HPE Reference Architecture for VMware Cloud Foundation on HPE Synergy
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Executive summary

Businesses face challenges to turn ideas into services faster, respond quickly to new customer demands, and innovate by building new services with technology to stay competitive. To meet these business demands, IT is increasingly adopting new cloud technologies, to replace expensive hardware with a software-defined model. Enterprises need an ideal Hybrid IT model that supports both traditional and cloud-native applications. Therefore, businesses are moving to digital transformation and software-defined data center (SDDC) to support this change.

To address this challenge, Hewlett Packard Enterprise and VMware® have collaborated to help customers accelerate the journey to hybrid cloud, bringing the promise of the software-defined data center to life. The combination of HPE Synergy Composable Infrastructure with VMware SDDC solution dramatically improves both the value and business outcomes for our customers. HPE Synergy combined with VMware Cloud Foundation™ (VCF) delivers a simplified and more secure private cloud-based on the VMware software-defined data center stack on composable infrastructure that is flexible, easy to deploy, seamless to manage, and simple to operate. For enterprise customers looking to accelerate their journey to hybrid cloud, HPE Synergy combined with VMware Cloud Foundation is the right solution to deliver a simplified and more secure private cloud to run all your enterprise apps—both traditional and containerized—in cloud environments.

This Reference Architecture provides guidance for deploying and managing VMware Cloud Foundation on HPE Synergy for virtual infrastructure (VI) in a single VCF workload domain. It demonstrates the integrated composability with VCF and HPE Synergy using HPE OneView connector for VCF. Also, the lifecycle management for HPE Synergy firmware using HPE OneView for VMware vRealize® Orchestrator™ based firmware update workflow is discussed in further sections.

This Reference Architecture also covers using the HPE 3PAR as an ancillary storage for VMware Cloud Foundation workload domain. The following are the benefits:

- The value of combining HPE Synergy with VCF from a deployment and lifecycle perspective in a cost-effective and simplified management for faster time to value.
- An easy-to-operate VI traditional data center in a VCF workload domain.
- Agility to expand and contract physical and virtual infrastructure on-demand, to quickly meet changing business requirements with HPE OneView connector, a unique Integration between VMware SDDC manager and HPE Synergy Composer to provide a single console to dynamically compose software-defined and physical infrastructure.
- An efficient monitoring for VCF environment using HPE OneView for VMware vRealize® Operations™ and custom dashboards.
- An easy and automated way to upgrade the HPE Synergy firmware using VMware vRealize Orchestrator workflow.
- Guidance to attach and configure HPE 3PAR StoreServ Storage and HPE Nimble Storage to use as ancillary storage for VCF VI workload domain.

Target audience: This document is intended for IT decision makers as well as architects and implementation personnel who want to understand enterprise ready private cloud solutions using the HPE Synergy Composable Infrastructure capabilities offered by the HPE Synergy platform and VMware Cloud Foundation. The reader should have a solid understanding and familiarity with VMware Cloud Foundation, VMware vRealize Orchestrator and HPE Synergy.

Document purpose: The purpose of this document is to demonstrate enterprise ready private cloud solutions by combining the value of VCF on HPE Synergy Composable Infrastructure that is flexible and, easy to deploy.

This Reference Architecture describes solution testing performed in November 2019.

Solution overview

This Reference Architecture demonstrates best practices for customers building a cloud solution in an enterprise data center and deploying business critical applications in an automated manner. The solution design is based on VMware Cloud Foundation on HPE Synergy. VCF provides a unified software-defined data center (SDDC) platform comprising of VMware vSphere® Hypervisor, VMware Virtual SAN™ Storage (vSAN) and VMware NSX® networking.

HPE Synergy is a single infrastructure of pools of compute, storage, and fabric resources, along with a single management interface that allows IT to rapidly assemble, disassemble and re-assemble resources in any configuration. HPE Synergy architecture eliminates hardware and operational complexity, so that IT can deliver applications faster and with greater precision and flexibility. HPE OneView is your infrastructure automation
engine built with software intelligence. It streamlines provisioning and lifecycle management across compute, storage, and fabric resources in the Synergy system.

This Reference Architecture demonstrates the following solutions for VMware Cloud Foundation on HPE Synergy:

- **HPE Storage for VMware Cloud Foundation** - HPE 3PAR StoreServ Storage and HPE Nimble Storage as an ancillary storage to a Virtual Infrastructure (VI) workload domain on HPE Synergy
- **VMware Enterprise PKS** - VMware Enterprise PKS as a cloud-native platform on a VMware Cloud Foundation NSX-T workload domain on HPE Synergy
- **HPE OneView connector for VMware Cloud Foundation** - Integrated composability with VCF and HPE Synergy using HPE OneView connector for VCF
- **HPE OneView for vRealize Orchestrator** – HPE OneView for vRealize Orchestrator workflow to update the HPE Synergy compute firmware
- **VMware Cloud Foundation lifecycle management** - Offline VMware Cloud Foundation update for HPE Synergy
- **High Availability of VMware Cloud Foundation management domain using VMware vSAN Stretched cluster**

This solution involves two (2) HPE Synergy 12000 Frames each equipped with eight (8) HPE Synergy 480 Gen10 servers, and an HPE Synergy D3940 Storage Module. Each HPE Synergy 12000 frame uses HPE Virtual Connect SE 40Gb F8 Module to provide uplink to the data center network. The sixteen (16) HPE Synergy 480 Gen10 servers are used to configure one VCF management domain and three (3) VCF workload domains. The HPE Synergy Storage Module D3940 hosts software-defined VMware vSAN storage. HPE 3PAR StoreServ Storage or HPE Nimble Storage provides the ancillary storage for the VI workload domains.
Figure 1 shows the physical rack layout showcasing the solution components involved.

**Figure 1.** Physical rack layout showcasing the solution components involved
Solution components

Hardware
HPE Synergy Composable Infrastructure
HPE Synergy is a composable infrastructure platform that empowers IT to create and deploy resources instantly and continuously, gain control of IT resources efficiently, and simplifies IT operation using a single software-defined infrastructure for physical, virtual, and containerized workload. Developers and independent software vendor (ISVs) can programatically control a HPE Synergy Composable Infrastructure through a single, open API that is native in HPE Synergy powered by HPE OneView. This Reference Architecture is built upon the following composability concepts and capabilities of the HPE Synergy platform.

Fluid resource pools
HPE Synergy allows the transformation of traditionally rigid physical systems into flexible virtual resource pools. HPE Synergy creates resource pools of “stateless” compute, storage, and fabric capacity that can be configured almost instantly to rapidly provision infrastructure for a broad range of applications.

Software-defined intelligence
The software-defined intelligence in HPE Synergy reduces operational complexity and enables IT organizations to make needed programmatic changes quickly and confidently, with minimal human intervention. HPE Synergy abstracts operational details and replaces them with high-level, automated operations. HPE Synergy uses templates to automatically implement change operations such as updating firmware, adding additional storage to a service, or modifying a network.

Unified API
HPE Synergy delivers automation through a unified API that provides a single interface to discover, inventory, configure, provision, update, and diagnose the composable infrastructure in a heterogeneous environment. This fully programmable interface integrates with dozens of popular management tools such as Microsoft® System Centre, VMware vCenter® and open source automation and DevOps tools such as Chef, Docker, and OpenStack.

Figure 2 describes the three architectural principles of HPE Synergy Composable Infrastructure.

Figure 2: Three architectural principles of HPE Synergy Composable Infrastructure

HPE Synergy Composer
HPE Synergy Composer provides enterprise-level management to compose and deploy system resources, for all of your application needs. This management appliance uses software-defined intelligence with embedded HPE OneView to aggregate compute, storage and fabric resources in a manner that scales to your application needs, instead of being restricted to the fixed ratios of traditional resource offerings. HPE OneView Server Profiles and profile templates capture the entire server configuration in one place, enabling administrators to replicate new Server Profiles and to modify them as needed to reflect changes in the data center. With HPE OneView REST API and automation tools, the entire process of...
server personality definition and configuration can be automated. For this Reference Architecture the HPE OneView REST API and PowerShell library were used to automate the Server Profile application to “stateless” servers.

