HPE Reference Architecture for HPE Morpheus VM Essentials Software

HPE ProLiant Servers and HPE Alletra Storage MP B10000-Fibre Channel

Contents

Executive summary

HPE Morpheus VM Essentials is a unique software offering which provides highly-available HPE Morpheus VM Essentials hypervisor (HVM) clusters based on KVM, while also providing the ability to connect to existing VMware vCenter clusters for unified management of VM workloads. The solution provides per-socket pricing, brownfield VM discovery, and a simple VM-as-a-service provisioning interface into both HPE Morpheus VM Essentials and VMware hosts. Available as standalone software or as an embedded option within HPE Private Cloud offerings, this enterprise-grade solution is supported by HPE's global support organization.

Built on the same KVM foundation that powers the world's leading hyperscale clouds, the HPE Morpheus VM Essentials hypervisor extends its capabilities with advanced cluster management features such as intelligent resource-based placement, host-to-host live migration, high availability, hot resize and reconfiguration, security hardening, and integrated data protection. In the event of a host failure within an HPE Morpheus VM Essentials (HVM) cluster, virtual machines are automatically restarted on another available host, ensuring continuous availability and minimal service disruption.

To enable flexibility for those continuing to use VMware by Broadcom-based clusters, HPE Morpheus VM Essentials manager software will also connect to existing VMware vSphere clusters for customers who want to simplify management and provisioning of instances into both VMware ESXi and HPE Morpheus VM Essentials hosts (HVM hosts) from one unified solution. In addition to a simple VM provisioning catalog, HPE Morpheus VM Essentials manager also includes integration into external IPAM and DNS solutions, secure key management, automation execution, built-in data protection, and basic VMware ESXi-to-HPE Morpheus VM Essentials image format conversion.

Lastly, HPE Morpheus VM Essentials software offers an upgrade path to the full HPE Morpheus Enterprise software platform for expanded hybrid cloud management including connectivity into dozens of on-prem and public clouds, Kubernetes cluster management, governance policy enforcement, and FinOps capabilities for optimization, metering, and reporting.

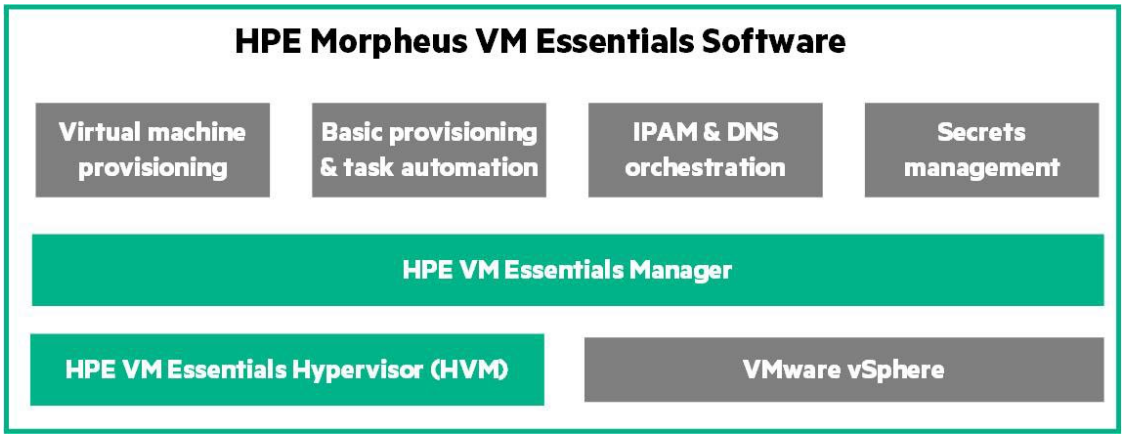


Figure 1. HPE Morpheus VM Essentials capability diagram

HPE Morpheus VM Essentials hypervisor features

1. HPE Validated Hardware: HPE Morpheus VM Essentials Software has been validated on a wide range of HPE ProLiant Gen10 Plus, Gen11, Gen12, and HPE Synergy 480 Gen11 and Gen12 servers to ensure an optimal, high-performance and fully compatible deployment experience.

2. Support for select third-party hardware is also available. For the complete, up-to-date list of supported hardware, refer to the Compatibility Matrix for HPE Morpheus VM Essentials Software on the HPE Support Portal.
3. **VM Live Migration:** Migrate a running VM Essentials virtual machine from one host to another within the same cluster with zero downtime.
4. **VM High Availability:** Automatically restart VM Essentials virtual machines on another host in the same cluster in the event of an unexpected host failure within the cluster.
5. **Dynamic Workload Scheduler:** Dynamically schedule the placement of VM Essentials virtual machines within a cluster based upon optimal workload distribution across the cluster.
6. **Storage Migration:** Migrate the virtual disk(s) of a running VM Essentials virtual machine from one storage datastore to another with zero downtime.
7. **VMware VM Conversion:** Convert existing VMware virtual machines to the HVM hypervisor using the native conversion feature within the VM Essentials solution.
8. **Native Data Protection:** Backup and restore VM Essentials virtual machines using the solution's native data protection feature.
9. **Virtual Machine Snapshots:** Create, revert and delete snapshots for VMware and VM Essentials virtual machines.
10. **External Storage Support:** The HVM hypervisor supports running virtual machines on external storage via iSCSI, NFS, and Fibre Channel. For this release of the Reference Architecture, only external storage with Fibre Channel has been validated.

Key features of HPE Morpheus VM Essentials Software for VMware and VM Essentials

- **Multi-Hypervisor Support:** VM Essentials enables simple provisioning and management of VM Essentials virtual machines as well as VMware virtual machines.
- **Centralized Identity & Single Sign-On (SSO):** Enable external user authentication using Active Directory (AD) or LDAP. Enable single sign-on with Okta, OneLogin, Azure AD, or SAML.
- **IPAM Integration:** Integrate with external IPAM providers (Infoblox, phpIPAM, BlueCat, SolarWinds) to automate the reservation of an IP address for the virtual machine during the provisioning process.
- **DNS Integration:** Integrate with external DNS providers (Infoblox, Microsoft DNS, BlueCat, SolarWinds) to automate the creation of DNS records for a virtual machine during the provisioning process.
- **Provisioning Automation:** Execute Bash or PowerShell scripts during virtual machine provisioning to automate system bootstrapping operations.
- **Day 2 Automation:** VM Essentials supports the execution of Bash and PowerShell scripts on provisioned and discovered virtual machines.
- **Secrets Management:** Securely store and retrieve secrets from Cypher, the native secrets manager for use with the embedded Bash and Powershell task automation feature.
- **HTML 5 Virtual Machine Console:** Access the console of VM Essentials virtual machines and VMware virtual machines via the HTML5 VM console.

Target audience: This document is intended for IT decision makers as well as architects, system engineers, partners, and system administrators who want to understand the capabilities of enterprise-ready VMaaS solutions

using the HPE ProLiant DL Servers and HPE Morpheus VM Essentials software. The reader should be well-versed with virtualization, enterprise networking, storage, and HPE ProLiant DL Servers. For assistance with the deployment of HPE ProLiant DL Servers with VM Essentials, contact your Hewlett Packard Enterprise Representative or channel partner.

