployment process is initiated from within the HPE Synergy Composer interface through the server profile creation process.

1. Log in to HPE OneView.
2. From the OneView drop-down menu, select **Server Profiles.**
3. Click **+ Create Profile.**
4. Provide the values for the following parameters:
   a. **Name:** Provide a unique name
   b. **Server profile template**: None
   c. **Server Hardware:** Select any available server from the drop-down menu
   d. **Enclosure Group**: << Enclosure Group name >>
   e. **Affinity**: Device Bay
   f. **OS deployment plan**: From the drop-down menu, select **HPE - Foundation 1.0 - create empty OS Volume-2017-10-13** as the OS deployment plan
   g. **VolumeSize**: 40960 MiB
   h. Configure the **Connections**:
      - Deployment Network A, 1Gb/s iSCSI primary boot
      - Deployment Network B, 1Gb/s iSCSI secondary boot
      - Management_A, 2GB
      - Management_B, 2 GB
      - Datacenter_A, 9GB
      - Datacenter_B, 9 GB
      - iSCSI_A 8 GB
      - iSCSI_B 8 GB
   i. Enable the **Manage boot** mode:
      - Boot mode: UEFI optimized
      - Secure boot: Disabled
      - PXE boot policy: Auto
5. Click **Create**.

Install the hypervisor

1. From the HPE OneView interface, navigate to **Server Profiles** and select **ESXi-empty-volume Server Profile**.
2. Select **Actions > Launch Console**.
3. From the Remote Console window, choose **Virtual Drives -> Image File CD-ROM/DVD** from the [1]iLO options menu bar.
4. Navigate to the **VMware ESXi 6.7 .iso** file located on the installation system.
5. Select the .iso file and click **Open**.
6. If the server is in the powered off state, power on the server by selecting **Power Switch -> Momentary Press**.
7. During boot, press **F11 Boot Menu** and select **iLO Virtual USB 3: iLO Virtual CD-ROM**.
8. When the VMware ESXi installation media has finished loading, proceed through the VMware installer prompts. For **Storage Device**, select the 40GiB OS volume created on the HPE Image Streamer during server profile creation and set the **root password**.
9. Once the OS installation is complete, navigate to **Power Switch** from the HPE iLO options menu and select the **momentary press** from the drop-down menu to power off the server.

Capture the VMware ESXi base golden image

1. From the HPE Synergy Image Streamer interface, select **Image Streamer -> Golden Images**.
2. Click **Create Golden image**.
3. Provide the following details as shown in Figure 6:
   a. **Name**: << Provide a name for the golden image >>
   b. **OS volume**: <<OS volume associated with the ESXi empty volume server profile >>
   c. **OS Build Plan**: From the drop-down menu, select the **ESXi 6.7: HPE - Foundation 1.0 - capture OS Volume as is-2017-03-24** OS build plan.

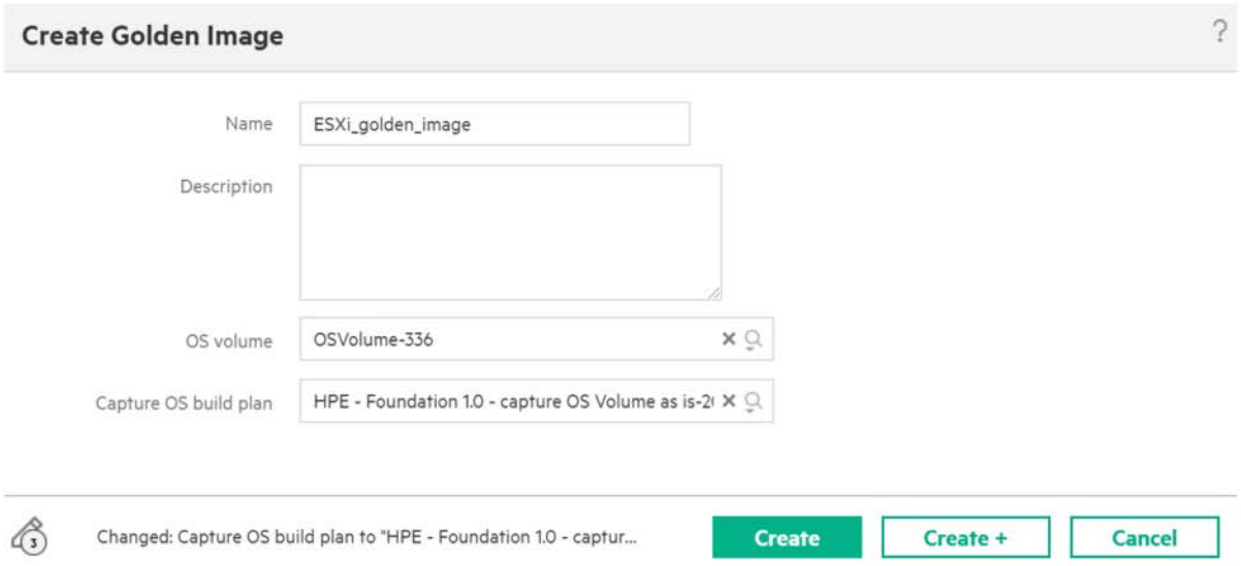

Figure 6. Create Golden Image

4. Click **Create**.

[1] HPE Integrated Lights-Out (iLO) is a remote server management processor embedded on the system boards of HPE Servers.

Delete ESXi empty volume Server Profile

1. From the HPE OneView interface, select **OneView -> Server Profiles**.
2. Select the ESXi-empty-volume Server Profile and choose **Actions -> Power Off**.
3. With the ESXi-empty-volume server profile selected, choose **Actions -> Edit**.
4. **Unassign** the assigned server hardware and wait until the task completes.
5. With the ESXi-empty-volume server profile selected, select **Actions -> Delete**.
6. Click **Yes, Delete**.

Add the ESXi Golden image to the deployment plan

1. From the HPE Synergy Image Streamer interface, select **Image Streamer -> Deployment Plans**.
2. Click **Create Deployment Plan**.
3. Provide the values for the following parameters as illustrated in Figure 7:
   a. **Name**: <<Name for the deployment plan>>
   b. **OS build plan**: From the drop-down list, select the **HPE - ESXi 6.7 - deploy with multiple management NIC HA config - 2018-08-02** OS build plan.
   c. **SSH**: enabled
   d. **Password**: <leave blank>
   e. **ManagementNIC**: n/a
   f. **ManagementNIC2**: n/a
   g. **HostName**: <leave blank>
   h. **DomainName**: <<management network domain name>>
   i. **Golden Image**: From the drop-down list, select the ESXi 6.7 golden image that was created earlier.

Figure 7 illustrates the parameters for the creation of deployment plan.

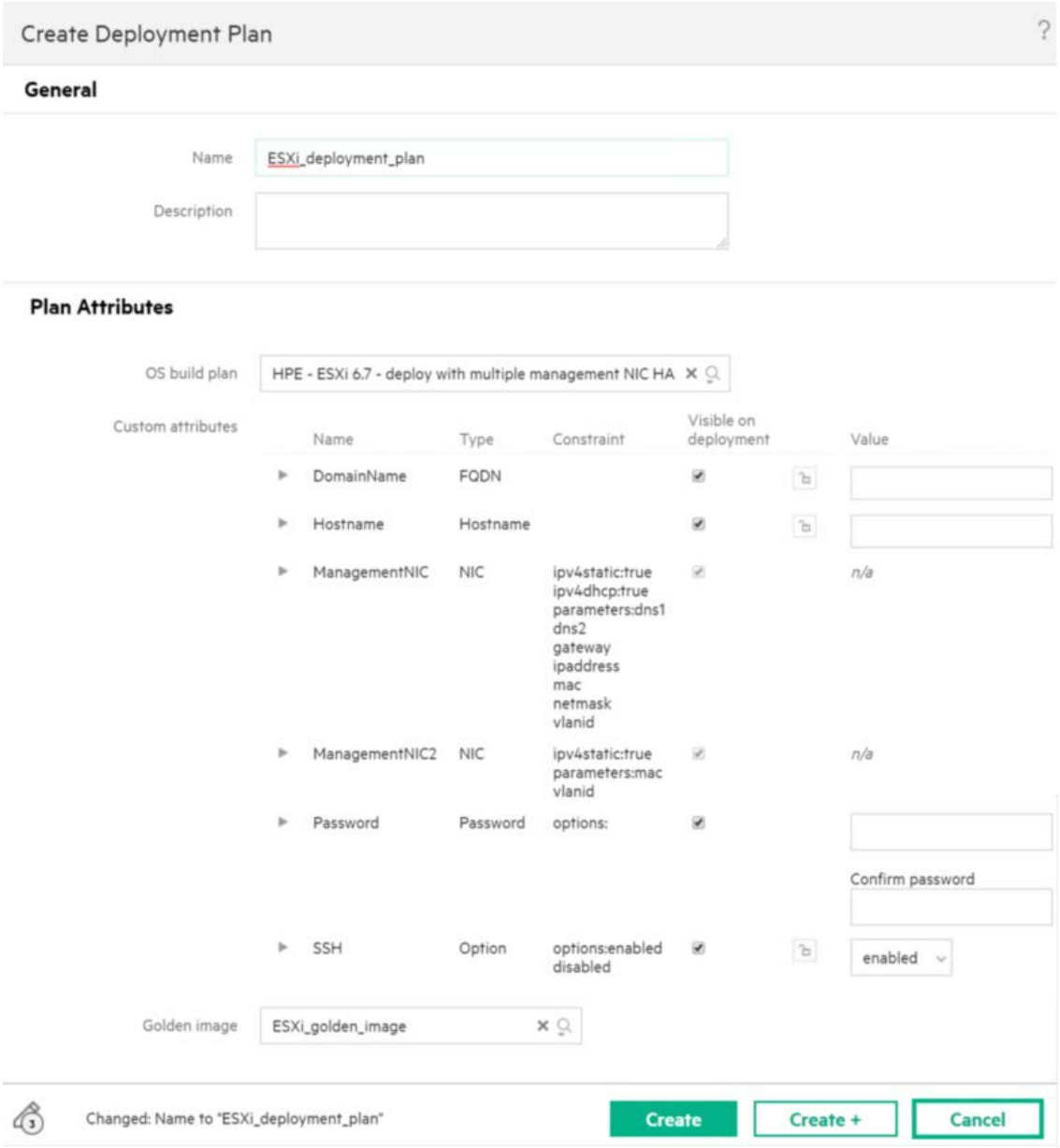

Figure 7 Deployment Plan

4. Click **Create**.

Editing and running the Ansible playbooks

The remaining host configuration is handled via Ansible playbooks. The repository cloned from https://github.com/hewlettpackard/hpe-solutions-openshift/ is utilized for further configuration of the hosts. If you have not cloned the repository, execute the following commands:

```
# cd /etc/ansible
# git clone https://github.com/HewlettPackard/hpe-solutions-openshift.git
```

Deploy the golden image

The virtualization hosts are deployed using the golden image created in the earlier steps. This can be achieved by creating the Server Profiles with the appropriate deployment plan and the network connections. The consistency among the virtualization hosts is achieved using the Server Profile template.

Note

This document illustrates the steps for the deployment of virtual worker nodes. If the intent is to utilize physical worker nodes please refer to the master Deployment Guide found at, https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/nimble.

The playbook **ServerProfileTemplate.yml** and **ServerProfile.yml**, located at /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts, creates the Server Profile template and Server Profile.

To create the Server Profile template and the Server Profile, the installer should edit the variables YAML file. Using an editor, open the file /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/HostVariables.yml and provide the values for the configuration details of HPE OneView and HPE Image Streamer, network connections, IP address details, enclosure group name, server hardware name, server hardware type, the path to the template files for the Server Profile template and Server Profile. A sample file is shown below. This file should be edited to match the installation environment.

```
deployment_network_name: Deployment
management_network_name: TenNet
iSCSI_A_network_name: iSCSI_A
iSCSI_B_network_name: iSCSI_B
datacenter_network_name: TwentyNet

dns_ip: 10.x.x.x
gateway: 10.x.x.x
subnet_mask: 255.255.0.0
domain_name: tennet.local

enclosure_group_name: Enclosure_Group
deployment_plan_name: ESXi_deployment_plan
server_profile_template_name: vsphere_template
```

Update the HPE OneView IP address and credentials and the HPE Synergy Image Streamer IP address in the **OneViewConfig.json** file located at /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts. It is recommended to follow the same structure as shown below.

```
{
    "ip": "10.0.x.x",
    "credentials":{
    "userName": "your username",
    "password": "your password"
    },
    "image_streamer_ip": "10.0.x.x",
    "api_version": 1000
}
```

In the hosts file located at /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/hosts, under the Servers section, add the enclosure serial number with the bay number of the server hardware, type of the server hardware, name, IP address and hostname which needs be assigned for the servers utilized as the virtualization hosts. Assign one of the servers among them under the Server Profile template section as illustrated below.

```
[servers]
"2S1721PK4K, bay 5" name=ESXI_01 ip=10.0.x.x hostname=vspherehost01 type="SY 480 Gen10 4"
"MXQ73007JR, bay 11" name=ESXI_02 ip=10.0.x.x hostname=vspherehost02 type="SY 480 Gen10 2"
"MXQ73007JQ, bay 5" name=ESXI_03 ip=10.0.x.x hostname=vspherehost03 type="SY 480 Gen10 3"


[server_profile_template]
"2S1721PK4K, bay 5" type="SY 480 Gen10 4"
```

Once the host and variable files are updated with the appropriate values, execute the following commands from the Ansible Engine to create the Server Profile template and Server Profile:

```
# ansible-playbook -i /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/hosts
/etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/ServerProfileTemplate.yml

# ansible-playbook -i /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/hosts
/etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployESXiHosts/ServerProfile.yml
```

Utilize the virtualization platform

Power on the server hardware and wait for the ESXi to be installed. It will take a few minutes after which the server hardware is ready for use.