**HPE Synergy 12000 Frames**

The HPE Synergy 12000 Frame is a base infrastructure of compute, storage, network fabric, and power into a scalable solution that addresses and scales with various customer workloads and infrastructures. The HPE Synergy 12000 Frames reduces complexity in the IT infrastructure by unifying all these resources into a common bus, and with the myriad of available network and storage interconnects which allows the frame to interoperate with any other IT environment. At a high level, the HPE Synergy Frame supports the following:

- Twelve half-height or six full-height compute modules. The HPE Synergy design additionally allows for the inclusion of double-wide modules as well, such as the HPE Synergy D3940 Storage Module.
- Ten fans and a single frame link module for in-band and out-of-band management.
- Up to six 2650 Watt power supplies.
- Up to six interconnect modules for full redundancy of three fabrics.

The HPE Synergy 12000 Frame features a fully automated and managed composer module using HPE OneView, contained within the HPE Synergy Composer module. HPE OneView handles all the setup, provisioning, and management both at the physical and logical level.

Figure 3 shows front and rear view of HPE Synergy 12000 Frame.

**Figure 3.** HPE Synergy architecture

**HPE Synergy 480 Gen 10 Compute Module**

The HPE Synergy 480 Gen10 Compute Module delivers superior capacity, efficiency, and flexibility in a two-socket, half-height, single-wide form factor to support demanding workloads. Powered by the latest Intel® Xeon® E5-2600 v4 processors and featuring support for up to 1.5TB of HPE DDR4 SmartMemory, flexible storage controller options, three I/O connectors, and designed to create a pool of flexible compute capacity within a composable infrastructure, the HPE Synergy 480 Gen10 Compute Module is an ideal platform for general-purpose enterprise workload performance now and in the future.

The solution as presented in this Reference Architecture contains two HPE Synergy 12000 Frames. Each HPE Synergy 12000 Frames in a rack consist of four (4) HPE Synergy 480 Gen10 Servers.
Figure 4 shows the HPE Synergy 480 Gen10 Compute Module.

HPE Synergy D3940 Storage Module
The HPE Synergy D3940 Storage Module is a direct attached storage module with 40 Small Form Factor (SFF) drive bays designed for use in HPE Synergy 12000 Frames. Through the HPE Synergy 12Gb SAS Connection module, it provides composable storage for up to 10 compute modules in a single frame. HPE Synergy Storage is optimized to use as either a direct attached storage array or as software-defined storage. HPE Synergy D3940 Storage Modules support a family of 12G SAS or 6G SATA HDD and SSD Smart Drives.

Figure 5 shows the HPE Synergy D3940 Synergy Module.
HPE Virtual Connect SE 40Gb F8 Module for Synergy
The HPE Virtual Connect SE 40Gb F8 Module, master module based on composable fabric, is designed for composable infrastructure. The disaggregated, rack-scale design uses a master/satellite architecture to consolidate data center network connections, reduce hardware, and scale network bandwidth across multiple HPE Synergy 12000 Frames. The master module contains intelligent networking capabilities that extend connectivity to satellite frames through Interconnect Link Modules. This decreases top of rack switch needs and substantially reduces costs. The components reduction simplifies fabric management at scale while consuming fewer ports at the data center aggregation layer.

The HPE Virtual Connect SE 40Gb F8 Module for Synergy eliminates network sprawl at the edge with one device that converges traffic inside the HPE Synergy 12000 Frames and directly connects to external LANs.

HPE Synergy 20Gb Interconnect Link Module
The HPE Synergy 20Gb Interconnect Link Module (satellite module) is designed for composable infrastructure. Based on a disaggregated, rack-scale design, it uses a master/satellite architecture to consolidate data center network connections, reduce hardware and scale network bandwidth across multiple HPE Synergy 12000 Frames.

HPE Virtual Connect SE 32Gb FC Module
The HPE Virtual Connect SE 32Gb FC Module for Synergy is a Storage Area Network (SAN) interconnect with a wire-once change-ready technology. The Fibre Channel (FC) module in conjunction with HPE Synergy Composer powered by HPE OneView allows workloads to be moved or managed without modifying the network. HPE OneView provides an intuitive management console for seamless connectivity between virtualized Synergy Compute Modules and 32Gb FC SAN fabrics.

HPE Virtual Connect SE 16Gb FC Module for HPE Synergy
The HPE Virtual Connect SE 16Gb FC Module for HPE Synergy is a Storage Area Network (SAN) interconnect with a wire-once change-ready technology. The Fibre Channel (FC) module in conjunction with Synergy composer powered by HPE OneView allows workloads to be moved or managed without modifying the network. HPE OneView provides an intuitive management console for seamless connectivity between virtualized Synergy Compute Modules 16Gb FC SAN fabrics.

HPE Synergy 3820C 10/20Gb Converged Network Adapter
The HPE Synergy 3820C 10/20Gb Converged Network Adapter is a key element in HPE Composable Fabric connecting pools of compute resources to networks with reliable, high-performing converged 10Gb or 20Gb Ethernet connectivity. With Flex-20 technology, the Synergy 3820C converges Ethernet and FCoE onto a single connection, simplifying hardware and reducing costs. Each port replaces a 10/20Gb NIC and 8Gb Fibre Channel HBA simplifying I/O hardware by 50% and reducing costs up to 60%. The HPE Synergy 3820C is an ideal choice for any virtualized or converged data center.

HPE Virtual Connect SE 40Gb F8 Module
The HPE Virtual Connect SE 40Gb F8 Module is designed for composable infrastructure. Its disaggregated, rack-scale design uses a master/satellite architecture to consolidate data center network connections, reduce hardware and scales network bandwidth across multiple HPE Synergy Frames. The master module contains intelligent networking capabilities that extend connectivity to satellite frames through Interconnect Link Modules. This eliminates top of rack switch need and substantially reduces cost. The reduction in components also simplifies fabric management at scale, while consuming fewer ports at the data center aggregation layer.

HPE FlexFabric 5940 Switch
The HPE FlexFabric 5940 Switch Series is a family of high performance and low-latency 10GbE, 40GbE top-of-rack (ToR) data center switches. The switch series include also 100G uplink technology and also a 2-slot and 4-slot modular form factor providing ultimate flexibility for an ever-changing data center requirements.

Figure 6 shows the front view of the HPE FlexFabric 5940 switch.
HPE StoreFabric SN6600B Fibre Channel Switch

The HPE SN66x0B Fibre Channel Switch meets the demands of hyper-scale virtualization, larger cloud infrastructures, and growing flash-based storage environments by delivering market-leading 32Gb Fibre Channel technology and capabilities. It provides a high-density building block for increased scalability, designed to support growth, demanding workloads, and data center consolidation in small to large-scale enterprise infrastructures. It is built for maximum flexibility, scalability, and ease of use. Organizations can scale from 24 to 128 ports, all in an efficient 1U or 2U package. It also provides a simplified deployment process and a point-and-click user interface, making it both powerful and easy to use. With the SN66x0B Switch, organizations gain the best of both worlds: high-performance access to industry-leading storage technology and "pay-as-you-grow" scalability to support an evolving storage environment.

If using a fabric attached Fibre Channel topology, a minimum of two (2) SAN switches are required. If more than two switches are needed in the solution, switches of the same vendor/type must be added in pairs, so there is always an even number of switches. It is important to ensure that you select the correct model switch for your future growth plans. Select a bigger switch with only the ports requires license to start, if you plan on expanding your HPE Synergy solution in the future.

HPE 3PAR StoreServ Storage

Hewlett Packard Enterprise leveraged HPE 3PAR StoreServ Storage to meet the architectural guidelines of an HPE Synergy 480 solution to eliminate any single point of failure (hardware or software) in the system. To mitigate single points of failure at the hardware layer, the system is designed with redundant components, including redundant power domains. At a minimum, there are two controller nodes and two copies of the HPE 3PAR Operating System, even in the smallest system configuration.

To further the resiliency of HPE 3PAR StoreServ Storage, each nodes are powered by two (1+1) redundant power supplies and backed up by a string of two batteries. Each battery has sufficient capacity to power the controller nodes and have enough space to save all necessary data in memory into the local physical drive. Although many architectures use “cache batteries,” they are not suitable for extended downtimes that are usually associated with natural disasters and unforeseen catastrophes.