Document purpose: The purpose of this document is to demonstrate the capabilities of HPE Morpheus VM Essentials Software as an enterprise-ready hybrid cloud solution by leveraging the combined value of VM Essentials, HPE ProLiant DL servers, and the HPE Alletra Storage MP B10000. This integrated stack provides a flexible, scalable, and easy-to-deploy infrastructure suitable for both general-purpose and mission-critical workloads. It offers guidance and best practices for deploying VM Essentials on HPE ProLiant DL servers with the HPE Alletra Storage MP B10000 Fibre Channel array in a greenfield environment. While this document provides a recommended deployment approach, it is not intended to represent the only supported scenario or address all possible customer use cases and environments. This Reference Architecture describes solution testing performed in Jan 2026.

Introduction

Organizations are increasingly seeking ways to simplify virtualization management, reduce costs, and futureproof their IT infrastructure as they move toward hybrid cloud operating models. Traditional hypervisors like VMware have long dominated the virtualization landscape but come with rising costs and limited flexibility in hybrid environments. There is a growing need for a modern, cost-effective, and integrated platform that can manage existing VMware environments while enabling a seamless transition to open, cloud-ready architectures.

HPE Morpheus VM Essentials Software is designed to address these needs by offering a unified solution that supports both VMware and HPE's native KVM-based virtualization stack. It provides enterprises with a simplified, flexible, and enterprise-grade foundation to manage and scale their virtual workloads—on-premises or across hybrid cloud environments.

VM Essentials empowers organizations to efficiently manage and modernize their virtual infrastructure through four core pillars:

Integrated management of VMware and HPE native KVM Workloads

With VM Essentials, customers can continue managing existing VMware workloads while gradually re-platforming to HPE's native KVM-based hypervisor. This dual-stack approach provides a consistent and intuitive management experience, enabling VM provisioning, lifecycle management, and automation across both VMware ESXi and HPE KVM environments—all from a unified interface.

Cost optimization with a Built-in KVM Hypervisor

VM Essentials includes a powerful, built-in KVM-based hypervisor that delivers essential enterprise-grade features such as:

— Support for GFS2, NFS, iSCSI, and Fibre Channel storage

— Distributed workload placement

— VM high availability and live migration

— Integrated data protection

— Image conversion from VMware to KVM

This helps customers significantly reduce licensing costs while maintaining the performance, scalability, and resiliency required for production workloads.

Futureproof architecture with flexible deployment options and Enterprise-Grade support

HPE Morpheus VM Essentials Software is offered as both a standalone software solution and as part of HPE Private Cloud offerings, starting with HPE Private Cloud Business Edition. It also provides a seamless upgrade path to the HPE Morpheus Enterprise Software, enabling advanced hybrid cloud management, governance, and FinOps capabilities. By enabling a progressive transition strategy, customers can modernize at their own pace while avoiding vendor lock-in. This flexibility allows customers to scale and evolve their virtualization strategy as their business evolves.

Lower risk with Enterprise-Grade support and ecosystem integration

Built on a proven KVM foundation, VM Essentials is backed by HPE enterprise-class global support to ensure consistent performance and reduce operational risk. HPE is also working closely with its ecosystem of Independent Software Vendors (ISVs) to expand certification and compatibility for key enterprise workloads such as Data Protection, Virtual Desktop Infrastructure (VDI), Enterprise Resource Planning (ERP) systems, and more—ensuring a reliable and supported platform across a wide range of applications. Existing Independent Software Vendors (ISVs) support matrix can be found in the compatibility matrix https://www.hpe.com/support/VME-Compatibility-Matrix.

HPE Morpheus VM Essentials solution overview

This Reference Architecture demonstrates best practices and typical deployment for supportability for customers building a cloud solution in an enterprise data center and deploying applications in an automated manner. The solution design is based on HPE Morpheus VM Essentials on HPE ProLiant DL Servers connected to HPE Alletra Storage MP B10000 Fibre Channel storage. VM Essentials, comprising of HPE Morpheus VM Essentials (HVM) hypervisor and HPE Morpheus VM Essentials manager, provides a unified platform for managing both HPE Morpheus VM Essentials (HVM) cluster and VMware-based environments.

This Reference Architecture demonstrates the following supported components for HPE Morpheus VM Essentials Software:

- **HPE Servers** - HPE ProLiant and HPE Synergy servers listed in the compatibility matrix https://www.hpe.com/support/VME-Compatibility-Matrix.
- **HPE Storage** –The HPE Alletra Storage MP B10000 is configured as principal block storage for the HPE ProLiant DL servers over Fibre Channel.
- **HPE Networking** – HPE Aruba 8325 (Top of Rack) and Aruba 6300 (Management) switches connecting the HPE ProLiant DL servers and HPE Alletra Storage MP B10000.
- **HPE SAN Switches** - HPE Storage Fibre Channel B-series SN6700B switches connecting the HPE ProLiant DL servers and HPE Alletra Storage MP B10000 for SAN traffic.

HPE Morpheus VM Essentials Manager - Enables the HPE Morpheus VM Essentials administrator to easily manage array storage, datastores, and virtual machines.

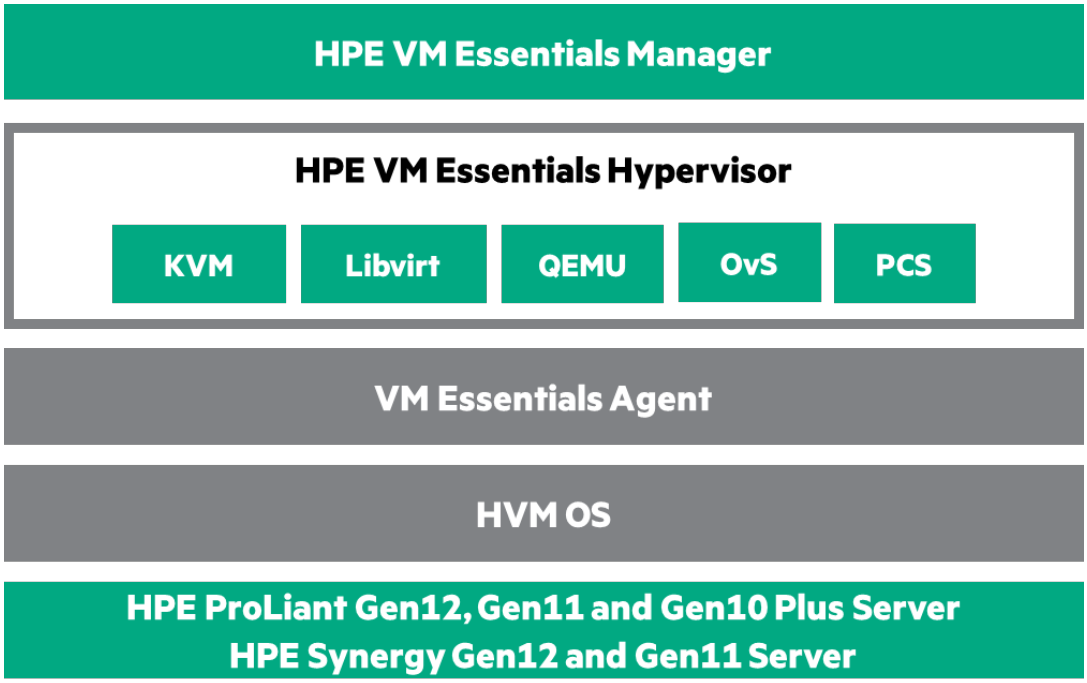


Figure 2. Diagram layout showcasing the HPE Morpheus VM Essentials solution stack

Rack Layout Overview

The rack diagram that form the solution is shown in the following figure 3:

Aruba networking switches, SAN switches, rack units reserved for cable management, HPE Alletra storage controllers with expansion shelves, and an HPE three ProLiant DL servers that run the Morpheus HVM cluster.

