

# HPE Reference Architecture for VMware Cloud Foundation 5.1 on HPE Synergy

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# Executive Summary

Businesses face challenges in turning ideas into services faster, responding quickly to new customer demands, and innovate better 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) solutions to support this shift.

Hewlett Packard Enterprise and VMware® collaborate to help customers accelerate the journey to the hybrid cloud and bring the promise of the software-defined data center to life. The combination of HPE Synergy Composable Infrastructure and VMware SDDC solution dramatically improves business outcomes as well as overall value for our customers. HPE Synergy combined with VMware® Cloud Foundation™ (VCF) delivers a simplified and more secure private cloud - 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 with VMware Cloud Foundation is the right solution to support and 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 and deployment of vSphere Lifecycle Manager (vLCM) based VI workload domain.

VMware Validated Solutions (VVS) are technically validated implementations, serving as a blueprint for SDDC implementation. VVS can be used along with the VMware Cloud Foundation 5.1 documentation and HPE's Reference Architecture, to build VMware Cloud Foundation 5.1 as a private cloud on HPE Synergy.

Solution benefits include the following:

- From a deployment and lifecycle perspective, HPE Synergy with VMware Cloud Foundation is a cost-effective and simplified management solution with a faster time to value
- An easy-to-operate Virtual Infrastructure (VI) provided as a VMware Cloud Foundation workload domain
- Remediate drivers and firmware upgrades in a single maintenance window along with ESXi update for a vLCM based workload domain through the Hardware Support Manager (HSM) service provided with HPE OneView for VMware vCenter® (OV4vC) integration
- Support for consolidated architecture deployment of VMware Cloud Foundation

Application Virtual Network (AVN) is a software-defined overlay network that provides many benefits in SDDC such as simplified data mobility, improved security, and disaster recovery procedures. The use of AVN in VMware Cloud Foundation 5.1 is optional however, it is required to set up and use the optional VMware Aria suite of products. Aruba CX 8325 switches that support up to 100Gb per port, high-performance server connectivity, and the capability to handle virtual environments are used as top of rack switches (TORs) to deploy NSX edge clusters on VMware Cloud Foundation.

Target audience: This document is intended for IT decision-makers as well as architects, system engineers, and system administrators who want to understand enterprise-ready private cloud solutions using the HPE 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, Enterprise Networking, and HPE Synergy. For assistance with the automated deployment of HPE Synergy with VMware Cloud Foundation, contact your HPE representative.

Document purpose: The purpose of this document is to demonstrate an example use case of enterprise-ready private cloud solutions by combining the value of VMware Cloud Foundation and HPE Synergy Composable Infrastructure that is flexible and easy to deploy.

This Reference Architecture describes solution testing performed in March 2024.

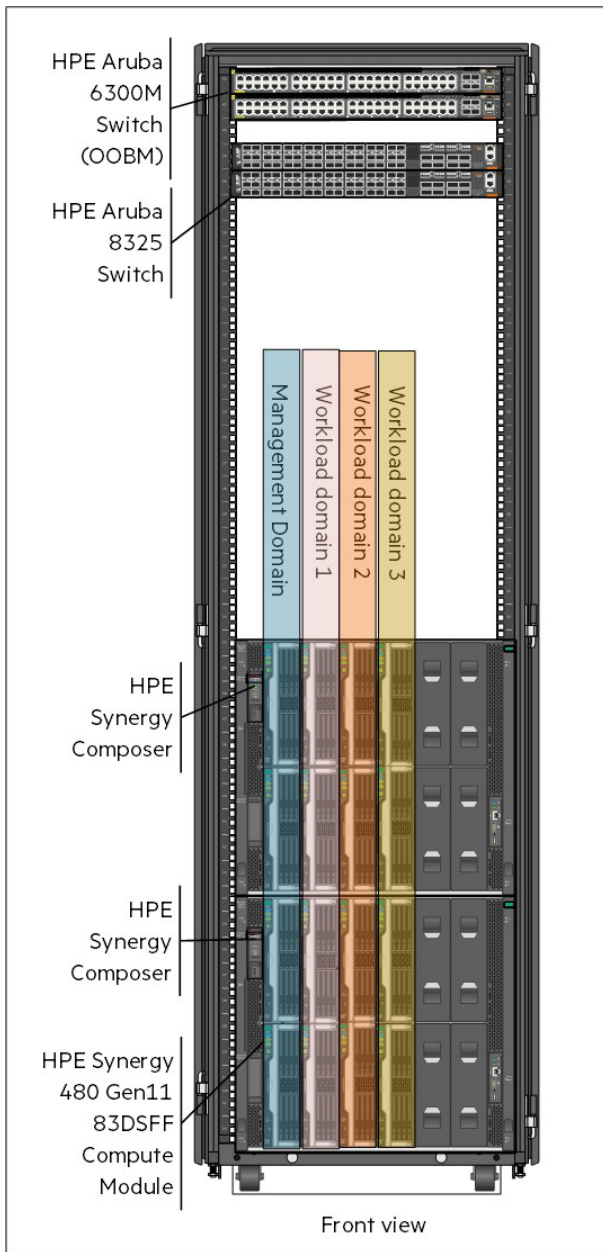
## Solution Overview

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

HPE Synergy is a single infrastructure of pools of compute, storage, and fabric resources, along with a single management interface.

HPE OneView 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 HPE Synergy system.

This document demonstrates the concept of using two (2) HPE Synergy 12000 Frames each equipped with eight (8) HPE Synergy 480 Gen11 8EDSFF servers to bring up 4 node VMware Cloud Foundation management domain and a 4 node VMware Cloud Foundation workload domain. Each HPE Synergy 12000 Frame uses HPE Virtual Connect SE 100Gb F32 Module to provide uplink connectivity to the data center network. HPE Synergy 480 Gen11 8 EDSFF NVMe E3.S Direct Connect Drive Cage Kit hosts 8 direct attach NVMe drives used for software-defined VMware vSAN storage. Figure 1 shows the physical rack layout showcasing the solution components validated in this Reference Architecture.



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

# Solution Components

## Hardware

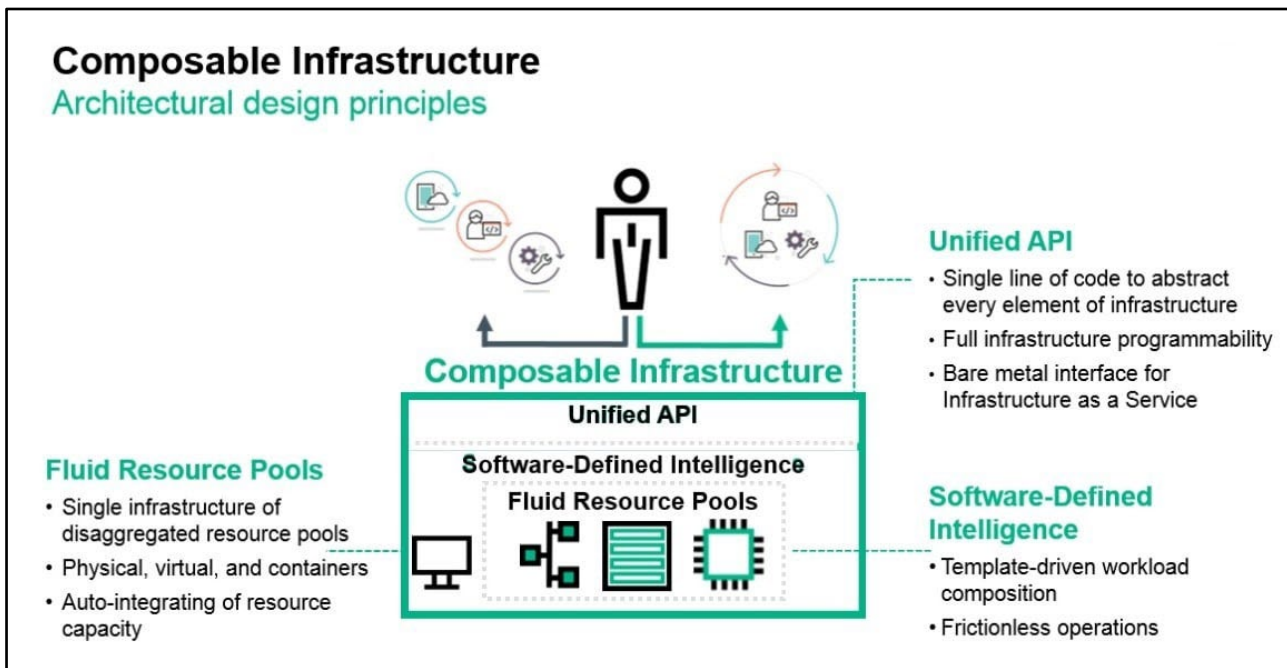
HPE Synergy is a composable infrastructure platform that empowers IT to create and deploy resources instantly and continuously, gain control of IT resources efficiently, and simplify IT operations using a single software-defined infrastructure for physical, virtual, and containerized workload. Developers and independent software vendors (ISVs) can programmatically control an HPE Synergy Composable Infrastructure through a single, open API that is native to HPE Synergy powered by HPE OneView. This Reference Architecture is built upon the following compossability 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 required 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 2

HPE Synergy Composer 2 provides enterprise-level management to compose and deploy system resources for all 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 Profile templates capture the entire server configuration in one place, enabling administrators to replicate new Server Profiles and 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.

## HPE Synergy 12000 Frame

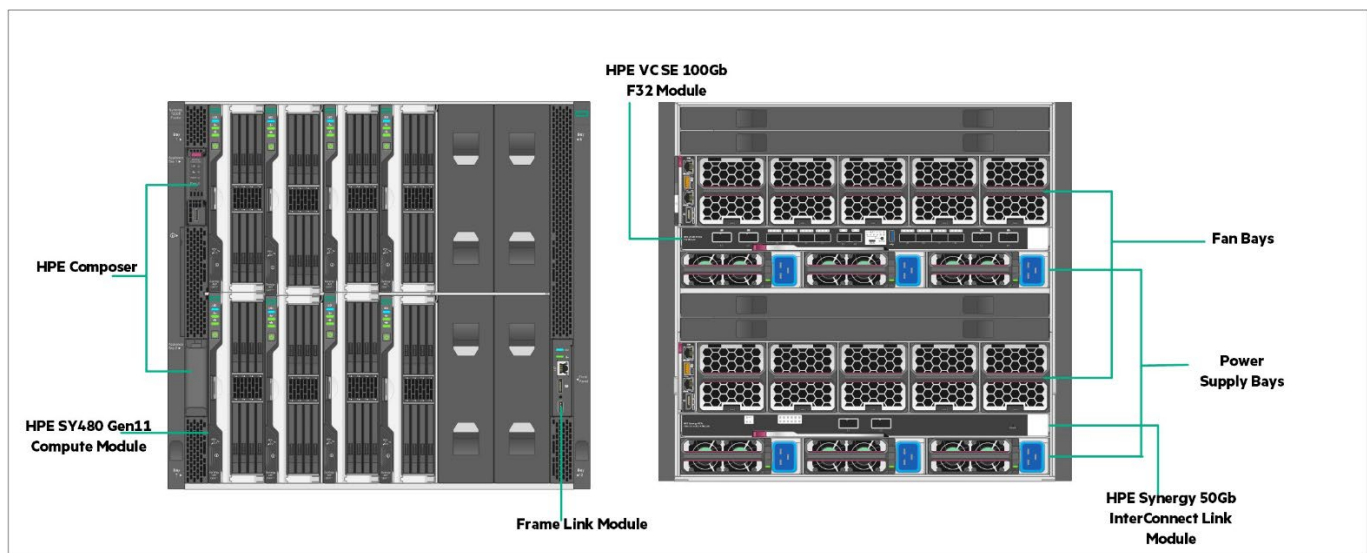
The HPE Synergy 12000 Frame is a base infrastructure of compute, storage, network fabric, and power into a scalable solution that addresses and scales various customer workloads. The HPE Synergy 12000 Frame reduces

complexity in the IT infrastructure by unifying all these resources into a common bus, and with the myriads of available network and storage interconnects, which allow the frame to interoperate with any other IT environment.

In this solution, each HPE Synergy Frame has the following components:

- Eight half-height compute modules.
- Frame link module for in-band and out-of-band management.
- Up to six 2650-Watt power supplies and ten fan bays.
- One HPE Synergy VC SE 100Gb F32 interconnect and one 50Gb interconnect link module.
- 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 levels.