Note

Log into each of the ESXi hosts and make sure that the NIC for the management network is enabled to ensure connectivity.

VMware vCenter Server Appliance

In this solution, VMware vCenter Server Appliance (vCenter) is used to manage the virtualized environment. This section explains the deployment of vCenter. If an acceptable vCenter is already available in your environment skip forward to Integrate HPE Nimble Storage to vCenter.

Prerequisites

Ensure that a DNS entry is present for the vCenter.

Procedure

The installation of vCenter is a two-stage process:

- Stage 1 - Deployment
- Stage 2 - Configuration

Stage 1 - Deploy the appliance

1. From the installer's laptop, navigate to the location of the vCenter iso file and double-click to open it.
2. Depending on the OS, navigate to the vcsa-ui-installer/<OS type> folder and run **installer.exe**.
3. From the installation window, select **Install** to proceed with the installation of a new vCenter.
4. Accept the **End User License Agreement**, and then click **Next**.
5. Select **Deployment Type** as **vCenter server with an Embedded Platform Service Controller** and click **Next**.
6. Provide the root credentials of the ESXi host where vCenter is to be installed and click **Next**.
7. **Accept** the **SSL certificate** from the selected host.
8. Enter a unique **Name** for vCenter and provide the password and click **Next**.
9. Based on your environment, provide **Deployment Size** and **Storage Size**, and then click **Next**.

10. Select the **Datastore** of the host which needs to be used and click **Next**.
11. Configure the network settings and provide values for the following parameters and click **Next**:
    - **IP address**: IP address for the vCenter
    - **Domain name**: Domain name of the management network of the vCenter
    - **FQDN**: Fully qualified domain name of the vCenter
    - **Subnet mask**: Subnet mask for the vCenter network
    - **DNS server:** IP address of the DNS server
12. Click **Finish** to start the installation. The vCenter will be deployed to the specified host.
13. When Stage 1 is successfully completed, click **Continue** to resume the Stage 2 installation.

Stage 2 - Set Up the vCenter

1. When the Stage 2 window is displayed, click **Next** to begin the configuration process.
2. Specify an **NTP Server**, enable **SSH access** and click **Next**. Enabling SSH is required to enable the execution of Ansible playbooks.
3. Select the **Create a new SSO domain** option and provide the SSO domain name and a unique SSO password. Click **Next** when done.
4. Click **Finish** to finalize the deployment and then click **OK** to proceed. The setup process is then instantiated.
5. When Stage 2 executed successfully, the vCenter deployment is complete.

Accessing vCenter

To access the appliance, type the address https:// <vCenter Server Appliance IP address>:443 in the browser and enter the root credentials and click **Login**.

Integrate HPE Nimble Storage to vCenter

Overview of the tasks

1. Create initiator groups in the HPE Nimble Storage Management console.
2. Create a volume for the ESXi hosts.
3. Integrate VASA provider with vCenter.

Create initiator groups in the HPE Nimble Storage Management console

The initiator group allows connecting volumes directly to the IQNs of the iSCSI adapters. On the HPE Nimble Storage Management console, Initiator group should be created with the IQNs of each of the ESXi host. Initiator group can be created by following the below steps:

1. Log in to the HPE Nimble Storage Management Console.
2. Navigate to **Manage -> Data Access**. as shown in Figure 8.

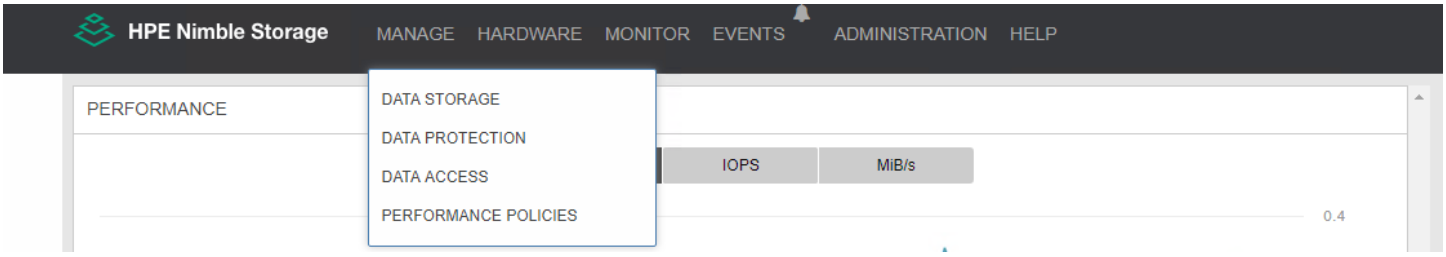

Figure 8. Data access option within the HPE Nimble Storage Management Console

3. Click **"+"** icon in the **Initiator Groups** as shown in Figure 9.

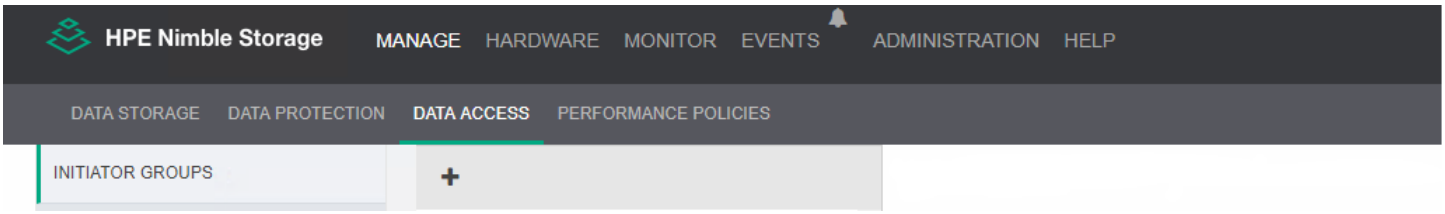

Figure 9. Create an initiator group within the HPE Nimble Storage Management console

4. On the **Create Initiator Group** page, enter the details for the following parameters as illustrated in Figure 10.
   a. **Name:** << Name of the initiator group >>
   b. **Subnets:** From the drop-down menu, select Use selected subnets and add the selected data subnets
   c. **Initiators:** Add the name and IQNs of all the initiators (vSphere hosts), and click **Create**.

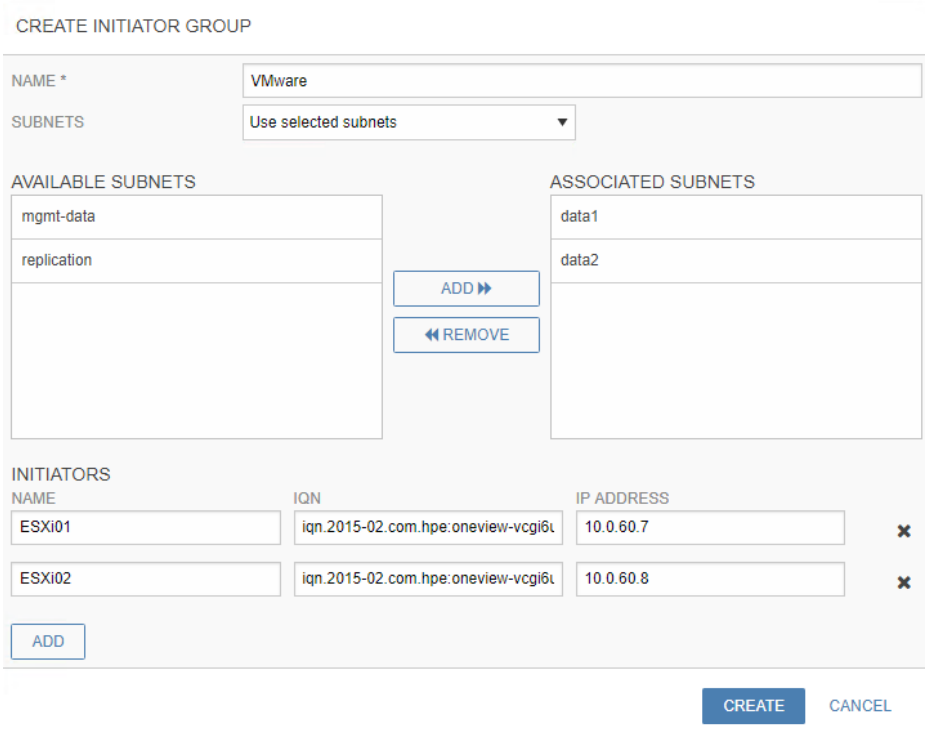

Figure 10. Input parameters for creating the Initiator group

Note

IQNs can be found in the Server Profile of the ESXi hosts in HPE OneView. If hosts are already added into the cluster of vCenter, IQNs can be found at **Host** > **Configuration** > **Storage Adapter** > Highlight your **iSCSI Software Adapter** > **Details**.

Create a volume for the ESXi hosts in HPE Nimble Storage Management Console

Once the initiator group is created, perform the following to provision a new volume.

1. From the HPE Nimble Storage management console, navigate to **Manage -> Data storage** as shown in Figure 11.

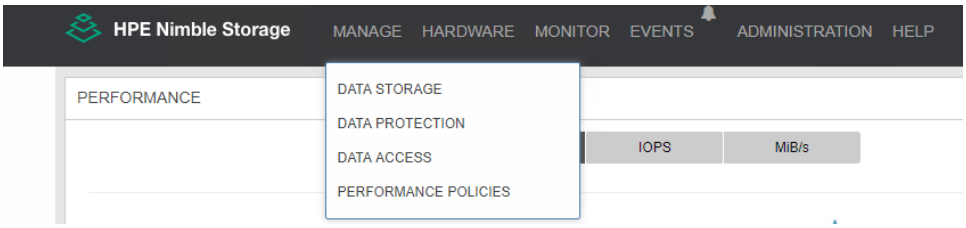

Figure 11. Data storage option within the HPE Nimble Storage Management Console

2. Click **"+"** icon as shown in Figure 12 to create a new volume.

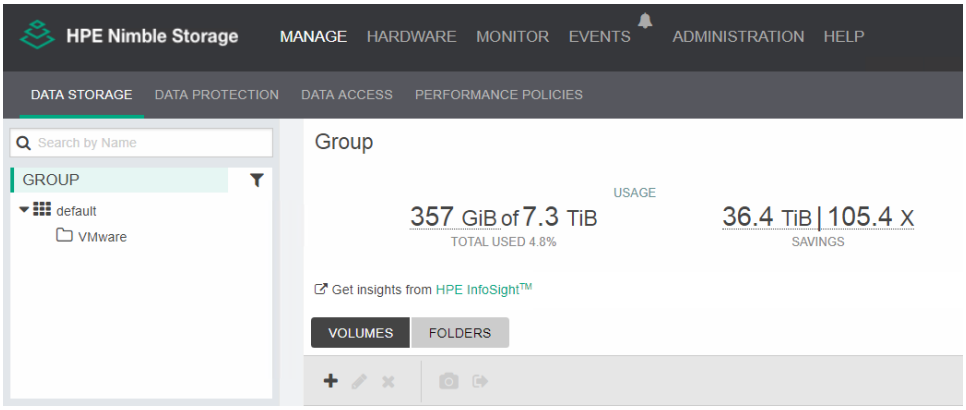

Figure 12. Create a volume within HPE Nimble Storage management console

3. Provide the values to the following parameters for creating a volume. Sample values for the parameters are listed in Figure 13.
   - **Name**: << Name for the Volume >>
   - **Location**: << Desired location of the Volume >>
   - **Performance policy**: Assign a performance policy for the volume.
   - **Size**: 5TiB
   - **Protection policy**: Assign a protection policy as required
   - **Access**: Assign the initiator group for the vSphere hosts created earlier
   - **CHAP Account**: Assign the CHAP account and select the **Allow Multiple Initiator access** box

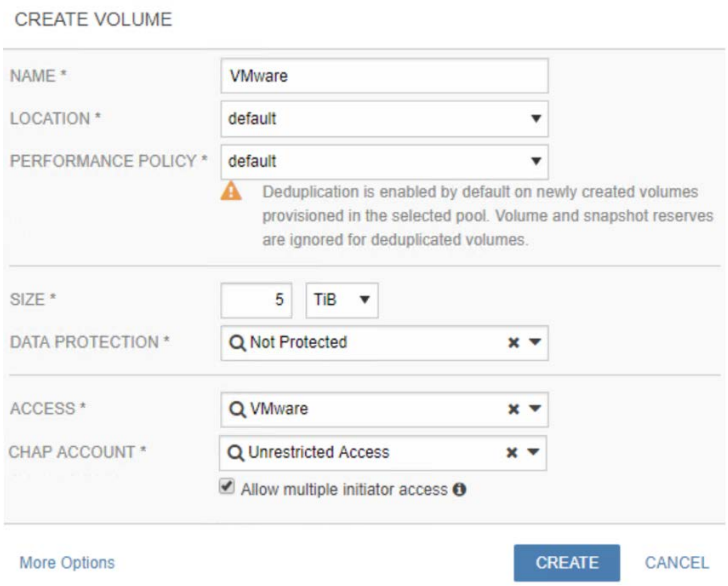

Figure 13. Parameters for creating volume in the HPE Nimble Storage management console

4. Click **Create** to complete the volume creation.

Integrate VASA provider with vCenter

1. To access the volume from HPE Nimble Storage in VMware vCenter, configure the VASA provider in the HPE Nimble Storage management console.
2. From the drop-down **Administration**, select **VMware Integration** as shown in Figure 14.