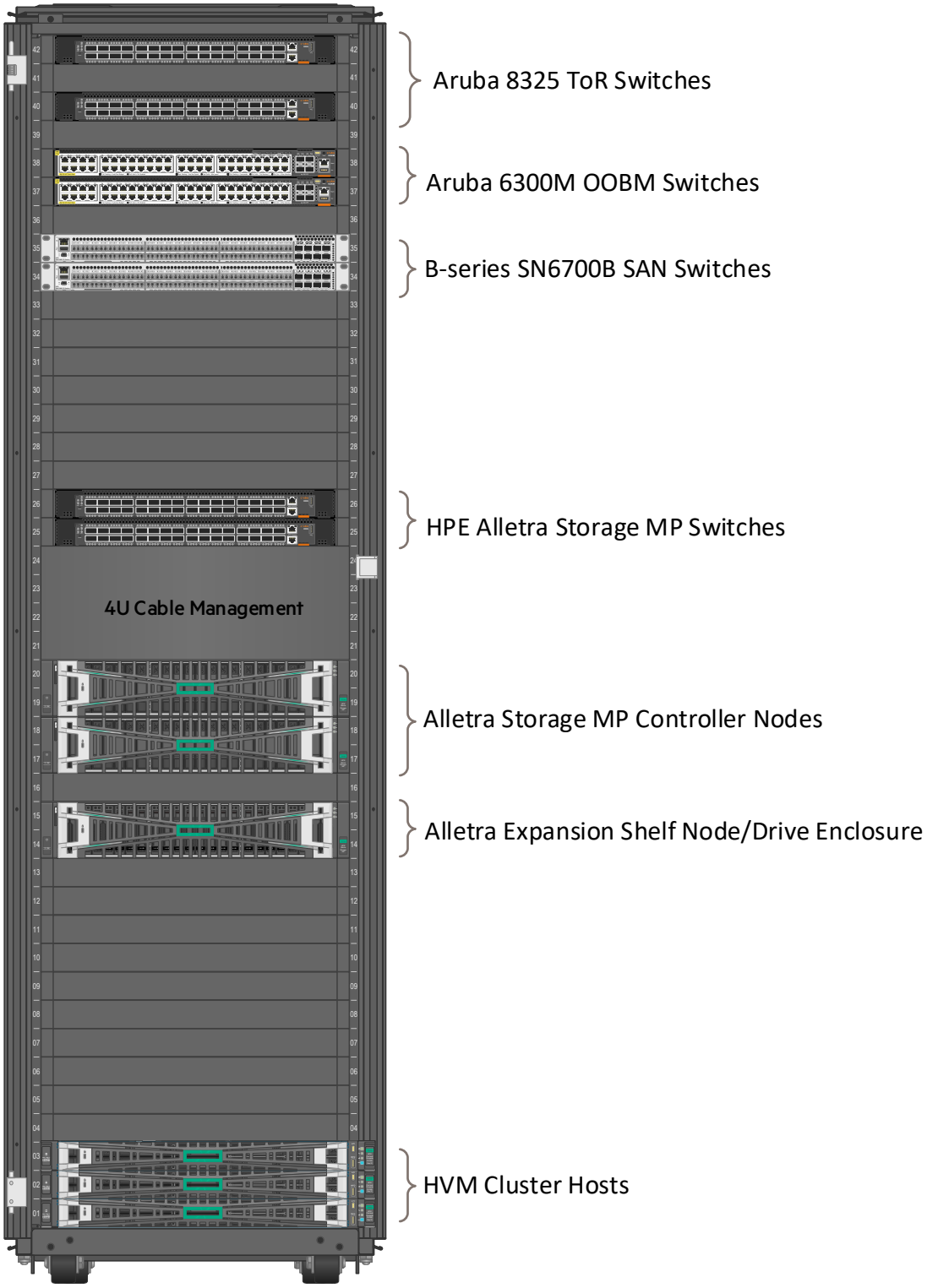


Figure 3. Overview of Hewlett Packard Enterprise VM Essentials Rack

HPE Morpheus VM Essentials Software solution components

HPE Morpheus VM Essentials and HPE Virtualization hypervisor (HVM hypervisor) is validated on the HPE ProLiant DL Servers and is tested with the hardware and software components listed in the following sections.

Collateral documentation can be found at https://www.hpe.com/us/en/hpe-vm-essentials.html.

Software

The logical architecture of the validated VM Essentials stack comprises the following components:

HPE Morpheus VM Essentials Manager

The VM Essentials Manager provides KVM clustering, identity management, virtual machine provisioning, monitoring, and logging. The HPE Morpheus VM Essentials Manager will be downloaded from the HPE Software center and installed as a pre-packaged virtual appliance. It is installed as a KVM-based virtual machine on any single host which will be part of the cluster. The manager itself is running on an Ubuntu 24.04 HVM host and can be installed in one of three pre-defined sizes as following:

— **Small**: 2 vCPUs and 12 GB RAM (Manages a maximum of 1 HPE Morpheus VM Essentials (HVM) cluster)

— **Medium**: 4 vCPUs and 16 GB RAM (Manages a maximum of 3 HVM clusters)

— **Large**: 4 vCPUs and 32 GB RAM (Manages a maximum of 10 HVM clusters)

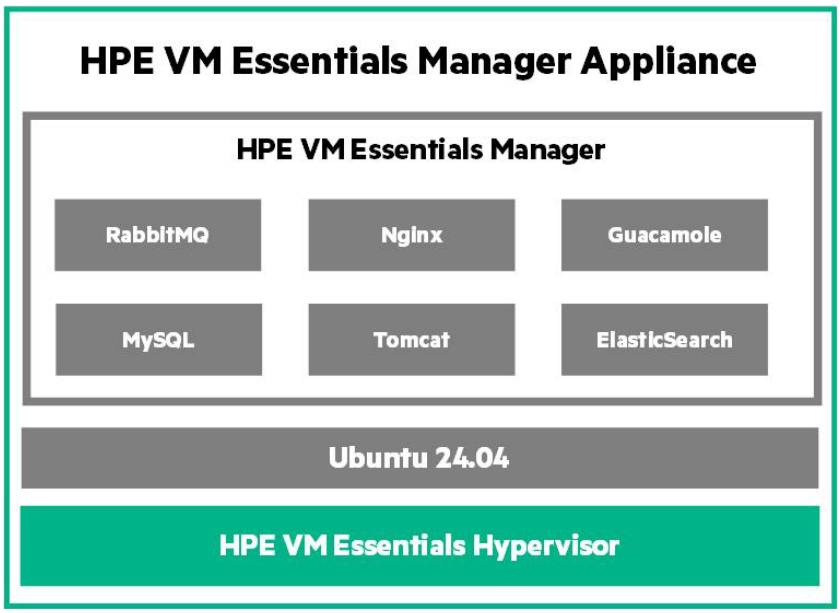


Figure 4. HPE Morpheus VM Essentials Manager layout diagram

HPE Morpheus VM Essentials Hypervisor

HVM hypervisor is a KVM-based hypervisor hosting virtual machines being managed by the VM Essentials Manager.

— **CPU**: One or more 64-bit x86 CPUs, 1.5 GHz minimum with Intel VT or AMD-V enabled.

— **Memory**: 8 GB minimum.