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



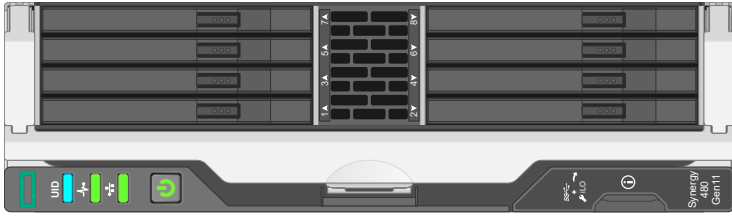
**Figure 3.** Front and rear view of HPE Synergy Frame 1 of a multiple frame configuration

### **HPE Synergy 480 Gen11 8EDSFF Compute Module**

The HPE Synergy 480 Gen11 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 4th and 5th Generation Intel® Xeon® Scalable Processors upto 64 cores and featuring support for up to 4TB of HPE DDR5 Smart Memory, flexible storage controller options, multiple I/O connectors, and designed to create a pool of flexible compute capacity within a composable infrastructure, the HPE Synergy 480 Gen11 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 (2) HPE Synergy 12000 Frames. Each HPE Synergy 12000 Frame in a rack consists of eight (8) HPE Synergy 480 Gen11 Compute Modules.

Figure 4 shows the HPE Synergy 480 Gen11 8EDSFF Compute Module.



**Figure 4.** HPE Synergy 480 Gen11 8EDSFF Compute Module

**HPE Synergy 480 Gen11 8EDSFF NVMe Direct Connect Cage Kit**

The HPE Synergy 480 Gen11 8EDSFF NVMe Direct Connect Cage Kit is an 8 drive solution that supports up to 8x EDSFF NVMe direct connect drives for storage requirements

Figure 5 shows the HPE Synergy SY480 Gen11 8EDSFF NVMe Direct Connect Cage Kit



**Figure 5.** HPE Synergy 480 Gen11 8EDSFF NVMe E3.S Direct Connect Drive Cage Kit

**HPE Virtual Connect SE 100Gb F32 Module**

The HPE Virtual Connect SE 100Gb F32 Module, the master module based on HPE Synergy 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 although consuming fewer ports at the data center aggregation layer.

The HPE Virtual Connect SE 100Gb F32 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.

Figure 6 shows the HPE Virtual Connect SE 100Gb F32 Module.



**Figure 6.** HPE Virtual Connect SE 100Gb F32 Module

**HPE Synergy 50Gb Interconnect Link Module**

The HPE Synergy 50Gb 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.

Figure 7 shows the HPE Synergy 50Gb Interconnect Link Module.



**Figure 7.** HPE Synergy 50Gb Interconnect Link Module

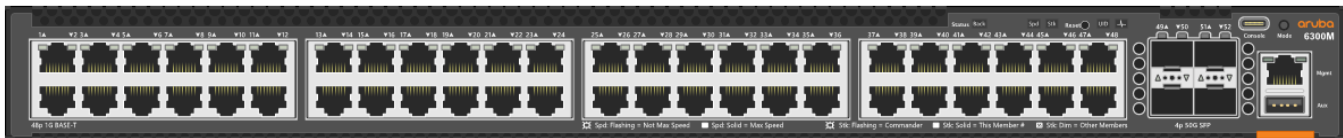
### **HPE Synergy 6820C 25/50Gb Converged Network Adapter**

The HPE Synergy 6820C 25/50Gb Converged Network Adapter is a key element in HPE Synergy composable fabric connecting pools of compute resources to networks with reliable, high-performing converged Ethernet connectivity up to 50Gb. The HPE Synergy 6820C 25/50Gb Ethernet Adapter provides more than two times the bandwidth compared to 10/20Gb adapters. Therefore, it simplifies hardware implementation by reducing the number of adapters, associated switches, and compute modules required to achieve higher bandwidth. This HPE Synergy 6820C adapter converges Ethernet and FCoE onto a single connection, simplifying hardware and reducing costs.

### **Aruba 6300M switch**

The Aruba CX 6300 switch series is a modern, flexible, and intelligent family of stackable switches ideal for enterprise network access, aggregation, core, and data center top of rack (ToR) deployments. Created for game-changing operational efficiency with built-in security and resiliency, the 6300 switches provide the foundation for high-performance networks supporting IoT, mobile, and cloud applications.

Figure 8 shows the front view of the Aruba 6300M switch.



**Figure 8.** Aruba 6300M switch

### **Aruba 8325 switch series**

The Aruba 8325 switch series offers a flexible and innovative approach to addressing the application, security, and scalability demands of the mobile, cloud, and IoT era. These switches serve the needs of the next-generation core and aggregation layer, as well as emerging data center requirements at the Top of Rack (ToR) and End of Row (EoR). They provide more than 6.4Tbps of capacity, with line-rate Gigabit Ethernet interfaces including 1Gbps, 10Gbps, 25Gbps, 40Gbps, and 100Gbps. The 8325 series include industry-leading line rate ports 1/10/25GbE (SFP/SFP+/SFP28) and 40/100GbE (QSFP+/QSFP28) with connectivity in a compact 1U form factor. These switches offer a fantastic investment for customers wanting to migrate from older 1GbE/10GbE to the faster 25GbE, or 10GbE/40GbE to 100GbE ports.

Figure 9 shows the front view of the Aruba 8325 32Y8C Switch.



**Figure 9.** Aruba 8325 32Y8C switch

## Software

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

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

**Table 1.** HPE software and firmware components

Component	Version
HPE Synergy Composer 2	8.70
HPE Custom Synergy SPP	Synergy_Service_Pack_SSP_2024.01.02_Z7550-97746.iso
HPE Add-on	VMware-ESXi-8.0.2-22380479-HPE-802.0.0.11.5.5.13-Jan2024-Synergy-depot.zip
HPE OEM customized vSphere distribution 8.0 U2-HPE Synergy	VMware-ESXi-8.0.2-22380479-HPE-802.0.0.11.5.5.13-Jan2024-Synergy
Aruba 6300M Switch	10.13.1005
Aruba 8325 Switch (R9F67A)	10.13.1005
Aruba Fabric Composer	6.6.1
HPE G2 Metered and Switches PDUs	2.0.0.N

**Table 2.** VMware software components

Component	Version
Cloud Builder VM	5.1 (Build 22688368)
SDDC Manager	5.1 (Build 22688368)
VMware vCenter Server® (Appliance)	8.0 Update 2a (Build: 22617221)
VMware ESXi	ESXi 8.0 Update 2 (Build: 22380479)
VMware vSAN™	8.0 Update 2 (Build: 22443122)
VMware NSX-T Data Center	4.1.2.1 (Build: 22667789)
VMware Aria Suite Lifecycle	8.14 (Build: 22630473)

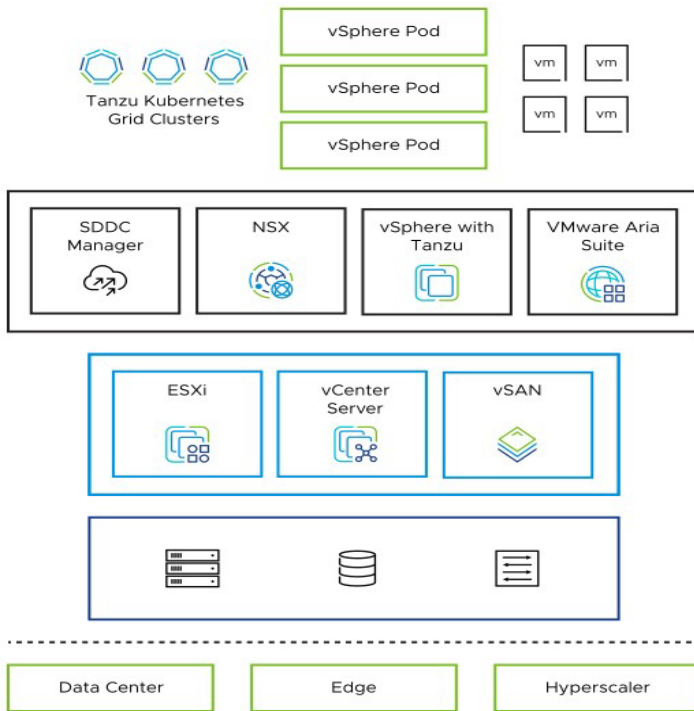
**Table 3.** HPE Solution Integration Software

HPE Solution Component	Version
HPE OneView (Hosted on Composer 2)	8.70
HPE OneView for VMware vCenter plug-in (OV4VC)	11.5

For more information on VMware Cloud Foundation 5.1 software and firmware, see the HPE Synergy firmware and software compatibility matrix for VMware Cloud Foundation at

<https://www.hpe.com/psnow/doc/a50010626enw>.

VMware Cloud Foundation is the industry’s most advanced enterprise-ready hybrid 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. VMware Cloud Foundation 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 SDDC platform by integrating VMware vSphere, vSAN, and NSX-T into a full-stack HCI solution that delivers enterprise-ready cloud infrastructure. Figure 10 shows the VMware Cloud Foundation components.



**Figure 10.** VMware Cloud Foundation components

**VMware Cloud Foundation components**

The following core components for VMware Cloud Foundation are explained:

**Cloud Foundation Builder VM**

The Cloud Foundation Builder VM is a one-time use VM that 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 IP Address, 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 4 shows the Cloud Foundation Builder VM resource requirements.

**Table 4.** Cloud Foundation Builder VM resource requirements

Components	Requirements
CPU	4 vCPUs
Memory	4GB
Storage	279 GB of Storage <ul style="list-style-type: none"> <li>• 25.1 GB (thin provisioned)</li> </ul>

Components	Requirements
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- 253.8 GB (thick provisioned)

### **SDDC Manager**

SDDC Manager manages the bring-up of the VMware 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 VMware Cloud Foundation. 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 VMware Cloud Foundation System. SDDC Manager controls these processes by using workflows. Each workflow comprises a series of tasks, which are executed by the SDDC Manager.

### **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 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 a 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 and simplifies storage configuration and virtual machine provisioning.

### **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 might include other hypervisors, containers, bare metal, and public clouds. NSX-T allows IT and development teams to choose the technologies best suited for their applications. NSX-T is also designed for management, operations, and consumption by development organizations besides being used by IT.

### **VMware Aria Suite Lifecycle**

VMware Aria Suite Lifecycle provides a comprehensive solution for deploying, configuring, managing, and upgrading VMware Aria Suite products. These products include VMware Aria Operations, VMware Aria Automation, VMware Aria Automation Orchestrator, VMware Aria Operations for Networks, and VMware Aria Operations for Logs. VMware Aria Suite Lifecycle provides product installation and content lifecycle management capabilities to automate the deployment of VMware Aria Suite content across different environments.

### **VMware vSphere Lifecycle Manager**

VMware vSphere Lifecycle Manager is the next version of Update Manager that enables centralized, automated patch, and version management for VMware vSphere. VMware vSphere Lifecycle Manager provides the functionality to upgrade and patch ESXi. VMware vSphere Lifecycle Manager along with HPE OneView Hardware Support Manager (HSM) plug-in can also perform server firmware, drivers, and software updates in the same maintenance window as the ESXi server operating system updates.

## HPE Software Solution Integration components

### HPE OneView

HPE OneView hosted on synergy composer in a frame is a management appliance used to deploy and maintain infrastructure faster, simplify IT operations, and increase productivity. It lets businesses simplify and automate today's complex hybrid IT infrastructure. Through software-defined intelligence, HPE OneView takes a template-driven approach for deploying, provisioning, updating, and integrating compute, storage, and networking infrastructure.

### HPE OneView Hardware Support Manager (HSM)

The HPE OneView Hardware Support Manager plug-in for VMware vSphere Lifecycle Manager allows users to update server's firmware in the same maintenance window as the ESXi server Operating System updates, with a single reboot if possible.

### HPE OneView for VMware vCenter

HPE OneView for VMware vCenter is a VMware vCenter plugin that provides server hardware management capabilities, including comprehensive monitoring, firmware update, vSphere/ESXi image deployment, remote control, and power optimization for HPE servers in the VMware environment. HPE OneView HSM is integrated inside HPE OneView for VMware vCenter.

# Design and Configuration Guidance

## Infrastructure Configuration

The solution involves two (2) HPE Synergy 12000 Frames each equipped with eight (8) HPE Synergy 480 Gen11 Servers. Each Synergy 480 Gen 11 server has eight direct attach NVMe drives that is leveraged to deploy vSAN Express Storage Architecture (ESA) for use as primary shared storage for the domain creation. The HPE Synergy 12000 Frames have a redundant pair of HPE Synergy Virtual Connect SE 100Gb F32 Modules, for high-speed uplink connectivity to multiple networks. For a detailed understanding, see <https://techlibrary.hpe.com/docs/synergy/shared/cabling/GUID-322C6B82-3183-42E6-A01D-B52BE4CF77C7.html>

Table 5 defines the hardware configuration used in this Reference Architecture.

**Table 5.** Hardware configuration

Hardware	Details
Number of racks	1
HPE Synergy 12000 Frames in the rack	2
HPE Synergy Composer 2 Module per Synergy 12000 Frame	1
HPE Synergy 480 Gen11 8EDSFF Compute Modules per Synergy 12000 Frame	8
HPE Virtual Connect SE 100Gb F32 Module for Synergy per Synergy 12000 Frame	1
HPE Synergy 50GB Interconnect Link Module per Synergy 12000 Frame	1

Table 6 defines the HPE Synergy 480 Gen11 hardware components used in this Reference Architecture.