To further mitigate downtime due to component failure, HPE 3PAR Persistent Cache is a resiliency feature built into the HPE 3PAR Operating System that enables graceful handling of an unplanned controller failure or planned maintenance of a controller node. This feature eliminates the substantial performance penalties that are associated with traditional modular arrays and the cache “write-through” mode they have to enter under certain conditions. For the HPE 3PAR StoreServ 8440 4-node array, any node that loses its adjacent node can dynamically form a mirrored cache relationship with another storage controller node.

Figure 7. HPE StoreFabric SN6600B Fibre Channel Switch

Figure 8. HPE 3PAR 8440 4-Node Storage system
**HPE Nimble Storage HF20 Adaptive Flash Array**

The HPE Nimble Storage HF20 Adaptive Flash Array is designed for both primary and secondary flash workloads. It is a hybrid flash array for mixed, primary workloads, where cost-efficient flash performance is important. It is a secondary flash array for backup and DR while allowing you to put your backup data to work.

![Image](image)

**Figure 9. HPE Nimble Storage**

**Software**

The table below lists the software components used in this Reference Architecture. Further below mentions the layers of the full solution stack.

Table 1 defines the HPE Synergy 480 Gen10 software components and versions used in this Reference Architecture.

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPE Synergy Composer</td>
<td>5.00.00.02</td>
</tr>
<tr>
<td>Custom Synergy SPP</td>
<td>2019.09.2109255 (HPE_Synergy_Custom_SPP_2019.09.2109255_27550-96769.iso)</td>
</tr>
<tr>
<td>HPE Nimble OS</td>
<td>5.0.7.300</td>
</tr>
<tr>
<td>HPE 3PAR OS</td>
<td>3.3.1.410 (MU2)+P32,P34,P36,P39,P40,P45,P51,P52,P57,P60</td>
</tr>
<tr>
<td>HPE 3PAR SSMC</td>
<td>3.6</td>
</tr>
<tr>
<td>B-series SAN Fabric OS (FOS)</td>
<td>8.2.1c</td>
</tr>
<tr>
<td>VMware Cloud Foundation</td>
<td>3.8.1</td>
</tr>
</tbody>
</table>

Table 2 defines the VMware Cloud Foundation software components.

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Builder VM</td>
<td>2.1.10</td>
</tr>
<tr>
<td>SDDC Manager</td>
<td>3.8.1</td>
</tr>
<tr>
<td>VMware vCenter Server® 6.7 (Appliance)</td>
<td>6.7 Update 3</td>
</tr>
<tr>
<td>VMware vSphere 6.7</td>
<td>ESXi 6.7 U3 (Build: 14320388)</td>
</tr>
<tr>
<td>HPE OEM Customized vSphere Distribution 6.7</td>
<td>VMware-ESXi-6.7-Update3-14320388-HPE-Gen9plus-670.U3.104.5.19-Aug2019.iso (Build 14320388)</td>
</tr>
<tr>
<td>VMware vSAN™</td>
<td>6.7 Update 3</td>
</tr>
<tr>
<td>VMware NSX-V Data Center for vSphere</td>
<td>6.4.5</td>
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<tr>
<td>VMware NSX-T Data Center</td>
<td>2.4.2 Patch 1</td>
</tr>
<tr>
<td>Pivotal Container Service</td>
<td>1.4.1</td>
</tr>
<tr>
<td>VMware vRealize® Suite Lifecycle Manager</td>
<td>2.1 Patch 2</td>
</tr>
<tr>
<td>Component</td>
<td>Version</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>VMware vRealize® Log insight™</td>
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</tr>
<tr>
<td>vRealize Log Insight Content Pack for NSX for vSphere</td>
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<tr>
<td>vRealize Log Insight Content Pack for Linux</td>
<td>1.0</td>
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<tr>
<td>vRealize Log Insight Content Pack for vRealize Automation 7.3+</td>
<td>2.2</td>
</tr>
<tr>
<td>vRealize Log Insight Content Pack for vRealize Orchestrator 7.0.1+</td>
<td>2.0</td>
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<tr>
<td>vRealize Log insight Content Pack for NSX-T</td>
<td>3.7</td>
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<tr>
<td>vRealize Operations Manager™</td>
<td>7.5</td>
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<td>vRealize Automation™</td>
<td>7.6</td>
</tr>
<tr>
<td>VMware Horizon™ 7</td>
<td>7.90</td>
</tr>
</tbody>
</table>

**VMware Cloud Foundation**

VMware Cloud Foundation is the industry’s most advanced enterprise-ready cloud platform providing a complete set of software-defined services for compute, storage, networking, security and cloud management to run enterprise apps whether it is traditional or containerized. VCF drastically simplifies data center operations by deploying a standardized and validated architecture with built-in lifecycle automation of the cloud stack. It orchestrates, provisions, and deploys a software-defined data center (SDDC) platform by stitching together VMware vSphere, vSAN, and NSX into a natively integrated stack to deliver enterprise-ready cloud infrastructure.

Figure 10 shows VMware Cloud Foundation components.

![VMware Cloud Foundation](image)

**Figure 10. VMware Cloud Foundation**

**VMware Cloud Foundation components**

The core components for VMware Cloud Foundation are explained below.

**Cloud Foundation Builder VM**

The Cloud Foundation Builder VM is a one-time use VM which deploys and configures the management domain and transfers inventory and control to SDDC Manager. During the deployment process, the Cloud Foundation Builder VM validates network information provided in the deployment parameter spreadsheet such as DNS, network (VLANS, IPs, MTUs), and credentials. After the management domain is up and the SDDC Manager is running, the Cloud Foundation Builder VM must be powered off and archived. Table 3 shows Cloud Foundation Builder VM resource requirements.
<table>
<thead>
<tr>
<th>Components</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>4 vCPUs</td>
</tr>
<tr>
<td>Memory</td>
<td>4GB</td>
</tr>
<tr>
<td>Storage</td>
<td>350GB</td>
</tr>
</tbody>
</table>

**SDDC Manager**

SDDC Manager manages the bring-up of the Cloud Foundation system, creates and manages workload domains, and performs lifecycle management to ensure the software components remain up-to-date. SDDC Manager also monitors the logical and physical resources of VCF. It allows data center administrators to configure the additional hosts and racks into a logical pool of resources and thus multiple racks can be managed as a single VCF System. SDDC Manager controls these processes by using workflows. Each workflow comprises of a series of tasks, which are executed by SDDC Manager. There are two VMs installed by VCF 3.0 for SDDC Manager, each VM is performing its own functions.

**VMware vCenter Server**

VMware vCenter Server provides management of a VMware virtualized environment with one or more ESXi hosts. SDDC Manager deploys one VMware vCenter Server per workload domain. By default, all vCenter Servers are configured in enhanced linked mode.

**VMware platform Services Controller**

During bring-up, SDDC Manager deploys two platform services controllers in the management domain. These instantiate an SSO domain. All vCenter Servers (management domain and compute workload domains) are registered with the SSO domain and configured in enhanced linked mode.

**VMware vSphere (ESXi)**

ESXi is a type 1 hypervisor used to implement virtualization on bare metal systems. ESXi provides compute virtualization within the software-defined data center and it is foundational building block for implementing a private cloud.

**VMware vSAN**

VMware vSAN aggregates local or direct-attached data storage devices to create a single storage pool shared across all hosts in the vSAN cluster. vSAN eliminates the need for external shared storage, simplifies storage configuration and virtual machine provisioning.

**VMware NSX data center for vSphere**

NSX is the network virtualization platform for the SDDC, delivering the operational model of a virtual machine for entire networks. With NSX network functions including switching, routing, and firewall are embedded in the hypervisor and distributed across the environment.