— **Disk Space**: For the Ubuntu 24.04 operating system, a minimum of 50 GB disk space is required, with at least 15 GB specifically allocated to the OS partition. The virtual image datastore must maintain at least 20% usable free space to avoid automatic deletion of older images. Clusters can be configured with external storage options such as iSCSI, Fibre Channel, or NFS.

— **Network Connectivity**: HVM Hypervisor hosts must be assigned static IP addresses. They also need DNS resolution for VM Essentials Manager and Internet access to download and install system packages for VM Essentials dependencies, such as KVM, Open vSwitch (OVS), and more.

- HVM clusters require a minimum of three hypervisor hosts when using Fibre Channel as the primary storage protocol. In this solution, each host is provisioned with block storage via LUNs from the HPE Alletra Storage MP B10000 array over FC connectivity.

The following network ports are being used for communication in the VM Essentials solution between components.

Table 1. HPE Morpheus VM Essentials Software Network Communication Ports

Description	Source	Destination	Port	Protocol
Morpheus Agent communication with the Morpheus appliance	HPE Morpheus VM Essentials Hypervisor Host	HPE Morpheus VM Essentials Manager	443	TCP
HPE Morpheus VM Essentials Hypervisor host configuration and management	HPE Morpheus VM Essentials Manager	HPE Morpheus VM Essentials Hypervisor Host	22, 5900	TCP
HPE Morpheus VM Essentials Hypervisor interhost communication for clustered deployment	HPE Morpheus VM Essentials Hypervisor Host	HPE Morpheus VM Essentials Hypervisor Host	22, 2224,3121, 5403, 5404, 9929, 21064	TCP
HPE Morpheus VM Essentials Hypervisor interhost communication for clustered deployment	HPE Morpheus VM Essentials Hypervisor Host	HPE Morpheus VM Essentials Hypervisor Host	5405, 9929	UDP
Morpheus server SSH access for deployed virtual machines	HPE Morpheus VM Essentials Manager	HPE Morpheus VM Essentials Hypervisor-hosted virtual machines	22	TCP
Morpheus server/ WinRM (HTTP) access for deployed virtual machines	HPE Morpheus VM Essentials Manager	HPE Morpheus VM Essentials Hypervisor-hosted virtual machines	5985	TCP
Morpheus server WinRM (HTTPS) access for deployed virtual machines	HPE Morpheus VM Essentials Manager	HPE Morpheus VM Essentials Hypervisor-hosted virtual machines	5986	TCP

Morpheus Agent

The software that runs on each HVM hypervisor host and collects system stats, logs, and executes operations received from the VM Essentials Manager.

HVM Unified Operating system

Utilizing the HVM operating system Install ISO to install the base HVM Host operating system is especially useful for disconnected sites (dark sites) without access to the Internet. This ISO contains Ubuntu 24.04 minimal pre-patched and including required kvm, ceph, and hpe-vm packages. When these packages are not present, the installer will attempt to download them from the Internet, which may not be available in all environments. By installing HVM operating system, you will only need to provide a few assets from My HPE Software Center to your HVM Hosts and will not need Internet access to pull down other required packages.

The installation of the base HVM unified ISO operating system is a prerequisite for deploying the HVM hypervisor. HVM unified ISO can be installed on local disks in the HPE ProLiant servers. A minimum of 50 GB disk space is required for the installation. During the HVM OS installation with LVM (Logical Volume Manager), the installer does not automatically allocate all available disk space. Ensure that the full disk space is manually allocated during the root OS disk partitioning step.

HPE Service Pack for ProLiant

The HPE Service Pack for ProLiant (SPP) is a collection of software, firmware and drivers for HPE ProLiant servers. It's delivered as an ISO image that can be used to update the firmware and systems software on HPE ProLiant servers.

Hardware

This section will discuss the hardware components used in the Reference Architecture.

- **HPE Servers** - HPE ProLiant DL360 Gen12 server with 100Gb 2-port ethernet network adapters and 32Gb 2-port host bus adapters as HVM hypervisor hosts.
- **HPE Storage** – The HPE Alletra Storage MP B10000 is configured as principal block storage for the HPE ProLiant DL servers over Fibre Channel.

HPE Networking – HPE Aruba 8325 and Aruba 6300 switches connecting the HPE ProLiant DL servers production traffic and management traffic respectively.

HPE Aruba MP Switches - With the HPE Alletra Storage MP B10000, Aruba MP switches serve as the high-performance storage fabric backbone, enabling robust connectivity between HPE servers and storage controller nodes, as well as between controller nodes and disk enclosures. For smaller deployments or limited node scalability, the HPE Alletra Storage MP B10000 also supports switchless configurations through direct-attached connections, making it suitable for test environments or small-scale production setups.

HPE SAN - HPE Storage Fibre Channel B-series SN6700B switches connecting the HPE ProLiant DL servers and HPE Alletra Storage MP B10000 for SAN traffic.

HPE ProLiant DL360 Gen12 server

The HPE ProLiant Compute DL360 Gen12 is a highly versatile and resilient 1U, 2-socket server designed for enterprise and hybrid cloud environments. Powered by Intel® Xeon® 6 processors with up to 144 cores and up to 8 TB of DDR5 memory operating at speeds up to 6400 MT/s, it delivers strong performance and scalability. The system supports flexible front storage configurations, including LFF, SFF, and E3.S NVMe drives, along with front-mounted OCP networking and RAID 1 OS boot options optimized for airflow.

Built with an intelligent architecture, the DL360 Gen12 features a multi-purpose front cage for scalable storage and networking, intelligent leak detection for liquid cooling technologies, and a Smart Chassis design to accommodate high-power CPUs and high-bandwidth networking. These capabilities improve thermal efficiency and make the DL360 Gen12 well suited for modern enterprise workloads.

Front view

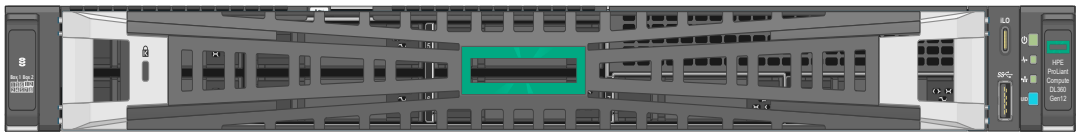


Figure 5. Front view of HPE ProLiant DL360 Gen12 Server

Rear view

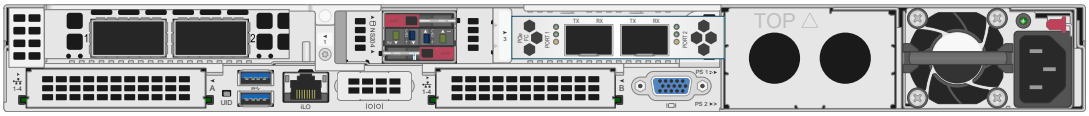


Figure 6. Rear view of HPE ProLiant DL360 Gen12 Server

HPE Alletra Storage MP B10000

HPE Alletra Storage MP B10000 is a unique, software-defined, scale-out data system that consolidates a high-performance all-flash object storage service, exabyte-scale capacity, and easy management for data intensive initiatives like data lakes, digital repositories, and backup with flash-accelerated recovery. The HPE Alletra Storage MP takes advantage of the industry's first disaggregated multi-protocol architecture, which makes it possible for you to scale from terabytes to exabytes on the same hardware. Cost savings are provided through the ability to efficiently scale capacity and performance independently.