**Table 6.** HPE Synergy 480 Gen11 hardware components (quantities are per node)

Hardware	Quantity	Description
CPU	2	Intel® Xeon® Platinum 8480+ (4 GHz/56-core/200W)
Memory	32	HPE 64GB (1 x 64GB) DDR5
CNA	1	HPE Synergy 6820C 25/50Gb Converged Network Adapter

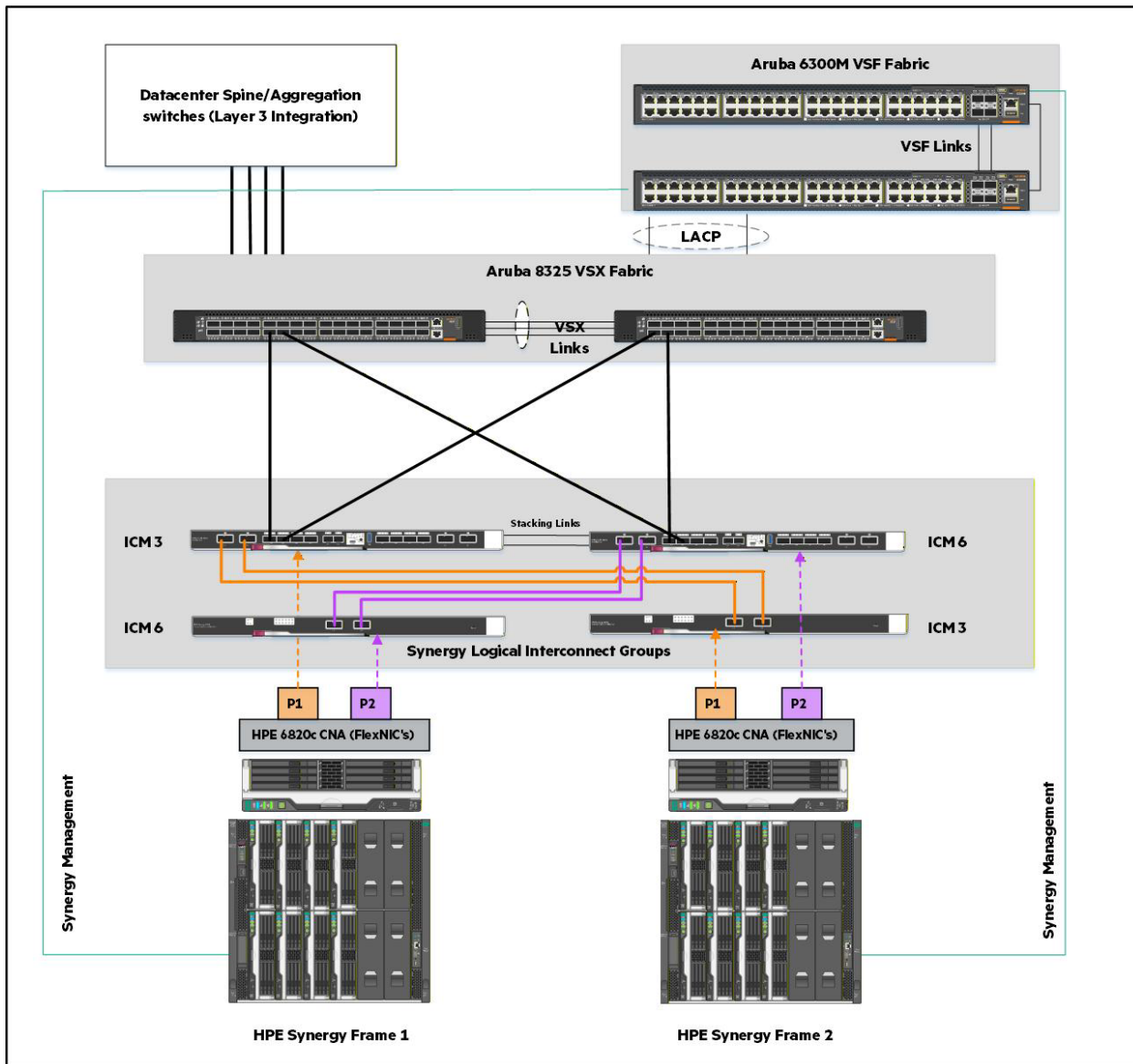
The VMware Cloud Foundation infrastructure needs different external services for the initial deployment and to deploy other optional components like VMware Aria Operations or VMware Aria Automation. Core infrastructure services including active Directory, Dynamic Host Configuration Protocol (DHCP), Domain Name Service (DNS), and Network Time Protocol (NTP) are the prerequisite services that should be leveraged from the customer’s data center environment.

### **Aruba 6300M Switches configuration**

Aruba 6300M switches are the out-of-band management switches in this solution. Both Aruba 6300M switches are configured for a Virtual Switching Framework that virtualizes two physical devices into one Virtual Fabric to provide high availability and scalability. Frame Link Module in each HPE Synergy Frame connects to solution out of band management network configured on Aruba 6300M switches. Frame link module efficiently manages the operations of a HPE Synergy Frame in conjunction with HPE Composer, which is powered by HPE OneView. After successfully configuring HPE OneView with the out of band solution management network, both HPE OneView and Integrated Lights Out, which helps with remote management of all Synergy servers can be accessed on this out of band solution management network.

### **Aruba CX 8325 Switches configuration**

Aruba 8325 Switches should be connected and configured for Virtual Switching Extension (VSX) that virtualizes the control plane of two aggregation switches to function as one device at layer 2 and as independent devices at layer 3. Aruba’s VSX has been designed from the ground up to provide industry-leading performance and high availability with much-needed simplicity. This is accomplished through the resiliency of AOS-CX, a modern network operating system that performs continuous state synchronization.



**Figure 11.** Network layout with Aruba switches

All the VLANs required for VMware Cloud Foundation deployment should be created on the Aruba 8325 top-of-rack (ToR) switches, and the physical ports on the Aruba 8325 should be trunk enabled, allowing VLANs required for the VMware Cloud Foundation stack. The VLANs configured on the Aruba physical switch ports must strictly match the requirements of the selected VCF vSphere distributed switch traffic segregation profile. Figure 11 shows the networking layout for HPE Synergy with Aruba Switches.

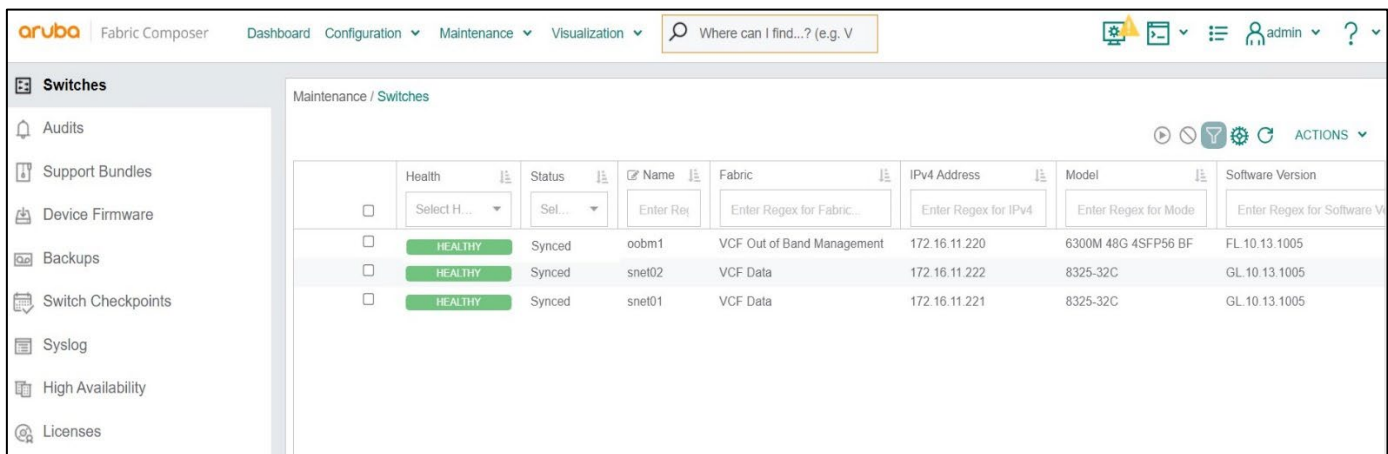
### Aruba Fabric Composer

Aruba Fabric Composer is an intelligent, API-based, software-defined orchestration solution that simplifies and accelerates leaf-spine network provisioning and day-to-day operations across rack-scale compute and storage infrastructure. Aruba Fabric Composer orchestrates a discrete set of switches as a single entity called a fabric which significantly simplifies operations and troubleshooting. Aruba's data center orchestration solution is fully infrastructure and application-aware providing automation of various configurations and lifecycle events. It also has key integrations with the VMware stack (SDDC Manager, vSphere/vCenter, NSX-T) to help with automation, visibility, and troubleshooting across the virtual and physical networks.

To know more about Aruba Fabric Composer, refer to <https://www.arubanetworks.com/en-in/products/switches/core-and-data-center/fabric-composer/>.

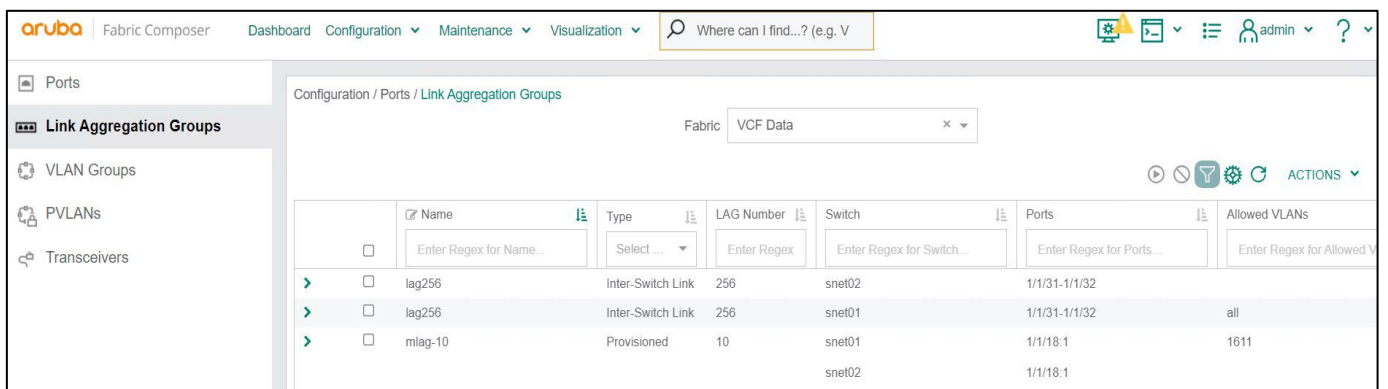
In this solution, Aruba 6300 OOBM management switches and 8325 data switches are orchestrated from the single AFC user interface providing connectivity visualizations and automation of factory integration deployments and day-to-day operations.

Aruba Fabric Composer available in OVA format is deployed as a virtual machine on a standalone ESXi server. This ESXi server has connectivity to the out of band solution management network and is also used to host other infrastructure virtual machines such as NTP and DNS, that are necessary to deploy this cloud solution. To begin with, both 6300M switches and 8325 switches are configured with management IPs that belong to out of band solution management network. A pair of 6300 OOBM switches and 8325 switches are onboarded to AFC as part of the Aruba Fabric before proceeding to configure VLANs and BGP to support VMware Cloud Foundation deployment. AFC UI helps avoid command-line interface to perform all network configurations, providing increased visibility and control. Figure 12 shows both OOBM and data switches onboarded to Aruba Fabric Composer.



**Figure 12.** Aruba switches onboarded to Aruba Fabric Composer

If Aruba VSX is not already configured, you can configure it from the Aruba Fabric Composer. Multi-Chassis Link Aggregation Group between OOBM and data switches can also be configured through Aruba Fabric Composer. Figure 13 shows MC-LAG between Aruba 6300 and Aruba 8325 switches and Aruba 8325 VSX Inter Switch Link configured through AFC.