VMware NSX for vSphere is a virtualized networking component in the software-defined data center (SDDC) architecture, which programmatically creates, snapshots, deletes, and restores software-based virtual networks. With network virtualization, the functional equivalent of a network hypervisor, NSX reproduces the complete set of Layer 2 to Layer 7 networking services (e.g., switching, routing, firewall, and load balancing) in software. It allows these services to be programmatically assembled in any arbitrary combination to produce unique, isolated virtual networks in a matter of seconds. NSX also provides a platform for various security services both network and endpoint based. NSX provides various built-in services, including L2-L4 firewall and activity monitoring. Additionally, security vendors can leverage its guest introspection and network introspection frameworks to deliver service chained next-generation firewall, IDS/IPS, agentless AV, file integrity monitoring, and vulnerability management capabilities.

**VMware NSX-T**

VMware NSX-T is designed to address application frameworks and architectures that have heterogeneous endpoints and technology stacks. In addition to vSphere, these environments may include other hypervisors, containers, bare metal, and public clouds. NSX-T allows IT and development teams to choose the technologies best suited for their particular applications. NSX-T is also designed for management, operations, and consumption by development organizations in addition use by IT.

**vRealize Log insight**

vRealize Log Insight delivers heterogeneous and highly scalable log management with intuitive, actionable dashboards, sophisticated analytics and broad third-party extensibility, providing deep operational visibility and faster troubleshooting.
VMware Cloud Foundation also has the following optional components for which separate licenses are needed:

- **VMware vRealize Operations Manager**: vRealize Operations Manager delivers intelligent operations management with application-to-storage visibility across physical, virtual, and cloud infrastructures. Using policy-based automation, operation teams automate key processes and improve IT efficiency. This is an optional component.

- **VMware vRealize Automation**: vRealize Automation is a cloud automation tool that accelerates the delivery of IT services through automation and pre-defined policies, providing high-level of agility and flexibility for developers, while enabling IT teams to maintain frictionless governance and control. This is an optional component.

- **vRealize Suite Orchestrator**: vRealize Orchestrator is a development- and process-automation platform that provides an extensive library of workflows and a workflow engine. It simplifies the automation of complex IT tasks.

### HPE OneView for VMware vRealize Operations

HPE OneView provides integrated and highly automated performance, capacity, configuration compliance, and cost management tools to the vRealize Operations custom GUI. The plugin seamlessly integrates the manageability features of HPE Synergy with VMware analytics engine that analyzes what is normal and then applies that baseline to a dynamic server environment.

When the HPE OneView for VMware vRealize Operations is installed, the custom HPE OneView dashboards are added to the vRealize Operation custom GUI. The HPE OneView dashboards allow you to monitor resources in a vRealize environment. The attributes that can be monitored include, resource health, power, temperature (server and enclosure), and system alerts. The analytics engine allows for proactive monitoring of the HPE OneView resource environment and indicates the state of the resources. If a problem occurs, an alert is triggered and displayed. The analytics engine also provides proactive prediction, which can determine the point in the future when a resource will reach a predefined critical level.

### HPE OneView for VMware vRealize Orchestrator

HPE OneView for VMware vRealize Orchestrator helps customers automate complex IT tasks in an extensible and repeatable manner. It provides a predefined collection of HPE tasks and workflows that can be used in vRealize Orchestrator (VRO) with easy-to-use, drag and drop access to automation of HPE OneView managed hardware deployment, firmware updates, and other life-cycle tasks. HPE OneView for VMware vRealize Orchestrator allows the advanced management features of HPE OneView to be incorporated into larger IT workflows. HPE OneView workflows and actions can also be integrated in VMware vRealize Automation via vRealize Orchestrator.

### HPE OneView Connector for VCF

This Connector provides a REST service to answer DMTF Redfish® compliant requests by querying HPE OneView. HPE OneView is a fresh approach to converged infrastructure management, inspired by the way you expect to work, with a single integrated view of your IT infrastructure.

DMTF Redfish is an open industry standard specification and schema that specifies a RESTful interface and utilizes JSON and OData to help customers integrate solutions within their existing tool chains.

### Design and configuration guidance

#### HPE Synergy solution design and configuration

The solution involves two (2) HPE Synergy 12000 frames each equipped with eight (8) HPE Synergy 480 Gen10 servers, and an HPE Synergy D3940 Storage Module. Each HPE Synergy D3940 storage module consists of 40 drive enclosures comprising a mix of 1.92TB SATA SSD drives for capacity tier and 800GB SAS SSD for cache tier, as per VMware vSAN requirement. The HPE Synergy 12000 Frames have a redundant pair of HPE Synergy 12Gb SAS Connection Modules, to provide powerful and redundant connectivity to the HPE Synergy D3940 Storage Module, and a redundant pair of HPE Synergy Virtual Connect SE 40Gb F8 Modules, for high-speed uplink connectivity to multiple networks.
Figure 11 shows the network layout of this Reference Architecture.
Table 4 defines the hardware configuration used in this Reference Architecture.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of racks</td>
<td>1</td>
</tr>
<tr>
<td>HPE Synergy 12000 Frames in rack</td>
<td>2</td>
</tr>
<tr>
<td>HPE Synergy 480 Gen 10 Compute Module per Synergy 12000 Frame</td>
<td>8</td>
</tr>
<tr>
<td>HPE Synergy D3940 Storage Module per HPE Synergy 12000 Frame</td>
<td>1</td>
</tr>
<tr>
<td>HPE Virtual Connect SE 40Gb F8 Module for Synergy per Synergy 12000 Frame</td>
<td>1</td>
</tr>
<tr>
<td>HPE Synergy 20GB Interconnect Link Module per Synergy per Synergy 12000 Frame</td>
<td>1</td>
</tr>
<tr>
<td>HPE Virtual Connect SE 16Gb FC Modules per Synergy per Synergy 12000 Frame</td>
<td>2</td>
</tr>
<tr>
<td>HPE Synergy Composer Module per Synergy 12000 Frames</td>
<td>1</td>
</tr>
<tr>
<td>HPE Synergy 3820C 10/20Gb Converged Network Adapter</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 5 defines the HPE Synergy 480 Gen10 hardware components used in this Reference Architecture.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>2</td>
<td>Intel(R) Xeon(R) Gold 6254 CPU (3.1 GHz / 18-core)</td>
</tr>
<tr>
<td>Memory</td>
<td>24</td>
<td>HPE 16GB Single Rank x4 DDR4-2933 CAS-21-21-21 Registered Smart Memory Kit Total 384GB memory on each node</td>
</tr>
<tr>
<td>10/20Gb CNA</td>
<td>1</td>
<td>HPE Synergy 3820C 10/20Gb Converged Network Adapter</td>
</tr>
</tbody>
</table>

Table 6 defines the ancillary storage hardware configuration used in this Reference Architecture.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of racks</td>
<td>1</td>
</tr>
<tr>
<td>HPE Nimble Storage HF20 Adaptive Dual Controller Array</td>
<td>1</td>
</tr>
<tr>
<td>HPE 3PAR StoreServ 8440 Storage</td>
<td>1</td>
</tr>
</tbody>
</table>

The VMware Cloud Foundation infrastructure needs different external services for initial deployment and deployment of other optional components like vRealize Operations or vRealize Automation. Those services as Active Directory, Dynamic Host Configuration Protocol (DHCP), Domain Name Service (DNS) and Network Time Protocol (NTP) are part of customer’s data center environment.

The Cloud Foundation Builder virtual machine was installed on one of the ESXi host that will be the part of the HPE Synergy VCF environment. It is configured to have network connectivity to the management network of all ESXi hosts to be added to the VMware Cloud Foundation solution as well network connectivity to Virtual Machines providing external services as Active Directory, Dynamic Host Configuration Protocol (DHCP), Domain Name Service (DNS), and Network Time Protocol (NTP).

**HPE FlexFabric 5940 configuration for VMware Cloud Foundation**

HPE FlexFabric 5940 Switches should be connected and configured for IRF. Ensure the VLANs have been created on the top-of-rack (ToR) switches or allowed from customer network data center uplinks. The Ethernet downlink ports on the HPE FlexFabric 5940 should be trunk enabled allowing all VLANs required for the VMware Cloud Foundation stack.
Create a LAG by selecting single port from each switch and ensure the LAG connects to the HPE Synergy Virtual Connect ports as shown in the Figure 11.

**HPE OneView Configuration through HPE Synergy Composer**

The following steps summarize the HPE Synergy configuration.