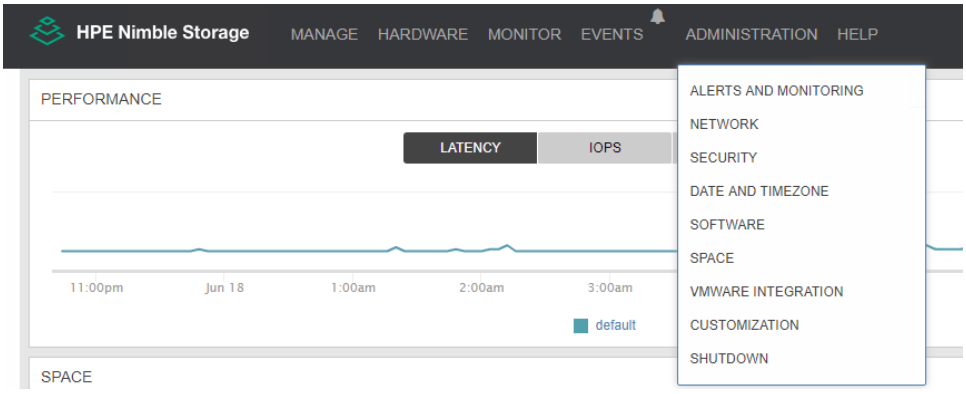

Figure 14. VMware integration with HPE Nimble Storage management console

3. Click **Add another vCenter** or **Edit** in VMware vCenter integration page as shown in Figure 15.

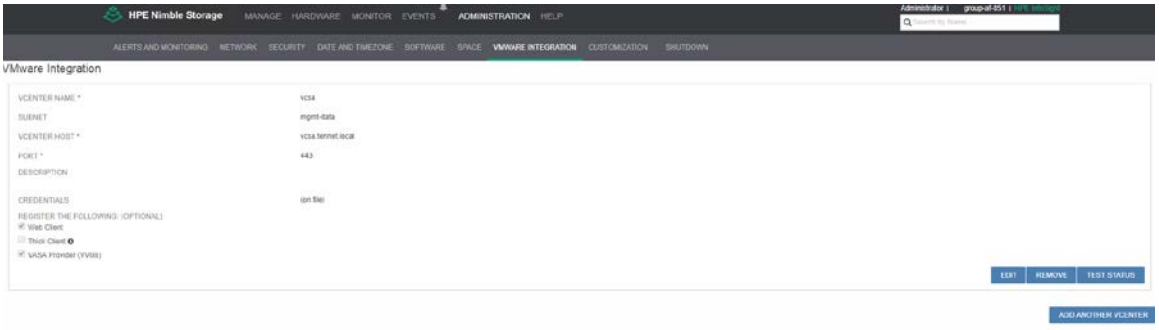

Figure 15. Integration of New VMware vCenter with HPE Nimble Storage management console

4. Provide the values for the following parameters as shown in Figure 16.
   a. **vCenter name**: << name of the vCenter Server Appliance >>
   b. **vCenter Host**: << FQDN or IP address of the vCenter >>
   c. **Port number**: 443
   d. **Credentials**: << Credentials to access the vCenter >>
   e. Select the **VASA provider** and **Web Client** boxes

Figure 16 illustrates the input parameters for the VMware vCenter integration with HPE Nimble Storage.

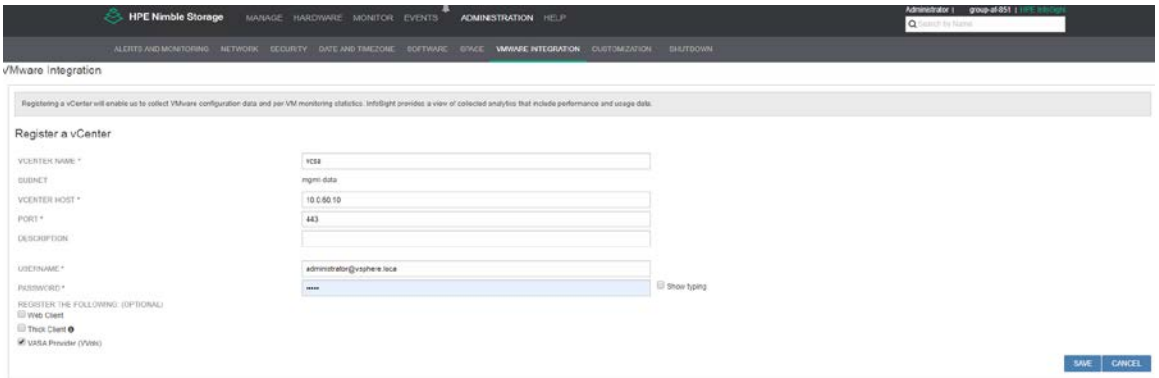

Figure 16. Parameters for VMware vCenter integration with HPE Nimble Storage management console

5. Click **Save.**

Red Hat OpenShift deployment

Overview of the tasks

1. Create a data center in vCenter.
2. Create a cluster for hosting the ESXi hosts in vCenter.
3. Bring the ESXi hosts into the newly created cluster.
4. Configure VMkernel network adapters for the iSCSI network in vCenter.
5. Create a datastore with the HPE Nimble Storage volume in vCenter.

6. Create a RHEL 7.6 VM template.
7. Deploy the RHEL 7.6 template to create the management and worker VMs for the OCP installations.

Prerequisites

- Ansible Engine should be installed and configured and capable of communicating with the hosts within this solution.
- VMware ESXi 6.7 is installed on at least three HPE Synergy 480 Compute Modules.
- A VMware vCenter Server Appliance is configured and available.
- DNS entries should exist for all hosts.
- HPE Nimble Storage has been integrated with vCenter.

Creating a data center in vCenter

A data center is a structure in VMware vCenter which holds the host clusters, hosts, datastore. To begin with, a data center needs to be created.

In order to create the data center, the installer will need to edit the variables YAML file. Using an editor, open the file /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/PrepareVCSA/vCenterVars.yaml to provide the VMware vCenter hostname and credentials, virtualization hosts and its credentials, data center and cluster name. A sample variable file can be found below. The installer should modify the file to suit their environment.

```
vcenter_hostname: << vCenter IP address / FQDN >>
vcenter_username: administrator@vsphere.local
vcenter_password: << password >>
datacenter_name: Nimble_datacenter
management_cluster_name: Nimble_management_cluster
worker_cluster_name: Nimble_worker_cluster
esxi_01: 10.0.x.x
esxi_02: 10.0.x.x
esxi_03: 10.0.x.x
esxi_04: 10.0.x.x
esxi_05: 10.0.x.x
esxi_06: 10.0.x.x
esxi_07: 10.0.x.x
esxi_08: 10.0.x.x
esxi_09: 10.0.x.x

esxi_uname: root
esxi_pwd: << password >>
```

Once the variable file is updated with the appropriate values, execute the following command to create the data center.

```
# ansible-playbook /etc/ansible/Openshift-Synergy-
RA/synergy/scalable/vsphere/nimble/PrepareVCSA/CreateDatacenter.yml
```

Creating a cluster for hosting the ESXi hosts in vCenter

The Cluster in vCenter is a pool of ESXi hosts, which provides high availability and reliability to the VMs deployed in it. Execute the following command to create a cluster in vCenter.

```
# ansible-playbook /etc/ansible/Openshift-Synergy-
RA/synergy/scalable/vsphere/nimble/PrepareVCSA/CreateCluster.yml
```

Add the ESXi hosts into the cluster in vCenter

Once the cluster is created within vCenter, the ESXi hosts need to be added into the cluster. Execute the following command to add the hosts into the cluster.

```
# ansible-playbook /etc/ansible/Openshift-Synergy-
RA/synergy/scalable/vsphere/nimble/PrepareVCSA/AddHostsToCluster.yml
```

Configure VMkernel network adapters for the iSCSI networks

VMkernel network adapters for the iSCSI networks need to be configured for the primary and the secondary iSCSI networks present in the environment. The following steps configure the VMkernel network adapters for the iSCSI networks, the Dynamic Discovery of the iSCSI server and the Network Port Binding:

1. Log into vCenter.
2. Navigate to **vSphere Host -> Networking -> Virtual Switches -> Add Networking**.
3. To configure the VMkernel network adapters for the iSCSI network A, navigate to **Select Connection type -> VMkernel Network Adapter,** as shown in Figure 17 and then click **Next.**

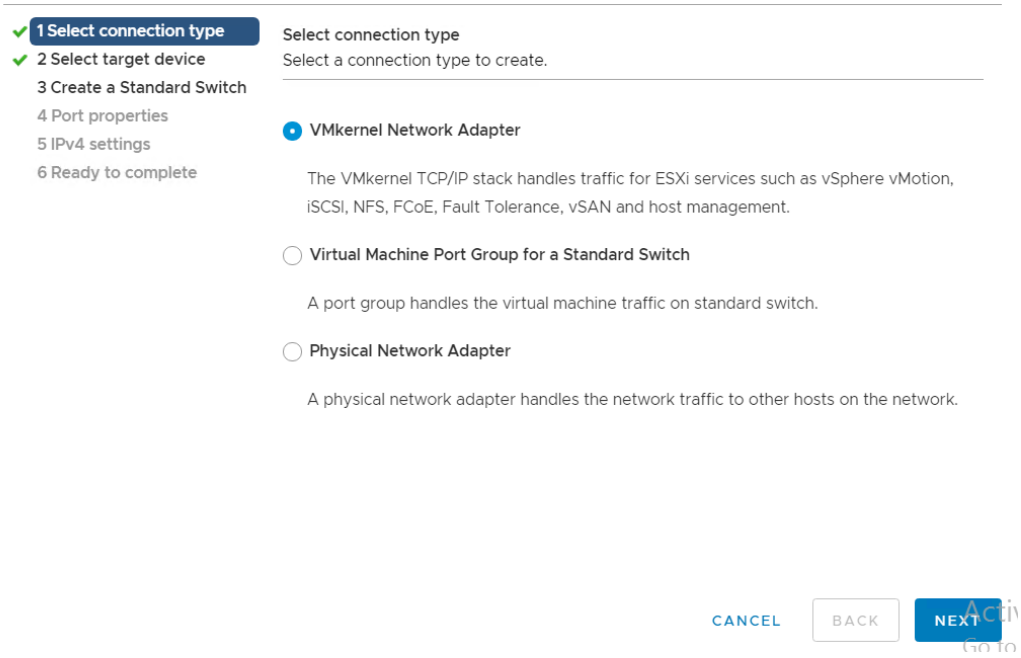

Figure 17. Connection type of the VMkernel Network adapter

4. Choose a **New Standard Switch** as shown in Figure 18 and click **Next**.

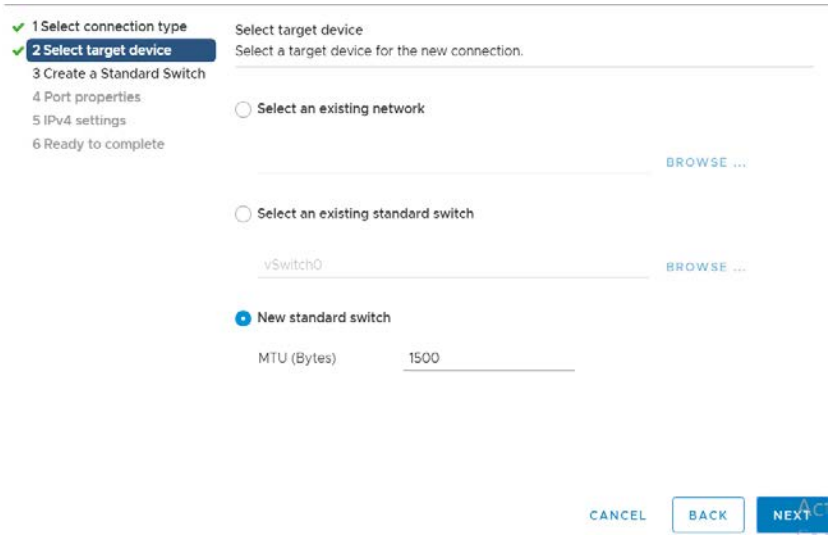

Figure 18. Create a new standard switch

5. From the **Create a Standard Switch** page, select the **Active Adapter** of the iSCSI_network A in your environment, as shown in Figure 19 and click **Next**.