**Figure 13.** MC-LAG and ISL configured through Aruba Fabric Composer

VLANs required for VMware Cloud Foundation deployment should be configured on both Aruba 8325 switches. Because the control plane is separate for paired Aruba 8325 switches, each interface VLANs have to be created on both the switches with identical IP addresses, and with the active gateway IP same as IP address configured for the VLAN interface. This active gateway IP assigned for interface VLANs is the default gateway virtual IP

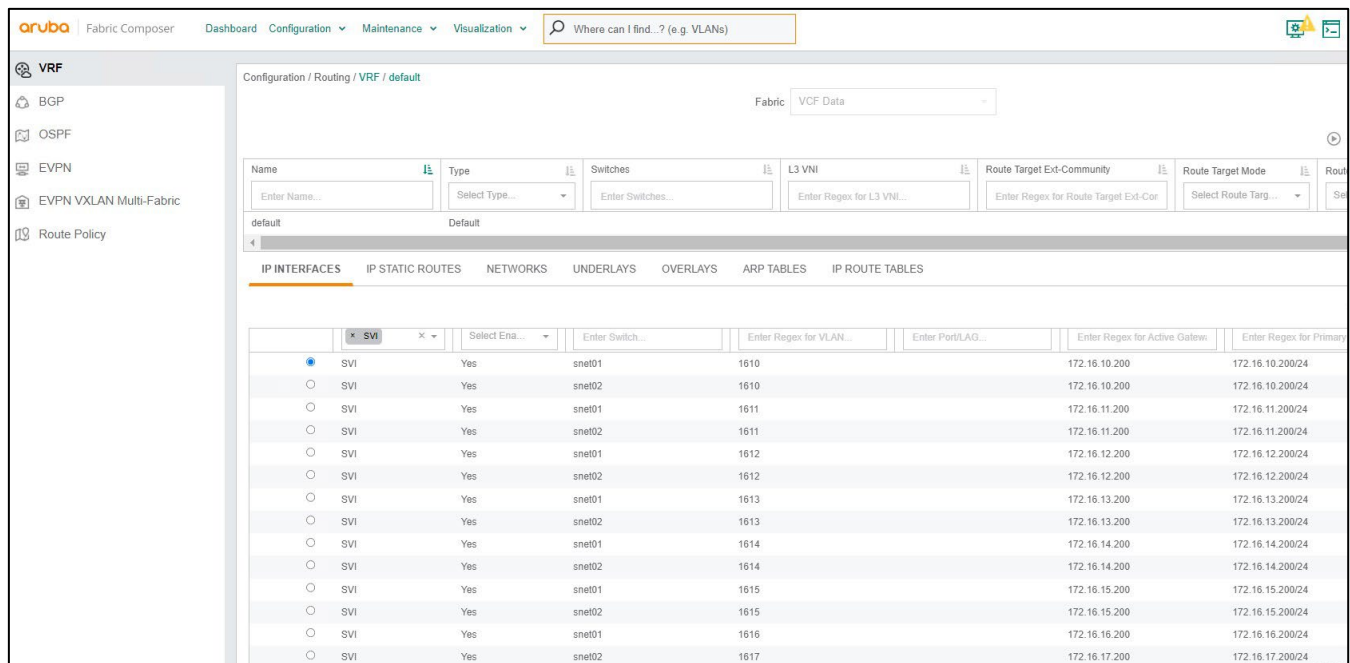
address that provides high availability for Top of Rack data switches. Figure 14 and 15 shows one of the interface VLAN (also called Switch Virtual Interface) created on both Aruba 8325 switches along with active gateway through the AFC.

**Figure 14.** Interface VLAN created through Aruba Fabric Composer

Name	vlan1611
Description	mgmt-network
Type	SVI
Enabled	Yes
VLAN	1611
Switch	snet01
Active Gateway IP Address	172.16.11.200
Active Gateway MAC Address	12:00:00:00:00:01
Primary IPv4 Network Address	172.16.11.200/24
VSX Shutdown on Split	No
VSX Active Forwarding	No
Local Proxy ARP Enabled	No

**Figure 15.** Summary of Interface VLAN created through Aruba Fabric Composer

All the interface VLANs required for VMware Cloud Foundation management domain, workload domain, and edge cluster deployment are configured through Aruba Fabric Composer. Figure 16 shows the VMware Cloud Foundation management domain VLANs configured through the Aruba Fabric Composer.



**Figure 16.** VMware Cloud Foundation Management Domain So VLANs created through Aruba Fabric Composer

### HPE OneView configuration through HPE Synergy Composer

The following steps summarize the HPE Synergy configuration:

1. Create HPE OneView networks for the VLANs created on the Aruba ToR data switches and updated in the cloud builder parameter sheet as shown in Table 7 and Table 8.

**Table 7.** HPE OneView networks for VCF management domain

HPE OneView networks (For VCF Bring up)	VLAN IDs	HPE OneView networks (For Edge Cluster)	VLAN IDs
VCF management domain VM Management VLAN	1610	VCF management domain Edge Overlay	1615
VCF management domain Management VLAN	1611	VCF NSX-T Edge Uplink 1	1616
VCF management domain vMotion VLAN	1612	VCF NSX-T Edge Uplink 2	1617
VCF management domain vSAN VLAN	1613		
VCF management domain Host Overlay	1614		

**Table 8.** HPE OneView networks for VCF Workload Domain

HPE OneView networks (For VCF Bring up)	VLAN IDs	HPE OneView networks (For Edge Cluster)	VLAN IDs
VCF Workload Domain Management VLAN	1621	VCF Workload Domain Edge Overlay	1625
VCF Workload Domain vMotion VLAN	1622	VCF NSX-T Edge Uplink 1 Workload	1626

HPE OneView networks (For VCF Bring up)	VLAN IDs	HPE OneView networks (For Edge Cluster)	VLAN IDs
VCF Workload Domain vSAN VLAN	1623	VCF NSX-T Edge Uplink 2 Workload	1627
VCF Workload Domain Host Overlay	1624		

2. Create HPE OneView network sets to be used in the respective HPE OneView Server Profile template of the VMware Cloud Foundation management domain nodes as shown in Table 9 and Table 10. Network sets created has to adhere to the virtual distributed switch profile chosen in parameter sheet. This example shows network sets created for VDS profile 3 chosen in parameter sheet.

**Table 9.** HPE OneView VCF management network sets

VCF management domain network Set A	VLAN
VM Management VLAN	1610
Management VLAN	1611
vMotion VLAN	1612
vSAN VLAN	1613
NSX-T Host Overlay VLAN	1614

**Table 10.** HPE OneView VCF management network sets (Includes VLANs for edge cluster and AVN deployment)

VCF management domain network Set B	VLAN
NSX-T Edge Overlay VLAN	1615
NSX-T Edge Uplink 1 VLAN	1616
NSX-T Edge Uplink 2 VLAN	1617

3. Create HPE OneView network sets to be used in the respective HPE OneView Server Profile template of the VMware Cloud Foundation workload domain nodes as shown in Table 11 and Table 12. Network sets created here will adhere to VDS profile 3 of VMware Cloud Foundation.

**Table 11.** HPE OneView VCF workload network sets

VCF management domain network Set A	VLAN
Management Workload VLAN	1621
vMotion Workload VLAN	1622
vSAN Workload VLAN	1623
NSX-T Host Overlay Workload VLAN	1624

**Table 12.** HPE OneView VCF workload network sets (Includes VLANs for edge cluster)

VCF Workload Domain network Set B	VLAN
NSX-T Edge Overlay Workload VLAN	1625
NSX-T Edge Uplink 1 Workload VLAN	1626
NSX-T Edge Uplink 2 Workload VLAN	1627

**Note**

The sample VLAN IDs have been used in the solution. However, the VLAN IDs need to be replaced as per the customer's requirements.

4. Create a Logical Interconnect Group for Synergy ethernet interconnects used in the solution and assign the proper uplink sets as shown in Table 13.

**Table 13.** HPE OneView Logical Interconnect Group

Logical Interconnect Group	Values
Name of Logical Interconnect Group	VC-SE-100Gb-F32-LIG
Add Network Set A of Management Domain and Workload Domain to uplink set 1 Note: This uplink set handles traffic for Management, vMotion, and vSAN	1610-1614 1621-1624
Add Network Set B of Management Domain and Workload Domain to uplink set 2 <b>Note:</b> This uplink set handles traffic for NSX Overlay	1615-1617 1625-1627
Add Uplink Port from Virtual Connect ICM3 and ICM6 to uplink set 1 <b>Note:</b> Add at least 1 uplink port from each interconnect such that one ICM Port connects to first switch while the other ICM port connects to second switch.	Q1
Add Uplink Port from Virtual Connect ICM3 and ICM6 to uplink set 2 <b>Note:</b> Add at least 1 uplink port from each interconnect such that one ICM Port connects to first switch while the other ICM port connects to second switch.	Q2

5. Create an Enclosure Group.
6. Create a Logical Enclosure and apply the appropriate firmware baseline.
7. Create the HPE OneView Server Profile templates, selecting the appropriate hardware type and the Enclosure Group created in the previous steps. Table 14 and Table 15 lists the Server Profile template settings for the VMware Cloud Foundation management domain and workload domain servers.

**Table 14.** Sample Values for HPE OneView Server Profile for VCF Management domain

HPE OneView Server Profile template for VCF management domain node	Sample values
Server Profile Template Name	VCF Management Domain Template
Firmware	(This is the firmware baseline chosen and added to HPE OneView as per firmware matrix)
Connection 1	VCF Management Domain Network Set A

HPE OneView Server Profile template for VCF management domain node	Sample values
Connection 2	VCF Management Domain Network Set A
Connection 3	VCF Management Domain Network Set B
Connection 4	VCF Management Domain Network Set B

Table 15. Sample Values for HPE OneView Server Profile for VCF workload domain.

HPE OneView Server Profile template for Workload Domain node	Sample values
Server Profile Template Name	VCF Workload Domain Template
Firmware	(This is the firmware baseline chosen and added to HPE OneView as per firmware matrix)
Connection 1	VCF Workload Domain Network Set A
Connection 2	VCF Workload Domain Network Set A
Connection 3	VCF Workload Domain Network Set B
Connection 4	VCF Workload Domain Network Set B

#### Note

HPE NS204i-d Gen11 boot drives should be configured through iLO for RAID 1 and this boot controller will not be available under local storage during HPE Synergy Server Profile Template creation. 8 x 3.2TB NVMe Drives connected to HPE Synergy 480 Gen11 servers through HPE Synergy 480 Gen11 8EDSFF NVMe E3.S Direct Connect Drive Cage Kit will be available for vSAN ESA storage directly after successful ESXi installation.

#### Server Configuration

1. Deploy ESXi on all management and workload domain server nodes.
2. Configure VLAN ID, IP Address, DNS server IP, and FQDN for all the ESXi nodes.
3. Configure Network Time Protocol (NTP) on an ESXi host using the vSphere Client.
4. Start SSH and NTP services on an ESXi host using the vSphere Client.
5. Regenerate certificates on all ESXi hosts to ensure correct common name based on host FQDN.

## VMware Cloud Foundation management domain Bringup on HPE Synergy

1. Download the VMware Cloud Foundation parameter sheet from VMware downloads.
2. Download and deploy Cloud Builder Virtual Machine (CBVM) on one of the HPE Synergy 480 Gen11 server chosen for the management domain.
3. Fill in the parameters and upload the VMware Cloud Foundation parameter sheet in the CBVM for the VMware Cloud Foundation management domain to deploy the SDDC Manager, vCenter Server, NSX, and vSAN.

- After the SDDC Manager bring-up is successful, verify vCenter and SDDC Manager have no errors to be resolved.
- Power off and delete the CBVM.
- Enable vSAN performance service.
- Update Skyline Health.

### Cloud-Builder Parameter Sheet

The VMware Cloud Foundation Builder virtual machine should be configured to have network connectivity to the management network of all ESXi hosts to be added to the VMware Cloud Foundation solution, as well as network connectivity to VM management network and prerequisite data center services.

After cloud-builder VM is deployed, a parameter sheet filled with deployment details is uploaded to the cloud-builder to bring up the SDDC. Figure 17 highlights the VLANs required to build VMware Cloud Foundation management domain, Static IP Pool support for NSX-T host overlay, and virtual distributed switch Profile-3 for VMware Cloud Foundation management domain in the Hosts and Networks tab of the parameter sheet.

**Hosts and Networks**

Instructions: Use the Hosts and Networks tab to input network details, hostname and IPs for the ESXi hosts to be used to implement the Management Domain.  
 - Grey cells are for information purposes and cannot be modified.  
 - Red cells mean the input data is either missing and mandatory or some type of validation of the input data has failed.  
 - Yellow cells indicate input data, default values are included to help illustrate the formatting to be used and align to the VMware documentation. If a value is not required enter 'na', if it turns red then its mandatory.