1. Create HPE OneView networks with respect to the VLANs created on the ToR switches as shown in the Table 7.

<table>
<thead>
<tr>
<th>HPE OneView Networks</th>
<th>VLAN IDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCF Management Domain Management VLAN</td>
<td>1611</td>
</tr>
<tr>
<td>VCF Management Domain vMotion VLAN</td>
<td>1612</td>
</tr>
<tr>
<td>VCF Management Domain vSAN VLAN</td>
<td>1613</td>
</tr>
<tr>
<td>VCF Management Domain VTEP (VXLAN)</td>
<td>1614</td>
</tr>
<tr>
<td>VCF Workload Domain Management VLAN</td>
<td>1615</td>
</tr>
<tr>
<td>VCF Workload Domain vMotion VLAN</td>
<td>1616</td>
</tr>
<tr>
<td>VCF Workload Domain vSAN VLAN</td>
<td>1617</td>
</tr>
<tr>
<td>VCF Workload Domain VTEP (VXLAN)</td>
<td>1618</td>
</tr>
</tbody>
</table>

2. Create HPE OneView network sets to be used in the respective HPE OneView Server Profile template of VMware Cloud Foundation workload domain nodes, as shown in Table 8 and Table 9.

<table>
<thead>
<tr>
<th>HPE OneView VCF Management Network Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VCF Management Domain Network Set A</strong></td>
</tr>
<tr>
<td>Management VLAN</td>
</tr>
<tr>
<td>vMotion VLAN</td>
</tr>
<tr>
<td>vSAN VLAN</td>
</tr>
<tr>
<td>VTEP (VXLAN)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HPE OneView VCF Workload Network Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VCF Workload Domain Network Set A</strong></td>
</tr>
<tr>
<td>Management VLAN</td>
</tr>
<tr>
<td>vMotion VLAN</td>
</tr>
<tr>
<td>vSAN VLAN</td>
</tr>
<tr>
<td>VTEP (VXLAN)</td>
</tr>
</tbody>
</table>

3. Create one Logical Interconnect Group for each physical type of interconnect used in the solution and assign the proper uplink sets as shown Table 10.

<table>
<thead>
<tr>
<th>Logical Interconnect Group A</th>
<th><strong>VLAN</strong></th>
<th>Logical Interconnect Group B</th>
<th><strong>VLAN</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Logical Interconnect Group</td>
<td>LIG-A</td>
<td>Name of Logical Interconnect Group</td>
<td>LIG-B</td>
</tr>
<tr>
<td>Add HPE OneView Networks</td>
<td>1611-1618</td>
<td>Add HPE OneView Networks</td>
<td>1611-1618</td>
</tr>
<tr>
<td>Add Uplink Ports from Virtual Connect</td>
<td>ICM3</td>
<td>Add Uplink Ports from Virtual Connect</td>
<td>ICM6</td>
</tr>
</tbody>
</table>
5. Create a Logical Enclosure and apply the appropriate firmware baseline.
6. Create the HPE OneView Server Profile templates, selecting the appropriate hardware type and the Enclosure Group created in the previous steps.
7. Create a Server Profile template for the VMware Cloud Foundation management domain and workload domain with the following settings, as listed in Table 11 and Table 12.

| Table 11. Sample Values for HPE OneView Server Profile for VCF management domain |
|---------------------------------|------------------|
| **HPE OneView Server Profile template for VCF Management Domain Node** | **VLAN IDs** |
| Server Profile Template Name    | VCF Management Domain Template |
| Firmware                        |                                 |
| Connection 1                    | VCF Management Domain Network Set A |
| Connection 2                    | VCF Management Domain Network Set B |
| Local Storage (2 SSDs) via Integrated Storage Controller | RAID-1 for VMware ESXi 6.7 U3 |
| HPE D3940 (SSDs/HDDs) via SAS Mezz 1 Storage Controller | Cache, Tier (SSD), Capacity Tier (SSD/HDD) *Configure capacity and cache Tiers in Logical JBODs in HPE OneView in the Storage tab |

| Table 12. Sample Values for HPE OneView Server Profile for VCF workload domain |
|---------------------------------|------------------|
| **HPE OneView Server Profile template for NSX-T Workload Domain Node** | **VLAN IDs** |
| Server Profile Template Name    | VCF Workload Domain Template |
| Firmware                        |                                 |
| Connection 1                    | VCF Workload Domain Network Set A |
| Connection 2                    | VCF Workload Domain Network Set B |
| Local Storage (2 SSDs) via Integrated Storage Controller | RAID-1 for VMware ESXi 6.7 U3 |
| HPE D3940 (SSDs/HDDs) via SAS Mezz 1 Storage Controller | Cache, Tier (SSD), Capacity Tier (SSD/HDD) *Configure capacity and cache Tiers in Logical JBODs in HPE OneView in the Storage tab |

**Note**
The sample VLAN ID's mentioned above has been used in the solution, however the VLAN IDs need to be replaced as per the customer’s requirements.

**VMware Cloud Foundation installation on HPE Synergy**
Initiate VMware Cloud Foundation deployment across the four management nodes via VMware Cloud Builder virtual machine and the VCF deployment parameter sheet. For more details, refer to the VMware Cloud Foundation deployment on HPE Synergy, [https://support.hpe.com/hpsc/doc/public/display?docId=a00062293en_us](https://support.hpe.com/hpsc/doc/public/display?docId=a00062293en_us).

After the VMware Cloud Foundation is deployed successfully, log in to the SDDC Manager via browser https://<SDDC_Manager_IP>.

**Demonstration of HPE Storage Solutions for VMware Cloud Foundation workload domain**
VMware Cloud Foundation supports block storage though IP based (iSCSI) external storage or FC based external storage enabling addition of ancillary storage options for Virtual Infrastructure (VI) workload domain. However, both this storage solutions are managed Out of Band and must be manually provisioned. The datastores provided through external storage system connected either through iSCSI or FC protocol and managed independently through the workload domain vCenter instance.
This Reference Architecture describes the deployment of HPE 3PAR StoreServ Storage or HPE Nimble Storage as an ancillary storage to a VMware Cloud Foundation v3.8.1 VI workload domain on the HPE Synergy hardware platform.

**HPE 3PAR StoreServ Storage as an ancillary storage for Virtual Infrastructure (VI) workload domain**

VMware Cloud Foundation VI workload domains can be integrated with HPE 3PAR StoreServ for various workloads and applications. VMware Cloud Foundation workload domain on HPE Synergy can have HPE 3PAR StoreServ integrated through Fibre Channel (FC) protocol in either of the following ways:

- HPE 3PAR Fabric-Attach Fibre Channel (FC) topology
- HPE 3PAR Direct-Attached topology.
Figure 12 shows HPE 3PAR StoreServ Storage as an ancillary storage for Virtual Infrastructure (VI) workload domain.

**HPE 3PAR Fabric-Attach Fibre Channel (FC) topology**

HPE 3PAR storage is with a dedicated 32Gb Fibre Channel topology that provides better storage networking performance for HPE Synergy compute modules.

HPE OneView is used to provision, manage, and administer the HPE 3PAR StoreServ Storage thus providing a single unified management pane for storage operations for the Virtual Infrastructure (VI) workload domain.
Figure 13 shows the cabling of HPE 3PAR StoreServ Storage to SAN fabrics. It is recommended to connect all the odd numbered ports in the storage to one SAN fabric and the even numbered ports to another. At the minimum, you must have two ports per component to enable continued server operation during the failure of a switch, fibre cable, or server fibre port and to enable continued operation during a firmware update to the SAN fabrics in the solution.

**HPE 3PAR Direct-Attach topology**

In the HPE 3PAR Direct-Attach configuration, the storage for VMware Cloud Foundation workload domain is provided by direct cabling of HPE Virtual Connect 40Gb SE for HPE Synergy module to HPE 3PAR. Each HPE Virtual Connect for HPE Synergy module must be connected to at least two separate controllers in the same array. A minimum of two ports are required per component to allow the continued server operation during controller failure and during firmware updates.
Figure 14 describes HPE 3PAR StoreServ Storage cabling in the Direct-Attach topology.