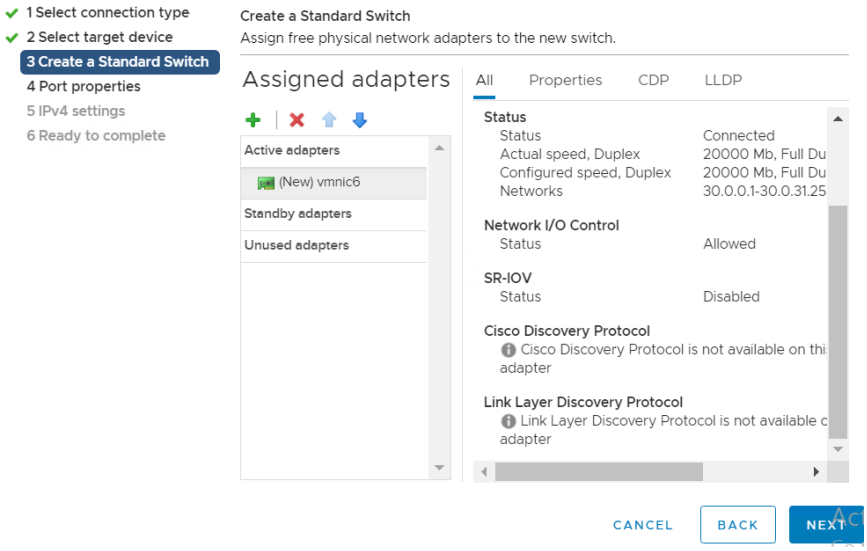

Figure 19. Standard switch configuration for the VMkernel adapter

6. On the **Port Properties** page, provide the **Network Label** and select the required services in the **Available Networks** as shown in Figure 20, and click **Next**.

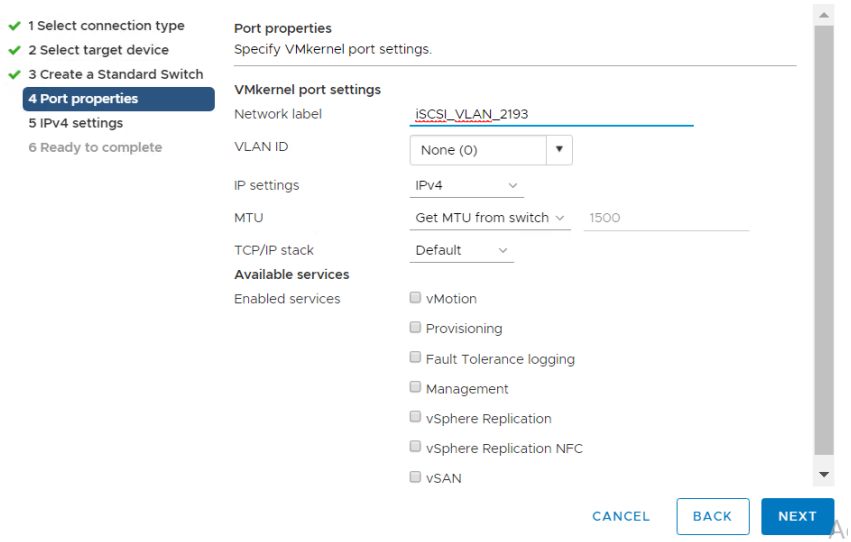

Figure 20. Port properties of the VMkernel network adapter

7. From the **IPV4 settings** page, select **Use Static IPV4 settings** and provide the **IP address** and **subnet mask** for the corresponding iSCSI data network, as shown in Figure 21 and click **Next**.

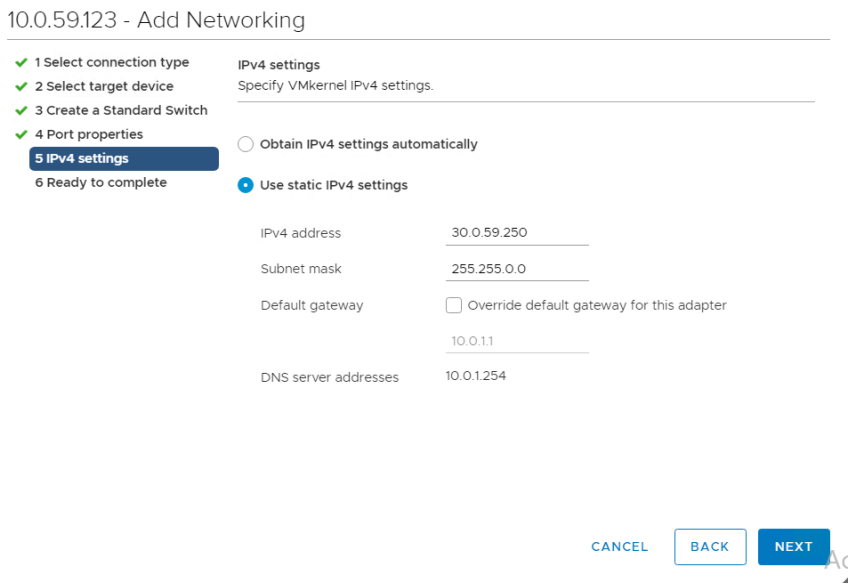

Figure 21. IP address configuration of the VMkernel network adapter

8. On the **Ready to complete** page, as shown in Figure 22, review the configuration details and click **Finish**.

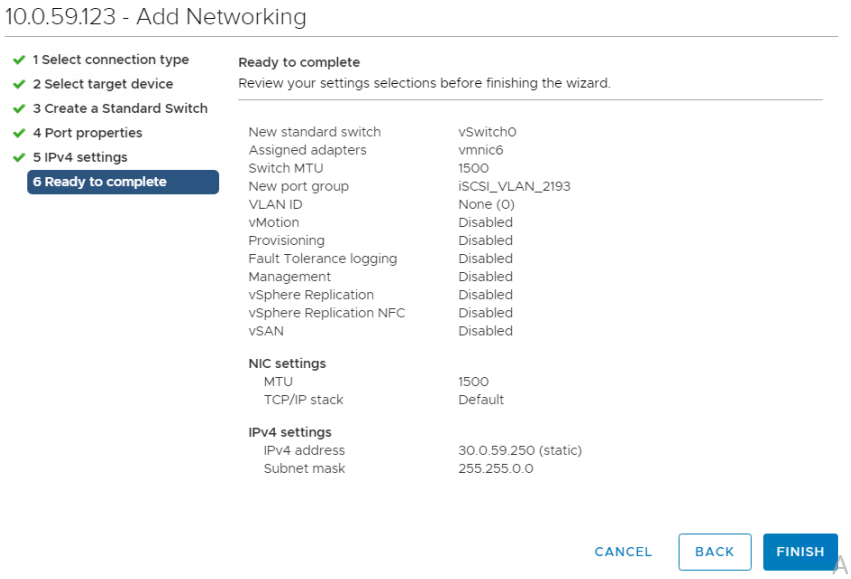

Figure 22. Configuration of the VMkernel network adapter

9. After the VMkernel adapter is created for iSCSI_A network, select the host and navigate to **Configure -> Storage -> Storage Adapters -> iSCSI Adapter -> Dynamic Discovery**.
10. Click the **"+"** icon as shown in Figure 23 to add **Send Target Server**.

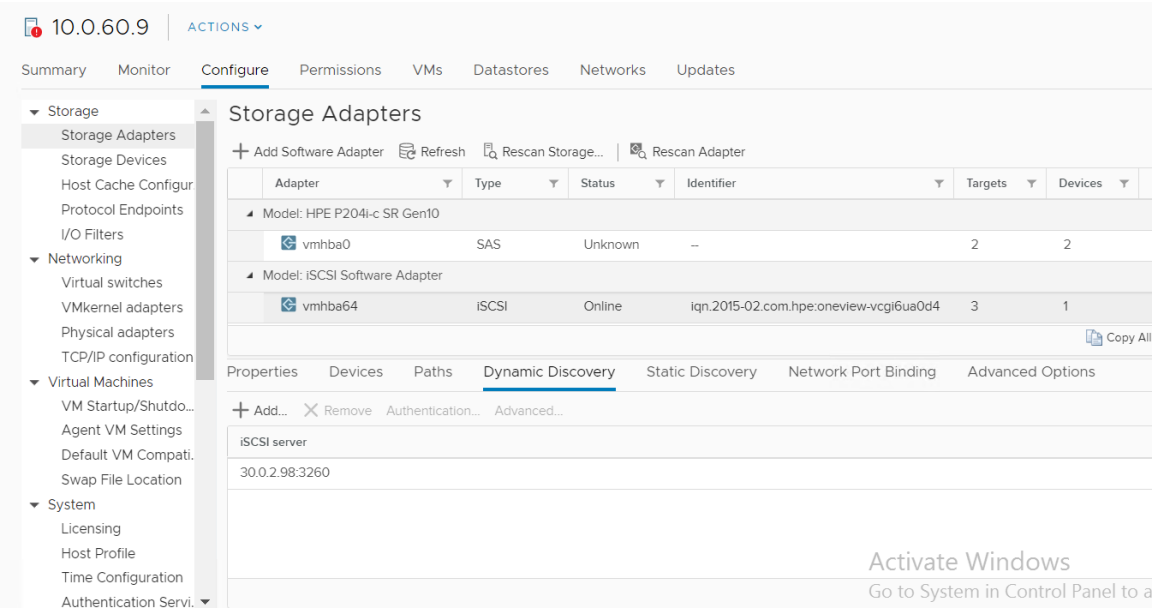

Figure 23. Host Storage Adapters

11. Provide the FQDN / IP address of **iSCSI A server** and select the **inherit authentication settings from parent** box, as shown in Figure 24 and then click **OK**.

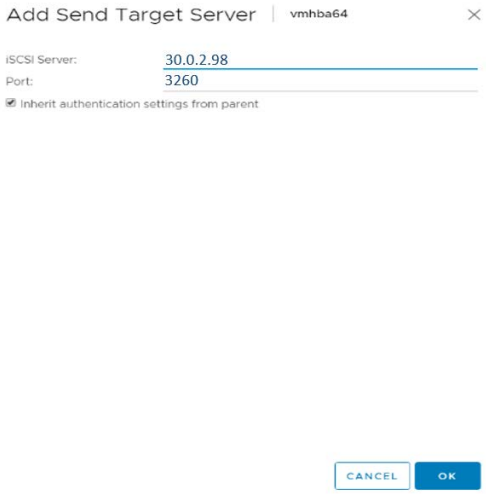

Figure 24. Target iSCSI server configuration

12. To configure the VMkernel network adapters for iSCSI_B network, navigate to **Select Target Device**, select the connection type as **VMkernel Network Adapter** as shown in Figure 25, and click **Next**.

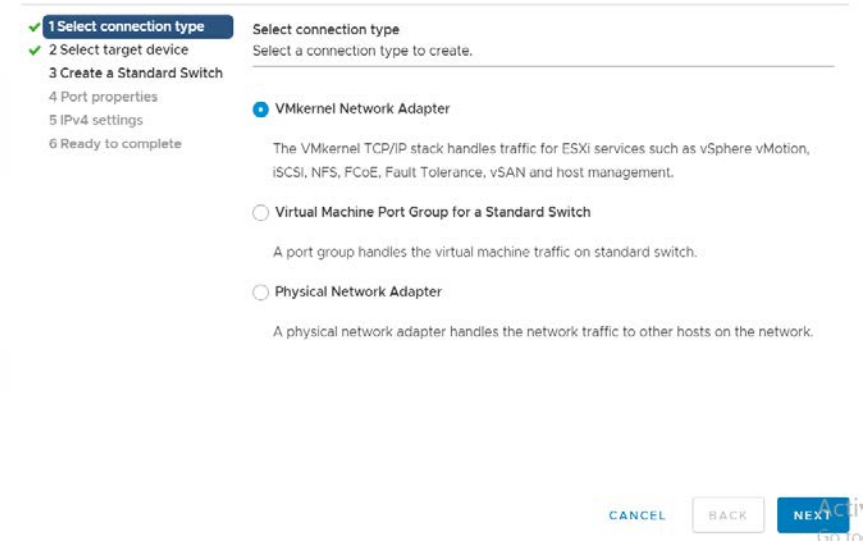

Figure 25. Connection type of the VMkernel network adapter

13. Choose a **New Standard Switch** as shown in Figure 26 and click **Next**.

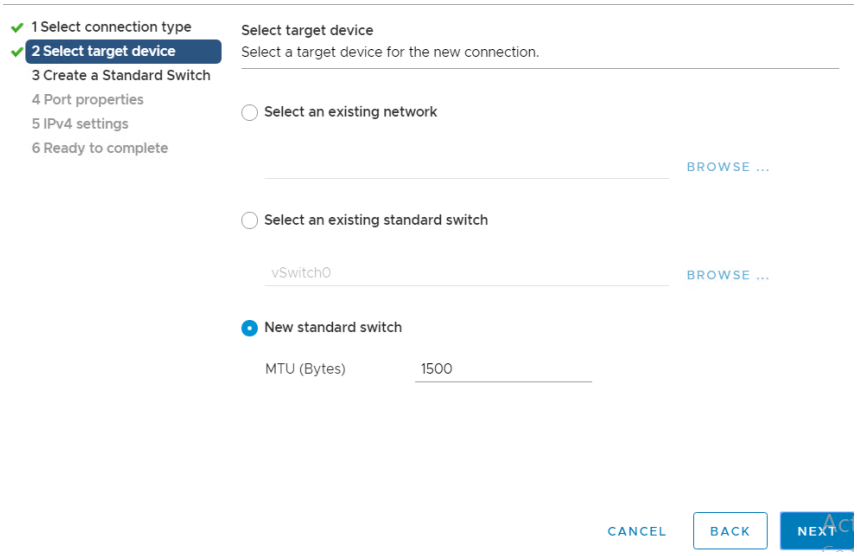

Figure 26. Create new standard switch

14. From the **Create a Standard Switch** page, select **Active Adapter** of the iSCSI_B network in your environment, as shown in Figure 27 and click **Next**.