It is a software-defined, multi-protocol storage platform that provides flexibility and high performance for both structured and unstructured data storage needs. It consists of standardized, composable building blocks - compute (node), capacity (JBOF), and switches that can be configured for different software-defined storage personas and use cases. This enables you to uniquely deploy block, file or object workloads on common hardware and manage everything with a unified cloud experience through the GreenLake cloud.

Figure 7 shows the front view of HPE Alletra Storage MP B10000.

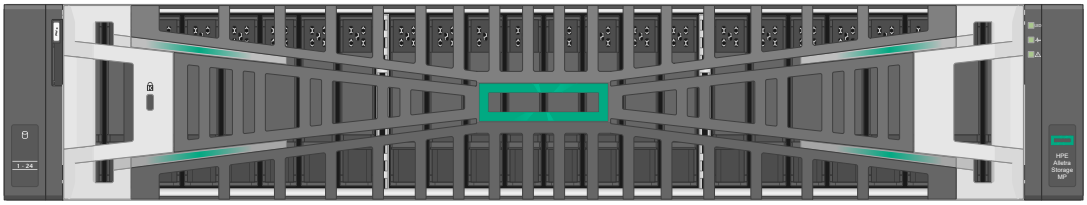


Figure 7. Front view of HPE Alletra Storage MP B10000 Storage

Figure 8 shows the rear view of HPE Alletra Storage MP B10000.

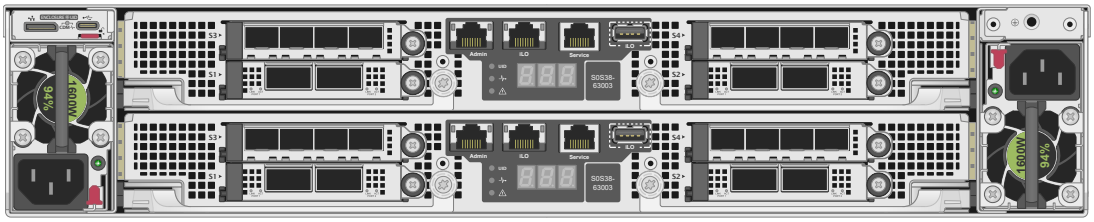


Figure 8. Rear view of HPE Alletra Storage MP B10000 Storage

HPE Alletra Storage MP B10000 Drive Enclosure

HPE Alletra Storage MP B10000 Drive Enclosures help extend the storage capacity of the storage array. Each enclosure contains multiple slots for either small or large form factor drives. Drive enclosures also contain Input/Output modules (cards), and a pair of PCMs (power-cooling modules) for redundant power and cooling of the enclosure.

Front View

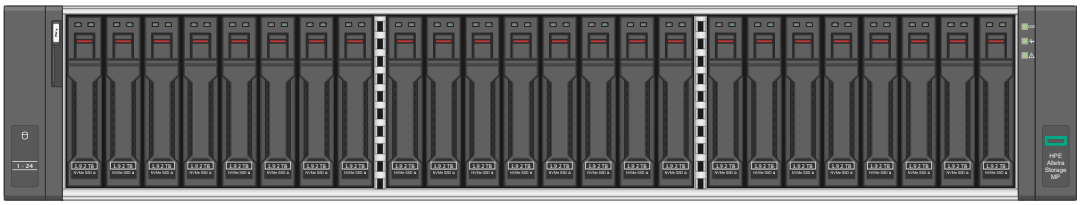


Figure 9. Front View of HPE Alletra Storage MP Drive Enclosure

Rear View

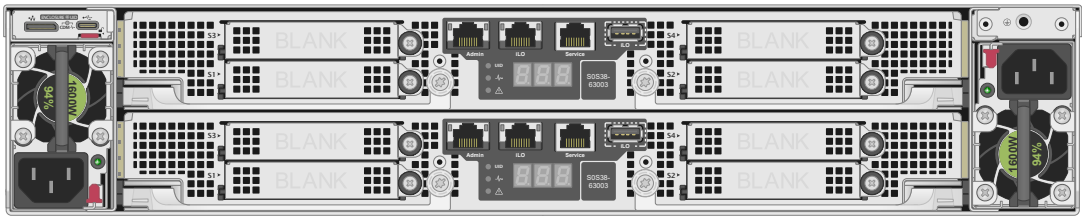


Figure 10. Rear view of HPE Alletra Storage MP

HPE Alletra Storage MP Switches

HPE Alletra Storage MP B10000 family of storage arrays support both switched and switchless architecture. For the purpose of this reference architecture, a switched storage array was used which is supported by HPE Alletra Storage MP Switches. These switches are used to connect HPE Alletra Storage MP B10000 controller nodes with disk enclosures and help with easy expansion of the storage capacity.

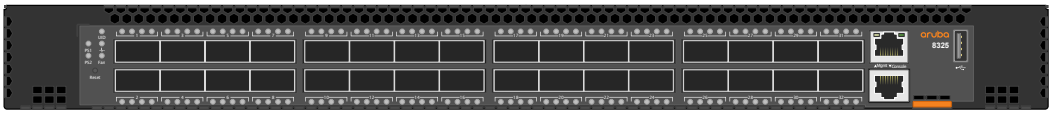


Figure 11. HPE Alletra Storage MP Switches

HPE B-series SN6700B SAN Switches

The HPE Storage Fibre Channel Switch B-series SN6700B is a high-performance, ultra-dense, highly scalable, and easy-to-use enterprise-class storage networking switch delivering Gen7 64Gb Fibre Channel (FC) capabilities. It is designed to support data growth, demanding workloads, and data center consolidation in small to large scale enterprise infrastructures. Delivering 64Gb performance, customized high port density, and integrated network sensors, it accelerates data access, adapts to evolving requirements, and drives 24x7 businesses.

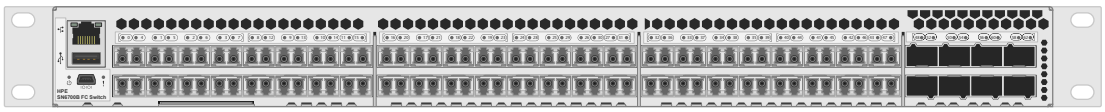


Figure 12. HPE Storage Fibre Channel SN6700B Switch

HPE Aruba 8325 Top of Rack Switches

The Aruba 8325 Switches 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). The Aruba 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.

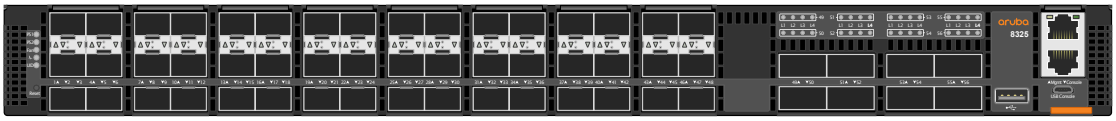


Figure 13. Aruba 8325 32Y8C Switch

HPE Aruba 6300M Out of Band Management Switches

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 Aruba 6300 switches provide the foundation for high-performance networks supporting IoT, mobile, and cloud applications

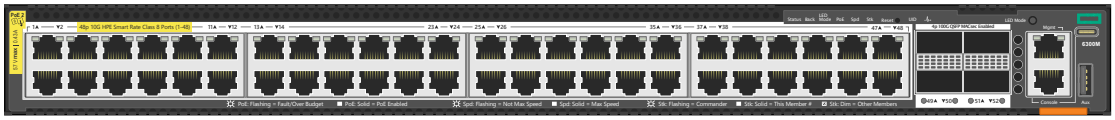


Figure 14. Aruba 6300M Switch

Software and firmware compatibility matrix

The following table outlines the software and firmware components used in the solution. While it provides a reference matrix, it does not represent the only supported versions. The goal of the Reference Architecture is to utilize the latest firmware and operating system versions available at the time of building the solution.