Management Domain Networks					
Network Type	VLAN #	Portgroup Name	CIDR Notation	Gateway	MTU
VM Management Network	1610	sf001-m01-c01-vds01-pg-vm-mgmt	172.16.10.0/24	172.16.10.200	9000
Management Network	1611	sf001-m01-c01-vds01-pg-mgmt	172.16.11.0/24	172.16.11.200	1500
vMotion Network	1612	sf001-m01-c01-vds01-pg-vmotion	172.16.12.0/24	172.16.12.200	9000
vSAN Network	1613	sf001-m01-c01-vds01-pg-vsan	172.16.13.0/24	172.16.13.200	9000

Management Domain ESXi Hosts			
Host Name	IP Address	Host Name	IP Address
ram01esx01	172.16.11.101	ram01esx02	172.16.11.102
ram01esx03	172.16.11.103	ram01esx04	172.16.11.104
vMotion Start IP	172.16.12.101	vMotion End IP	172.16.12.104
vSAN Start IP	172.16.13.101	vSAN End IP	172.16.13.104

**Virtual Networking**

Property	Value
vSphere Standard Switch Name	vSwitch0
Primary vSphere Distributed Switch - Name	ra-m01-c01-vds01
Primary vSphere Distributed Switch - pNICs	vmnic0,vmnic1
Primary vSphere Distributed Switch - MTU Size	9000
Primary vSphere Distributed Switch - Transport Zone Type	VLAN
Secondary vSphere Distributed Switch (Optional) - Name	ra-m01-c01-vds02
Secondary vSphere Distributed Switch - Transport Zone Type	Overlay
Secondary vSphere Distributed Switch - pNICs	vmnic2,vmnic3
Secondary vSphere Distributed Switch - MTU Size	9000

**vSphere Distributed Switch Profile**

Property	Value
vSphere Distributed Switch Profile	Profile-3
vSphere Distributed Switch - Dvs (2)	/ Physical NICs = Four (4)
Primary vDS - ra-m01-c01-vds01	- Traffic for Management, vMotion, vSAN - e.g. vmnic0,vmnic1
Secondary vDS - ra-m01-c01-vds02	- Traffic for Host Overlay - e.g. vmnic2,vmnic3

**Security Thumbsprints**

ESXi Hosts	Validate Thumbsprints
ram01esx01	No
ram01esx02	No
ram01esx03	No
ram01esx04	No

**NSX Host Overlay Network - Static IP Pool in NSX**

Property	Value
VLAN ID	1614
Configure NSX Host Overlay Using a Static IP Pool	Yes
Pool Description	ESXi Host Overlay TEIP IP Pool
Pool Name	sf001-m01-c01-teip01
CIDR Notation	172.16.14.0/24
NSX Host Overlay Start IP	172.16.14.101
NSX Host Overlay End IP	172.16.14.108

**Figure 17.** Hosts and Networks details in the VMware Cloud Foundation deployment parameter sheet

vSphere Distributed Switch Profile as shown in the above VMware Cloud Foundation parameter sheet allows deploying an SDDC with a custom VDS design. VMware Cloud Foundation 5.1 provides three (3) vSphere Distributed Switch profiles that perform host bring-up with two or four pNICs and create up to two vSphere Distributed Switches to isolate the VMkernel traffic. vSphere Distributed Switch section includes a parameter for Transport Zone Type with allowed values Overlay, VLAN, Overlay/VLAN or N/A. The vSphere Distributed Profile is chosen as Profile-3 out of the supported three vDS profile types as shown in Figure 17.

vmware

**Instructions:** Use the *Deployment Parameters* tab to input configuration details for physical infrastructure and the components used to implement the Management Domain.  
 - Grey cells are for information purposes and cannot be modified.  
 - Red cells mean the input data is either missing and mandatory or some type of validation of the input data has failed.  
 - Yellow cells indicate input data, default values are included to help illustrate the formatting to be used and align to the VMware documentation. If a value is not required enter 'n/a', if it turns red then its mandatory.

Existing Infrastructure Details		Infrastructure	Value	DNS Zone	Value
<input checked="" type="checkbox"/>	DNS Server and DNS Zone Defined	DNS Server #1	172.16.11.11	DNS Zone Name	synwcf.local
<input checked="" type="checkbox"/>	NTP Servers	DNS Server #2	n/a		
		NTP Server #1	172.16.11.12		
		NTP Server #2	n/a		
				<b>Enable Customer Experience Improvement Program (*C)</b>	No
				<b>Enable FIPS Security Mode on SDDC Manager</b>	No

License Keys		Use Keyless Licensing	License Key
<input checked="" type="checkbox"/>	ESXi License Key Defined	No	
		Licensing	
		ESXi	
		vSAN	
		vCenter Server	
		NSX	

vSphere Infrastructure		vCenter Server	Hostname	IP Address
<input checked="" type="checkbox"/>	Default Password for ESXi Hosts Defined	vCenter Server Hostname and IP Address	ram01vc01	172.16.10.21
<input checked="" type="checkbox"/>	vCenter Server Passwords Defined	<b>vCenter Server Appliance Size (Default)</b>	small	
<input checked="" type="checkbox"/>	vCenter Server - Hostname and Static IP Defined	<b>vCenter Server Appliance Storage Size</b>	default	
<input checked="" type="checkbox"/>	vCenter Datacenter and Cluster Defined			
<input checked="" type="checkbox"/>	vSphere Resource Pools Defined			
<input checked="" type="checkbox"/>	Virtual Networking Defined			
<input checked="" type="checkbox"/>	vSphere Datastores Defined			

vSphere Datastore		Value
	vSAN Datastore Name	ra-m01-cl01-ds-vsan01
	Enable vSAN Deduplication and Compression	No
	Enable vSAN-ESA	Yes
	Path to HCL JSON File	/opt/vmware/bringup/tmp/all.json

vCenter Datacenter and Cluster		Value
	Datacenter Name	ra-m01-dc01
	Cluster Name	ra-m01-cl01
	<b>Enable vLCM Cluster Image</b>	Yes
	Cluster EVC Setting	n/a

Proxy Server Configuration		Value
	Proxy Server	n/a
	Proxy Port	n/a

**Figure 18.** FIPS, vSAN-ESA, vLCM cluster image feature highlighted under the 'Deploy Parameters' tab in the parameter sheet

Figure 18 highlights the FIPS security mode, vLCM cluster image, and vSAN ESA enablement in the VMware Cloud Foundation deployment parameter sheet. Enabling vLCM Cluster Image allows the user to deploy management domain with vSphere Lifecycle Manager (vLCM) images. FIPS is disabled by default on the parameter sheet and enabling FIPS on the parameter sheet enforces FIPS onto all the SDDC components. Beginning with VMware Cloud Foundation 5.1, the management domain nodes may utilize vSAN/ESA architecture instead of vSAN/OSA. If the Management domain servers have vSAN/ESA compatible hardware, change the default setting for "Enable vSAN ESA". When ESA is enabled, cloud builder checks the ESXi hosts for ESA-compatibility. When ESA is enabled for offline installations, the vSAN HCL JSON file must be downloaded manually and uploaded to temporary folder in a cloud builder whose path is added to parameter sheet as shown in figure 18. The vSAN HCL JSON file can be downloaded from the URL, <https://partnerweb.vmware.com/service/vsan/all.json>. If internet connection is available, then cloud builder connects to VMware vSAN health server directly to fetch the HCL JSON file.

**Note**

Selecting keyless licensing in the parameter sheet leads to deploying VMware Cloud Foundation in an evaluation mode and switching to key-based licensing after the deployment is not supported. To switch to the key-based deployment, the bring-up process must be started again after deleting the vSAN partitions and re-imaging ESXi.

**vmware**

**Instructions:** Use the *Deployment Parameters* tab to input configuration details for physical infrastructure and the components used to implement the Management Domain.  
 - Grey cells are for information purposes and cannot be modified.  
 - Red cells mean the input data is either missing and mandatory or some type of validation of the input data has failed.  
 - Yellow cells indicate input data, default values are included to help illustrate the formatting to be used and align to the VMware documentation. If a value is not required enter 'n/a', if it turns red then its mandatory.

License Keys	
<input checked="" type="checkbox"/> ESXi License Key Defined	Use Keyless Licensing: No
	Licensing License Key: [Redacted]
	ESXi License Key: [Redacted]
	vSAN License Key: [Redacted]
	vCenter Server License Key: [Redacted]
	NSX License Key: [Redacted]

vSphere Infrastructure	
<input checked="" type="checkbox"/> Default Password for ESXi Hosts Defined	vCenter Server Hostname and IP Address: ram01vc01 172.16.10.21
<input checked="" type="checkbox"/> vCenter Server Passwords Defined	vCenter Server Appliance Size (Default): small
<input checked="" type="checkbox"/> vCenter Server - Hostname and Static IP Defined	vCenter Server Appliance Storage Size: default
<input checked="" type="checkbox"/> vCenter Datacenter and Cluster Defined	
<input checked="" type="checkbox"/> vSphere Resource Pools Defined	
<input checked="" type="checkbox"/> Virtual Networking Defined	
<input checked="" type="checkbox"/> vSphere Datastores Defined	

vSphere Datastore	
vSAN Datastore Name	ra-m01-cl01-ds-vsan01
Enable vSAN Deduplication and Compression	
Enable vSAN-ESA	Yes
Path to HCL JSON File	topofvmware/bringup/impl/all.json

Proxy Server Configuration	
Proxy Server	n/a
Proxy Port	n/a

vCenter Datacenter and Cluster	
Datacenter Name	ra-m01-dc01
Cluster Name	ra-m01-cl01
Enable vLCM Cluster Image	Yes
Cluster EVC Setting	n/a

Select the VCF Architecture to be deployed: Standard

Resource Pool SDDC Management	ra-m01-cl01-tp-sddc-mgmt
Resource Pool SDDC Edge	ra-m01-cl01-tp-sddc-edge
Resource Pool User Edge	ra-m01-cl01-tp-user-edge
Resource Pool User VM	ra-m01-cl01-tp-user-vm

You have selected the Standard Architecture, as a result VMware Cloud Builder will not create vSphere Resource Pools within the Management Domain

**Figure 19.** VMware Cloud Foundation architecture support highlighted in the parameter sheet

Figure 19 shows the VMware Cloud Foundation architecture type that can be deployed using the parameter sheet. VMware Cloud Foundation architecture can either be chosen as Standard or Consolidated.

With the standard architecture model, management workloads run on a dedicated management domain and other workloads in a separate virtual infrastructure (VI) workload domain. Where as in case of consolidated architecture, the management and workloads run together on a shared management domain. This consolidated environment is managed from a single vCenter Server and vSphere resource pools provide isolation between management and customer workloads.

**Edge Cluster Deployment on VCF Management Domain**

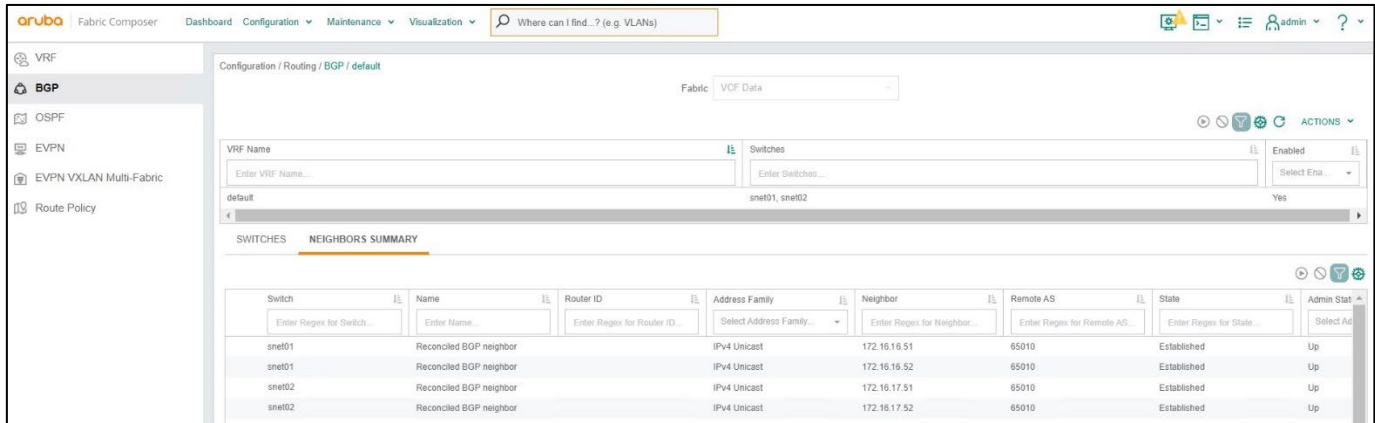
An NSX-T Edge Cluster is a logical grouping of NSX-T Edge nodes. These NSX-T Edge nodes run on a vSphere cluster and provide north-south routing and network services for the management and VI workloads. NSX-T data center supports a 2-tier routing model. At the top tier is the tier-0 logical router. Northbound, the tier-0 logical router connects to one or more physical routers or layer 3 switches and serves as a gateway to the physical infrastructure. Southbound, the tier-0 logical router connects to one or more tier-1 logical routers or directly to one or more logical switches also called segments in the NSX-T Data Center. At the bottom tier is the tier-1 logical router. Northbound, the tier-1 logical router connects to a tier-0 logical router. Southbound, connects to one or more logical switches.

BGP configuration is necessary on the top of rack network switches to deploy edge cluster and three additional VLANs need to be configured for edge cluster deployment. One VLAN for Edge TEP connectivity and the other two VLANs are configured as 'Uplinks' for NSX-T Edge nodes in VCF Management Domain. These uplinks will represent the NSX Edge VM uplinks to the Physical ToR switch for North-South communication.

VLANs configured as Edge uplinks do not have an active gateway configured. Instead, switch virtual interface IP is used for BGP peering in case of edge uplink VLANs. The Autonomous System ID of the BGP instance on the Aruba Switch is mentioned as 65001. The edge cluster deployed as part of NSX-T deployment in the VCF management domain has the BGP Autonomous System ID as 65010. Both these BGP Autonomous Systems need to establish peering to allow North-South communication.