For more information on the deployment of HPE 3PAR StoreServ Storage as an ancillary storage to VMware Cloud Foundation workload domain, refer to https://h20195.www2.hpe.com/V2/GetDocument.aspx?docname=a50000668enw.
HPE Nimble Storage as an ancillary storage for VMware Cloud Foundation v3.8.1 workload domain

The HPE Nimble Storage HF20 Adaptive Dual Controller Array was configured to provide FC datastores as well as iSCSI datastores as an ancillary storage to VMware Cloud Foundation VI workload domains through Fabric attached (FC) topology and iSCSI topology. Figure 15 shows HPE Nimble Storage HF20 as ancillary storage for Virtual Infrastructure (VI) workload domain.

*Figure 15.* HPE Nimble Storage HF20 as ancillary storage for VMware Cloud Foundation v3.8.1 workload domain
HPE Nimble Storage Fabric-Attach Fibre Channel (FC) topology

The HPE Nimble Storage 2x 16Gb Fibre Channel 2-port adapter kit was added to the HPE Nimble Storage HF20 Base Array for FC connectivity. The HPE Virtual Connect SE 16Gb FC module for Synergy was mounted on the Interconnect Module Bay Set 2 (Interconnect Bay 2 and Interconnect Bay 5) of the HPE Synergy 12000 Frame. The HPE Virtual Connect SE 16Gb FC module was connected to two HPE StoreFabric SN6600B Fibre Channel Switches as a Storage Area Network (SAN) Switch.

Figure 16 shows the cabling of HPE Nimble Storage to SAN fabrics. All the odd numbered Fibre Channel ports in 2x16Gb Fibre Channel 2-port adapter of the HPE Nimble Storage is connected to one SAN fabric and the even numbered ports to second SAN fabric. This configuration ensures continued server operation during the failure of a switch, fibre cable, or server fibre port and to enable continued operation during a firmware update to the SAN fabrics in the solution.
HPE Nimble Storage iSCSI topology

Figure 17 shows the cabling diagram of HPE Nimble Storage (iSCSI) with HPE Synergy. The cabling shows that the HPE Synergy 12000 Frame is connected to VCF management network on HPE Synergy Frame through eth0a and eth0b on each HPE Nimble Storage controller via the HPE Synergy Virtual Connect SE 40GB Interconnect Module. HPE Nimble Storage is configured to use two different networks, management network of speed 1Gbps and data network of speed 10Gbps.

Figure 17. Cabling diagram of HPE Nimble Storage (iSCSI) with HPE Synergy


Demonstrate VMware Enterprise PKS as a cloud-native platform on HPE Synergy

The Reference Architecture is to illustrate the deployment of VMware Cloud Foundation NSX-T Workload Domain for VMware Enterprise PKS as the platform for cloud-native applications. This document highlights the implementation of VMware NSX-T as software-defined networking component on HPE Synergy Composable Infrastructure. VMware Cloud Foundation by default provides a software-defined data center (SDDC) architecture by virtualizing compute, storage and network. Using the SDDC Manager, VMware Enterprise PKS is deployed as a platform on the VMware Cloud Foundation NSX-T workload domain for organizations to deploy cloud-native applications.
HPE Synergy comfortably maps all its native components to the VMware SDDC model thus making it an ideal fit for VMware SDDC deployments. HPE Synergy Storage Module D3940 hosts software-defined VMware vSAN storage. HPE Synergy Virtual Connect SE F8 Networking Module along with HPE FlexFabric 5940 Switch provides logical networking components for VMware NSX-T that is a next-generation software-defined networking solution. HPE Synergy powered by HPE OneView composes and recomposes Server Profiles comprising of compute, storage and network for VMware vSphere environments.

The following are the deployment steps to configure VMware Cloud Foundation NSX-T workload domain and VMware Enterprise PKS on HPE Synergy.

1. Deploy and configure a VMware NSX-T workload domain on HPE Synergy.
2. Deploy and configure a VMware NSX-T Edge on the VMware Cloud Foundation workload domain for north-south communication.
3. Configure the VMware NSX-T Routers for East-West and north-south communication from the data center.
4. Configure and create overlay networks and logical switches for the VMware Enterprise PKS environment.
5. Deploy and configure a VMware Enterprise PKS as a platform on the VMware Cloud Foundation workload domain.
Figure 18 shows the HPE Synergy master satellite connections for HPE Synergy Frame 1 and 2. HPE Synergy Frame 3 will comprise of two satellite modules that will in turn connect to the master modules in Frame 1 and Frame 2 completing the network loop. For detailed understanding, refer to https://techlibrary.hpe.com/docs/synergy/shared/cabling/GUID-322C6BB2-3183-42E6-A01D-BS2BE4CF77C7.html.

Figure 18. Network Layout for VMware Enterprise PKS and VMware NSX-T on HPE Synergy
VMware NSX-T architecture

VMware NSX-T is designed to address application frameworks and architectures that have heterogeneous endpoints and technology stacks. In addition to vSphere, these environments may include other hypervisors, containers, bare metal, and public clouds. NSX-T allows IT and development teams to choose the technologies best suited for their particular applications. NSX-T is also designed for management, operations, and consumption by development organizations in addition to use by IT. Figure 19 shows the VMware NSX-T architecture.
VMware Enterprise PKS Architecture

VMware Enterprise PKS builds on Kubernetes, BOSH, VMware NSX-T, and project Harbor to form a production-grade, highly-available container runtime that operates on vSphere and public clouds. With built-in intelligence and integration, VMware Enterprise PKS ties all these open source and commercial modules together, delivering a simple-to-use product for customers, ensuring the customers have the most efficient Kubernetes deployment and management experience possible. Figure 20 shows VMware Enterprise PKS architecture.


Demonstrate integrated composability with VCF and HPE Synergy using HPE OneView connector for VCF

VMware introduced composability service component starting from VCF 3.5 within the SDDC Manager. This composability service communicates with HPE OneView via the HPE OneView connector for VCF. This HPE OneView connector for VCF is developed and will be managed by Hewlett Packard Enterprise and is powered by DMTF Redfish APIs, which is designed to deliver simple and secure management for SDDC. Technically, it acts as a translator for VCF SDDC Manager and HPE OneView.
HPE OneView Connector for VCF 0.3.3

HPE OneView Connector for VCF 0.3.3 enables composability feature to provide a pure cloud experience in provisioning and deprovisioning of composable resources (compute, storage, and networking resources of HPE Synergy). In this version, the support is extended for external storages – HPE 3PAR StoreServ and HPE Nimble Storage operating on both FC and iSCSI storage protocols. The volume templates of these storage are attached to the Server Profile templates in HPE OneView. Based on the need, the user may choose the required Server Profile template while composing the composable resources from the SDDC Manager.

Figure 21: Workflow of HPE OneView Connector for VCF


Once the installation is complete, we need to register HPE OneView Connector for VCF within SDDC Manager.
Register HPE OneView Connector for VCF with SDDC Manager

1. Navigate to SDDC Manager > Administration > Composable Infrastructure.

2. Enter the URL as https://<redfish_ip>:5000/redfish/v1 along with the HPE OneView credentials and click Connect as shown in Figure 22.

![Figure 22. Wizard to connect the SDDC Manager to composability translation layer](image)

Once connection to the HPE OneView Connector for VCF is successful, it populates the resources available for composing and decomposing.

**Note**

It might take some time to populate the compute resources for the first time.

Once the composability translation layer gets registered successfully in SDDC Manager, the resource inventory gets populated as shown in Figure 23.

![Figure 23. Discovered composable infrastructure by SDDC Manager via HPE OneView Connector for VCF](image)
Composability operations by HPE OneView Connector for VCF from SDDC Manager

The HPE OneView connector for VCF 0.3.3 brings in the feature to create a Server Profile, attached with volumes, from the HPE 3PAR StoreServ Storage / HPE Nimble Storage.

Compose an available resource

1. Choose the available compute resource from the available resource in the composable infrastructure as shown in Figure 24 and click compose.

![Figure 24. Select the compute resource to compose](image-url)
2. Allocate the resources per server, storage, network interfaces and number of servers as shown in Figure 25. Review the same and click Finish to complete the operation.