Additionally, the HPE Morpheus VM Essentials Software Compatibility matrix can be found here Qualification Matrix for HPE Morpheus VM Essentials Software

Table 2. Software and firmware version of components used in the solution

Component	Version
HPE Morpheus VM Essentials Software	8.0.12-2
SPP for HPE Morpheus VM Essentials nodes	2025.11.00.00
HVM unified Operating system	HVM_Install_24.04_S5Q83-11038.iso
Aruba CX 8325 Switch (R9F67A)	10.13.1110 {ArubaOS-CX_8325_10.13.1110}
Aruba 6300M Switch (R9F63A)	10.13.1110 {ArubaOS-CX_6400-6300_10.13.1110}
HPE SAN Switches 6700B	v9.0.1e
Aruba Fabric Composer (AFC)	7.2.2 {ArubaFabricComposer-7} Note: Aruba Fabric Composer orchestrates a discrete set of Aruba switches as a single entity called a fabric which significantly simplifies operations and troubleshooting
HPE Alletra Storage MP B10000 OS	10.5.0

Network architecture and requirements

This section outlines the different network connectivity options supported for deploying an HPE Morpheus VM Essentials cluster on HPE ProLiant Gen11 servers with various network adapter configurations along with Fibre Channel HBA's. The following are the network design considerations for HPE VM cluster deployed on HPE ProLiant Gen11 servers:

Link Aggregation Control Protocol (LACP) 803.2ad is a type of network bond that is more effective for virtualization. Network ports hosting management and compute (workload) traffic for the HPE VM cluster are bonded in 802.3ad mode to provide maximum throughput and network path redundancy.

Fibre Channel traffic to HPE Alletra MP array is carried over 2-port FC host bus adapters on the HPE VM hosts with first port connecting to SAN switch A and second port connecting to SAN Switch B.

Converged network connectivity

With converged network connectivity, management and compute (workload) traffic is carried over a set of network adapters bonded together using LACP. Fibre Channel traffic will flow over 2-port FC host bus adapters.

The following diagram illustrates this configuration on a server equipped with 2-port 100 Gbps ethernet network adapter and 2-port 32 Gbps Fibre Channel host bus adapter:

- **pNIC01** and **pNIC02** are bonded (LACP) to handle management and compute traffic.
- **FC HBA Port1** connected to SAN **Switch A.**
- **FC HBA Port2** connected to SAN **Switch B.**

This design ensures optimal throughput, path redundancy, and fault isolation across both compute/management and storage traffic.

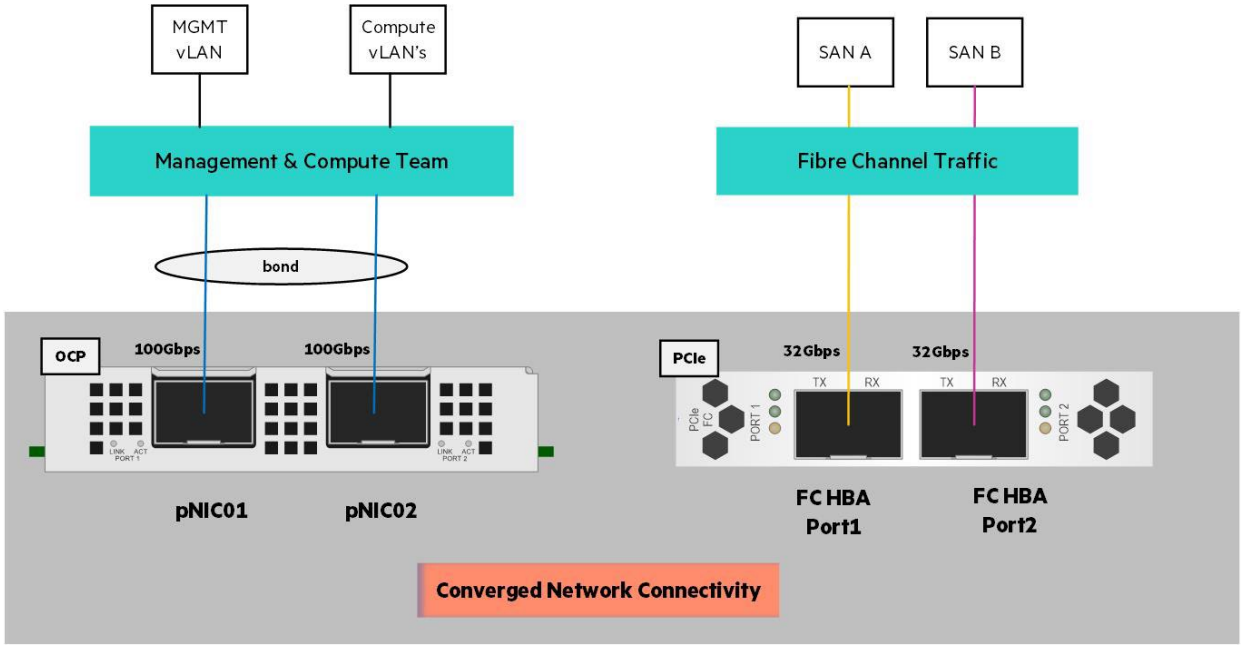


Figure 15. Converged network connectivity

Diverged network connectivity

In a diverged network connectivity model, each traffic type—management, compute, and storage—is isolated and mapped to a dedicated set of physical adapters. Management and compute traffic are handled through separate NIC pairs, each configured with LACP-based bonding for redundancy and performance. This separation ensures clear traffic isolation and optimized network performance. Fibre Channel traffic, on the other hand, is routed exclusively through dedicated dual-port FC Host Bus Adapters (HBAs), providing high-speed, low-latency connectivity to external storage fabrics.

The following diagram illustrates this setup on a server equipped with two 2-port100 Gbps network adapters and 2-port 32 Gbps Fibre Channel host bus adapter:

— **pNIC01** and **pNIC03** are bonded to handle **management traffic.**

— **pNIC02** and **pNIC04** are bonded to handle **compute (workload) traffic**.