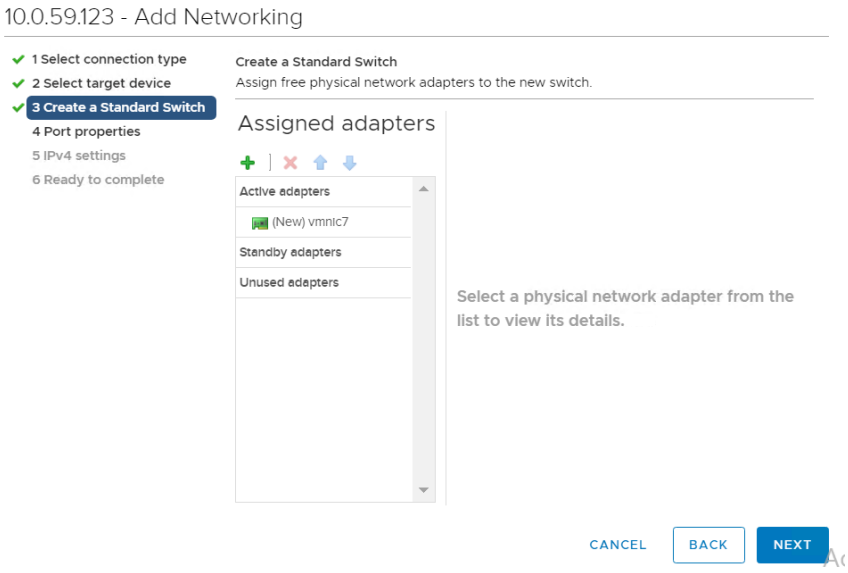

Figure 27. Standard switch configuration for the VMkernel network adapter

15. From the **Port Properties** page, provide details for **Network Label** and select the required services under **Available Networks** as shown in Figure 28, and click **Next**.

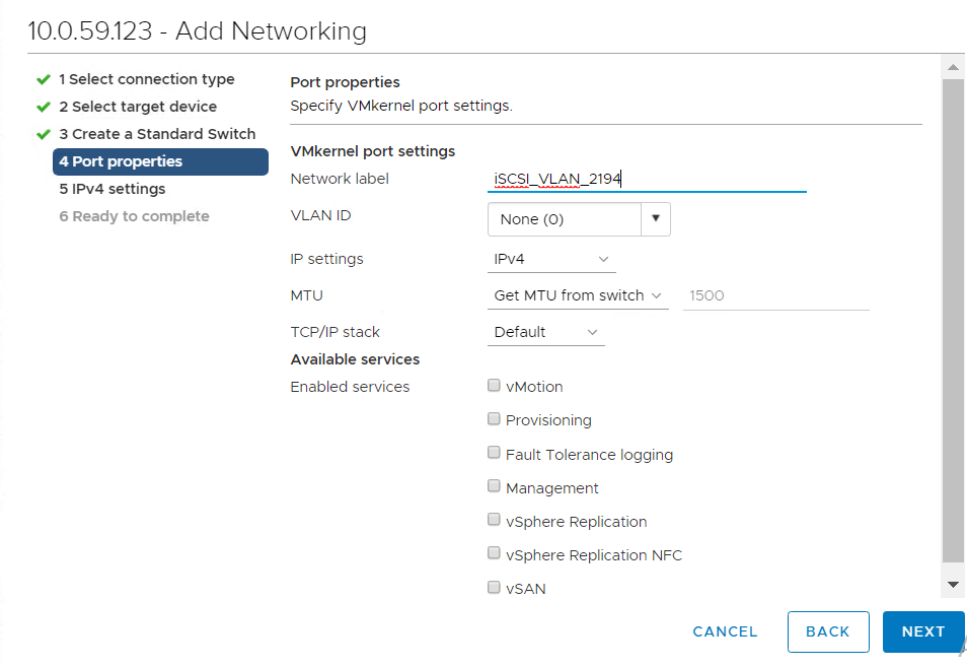

Figure 28. Port properties of the VMkernel network adapter

16. From the **IPV4 settings** page, select **Use static IPV4 settings** and provide the IP address and subnet mask for the corresponding data network as shown in Figure 29, and click **Next**.

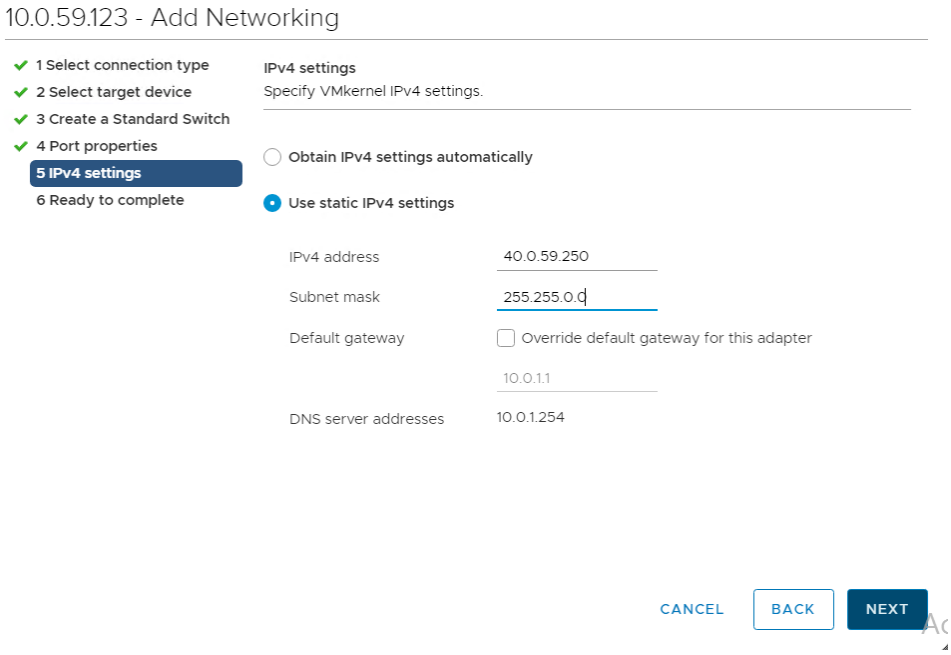

Figure 29. IP address configuration of the VMkernel network adapter

17. On the **Ready to complete** page as shown in Figure 30, review the configuration details and click **Finish**.

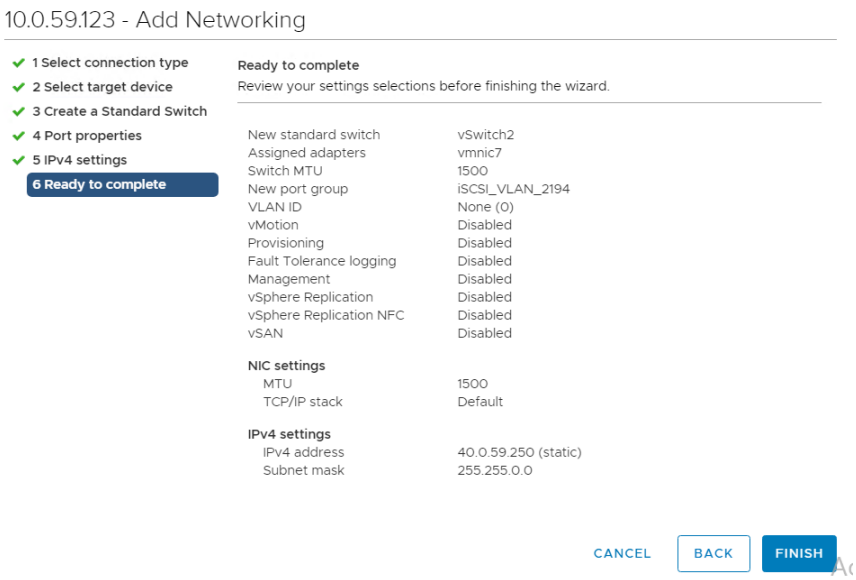

Figure 30. Configuration of the VMkernel network adapter

18. After the VMkernel network adapter is created for iSCSI_B network, select the host and navigate to **Configure -> Storage -> Storage Adapters -> iSCSI Adapter -> Dynamic Discovery**.as shown in Figure 31

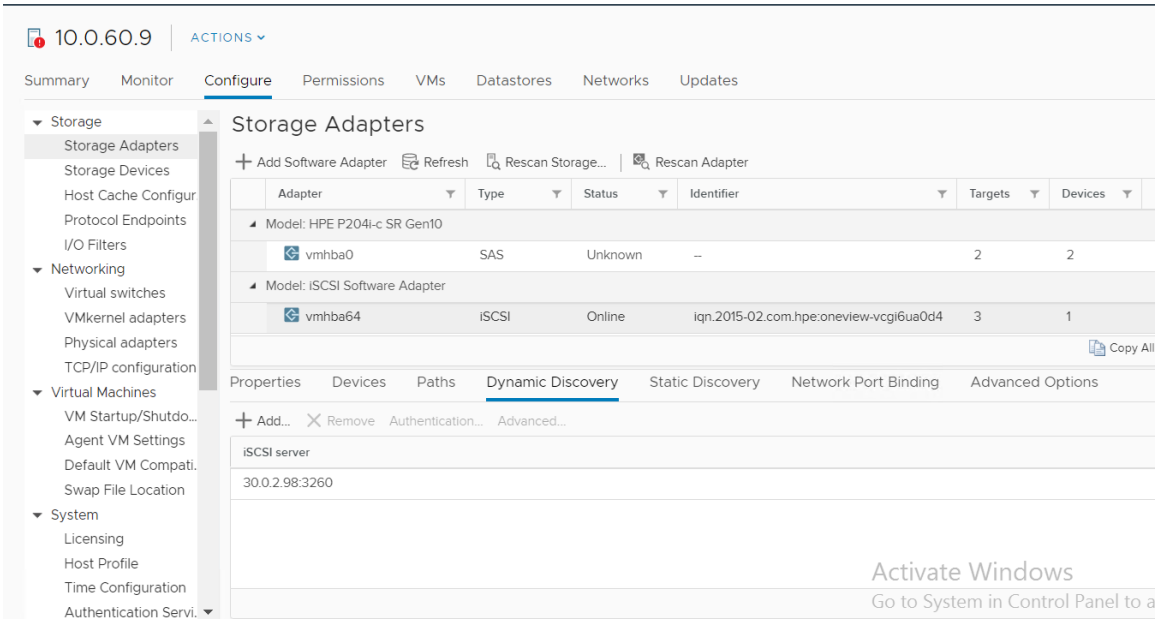

Figure 31. Host Storage Adapters

19. Click **"+"** icon to add **Send Target Server**.

20. Provide the FQDN / IP address of the **iSCSI B server** and select the **inherit authentication settings from parent** checkbox as shown in Figure 32, and then click **OK**.

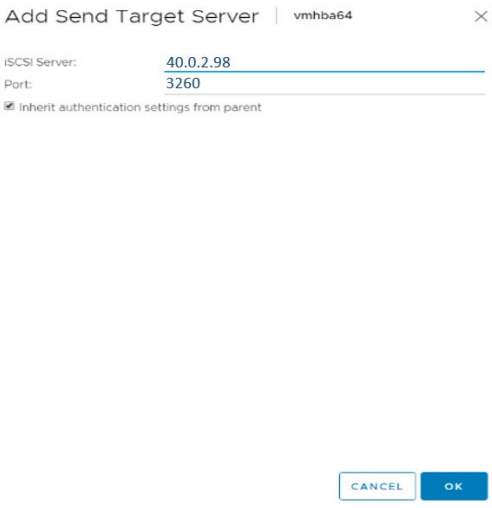

Figure 32. Target iSCSI server configuration

21. To configure **Network Port Binding**, navigate to **Configure -> Storage -> Storage Adapters -> iSCSI Adapter -> Network Port Binding**.