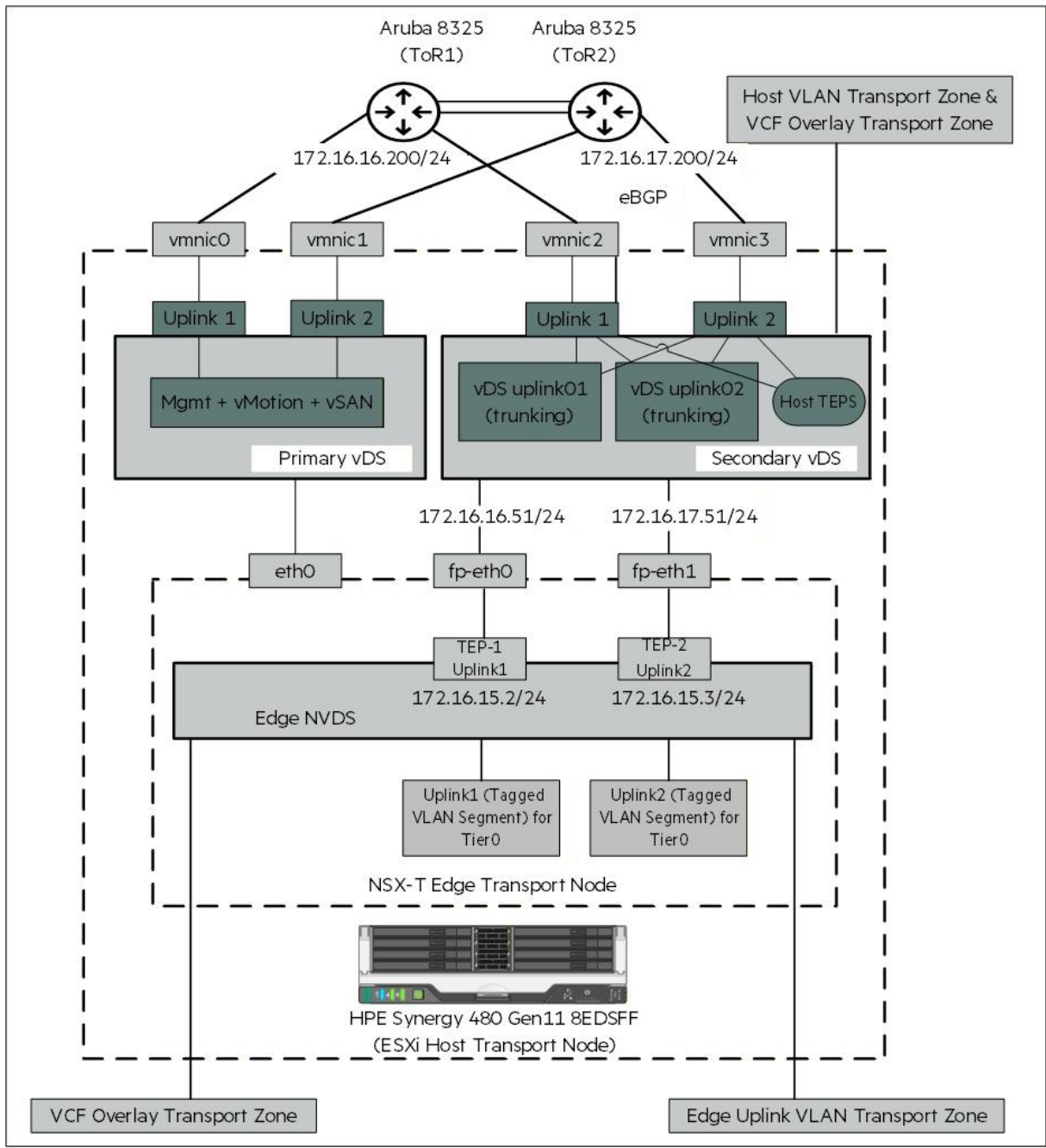
Aruba Fabric Composer configures the NSX Edge uplinks as BGP neighbors on the ToRs with neighbor Autonomous System ID 65010. Figure 20 shows the BGP configuration for VCF Management Domain NSX-T edge

cluster on 2 ToR Aruba 8325 Switches. After the edge cluster is successfully deployed, the connectivity status of peers on Aruba 8325 TORs and NSX-T edge virtual machines will show as established.



**Figure 20.** BGP peering configured between VCF management domain edge VMs and Aruba top of rack switches shown in Aruba Fabric Composer.

Figure 21 shows the BGP Peering between the NSX Edge virtual machine and Aruba Top of Rack switches. This figure represents the virtual distributed switch profile 3 of VMware Cloud Foundation which segregates the NSX Overlay traffic from management, vMotion and vSAN traffic.



**Figure 21.** BGP peering between VCF edge VMs and Aruba top of rack switches

**Note**

VLANs configured as edge uplinks do not have an active gateway configured. Instead Switch Virtual Interface IP is used for BGP peering between Aruba Top of Rack switches and NSX Edge VMs.

After edge cluster is deployed, application virtual networks can be created which are a logical software-defined network topology for management applications (e.g., VMware Aria Suite) in VMware Cloud Foundation. AVN applications can be deployed on either an overlay-backed NSX segments or VLAN-backed NSX segments in the management domain.

## Deploying HPE OneView for VMware vCenter in VMware Cloud Foundation Management domain

VMware vLCM remediation requires a Hardware Support Manager (HSM) service to facilitate firmware updates on the servers. For HPE servers, the HSM service is bundled with HPE OneView for VMware vCenter (OV4vC) which leverages the firmware repository hosted on HPE OneView. The combination of these software components facilitates the firmware upgrade on all the hosts in the cluster.

The following steps explain the deployment of HPE OneView for vCenter 11.5.

1. HPE OneView for vCenter 11.5 appliance .ova can be downloaded from <https://myenterpriselicense.hpe.com/cwp-ui/software> (Sign-in credentials using HPE Passport account is required).
2. After download, extract the downloaded zip file "HPE\_OneView\_for\_VMware\_vCenter\_11.5\_February\_2024\_Z7550-03659.zip" to a folder.
3. Before starting with the deployment, a forward and reverse DNS record has to be created for OneView for vCenter on the DNS server.
4. Log in to vCenter Server in the VMware Cloud Foundation management domain and right-click the cluster and select "Deploy OVF template" to start the deployment wizard for deploying the OneView for vCenter appliance.

Table 16 describes the details of each screen and performs the required action.

**Table 16.** Deployment wizard actions for each screen

Installation	Action needed
Select an OVF template	Select "local files" and point to extracted folder "HPE_OneView_for_VMware_vCenter_11.5_February_2024_Z7550-03659". Select the "OV4VC-11.5.0.8.ova" within the folder to deploy
Select a name and folder	Provide the HPE OneView for vCenter Virtual Machine name and chose the default folder location
Select a compute resource	Select the VCF management domain cluster as a destination compute resource for this virtual machine
Review details	Check details of the appliance
License agreement	Accept the license agreement
Select Storage	Select VM storage policy as "vSAN default Storage policy". Select VCF management domain vSAN storage in the list of storage
Select network	HPE OneView for VMware vCenter allows you to configure up to three networks. At least one network needs to be configured during deployment. Configure "Network 1" to the VCF management network during deployment. You might configure additional networks for redundancy or if the storage network is on a private network and vCenter on a public network. Configure additional networks from the Administrator Console post-deployment as needed.
Customize template	Provide IP Address, Subnet Mask, Default gateway, DNS server, and fully qualified domain name under the "Network Settings" section
Ready to Complete	Review the details for the installation and click Finish to start the installation

See the [HPE OneView for VMware vCenter Installation Guide](#) for further details about installations of HPE OneView for VMware vCenter.

1. After the HPE OneView for vCenter appliance is deployed, power on the appliance and connect to the Administrator console using the appliance's fully qualified domain name (FQDN) or IP as `https://<<ApplianceHostname/IPaddress>>`.
2. Click **Setup**. Enter a New Password for 'Admin' user and Confirm password and click OK.
3. Add management domain vCenter to HPE OneView for vCenter.
4. Add the HPE OneView for VMware vCenter certificate to VMware Cloud Foundation management domain vCenter, vSphere Client > HPE OneView for VMware vCenter > HPE OneView Service Pack Management > Add Certificate.
5. Configure the management domain vCenter certificate in the HPE OneView.
6. Validate iSUT and AMS settings for all the servers in the cluster via vCenter UI, Cluster > Configure > HPE OneView for VMware vCenter.
7. Register HPE OneView IP and Credentials within HPE OneView for the vCenter plug-in on the management domain vCenter.

### **Workload Domain Deployment on HPE Synergy**

After the VCF management domain deployment is successful, the SDDC Manager is used to bring up the VCF workload domain. Before starting the deployment of the VCF workload domain, ESXi should be installed on workload servers followed by the commissioning of hosts onto the SDDC Manager. A minimum of three servers are required to form a VCF workload domain and the workload domain storage can be either vSAN, VVols, and Fibre Channel-based VMFS\_FC.

Deployment of VMware Cloud Foundation workload domain with vSphere Lifecycle Manager of type 'Baselines' is deprecated and vSphere Lifecycle Manager of type 'Images' is the recommended method from VMware. However workload domain deployment using Baselines is still supported with VCF 5.1 to provide backward compatibility. However, to enable vSAN ESA, it is mandatory to deploy VCF workload domain with vSphere Lifecycle Manager Images option.

### **Isolated workload domain**

With VMware Cloud Foundation 5.1, each workload domain can either choose to join the management domain's vCenter Single Sign-On domain or a new vCenter Single Sign-On domain that is not used by any other workload domain making it isolated from the rest of the clusters.

### **vSAN Express Storage Architecture**

Express Storage Architecture (ESA) in vSAN is designed to provide new all-levels of efficiency, performance, and scalability. It is an alternative to Original Storage Architecture used in previous editions of vSAN. It is a single-tier architecture designed for NVMe-based platforms that provides high performance and space efficiency.

To enable vSAN ESA, it is required to use vLCM images to manage the clusters in the workload domains.

### **Deploy vSphere Lifecycle Manager Images Workload Domain on HPE Synergy**

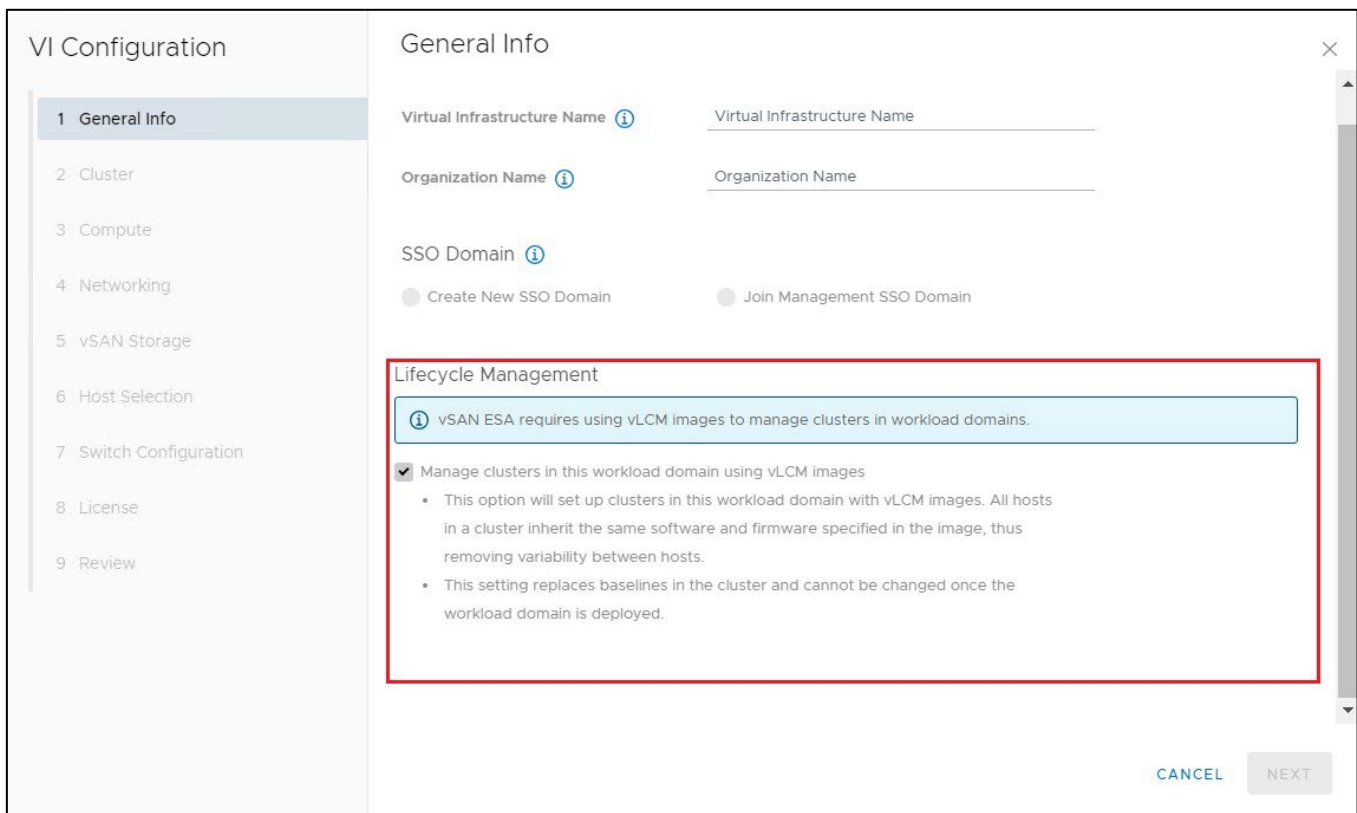
With vLCM Images based workload domain, firmware and driver updates are done using HPE OneView for VMware vCenter and VMware vSphere Lifecycle Manager. VMware vSphere Lifecycle Manager provides the functionality to upgrade and patch ESXi. VMware vSphere Lifecycle Manager along with HPE OneView Hardware Support Manager (HSM) plug-in can also perform server firmware, drivers, and software updates in the same maintenance window as the ESXi server Operating System updates. HPE OneView Hardware Support Manager (HSM) is integrated inside HPE OneView for VMware vCenter.