— **FC HBA Port1** connected to **SAN Switch A.**

— **FC HBA Port2** connected to **SAN Switch B.**

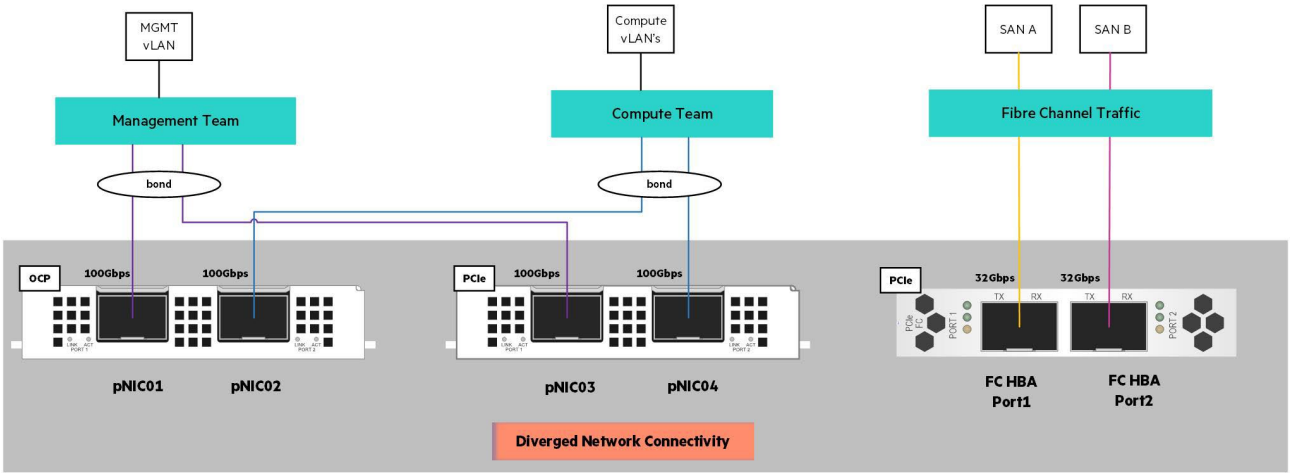


Figure 16. Diverged Network Connectivity

Storage architecture and requirements

HPE Alletra Storage MP B10000 is a disaggregated, scale-out block storage solution designed to deliver 100% data availability while ensuring mission-critical storage at midrange economics. It is built on the HPE Alletra Storage MP hardware platform and is managed via GreenLake cloud, bringing cloud agility, performance, and resiliency to mission-critical workloads.

Architecture overview

Disaggregated, Scale-Out Design: The architecture allows for independent scaling of performance and capacity, enabling organizations to tailor their storage infrastructure to specific workload requirements.

Composable Building Blocks: The system is built using a chassis that can house compute nodes and storage media. For instance, Just a Bunch of Flash (JBOF) expansion shelf includes storage media and two controllers, each equipped with an operating system RAM, and CPU. This design ensures flexibility in configuring storage solutions.

Multi-Protocol Support:

The HPE Alletra Storage MP B10000 offers broad support for multiple storage protocols, making it ideal for a wide range of application environments.

Switch-Based Deployment (Enterprise-Scale):

— Leverages Ethernet or Fibre Channel switches to enable high scalability and redundancy.

— Hosts connect through a redundant switch fabric to ensure high availability and fault tolerance.

— Ideal for large-scale, mission-critical enterprise workloads requiring maximum uptime and flexibility.

Direct-Attached Deployment (Switchless):

— Storage nodes are connected directly to hosts using NVMe, iSCSI, or Fibre Channel interfaces.

— Simplified architecture with reduced cost and setup complexity.

— Best suited for edge deployments, test environments, or smaller-scale production use cases with limited scalability requirements.

Note

For this reference architecture switched storage array was used which are supported by HPE Alletra Storage MP Switches. These switches are used to connect HPE Alletra Storage MP B10000 controller nodes with disk enclosures and help with easy expansion of the storage capacity.

Configuration guidance for the solution

Prerequisites

HPE ProLiant servers

Qualified HPE ProLiant servers are listed in the HPE Morpheus VM Essentials Software Compatibility Matrix https://www.hpe.com/support/VME-Compatibility-Matrix.

Network

— **Out of Band Management Switch:** A pair of Aruba 6300M OOBM switches to support management traffic.

— **Top of Rack Switch:** A pair of Aruba 8325 Top of Rack switches to support compute traffic.

— **Management VLAN:** One dedicated network (VLAN) created on OOBM and ToR switches for server iLO management and host(ubuntu) management traffic.

— **Compute VLAN:** One network (VLAN) created on ToR switches for workload traffic. If the user needs isolation for workloads, more compute VLANs can be created as required.

Software

HPE Gen12 SPP: The HPE Gen12 Service Pack for ProLiant (SPP) version 2025.11.00.00 is available here. An active HPE support contract is required to download the SPP.

HVM OS: The base host operating system for HVM is provided as an installable ISO. It includes a minimal Ubuntu 24.04 installation, pre-patched with necessary KVM and HPE-VM packages, making it ideal for disconnected or "dark" sites. For customer or partner access to VM Essentials software, please contact your HPE Sales Representative.

HPE Morpheus VM Essentials Software and HPE Morpheus VM Essentials Manager: VM Essentials software version 8.0.12 and VM Essentials Manager are bundled in a single package: HPE_VM_Essentials_SW_image_v8.0.12_2_S5Q83-11043.iso. For customer or partner access to VM Essentials software, contact your Hewlett Packard Enterprise Sales Representative.

Storage

The storage provisioning process requires that physical connectivity is properly established between the HPE Morpheus VM Essentials nodes, the HPE Alletra MP B10000 storage array, and the associated HPE network switches. In Fibre Channel configurations, appropriate zoning must be configured on the Fibre Channel switches to ensure secure and isolated communication paths between each host and the storage array. Additionally, the storage array must be initialized and accessible via the HPE Data Services Cloud Console (DSCC) to enable configuration management, monitoring, and lifecycle operations.

License

License is priced per CPU socket for HPE Morpheus VM Essentials hypervisor nodes and service is made available in 1, 3 and 5-year terms. For licensing questions and trial licenses contact your Hewlett Packard Enterprise Sales Representative.

Server BIOS

Boot drives present on HPE ProLiant Gen11 servers need to be configured in **RAID 1** mode. Workload profile in HPE ProLiant Gen11 server BIOS should be set to **Virtualization – Max Performance.**

Other requirements

— Internet Connectivity required on the management network to download and install the required packages and dependencies on Ubuntu HPE-VME servers.

— NTP server to enable time sync on all Ubuntu HPE Morpheus VM Essentials servers.

— HPE Alletra Storage MP B10000 array should have been activated and ready to be consumed and the scope of this reference architecture does not cover Cloud enablement, discovery setup and initialization.

Workflow

The following figure describes the high-level workflow for the HPE Morpheus VM Essentials deployment:

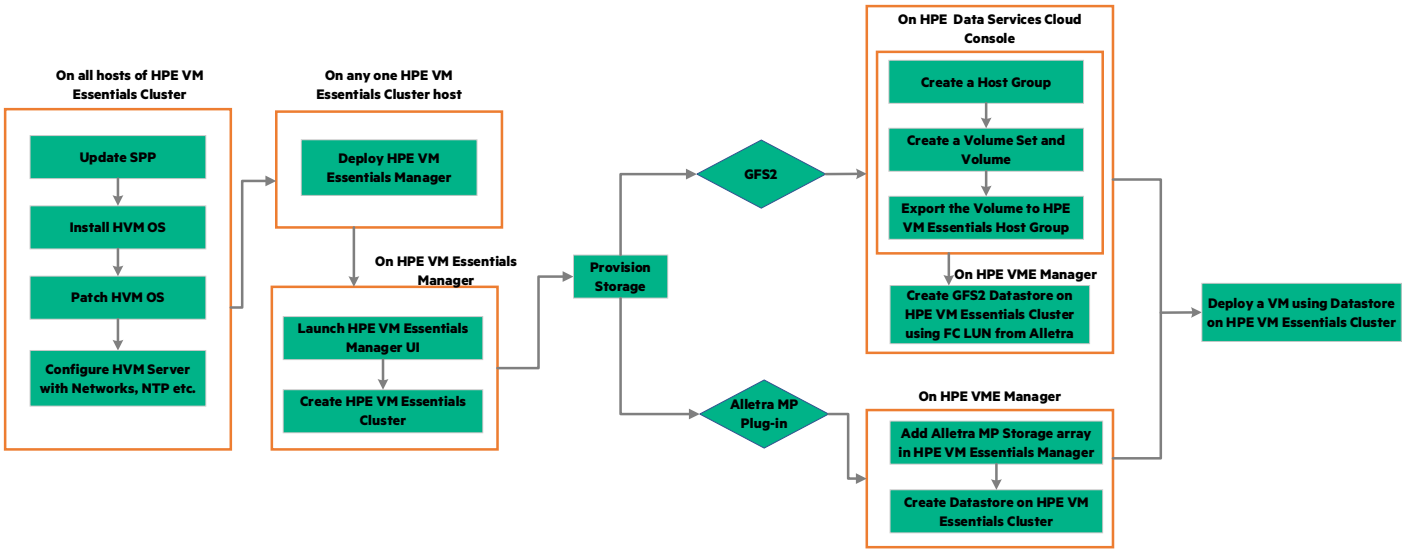


Figure 17. Workflow

Install and configure Unified HVM operating system

This section discusses installation and configuration of HVM Hypervisor on HPE ProLiant Servers.