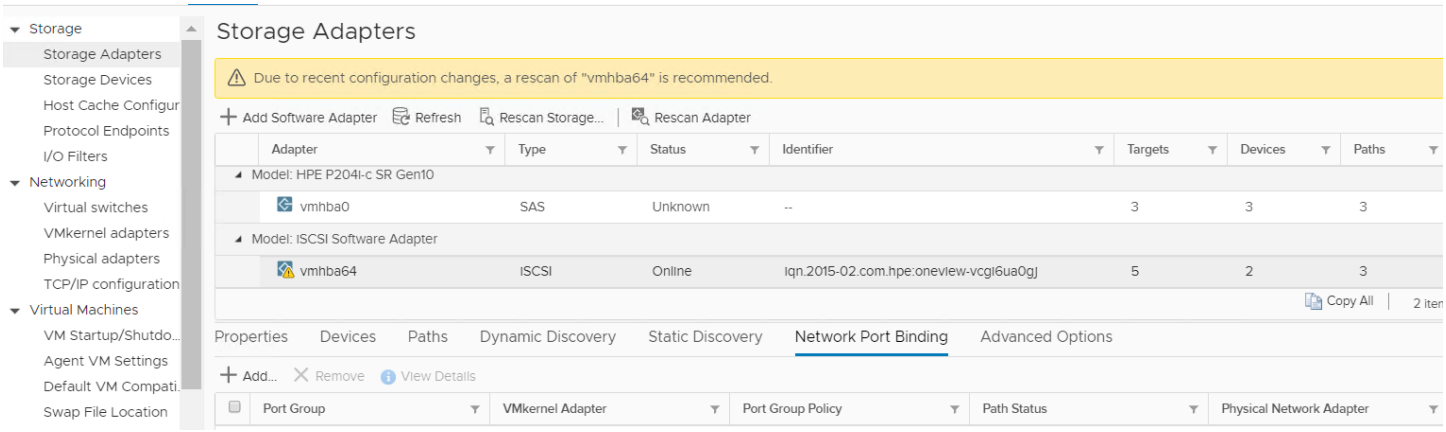

Figure 33. Network Port Binding

22. Click **"+"** as shown in Figure 33.

23. Select **Port Group** of the **iSCSI_A network** shown in Figure 34 and click **OK**.

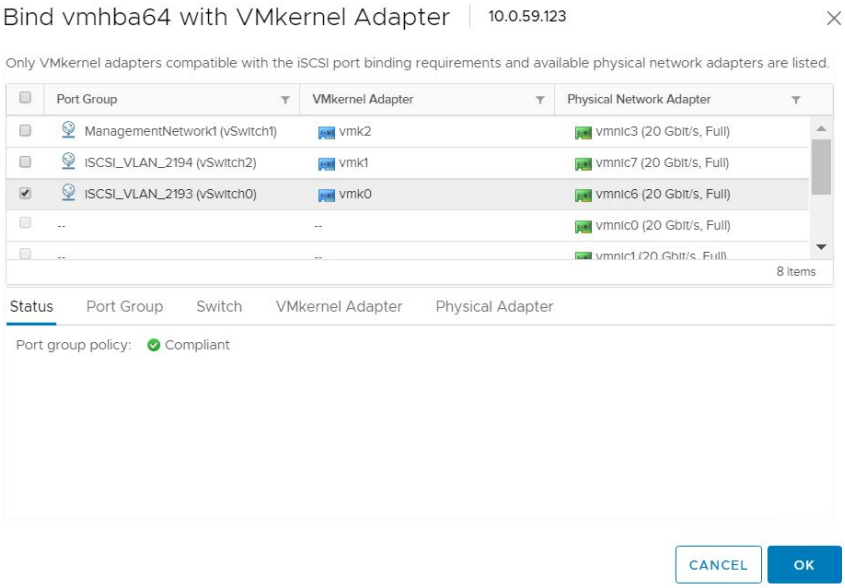

Figure 34. Adding iSCSI_A network for network port binding

24. Select **Port Group** of the **iSCSI_B network** as shown in Figure 35 and click **OK**.

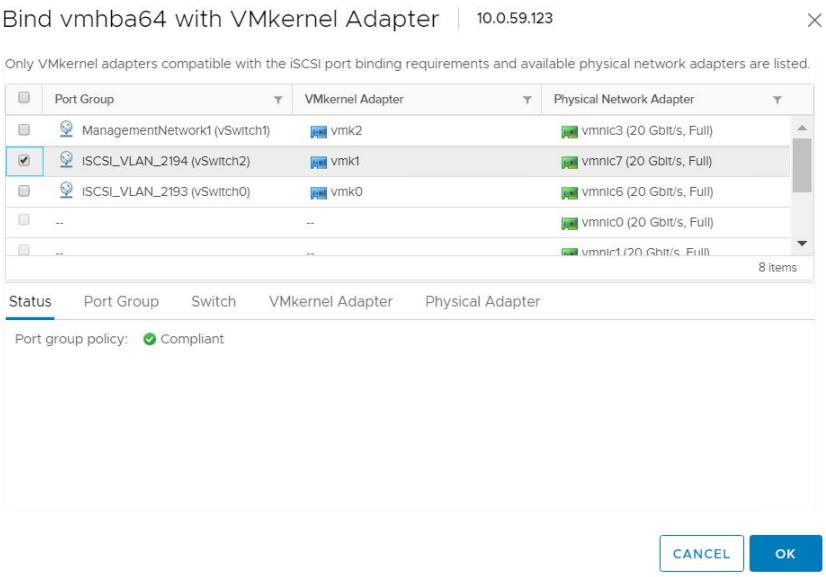

Figure 35. Adding iSCSI_B network for network port binding

Note

Repeat the steps in the **Configure VMkernel network adapter for the iSCSI network** section for all the vSphere hosts to ensure connectivity between the HPE Nimble Storage and the virtualization hosts.

Creating a datastore with the HPE Nimble storage volume in vCenter

A datastore needs to be created in VMware vCenter from the volume carved out of HPE Nimble Storage to store the VMs. The following steps create a datastore on the HPE Nimble Storage.

1. From the vSphere Web Client navigator, right-click the cluster, select **Storage** from the drop-down menu, and then select the **New Datastore** as shown in Figure 36.

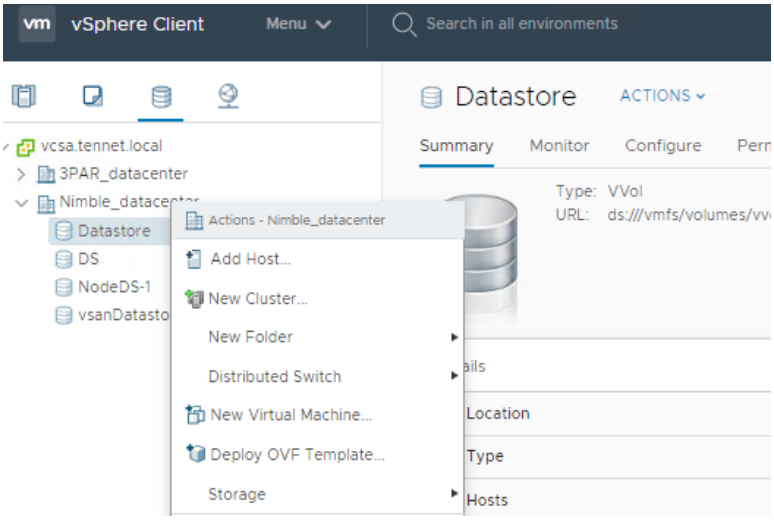

Figure 36. Create a Datastore in vCenter

2. Select VMFS as the datastore type as shown in Figure 37 and click **Next**.

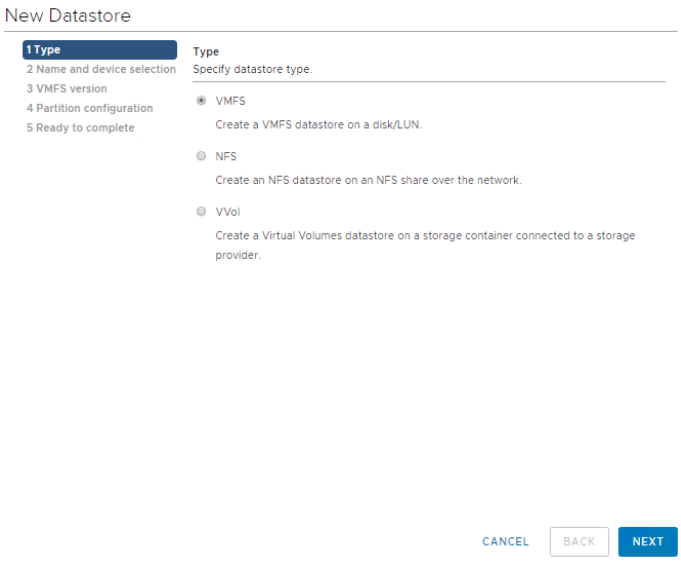

Figure 37. Selecting datastore type in vCenter

3. On the Name and Device selection page, provide the values for the following parameters. Figure 38 provides an example.
   a. Name: << unique name for the datastore >>.
   b. Select a host to view its accessible disk/LUNs. Any of the hosts that are associated with the HPE Nimble Storage volume may be selected.
   c. Select the volume from HPE Nimble Storage and click **Next**.

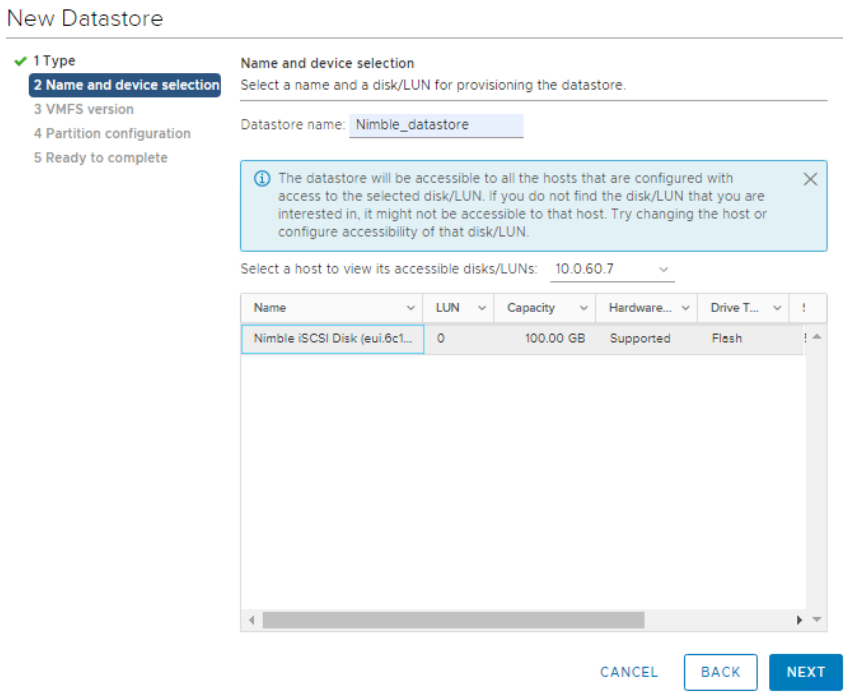

Figure 38. Device selection screen for the datastore within vCenter.

4. From **VMFS version** page, select **VMFS 6**, and click **Next**.

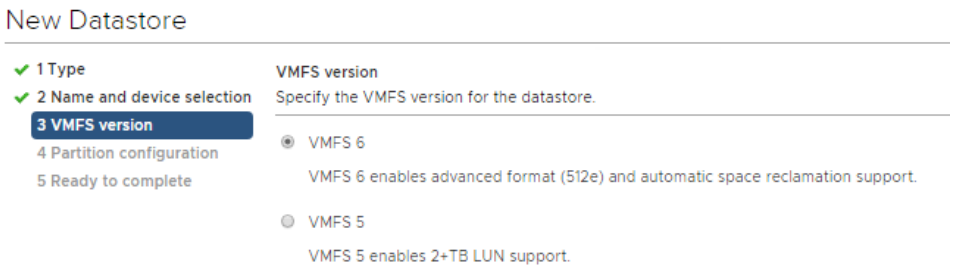

Figure 39. VMFs version screen within vCenter

5. Specify details for **Partition configuration** as shown in Figure 40 and click **Next**. By default, the entire free space on the storage device is allocated. You can customize the space if required.