Figure 25. Review the compute resources for composing operation
3. Compose operation will be triggered thereafter and Server Profiles will be created in HPE OneView along with external storage volumes that are associated with Server Profile templates listed under zone name as shown in Figure 26.

![Figure 26. Compose operation of compute resources being reflected in HPE OneView](image)

4. Server resources are successfully composed as shown in Figure 27.

![Figure 27. Compute resources being successfully composed and populated in Server Composition Summary section](image)
Decompose the composed resource

1. Choose the composed server from the Server Composition Summary in the composable infrastructure section of the SDDC Manager and click **Decompose** as shown in Figure 28.

![Figure 28. Composed compute resources being chosen to decompose](image)

Decomposition starts and this decomposition operation is reflected in the HPE OneView as well as shown in Figure 29.

![Figure 29. Decomposition of compute resources in action](image)

Demonstrate patching and upgrading in VMware Cloud Foundation

SDDC Manager internally has Lifecycle Management (LCM) enabled, which performs automated updates on VMware Cloud Foundation components such as SDDC Manager and its internal services and VMware components such as NSX for vSphere, vCenter Server, VMware ESXi™, Platform Services Controller (PSC), vRealize Suite, NSX-T, and VMware vRealize Suite Lifecycle Manager™. SDDC Manager is configured to communicate with the VMware software repository, if the SDDC Manager VM has internet access and the VMware depot credentials are valid.

The high-level update workflow is as follows:

1. Receive notification of update availability.
2. Download the update bundle.
3. Select update targets and schedule the update.

However, the intent of this document is to help administrators understand how to perform VMware Cloud Foundation upgrade when SDDC Manager does not have access to the internet.

**Offline VMware Cloud Foundation update**

The intent of this document is to describe how to upgrade your VMware Cloud Foundation system if the SDDC Manager VM does not have internet access. The document goes in detail of how to use the Bundle Transfer utility to manually download the bundles from the VMware depot on your local computer with internet access and then upload them to an SDDC Manager VM, and update your VMware Cloud Foundation system.

**When to perform offline update**

VMware Cloud Foundation update needs to be performed only after verifying if the underlying HPE Infrastructure including drivers and firmware are compatible with the version that is going to be installed. Refer to the HPE Synergy Firmware and Software Compatibility Matrix for VMware Cloud Foundation guide to check if the VCF version is listed as compatible along with the drivers and firmware.

**Bundle types**

**Upgrade bundle**

An upgrade bundle contains bits to update the appropriate Cloud Foundation software components in your management domain or VI workload domain. In most cases, an upgrade bundle must be applied to the management domain before it can be applied to workload domain.

Some upgrade bundles are cumulative bundles. With a cumulative upgrade bundle, you can directly upgrade the appropriate software in your workload domain to the version contained in the cumulative bundle rather than applying sequential upgrades to reach the target version. Cumulative bundles are available only for vCenter Server, Platform Services Controller, and ESXi.

**Note**

You can apply a cumulative bundle to a workload domain only if the target release in the bundle is lower than or at the same version as the management domain. If the cumulative bundle is available for both the management domain and VI workload domains, you must apply it to the management domain before applying it to VI workload domains.

**Install bundle**

VMware Cloud Foundation includes the following install bundles:

- VI workload domain install bundle is used to deploy later versions of the software components instead of the versions in your original Cloud Foundation installation. It includes software bits for vCenter Server and NSX for vSphere.
- Individual install bundles for vRealize products are used for deploying vRealize components.
- NSX-T install bundle is used for deploying an NSX-T based VI workload domain.
- Horizon 7 install bundle is used for creating a Horizon domain.

**Apply the SDDC Manager bundle**

This section describes how to apply the SDDC Manager bundle. For more information, refer the update sequence section in Upgrading VMware Cloud Foundation (VCF) on HPE Synergy.
Update SDDC Manager

1. Navigate to the **Updates/Patches** tab of the management domain to confirm the available update is from 3.8 to 3.8.1.

![Figure 30](Image)


### Demonstrate Stretching a vSAN cluster of a VMware Cloud Foundation management domain

VMware vSAN Stretched clusters allow stretching of a single data site to two sites for a higher level of availability and inter-site load balancing. This Reference Architecture tells about protecting VMware Cloud Foundation management domain, a special purpose workload domain dedicated to management tasks, which is crucial to business. It contains the following management components:

- SDDC Manager
- vCenter Server and Platform Services Controllers
- vRealize Log Insight
- NSX Manager and controllers

VMware Cloud Foundation management domain is brought up on a single site with no protection or avoidance from disaster and a single point of failure could disrupt application availability. Thus, it becomes important to protect the management domain to ensure business continuity.

To address this issue, we could take advantage of the disaster avoidance and protection solution that vSAN offers in the form of stretched cluster. A vSAN stretched cluster is a specific configuration implemented when disaster/downtime has to be avoided in any situation where business continuity is a critical requirement. The vSAN stretched cluster extends the cluster from one data site to two sites for high availability and load balancing.
Use cases for implementing stretched cluster for VMware Cloud Foundation management domain are:

- **Planned maintenance**: Perform a planned maintenance on an availability zone without any downtime and then migrate the applications after the maintenance is completed.

- **Automated recovery**: Stretching a cluster automatically initiates VM restart and recovery, and has a low recovery time objective for the majority of unplanned failures.

- **Disaster avoidance**: With a stretched cluster, you can prevent service outages before an impending disaster.

VMware Cloud Foundation management domain is stretched across two sites (VCF Site1 and VCF Site2) within the region, so the network latency between two sites should be minimum. A third site (vSAN witness Site3) contains a witness host separate from the location of the other two data sites. Figure 31 shows architecture of VMware Cloud Foundation stretched management domain vSAN cluster across two sites in an Active/Active configuration.

![Figure 31. Stretched VMware Cloud Foundation management domain vSAN cluster](image)


**Demonstrate ease of monitoring and reporting of VCF infrastructure using HPE OneView for vRealize Operations**

HPE OneView for VMware vRealize Operations provides an integrated monitoring and reporting tool for VCF infrastructure.

When the HPE OneView for VMware vRealize Operations is installed, the custom HPE OneView dashboards are added to the vRealize Operations custom GUI. The HPE OneView dashboards allow you to proactively monitor HPE Synergy hardware resources and also shows the object relationship with other objects in the environments. A proactive monitoring of the HPE Synergy hardware used for VMware Cloud Foundation helps in improve productivity, efficient use of the resources and hence minimizing cost.
HPE OneView for vRealize Operations can be downloaded from Software Depot1, please download “HPE_OneView_for_VMware_vRealize_Ops_2.3_July_2019_Z7550-02544.zip” file and extract the “HPEOneViewAdapter_2.3.0.21_signed.pak”. The details about the installation and configurations can be found at, https://support.hpe.com/hpsc/doc/public/display?docId=a00077762en_us.

Following are the dashboards available for use:

- HPE OneView Infrastructure dashboard
- HPE OneView networking dashboard
- HPE OneView Servers overview dashboard
- HPE OneView Enclosure overview dashboard
- HPE OneView Uplink Port overview dashboard

The following sections show examples of four among above five dashboards.

**HPE OneView Infrastructure dashboard**

The HPE OneView Infrastructure dashboard provides an overview of the entire HPE Synergy Infrastructure managed by HPE OneView. It displays the status of HPE OneView managed hardware and allows you to see how the hardware relates to your virtual environment. Figure 32 shows an example of HPE OneView Infrastructure dashboard. It displays the entire VCF environment physical and virtual resources and interrelation between each object in the environments. Thus, the administrator gets a quick summary of the environment as well as an idea how an object is related to other objects. It also shows metric charts demonstrating the performance and usage of the resources.

![HPE OneView Infrastructure dashboard](image)

**Figure 32.** HPE OneView Infrastructure dashboard
HPE OneView Networking dashboard

The HPE OneView Networking dashboard provides an overview of the HPE OneView networking along with its connection to the virtual environment. Selecting an object in the environment overview allows you to see how this object relates to other objects and generates a graph for each metric collected. Figure 33 shows an example of HPE OneView Networking dashboard with VCF-Node1 server selected and its necessary connections.