After enabling vSphere Lifecycle Manager Images, it is not possible to change to vSphere Lifecycle Manager (vLCM) Baselines for firmware upgrades. This section illustrates the deployment of the VMware Cloud Foundation vLCM Image based workload domain on HPE Synergy.

1. Create a new cluster image on an empty cluster from the management domain vCenter Server by composing a new image with VMware Base Image and HPE Add-on or by importing an image from existing hosts in vCenter inventory. This cluster image created is without the firmware baseline option.
2. Import the Cluster image into SDDC Manager.
3. Configure Network Pool for workload domain on SDDC Manager.
4. Commission ESXi Hosts on SDDC Manager to deploy workload creation.
5. Create a vLCM based Workload Domain using the imported cluster image.
6. Enable vSAN performance service.
7. Update Skyline Health.

During the deployment of the VCF workload domain, the Manage Clusters in this workload domain using the images option should be selected to support the deployment of vLCM Images based workload domain. If vSAN ESA is enabled, then vSphere Lifecycle Manager Images is mandatory and is chosen as a default deployment option.

Figure 22 shows the selection option for vLCM Images based workload domain deployment when vSAN ESA is enabled.

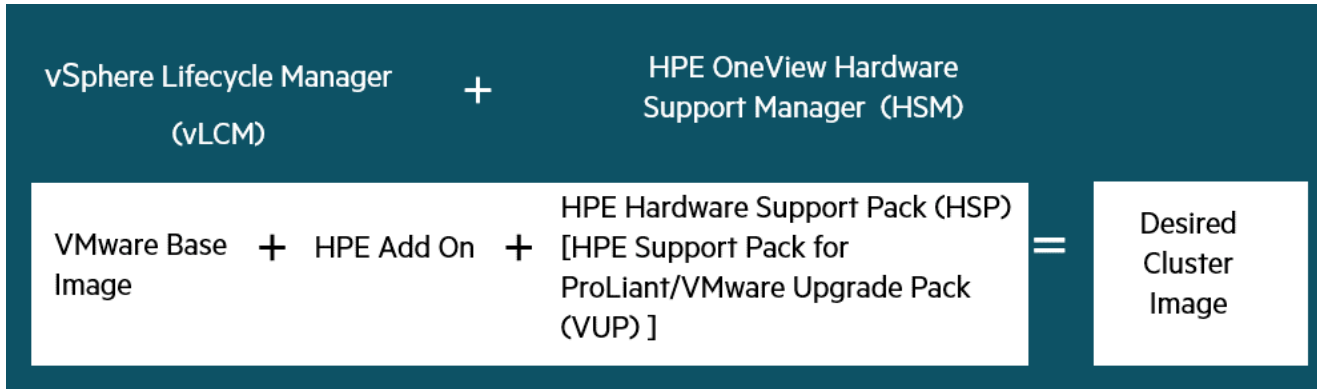


**Figure 22.** vLCM Images based workload domain option enabled during VCF workload domain deployment

## vLCM Cluster image

A vLCM image is a description of the software specification of the software, components, vendor add-on, and firmware to be applied on all hosts in vSphere clusters in VMware Cloud Foundations domains. Upgrading all hosts in the cluster using a single image helps in achieving a homogenous cluster environment and updates happen to software and firmware simultaneously and thus reducing downtime.

vLCM Cluster image components for HPE Synergy-based workload domain are as shown in Figure 23 and Figure 24. vLCM Cluster image consists of the following files as mentioned in Table 16. It is important to note the versions detailed below are relevant to VCF 5.1 and will change depending upon the VCF build versions. For detailed software and firmware versions, see the software and firmware matrix documentation at <https://www.hpe.com/psnow/doc/a50010626enw>.



**Figure 23.** vLCM Cluster Image components

Table 17 shows the vLCM image components.

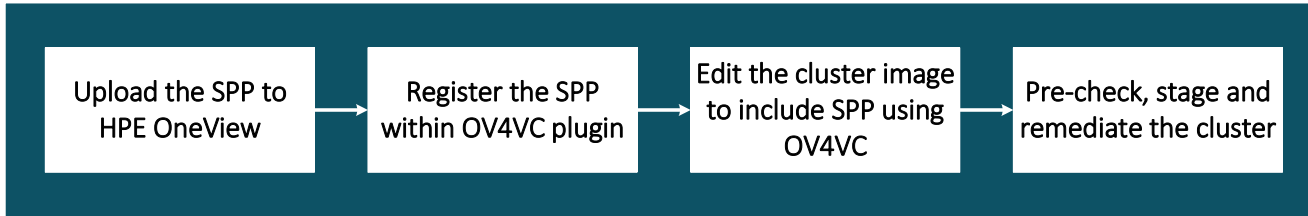
**Table 17.** vLCM image components

Name	Image file
VMware Base Image	VMware-ESXi-8.0U2-22380479-depot.zip
HPE Add-On	VMware-ESXi-8.0.2-22380479-HPE-802.0.0.11.5.5.13-Jan2024-Synergy-depot.zip
HPE Custom Synergy SPP	Synergy_Service_Pack_SSP_2024.01.02_Z7550-97746.iso

## Workflow for remediating the vSphere cluster

Updating all the hosts in the cluster using a single desired state specification of a vLCM cluster image and firmware maintains a homogeneous cluster environment and updates occur to software and firmware in a single remediation workflow and thus reducing downtime.

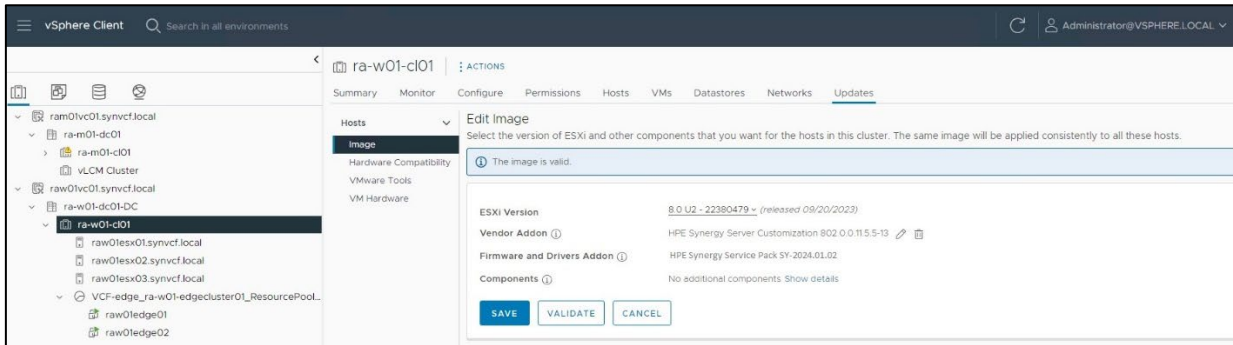
Figure 24 shows the approach for remediating the VMware Cloud Foundation cluster with the vLCM desired cluster image.



**Figure 24.** Flow diagram for vLCM based VMware Cloud Foundation workload domain remediation

Following are the overview steps to remediate the cluster with the desired cluster image. The same steps can be followed for both management and workload domain clusters:

1. Upload the Support Pack for ProLiant (SPP) package to HPE OneView.
2. Register the Uploaded package using HPE OneView for VMware vCenter plug-in in vCenter and wait for the “Sync Updates” task to complete.
3. Update the cluster image with desired components for ESXi version, Vendor Addon and Firmware and Drivers Addon. Validate and save the image.



**Figure 25.** vLCM Cluster Image components chosen in vCenter when remediating cluster

4. Pre-check, stage and remediate the VMware Cloud Foundation cluster with the new image created after adding the HPE Support Pack for ProLiant.

## Patch and upgrade VMware Cloud Foundation

SDDC Manager internally has Lifecycle Management (LCM) feature enabled, which performs automated updates on VMware Cloud Foundation components such as SDDC Manager and its internal services and VMware components such as vCenter Server, VMware ESXi™, NSX-T, and VMware Aria 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 LCM organizes the upgrade workflow to ensure components are upgraded in the proper sequence as defined by VMware.

The high-level update workflow is as follows:

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

## Offline VMware Cloud Foundation update

This section intends to describe how to upgrade your VMware Cloud Foundation system if the SDDC Manager VM does not have internet access. Offline update leverages the Bundle Transfer utility to manually download the bundles from the VMware depot on local computer with internet access and then upload them to an SDDC Manager VM to update VMware Cloud Foundation system.

### When to perform an offline update

VMware Cloud Foundation update needs to be performed only after verifying if the underlying HPE Infrastructure including drivers and firmware is compatible with the version that is going to be installed. See the HPE Synergy 480 Gen11 Server firmware and software compatibility matrix for the VMware Cloud Foundation guide at <https://www.hpe.com/psnow/doc/a50010626enw> for guidance if the VMware Cloud Foundation version is listed as compatible along with the drivers and firmware.

### ESXi cluster-level and parallel upgrades

Enables customers to update the ESXi software on multiple clusters in the management domain or a workload domain in parallel. Parallel upgrades reduce the overall time required to upgrade the VMware Cloud Foundation environment.

### 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 the workload domain.

Some upgrade bundles are cumulative. 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 the vCenter Server 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 domain, you must apply it to the management domain before applying it to the VI workload domain.

---

### Install bundle

VMware Cloud Foundation includes the following install bundles:

VI workload domain install bundle is used to deploy a new installation 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.

VMware Aria Suite Lifecycle install bundle is used for deploying Aria Suite Lifecycle Manager. For other products of Aria Suite, the installation binaries can be downloaded and managed from Aria Suite Lifecycle Manager.

### Async Patch bundle

An async patch bundle allows to apply critical patches to certain VMware Cloud Foundation components (NSX Manager, vCenter Server, and ESXi) when an update or upgrade bundle is not available.

## Async Patch Tool

The Async Patch Tool is a utility that allows application of critical patches to VMware Cloud Foundation components outside of VMware Cloud Foundation. The tool supports both offline and online mode to apply an async patch depending on whether or not the SDDC Manager appliance has internet access.

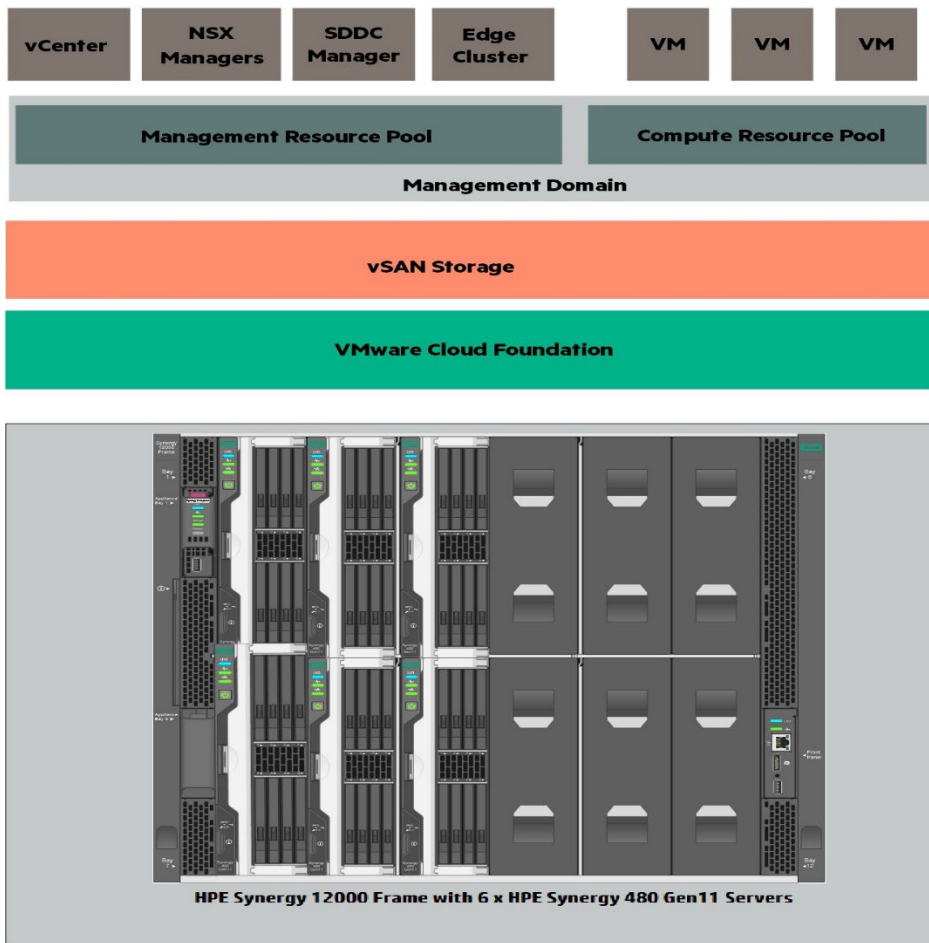
For more information on upgrading VMware Cloud Foundation, see [Upgrade VMware Cloud Foundation Software](#).