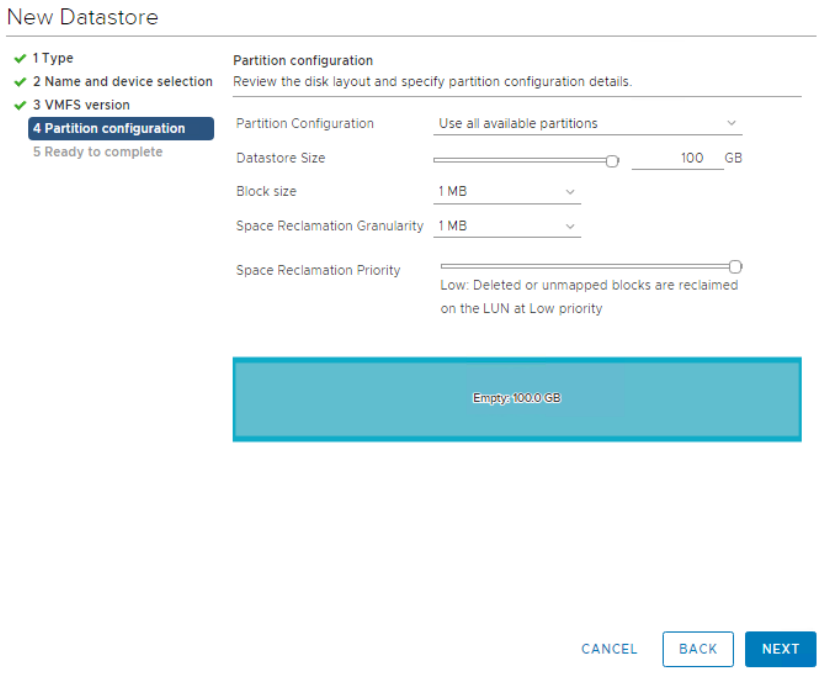

Figure 40. Partition configuration screen of the new datastore within vCenter

6. On the **Ready to complete** page, review the datastore configuration as shown in Figure 41 and click **Finish**.

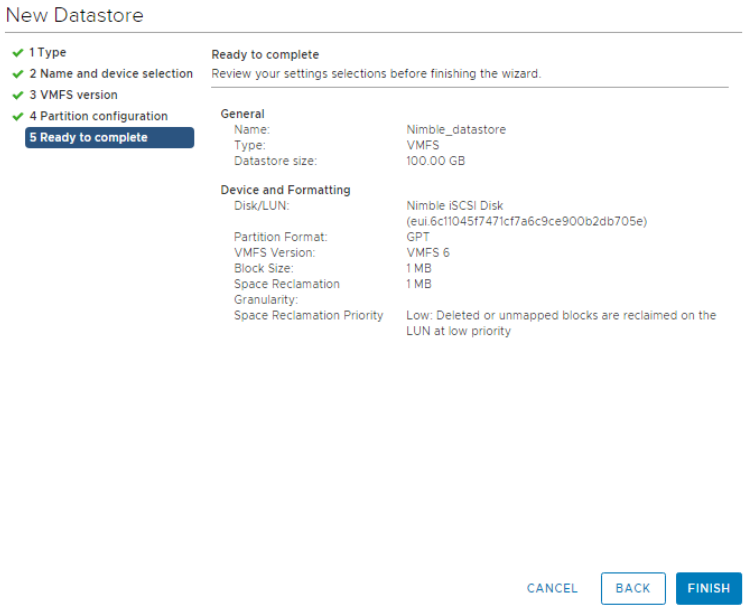

Figure 41. Summary screen of the datastore within vCenter

Creating a Red Hat Enterprise Linux version 7.6 VM Template

A VM template with Red Hat Enterprise Linux (RHEL) version 7.6 operating system with VMware tools installed on it. The following section explains the steps that are required to complete in order to create a RHEL version 7.6 VM template.

Overview of the tasks

1. Create a VM with RHEL version 7.6 OS.
2. Convert the VM to a template.

Create a VM with RHEL version 7.6 Operating System

1. Log into VMware vCenter using Web Client or vSphere Client and select an ESXi host. Right-click and select **New Virtual Machine**.
2. From the **Select a creation type** page, select **Create a new virtual machine**, as shown in Figure 42 and click **Next**.

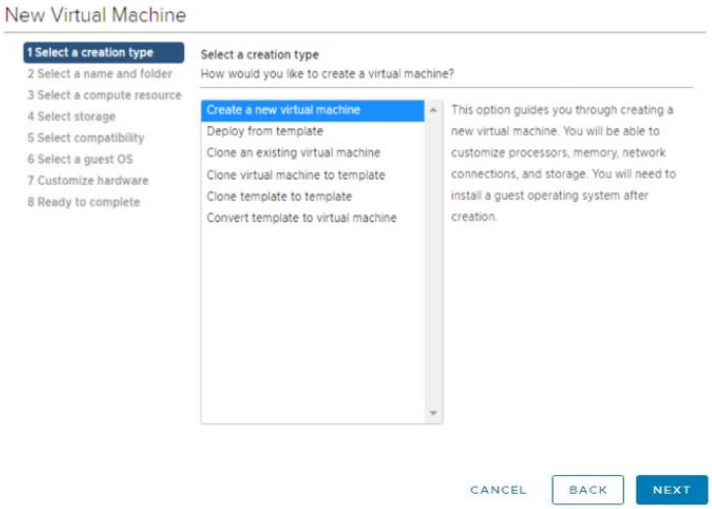

Figure 42. Creation type screen within vCenter

3. Enter a unique name for the Virtual Machine and select the location to deploy the VM, as shown in Figure 43 and click **Next**.

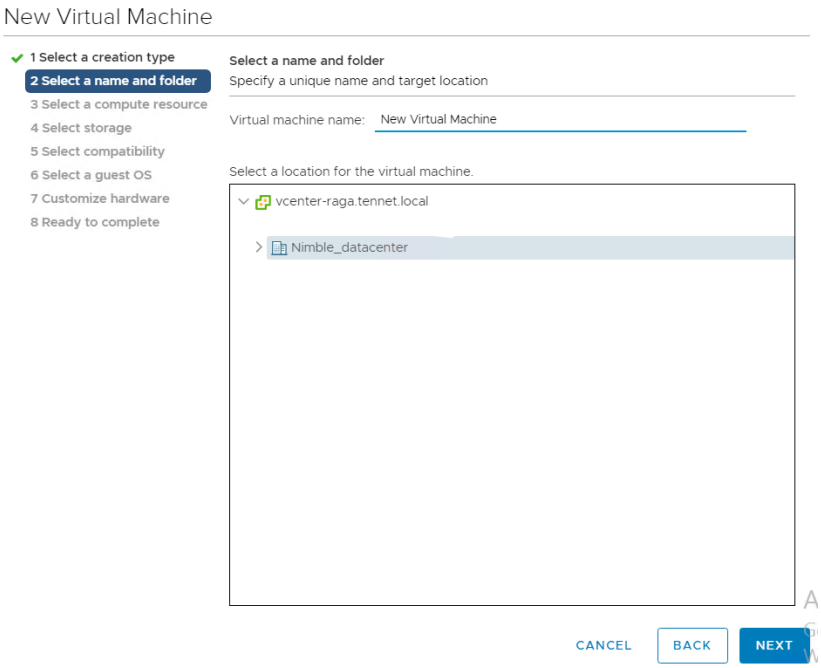

Figure 43. Select Virtual Machine name and folder location within vCenter

4. Select the cluster on which the VM can be deployed and click **Next**.
5. Select the VM storage policy and datastore on which the VM data can be stored as shown in Figure 44 and click **Next**.

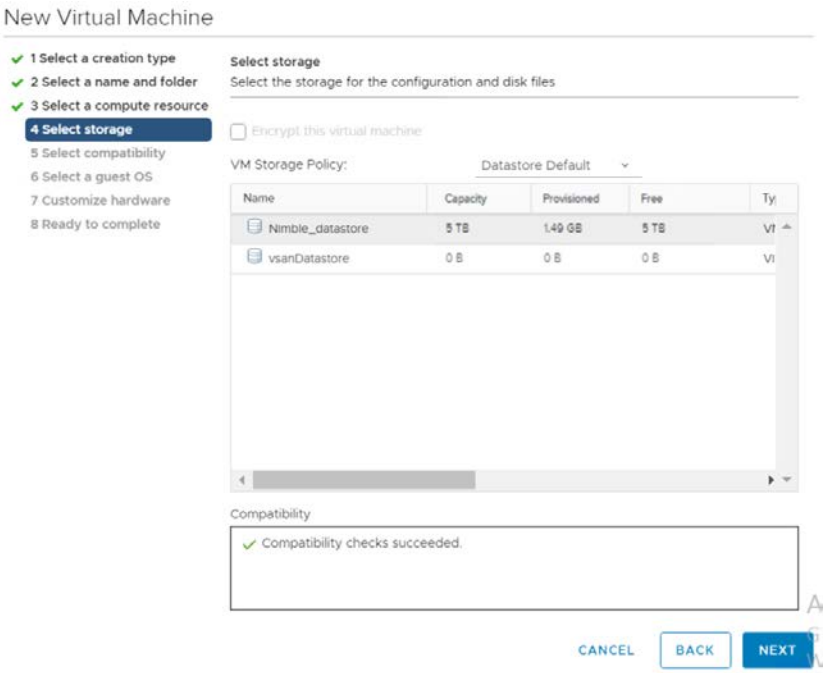

Figure 44. Storage selection within vCenter

6. From the **Select compatibility** page, select **ESXi 6.7 and later** as shown in Figure 45, and then click **Next**.

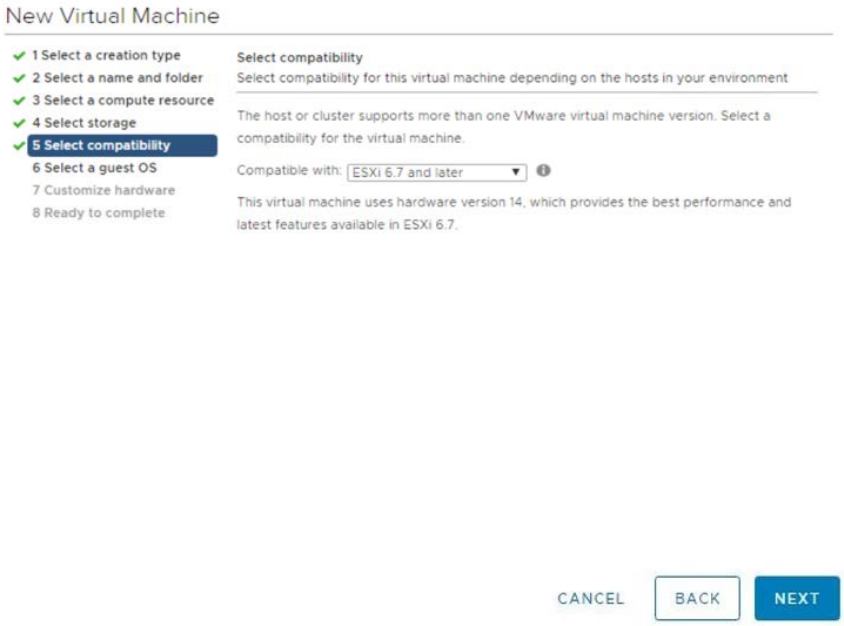

Figure 45. Select VM compatibility within vCenter

7. From the **Select a guest OS** page, set the **Guest OS family** to **Linux** and the **Guest OS version** to **Red Hat Enterprise Linux 7 (64 bit)** as shown in Figure 46 and click **Next**.

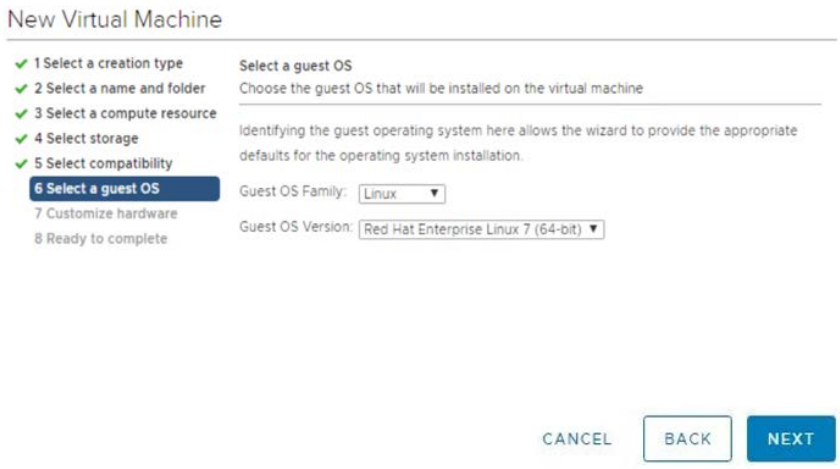

Figure 46. Guest OS selection screen in vCenter

8. From the **Customize hardware** page, configure the **Virtual Hardware** with **4 CPU, 16 GB memory, 50 GB Dual hard disk** and attach the **Operating System** from the datastore/installer's laptop. Select the **Connect at power on** checkbox as shown in Figure 47, and click **Next**.