![HPE OneView Networking dashboard](image)

**Figure 33.** HPE OneView Networking dashboard
HPE OneView Servers Overview dashboard

The HPE OneView Servers Overview dashboard provides a summary and metrics information pertaining to CPU utilization, temperature, and power utilization of physical servers in the VCF environment. The heatmaps allow you to quickly compare these metrics.

![HPE OneView Servers Overview dashboard](image)

Figure 34. HPE OneView Servers Overview dashboard
HPE OneView Enclosures Overview dashboard

The HPE OneView Enclosures Overview dashboard provides summary and metrics information pertaining to the temperature and power utilization of the HPE Synergy Enclosures. The Heatmaps allow you to quickly compare these metrics. Under each Heatmap, there is a comparative representation between the two enclosures. Selecting an enclosure from this list generates a sparkline chart displaying the metric history.

Figure 35 shows HPE OneView Enclosures Overview dashboard with the two enclosures as used in this Reference Architecture solution.

Figure 35. HPE OneView Enclosure Overview dashboard
Demonstrate HPE Synergy firmware upgrade using HPE OneView for VMware vRealize Orchestrator

HPE OneView for VMware vRealize Orchestrator helps customers automate complex IT tasks in an extensible and repeatable manner. It provides a predefined collection of HPE tasks and workflows that can be used in vRealize Orchestrator (vRO). The plugin can be added to vRealize Orchestrator seamlessly and various IT tasks can be performed using the workflows available.

Among the available workflows, administrator can use the “Update Cluster Firmware” workflow to update the HPE Synergy Compute Firmware through HPE OneView and HPE Synergy Service Pack for ProLiant for Day 2 operations.

Following are the steps needed to be performed to update compute firmware using the “Update Cluster Firmware” workflow.

1. Install HPE iSUT on each of the HPE Synergy Nodes.
2. Configure the VMware vRealize Orchestrator (vRO).
3. Install and configure the HPE OneView for vRO plugin.
4. Configure the vRO Clients for the workflows.

HPE OneView for vRealize Orchestrator can be downloaded from the Software Depot2, please download the “HPE_OneView_for_VMware_vRealize_Orchestration_1.3_October_2019_Z7550-02585.zip” file and extract the “o11npluginhpeov4vro-13.0.79.vmoapp” to add that as plug-in with VMware vRealize Orchestrator. Refer to http://h20195.www2.hpe.com/portal/swdepot/displayProductInfo.do?docname=a50000681enw for more detailed information.

We tested the “Update Cluster Firmware” workflow in the Hewlett Packard Enterprise Engineering lab to update the compute resources firmware inside the HPE Synergy Frame with VMware Cloud Foundation installed. The following sections provides details about the test environment and the process.

Prerequisites

- VMware vRealize Orchestrator is installed in the environment.
- VMware vRealize Orchestrator vSphere vCenter plug-in is configured with VMware vCenter(s).
- At least one instance of HPE OneView is installed and configured.
- An HPE OneView account is created and to be used by HPE OneView Management Instance in VMware vRealize Orchestrator.
- The VMware vRealize Orchestrator servers have network access to HPE OneView.
- VMware Cloud Foundation software is installed and configured on HPE Synergy.
- HPE OneView Server Profile template is configured for baseline Service Pack for ProLiant (SPP).
- The vRO workflows will be used to update new SPPs on the HPE Synergy Compute Nodes as available and configure them as baselines for Server Profile template.

Firmware and software versions
Table 13 shows the firmware and software used in the testing process.

Table 13. Firmware and software versions

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<tr>
<th>Name</th>
<th>Versions</th>
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<tr>
<td>VMware vRealize Orchestrator</td>
<td>7.6.0.317 Build Number -13020602</td>
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<td>HPE OneView for VMware vRealize Orchestrator(OV4VRO)</td>
<td>1.3</td>
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<td>HPE Synergy Composer</td>
<td>5.00.0002</td>
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<td>iSUT</td>
<td>sut-esxi6.7-offline-bundle-245.0-16</td>
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<td>VMware Cloud Foundation</td>
<td>3.8.1</td>
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<td>vCenter</td>
<td>6.7 U3</td>
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Testing the workflow
In the Hewlett Packard Enterprise Engineering lab environment, the following two HPE Synergy Service Packs are downloaded, as shown in Table 14.

Table 14: Firmware used in testing

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<tr>
<th>Name</th>
<th>Version</th>
<th>Size</th>
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<tr>
<td>HPE Synergy Custom SPP 2019031 2019 08 26</td>
<td>2019.08.26.00</td>
<td>4.60 GB</td>
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<td>HPE Synergy Custom SPP 201909  2019 09 25</td>
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In the Server Profile template, the **Firmware baseline** was selected as "HPE Synergy Custom SPP 2019031 2019 08 26" as shown in Figure 36.

**Figure 36.** Firmware baseline in HPE OneView
The firmware of the HPE Synergy Compute Nodes was updated to firmware version HPE Synergy Custom SPP 201909 2019 09 25” using the workflow “Update cluster Firmware” present in OV4VRO workflows. The following information was necessary to start the “Update cluster Firmware” workflows:

- **vCenter Cluster** – The vCenter Cluster on which the HPE Synergy host firmware would be upgraded as shown in Figure 37.

![Figure 37. vCenter Cluster selection](image-url)
• **HPE OneView Firmware Bundle** – The version to which the firmware update would happen as shown in Figure 38.

*Figure 38. HPE OneView Firmware Bundle selection*
1. Once the required details are updated, the "Update cluster Firmware" workflows is ready to start as shown in Figure 39.

Figure 39. Start workflow
2. In HPE OneView, the Server Profile status for each compute resource shows the activity details for the firmware update process as shown in Figure 40.

![Figure 40. OneView Screen showing new firmware baseline being applied](image)

**Figure 40.** OneView Screen showing new firmware baseline being applied
3. Once the Firmware update is complete, it shows the new firmware version “HPE Synergy Custom SPP 201909 2019 09 25” as the firmware baseline as shown in Figure 41. The firmware update state shows as **Applied along with the time** when it was installed.

![Figure 41. HPE OneView showing the new firmware applied](image)

**Note**

Certain firmware components need manual reboot for the complete installation of the firmware. In such scenario, a manual reboot of the host is recommended.

**Summary**

Hewlett Packard Enterprise and VMware can deliver a software-defined solution running on modular infrastructure across compute, storage, network, security, and cloud management. This Reference Architecture demonstrates a secured and scalable private cloud solutions built using VMware Cloud Foundation on HPE Synergy. It showcases the ability to:

- Integrate composability with VCF and HPE Synergy using HPE OneView Connector for VCF.
- Simplify deployment of VI workload domain and operations on VMware Cloud Foundation.
- Simplify firmware updates using HPE OneView for VMware vRealize Orchestrator.
HPE Synergy offers a unique design for running VMware private clouds, and for providing the right IT platform that matches VMware Cloud Foundation characteristics—automated, software-driven, and flexible. HPE Synergy is the only modular infrastructure to run VMware Cloud Foundation deployments, and it provides a foundation for supporting hybrid configurations.

The benefits of using VMware Cloud Foundation on HPE Synergy include:

- Reduced infrastructure complexity and cost.
- Elimination of top-of-rack switching and deployment.
- Availability of rack-scale fabric with HPE Virtual Connect.
- Efficiencies in scaling fabrics across multiple frames.
- Provision and management of the physical fluid resources for SDDC deployments through HPE OneView.

**Appendix A: Bill of materials**

**Note**

Part numbers are at time of publication and subject to change. The bill of materials does not include complete support options or complete rack and power requirements. For questions regarding ordering, consult with your HPE Reseller or HPE Sales Representative for more details.  

hpe.com/us/en/services/consulting.html

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Resources and additional links


HPE Reference Architecture, hpe.com/info/ra

HPE Synergy, hpe.com/info/synergy

HPE and VMware, hpe.com/partners/vmware

HPE Networking, hpe.com/networking

HPE Servers, hpe.com/servers

HPE Enterprise Information Library, hpe.com/info/convergedinfrastructure

HPE Technology Consulting Services, hpe.com/us/en/services/consulting.html

HPE OneView for VMware vCenter with operation Manager and Log Insight, hpe.com/hpeoneviewforvcenter

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