# Consolidated Architecture Deployment of VMware Cloud Foundation

VMware Cloud Foundation can be deployed as either a standard architecture model or a consolidated architecture model. In the standard architecture model, there is a dedicated management domain that hosts infrastructure virtual machines and at least one workload domain to host user workloads. It also requires a minimum of seven (7) servers, four (4) for the management domain, and three (3) for the workload domain. In the consolidated architecture model, the management and customer workload VMs are part of the same domain or cluster and consolidated architecture leverages vSphere resource pools to provide isolation between management and user workloads.

The consolidated architecture model targets smaller Cloud Foundation deployments, and special-use cases such as ROBO, SMB, or Proof of Concept. Consolidated architecture can be deployed with four (4) hosts or higher. Management and user workload VMs run together in the same vSphere cluster and the environment is managed from a single vCenter. vSphere resource pools provide isolation between the management and user workloads.

Figure 26 shows the VMware Cloud Foundation consolidated architecture deployed on HPE Synergy Frame hosting four to six compute servers.



**Figure 26.** VMware Cloud Foundation consolidated architecture deployed on HPE Synergy Frame hosting six compute servers

### Note

VMware Cloud Foundation consolidated deployment can support up to 64 hosts (to the limits of vCenter). If the number of nodes to be deployed in consolidated architecture is more than 4, then the VMware cloud-builder parameter sheet updated with correct number of ESXi servers must be converted to JSON format before uploading to the cloud-builder. To convert to JSON, refer to SoS Utility JSON Generator Options in <https://docs.vmware.com/en/VMware-Cloud-Foundation/5.1/vcf-deploy/GUID-10BA552D-FE25-4DF4-AFCA-F8A520DD881C.html>.

For more information on VMware Cloud Foundation consolidated architecture, see <https://docs.vmware.com/en/VMware-Cloud-Foundation/5.1/vcf-getting-started/GUID-C6AF75AE-569C-49F8-A15E-E9A6EF9549DA.html>.

## 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 solution built using VMware Cloud Foundation on HPE Synergy. It showcases the ability to:

- Build a VMware Cloud Foundation management domain with vSAN ESA for SDDC managed principal storage.

- Simplify deployment of vLCM VI workload domain and NSX edge cluster on VMware Cloud Foundation.
- Simplify firmware updates using HPE OneView for VMware vCenter with HSM service enabled.
- 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
- Availability of rack-scale fabric with HPE Virtual Connect
- Efficiencies in scaling fabrics across multiple frames
- Provision and manage the physical fluid resources for SDDC deployments through HPE OneView

## Appendix A: Bill of materials

### Note

Part numbers are at the 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](https://hpe.com/us/en/services/consulting.html).

**Table A1.** Bill of materials

Product	Qty	Product description
		Rack and power
P9K10A	1	HPE 42U 600mmx1200mm G2 Enterprise Shock Rack
P9K40A 001	1	HPE Factory Express Base Racking Service
H6J85A	1	HPE Rack Hardware Kit
120672-B21	1	HPE Rack Ballast Kit
BW932A	1	HPE 600mm Rack Stabilizer Kit
BW932A#B01	1	HPE 600mm Rack include with Complete System Stabilizer Kit
P9S21A	2	HPE G2 Metered/Switched 3Ph 14.4kVA/CS8365C 40A/208V Outlets (12) C13 (12) C19/Vertical NA/JP PDU
		Aruba Switches
R9F63A	2	Aruba 6300M 48-port 1GbE and 4-port SFP56 Power-to-Port 2 Fan Trays 1 PSU Bundle
R9F63A B2B	2	Aruba 6300M 48G Pwr2Prt 2F 1PS Bdl US en
R9F84A	4	Aruba 10G SFP+ to SFP+ 3m Direct Attach Copper Cable
R9G06A	2	Aruba 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable
R9F57A	2	Aruba X414 1U Universal 4-post Rack Mount Kit
R9F67A	2	Aruba 8325-32C 32-port 100G QSFP+/QSFP28 Back-to-Front 6 Fans and 2 Power Supply Bundle

Product	Qty	Product description
R9F67A B2B	2	Aruba 8325-32C 32-port 100G QSFP+/QSFP28 Back-to-Front 6 Fans and 2 Power Supply Bundle US en
721064-B21	6	HPE BladeSystem c-Class 40G QSFP+ to 4x10G SFP+ 3m Direct Attach Copper Splitter Cable
R9F77A	4	Aruba 100G QSFP28 to QSFP28 1m Direct Attach Copper Cable
R9F78A	8	Aruba 100G QSFP28 to QSFP28 5m Direct Attach Copper Cable
R9F59A	2	Aruba X474 4-post Rack Kit
		HPE Synergy Frames
P06011-B21	2	HPE Synergy 12000 Configure-to-order Frame with 10x Fans
867796-B21	2	HPE Virtual Connect SE 100Gb F32 Module for Synergy
867793-B21	2	HPE Synergy 50Gb Interconnect Link Module
755985-B21	4	HPE Synergy 12Gb SAS Connection Module with 12 Internal Ports
876259-B21	4	HPE Virtual Connect SE 32Gb Fibre Channel Module for Synergy
798096-B21	2	HPE 6x 2650W Performance Hot Plug Titanium Plus FIO Power Supply Kit
872957-B21	2	HPE Synergy Composer2 Management Appliance
876852-B21	4	HPE Synergy 4-port Frame Link Module
804943-B21	1	HPE Synergy Frame 4x Lift Handles
859493-B21	1	HPE Synergy Multi Frame Master1 FIO
876689-B21	4	HPE Synergy 300Gb Interconnect Link 3m Active Optical Cable
P39531-B21	16	HPE Synergy 480 Gen11 Configure-to-order Compute Module
P49607-B21	32	HPE Synergy 480Gen11 Intel Xeon-Platinum 8480+ 2.0GHz 56-core 350W Processor for HPE
P50312-B21	512	HPE 64GB (1x64GB) Dual Rank x4 DDR5-4800 CAS-40-39-39 EC8 Registered Smart Memory Kit
P01367-B21	16	HPE 96W Smart Storage Battery (up to 20 Devices) with 260mm Cable Kit
P44843-001	16	HPE NS204i-d Gen11 Boot Controller
P02424-B21	16	HPE Synergy 6820C 25/50Gb Converged Network Adapter
777456-B21	16	HPE Synergy 5830C 32Gb Fibre Channel Host Bus Adapter
845406-B21	10	HPE 100Gb QSFP28 to QSFP28 3m Direct-Attach Copper Cable
721064-B21	6	HPE BladeSystem c-Class 40G QSFP+ to 4x10G SFP+ 3m Direct-Attach Copper Splitter Cable
487655-B21	4	HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 3m Direct-Attach Copper Cable
R3P67AAE	2	HPE Synergy 32Gb Fibre Channel Upgrade E-LTU
		Storage
P61191-B21	128	HPE 3.2TB NVMe Gen5 High Performance Mixed Use E3S EC1 EDSFF SPDM CM7 SSD
P39593-B21	16	HPE Synergy 480 Gen11 8EDSFF NVMe E3.S Direct Connect Drive Cage Kit

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**Note**

The above BOM contains US localization (ABA is for the US), customers must choose a localization option based on the deployment location.

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# Urls for Firmware, Software, and Documentation

## Rack and power links

- HPE G2 Metered and Switches Power Distribution Unit, <https://buy.hpe.com/us/en/rack-power-infrastructure/power-distribution/power-distribution-units/c/3446292>
- HPE Rack and Power Infrastructure, <https://www.hpe.com/us/en/integrated-systems/rack-power-cooling.html>

## Network links

- Networking documentation page, <https://networkingsupport.hpe.com/>
- Aruba 6300 Switch documentation page, <https://www.arubanetworks.com/products/switches/6300-series/>
- Aruba 8325 Switch documentation page, <https://www.arubanetworks.com/products/switches/core-and-data-center/8325-series/>

## Servers links

- HPE Synergy, <https://www.hpe.com/us/en/integrated-systems/synergy.html>
- HPE Synergy Composer, <https://www.hpe.com/us/en/product-catalog/synergy/synergy-management.hits-12.html>
- HPE Synergy 480 Gen11, <https://buy.hpe.com/in/en/synergy/synergy-compute/synergy-compute-modules/synergy-compute-modules/hpe-synergy-480-gen11-compute-module/p/1014705721>
- HPE Synergy Fabric, <https://www.hpe.com/us/en/product-catalog/synergy/synergy-fabric.hits-12.html>

## Software links

- HPE Synergy software release, [https://techhub.hpe.com/us/en/enterprise/docs/index.aspx?doc=eginfo/lib/synergy/sw\\_release\\_info/index.html](https://techhub.hpe.com/us/en/enterprise/docs/index.aspx?doc=eginfo/lib/synergy/sw_release_info/index.html)
- HPE OneView
  - Software, [https://support.hpe.com/hpesc/public/swd/detail?swItemId=MTX\\_2d6946d609c64273b91dc1f861](https://support.hpe.com/hpesc/public/swd/detail?swItemId=MTX_2d6946d609c64273b91dc1f861)
  - License Portal, <https://myenterpriselicense.hpe.com/cwp-ui/software>
  - OneView Installation Guide, [https://support.hpe.com/hpesc/public/docDisplay?docId=sd00003666en\\_us](https://support.hpe.com/hpesc/public/docDisplay?docId=sd00003666en_us)
- HPE OneView Partner Integrations, <http://www.hpe.com/info/ovpartners>
- HPE OneView Update Readiness Checker, <https://www.hpe.com/support/ov-urc>
- HPE VMware OEM Software Delivery Repository, <http://vibsdepot.hpe.com>
- HPE OEM customized VMware image downloads, <https://www.hpe.com/us/en/servers/hpe-esxi.html>
- HPE OneView for VMware vCenter Release Notes, [https://support.hpe.com/hpesc/public/docDisplay?docId=sd00004010en\\_us&docLocale=en\\_US](https://support.hpe.com/hpesc/public/docDisplay?docId=sd00004010en_us&docLocale=en_US)

## **VMware links**

- VMware Cloud Foundation 5.1, <https://docs.vmware.com/en/VMware-Cloud-Foundation/5.1/rn/vmware-cloud-foundation-51-release-notes/index.html>
- VMware Cloud Foundation Planning and Preparation Guide, <https://docs.vmware.com/en/VMware-Cloud-Foundation/index.html>
- VMware product patch find by release name, <https://my.vmware.com/group/vmware/patch#search>

# Resources and additional links

VMware Cloud Foundation 5.1, <https://docs.vmware.com/en/VMware-Cloud-Foundation/5.1/rn/vmware-cloud-foundation-51-release-notes/index.html>

HPE Synergy Firmware and Software Compatibility Matrix for VMware Cloud Foundation 5.1  
<https://www.hpe.com/psnow/doc/a50010626enw>

HPE Reference Architecture, <https://www.hpe.com/docs/reference-architecture>

HPE Synergy, <https://hpe.com/servers>

HPE Storage, [hpe.com/storage](https://hpe.com/storage)

HPE Networking, [hpe.com/networking](https://hpe.com/networking)

HPE Aruba Fabric Composer, <https://www.arubanetworks.com/en-in/products/switches/core-and-data-center/fabric-composer/>

HPE and VMware, [hpe.com/partners/vmware](https://hpe.com/partners/vmware)

HPE Enterprise Support Center, <https://support.hpe.com/hpesc/public/home>

HPE GreenLake Advisory and Professional Services, [hpe.com/us/en/services/consulting.html](https://hpe.com/us/en/services/consulting.html)

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