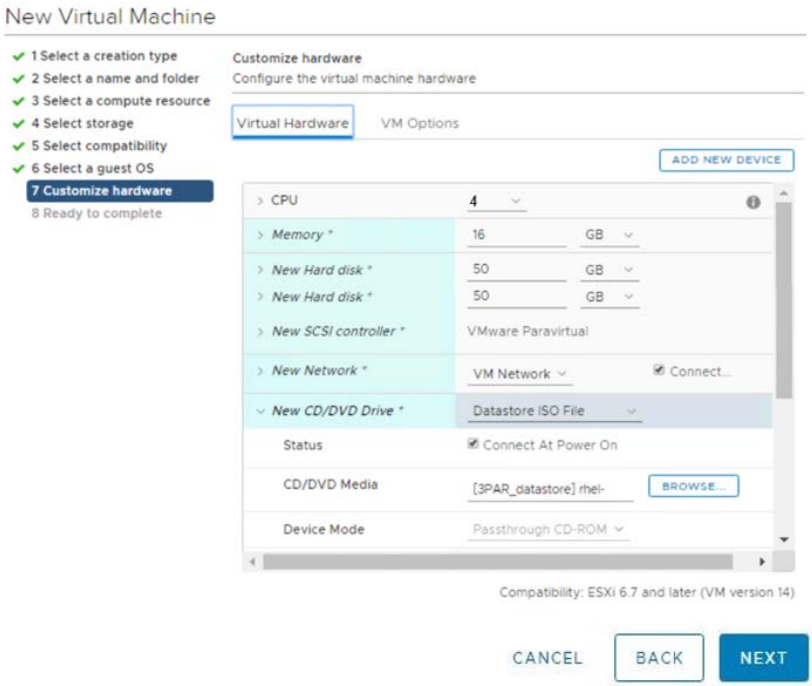

Figure 47. Customize hardware within vCenter

9. Review the VM configuration before deploying the virtual machine. Click **Finish** to complete the New Virtual Machine creation.

Once the new VM is created, install the RHEL version 7.6 guest operating system to complete the creation procedure. To Install a guest OS, follow the steps listed in the blog from Red Hat at, https://developers.redhat.com/products/rhel/hello-world#fndtn-vmware. It is strongly recommended that the installer register the template, update all packages using Yum and then unregister the template.

Note

VMware tools is necessary for the smooth execution of Ansible playbooks. Install VMware tools on the VM intended to be converted as a template by following the steps listed in the blog from Red Hat at, https://access.redhat.com/solutions/1447193.

Convert the VM as a template

1. Log into vCenter and select the VM created to be converted to a template.
2. From **Actions -> Power**, select **Power off** to power off the VM.
3. From **Actions,** select **Template**, and then select **Convert to Template**.

Deploying RHEL 7.6 template to create Management and Worker VMs for OCP installations

1. In order to clone from the template and create VMs for OpenShift deployment, the installer will need to edit the variables YAML file. Using an editor such as Vim or Nano, open the file /etc/ansible/Openshift-Synergy-RA/synergy/scalable/vsphere/nimble/DeployVMs/VirtualMachineVars.yaml.The variable file should look like the example below and contain information about the VMs, vCenter, hostnames, IPs, memory and CPU. The alignment of the details in the VMs section is important and should be maintained as outlined below.

```
vcenter_hostname:<< vCenter IP address / FQDN >>
```

```
vcenter_username: << vCenter username >>
vcenter_password<< vCenter password >>
management_cluster_name: Nimble_cluster
worker_cluster_name: Nimble_worker_cluster
datacenter_name: Nimble_datacenter
datastore_name: Nimble_datastore
vmtemplate: Nimble_template

# Disk size in GB/GiB
master_disk_size: 50
infra_disk_size: 50
etcd_disk_size: 50
lb_disk_size: 50
worker_disk_size:80

# number of CPUs
master_cpu_size: 4
infra_cpu_size: 4
etcd_cpu_size: 4
lb_cpu_size: 4
worker_cpu_size:4

# Memory size in MB/MiB
master_memory_size: 16184
infra_memory_size: 24276
etcd_memory_size: 16184
lb_memory_size: 16184
worker_memory_size: 16184

master01_ip: 10.0.x.x
master02_ip: 10.0.x.x
master03_ip: 10.0.x.x
infra01_ip: 10.0.x.x
infra02_ip: 10.0.x.x
infra03_ip: 10.0.x.x
etcd01_ip: 10.0.x.x
etcd02_ip: 10.0.x.x
etcd03_ip: 10.0.x.x
lb01_ip: 10.0.x.x
lb02_ip: 10.0.x.x
worker01_ip: 10.0.x.x
worker02_ip: 10.0.x.x
worker03_ip: 10.0.x.x

master01_ip2: 30.0.x.x
master02_ip2: 30.0.x.x
master03_ip2: 30.0.x.x
infra01_ip2: 30.0.x.x
infra02_ip2: 30.0.x.x
infra03_ip2: 30.0.x.x
etcd01_ip2: 30.0.x.x
etcd02_ip2: 30.0.x.x
etcd03_ip2: 30.0.x.x
```

```
lb01_ip2: 30.0.x.x
lb02_ip2: 30.0.x.x
worker01_ip2: 30.0.x.x
worker02_ip2: 30.0.x.x
worker03_ip2: 30.0.x.x

master01_ip3: 40.0.x.x
master02_ip3: 40.0.x.x
master03_ip3: 40.0.x.x
infra01_ip3: 40.0.x.x
infra02_ip3: 40.0.x.x
infra03_ip3: 40.0.x.x
etcd01_ip3: 40.0.x.x
etcd02_ip3: 40.0.x.x
etcd03_ip3: 40.0.x.x
lb01_ip3: 40.0.x.x
lb02_ip3: 40.0.x.x
worker01_ip3: 40.0.x.x
worker02_ip3: 40.0.x.x
worker03_ip3: 40.0.x.x

master01_fqdn: nmaster01.tennet.local
master02_fqdn: nmaster02.tennet.local
master03_fqdn: nmaster03.tennet.local
etcd01_fqdn: netcd01.tennet.local
etcd02_fqdn: netcd02.tennet.local
etcd03_fqdn: netcd03.tennet.local
infra01_fqdn: ninfra01.tennet.local
infra02_fqdn: ninfra02.tennet.local
infra03_fqdn: ninfra03.tennet.local
lb01_fqdn: nlb01.tennet.local
lb02_fqdn: nlb02.tennet.local
worker01_fqdn: nworker01.tennet.local
worker02_fqdn: nworker02.tennet.local
worker03_fqdn: nworker03.tennet.local

master01_name: nmaster01
master02_name: nmaster02
master03_name: nmaster03
etcd01_name: netcd01
etcd02_name: netcd02
etcd03_name: netcd03
infra01_name: ninfra01
infra02_name: ninfra02
infra03_name: ninfra03
lb01_name: nlb01
lb02_name: nlb02
worker01_name:nworker01
worker02_name: nworker02
worker03_name: nworker03

subnet_mask: 255.255.0.0
gateway_address: 10.0.x.x
```

```
dns_server_address: 10.0.x.x
domain_name: "tennet.local"
network_name: "VM Network"
```

2. When the installer has completed editing the variable file, the following commands will deploy all of the VMs that is specified.

```
# ansible-playbook /etc/ansible/Openshift-Synergy-
RA/synergy/scalable/vsphere/nimble/DeployVMs/DeployManagementVMs.yml

# ansible-playbook /etc/ansible/Openshift-Synergy-
RA/synergy/scalable/vsphere/nimble/DeployVMs/DeployWorkerVMs.yml
```

3. The play DeployManagementVMs.yml creates the following control plane VMs in vCenter and configures the IP address for each of them.

```
nmaster01
nmaster02
nmaster03
ninfra01
ninfra02
ninfra03
netcd01
netcd02
netcd03
nlb01
nlb02
```

4. The DeployworkerVMs.yml play creates the following worker node VMs in the vCenter and configures the IP address for each of them.

```
nworker01
nworker02
nworker03
```

5. After the VMs are created, SSH into each and update their hostnames to their fully-qualified domain names with the command listed below.

```
# hostnamectl set-hostname <fqdn as hostname of the virtual machine>
```

Deploying Red Hat OpenShift Container Platform

Once the Management and the Worker VMs are created and configured, the process of the deployment of Red Hat OpenShift Container Platform, validation of the deployment and other components align with the master Deployment Guide found at, https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/nimble. Consult the master Deployment Guide for the further steps and processes for the deployment of Red Hat OpenShift Container Platform and the validation of the deployment.

Note

The value for the variable second_disk_physical in the VMware VMs is /dev/sdb.

Appendix A: Playbook variables

Table A1 describes the variables used with the DeployESXiHosts.

Table A1. Variables used in the Deploy ESXi hosts

Variable	Scope	Description
config	OneView	Path to the config file with OneView and Image Streamer IP address and credentials
OneViewConfig.json **Ip** **userName** **password** **image_streamer_ip**	OneView	IP address and credentials of the OneView and the Image Streamer IP address
Network Connections Name **deployment_network_name** **management_network_name** **SAN_A_network_name** **SAN_B_network_name** **datacenter_network_name**	OneView	Names of the network connections utilized in the server profile
Network Details **dns_ip** **gateway** **subnet_mask** **domain_name**	OneView	Network Configuration details for the hosts
esxi_ip	OneView	IP address that needs to be assigned to the host
esxi_hostname	OneView	Hostname that needs to be assigned to the host
enclosure_group_name	OneView	Name of the enclosure group where the server belongs to
deployment_plan_name	OneView	Name of the deployment plan which will be applied to the servers
server_hardware_name	OneView	Server Hardware name
server_profile_template_name:	OneView	Name that needs to be associated to the Server Profile Template
server_profile_name	OneView	Name that needs to be associated to the Server Profile
server_profile_template_file	OneView	Path of the template file utilized for the server profile template creation
server_profile_file	OneView	Path of the template file utilized for the server profile creation

Table A2 describes the variables used in the Prepare vCSA.

Table A2. Variables used in the Prepare vCSA

Variable	Scope	Description
vcenter_hostname	vCenter	vCenter hostname/IP address
vcenter_username	vCenter	Username for the vCenter hosts
vcenter_password	vCenter	Password for the vCenter hosts
datacenter_name	vCenter	Datacenter within vCenter which will be used for template deployment
Management_cluster_name	vCenter	Compute Cluster within vCenter for the management VMs
Worker_cluster_name	vCenter	Compute Cluster within vCenter for the worker VMs
esxi_x	vCenter	ESXi host x's hostname

Variable	Scope	Description
esxi_uname	vCenter	Username for the ESXi hosts
esxi_pwd	vCenter	Password for the ESXi hosts

Table A3 describes the variables used in the deployment of the VMs.

Table A3. Variables used for deploying VMs

Variable	Scope	Description
vcenter_hostname	vCenter	FQDN/IP address of the vCenter
vcenter_username	vCenter	Username for the vCenter host
vcenter_password	vCenter	Password for the vCenter host
datacenter_name	vCenter	Datacenter within vCenter which will be used for template deployment
Management_cluster_name	vCenter	Compute Cluster within vCenter for the management VMs
worker_cluster_name	vCenter	Compute Cluster within vCenter for the worker VMs
<node>_name	vCenter	Name of the corresponding master, infra, etcd, load balancer, worker VMs
<node>_fqdn	vCenter	FQDN of the corresponding master, infra, etcd, load balancers, worker VMs
domain	vCenter	Domain name of the management network
subnet_mask	vCenter	Subnet mask
gateway_address	vCenter	Gateway IP address
dns_server_address	vCenter	DNS Server IP address
Ip, ip2, ip3	vCenter	IP address corresponding to the management and the data center networks
disk_size **master_disk_size** **infra_disk_size** **etcd_disk_size** **lb_disk_size** **worker_disk_size**	vCenter	Disk size in GB/GiB for the master, infra, etcd, load balancer and the worker VMs
cpu_size **master_cpu_size** **infra_cpu_size** **etcd_cpu_size** **lb_cpu_size** **worker_cpu_size**	vCenter	Number of vCPUs for the master, infra, etcd, load balancer and worker VMs
memory_size **master_memory_size** **infra_memory_size** **etcd_memory_size** **lb_memory_size** **worker_memory_size**	vCenter	Memory size in MB/MiB for the master, infra, etcd, load balancer and the worker VMs

Table A4 describes the variables used during host preparation.

Table A4. Variables used during host preparation

Variable	Scope	value	Description
second_disk_physical	Virtual Machines	/dev/sdb	Path to the second disk

Change Tracker

Version	Release Date	Changes
1.0	07/03/2019	Initial release

Resources and additional links

Red Hat, https://www.redhat.com

Red Hat OpenShift Container Platform 3.11 Documentation, https://docs.openshift.com/container-platform/3.11/welcome/index.html

HPE Synergy, https://www.hpe.com/info/synergy

HPE Nimble Storage, https://www.hpe.com/us/en/storage/nimble.html

HPE Solutions for OpenShift GitHub, https://github.com/hewlettpackard/hpe-solutions-openshift

Red Hat OpenShift Container Platform on HPE Synergy with HPE Nimble Storage – The master deployment guide - https://github.com/HewlettPackard/hpe-solutions-openshift/tree/master/synergy/scalable/nimble.

HPE FlexFabric 5940 switching, https://www.hpe.com/us/en/product-catalog/networking/networking-switches/pip.hpe-flexfabric-5940-switch-series.1009148840.html

HPE Workload Aware Security for Linux, https://h20392.www2.hpe.com/portal/swdepot/displayProductInfo.do?productNumber=WASL

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