To install HVM Hypervisor on the HPE ProLiant servers, perform the following steps:

1. Log into the iLO of the server and launch the iLO console.
2. Click Virtual Media and select Local *.iso file under option CD/DVD.

3. Downloaded HVM_Install_24.04.ISO image from My HPE Software Center.
4. Under Menu, select Reset server.
5. Select F11 (Boot Menu) during reset and click 'iLO Virtual USB: iLO Virtual CD/DVD' option to start the installation.
6. Under GRUB GNU screen, select Try and install Ubuntu.
7. Select the type of installation as Ubuntu Server.

Unified HVM OS network setup

During the networking setup portion of the HVM OS installation, bonding must be created for management and compute traffic.

1. Select the first two ethernet network adapters on the VM Essentials hosts to create a bond (Ex: bond0) with default load balancing algorithm. The following are the sample VLANs used in this solution validation.

   Table 3. Sample VLANs

VLANs	Subnets	Purpose
101	172.28.1.0/24	ILO, Alletra Mgmt, and HPE Morpheus VM Essentials Node Mgmt.
102	172.28.2.0/24	Compute (workloads)

2. After the bond is created, add a VLAN tag with management VLAN (Ex: 101) to create management virtual network adapter.
3. Select the virtual adapter named bond0.<mgmt.-vlan-id> (Ex: bond0.101), choose **Edit** to activate the management network by selecting IPV4 Method as Manual and add the static IP address, DNS server, and DNS search domain for management network.

   For network configuration on the HVM host, refer to the Network Considerations section
4. The following figure shows the bonding created for management network.

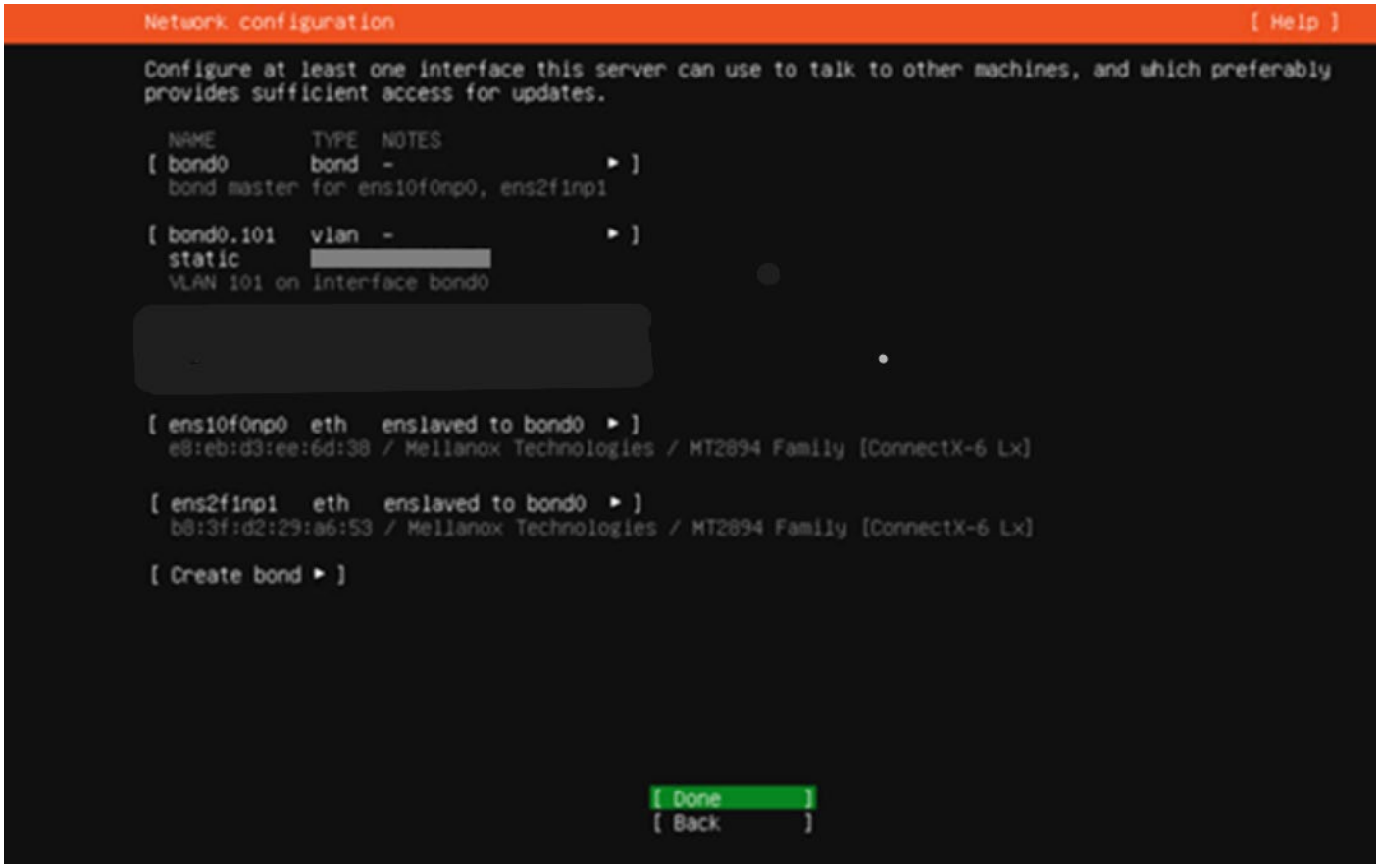


Figure 18. Ubuntu Network Setup

Unified HVM OS partition setup

During the storage setup portion of the Ubuntu installation, select "Use an entire disk" and choose the Gen12 boot drive configured in RAID 1. Enable the option "**Set up this disk as an LVM group**"; optionally, you can encrypt this LVM group with a passphrase.

After the LVM group is created, a file system summary (as shown in the screenshot) will be displayed, including mount points for /boot and / (root). By default, the root logical volume does not consume the entire available space of the boot disk. It is recommended to manually allocate all remaining available space of the boot disk to the root logical volume to avoid the need for later expansion.

Example:

- /boot partition: 1–2 GB
- / (root) logical volume: remaining disk space (entire usable space of RAID 1 boot drives)

Allocating the full disk to the root volume ensures maximum storage availability for the operating system and applications. The figure illustrates a root volume utilizing all available space on Gen12 RAID 1 boot drives.

It is recommended to increase the root logical volume size to consume the entire size of the boot disk. This helps avoid the hassle of expanding the root disk later if more storage is required. The following figure shows the boot partition and root volume created on the Ubuntu OS using all available space on Gen12 boot drives in RAID1 mode.

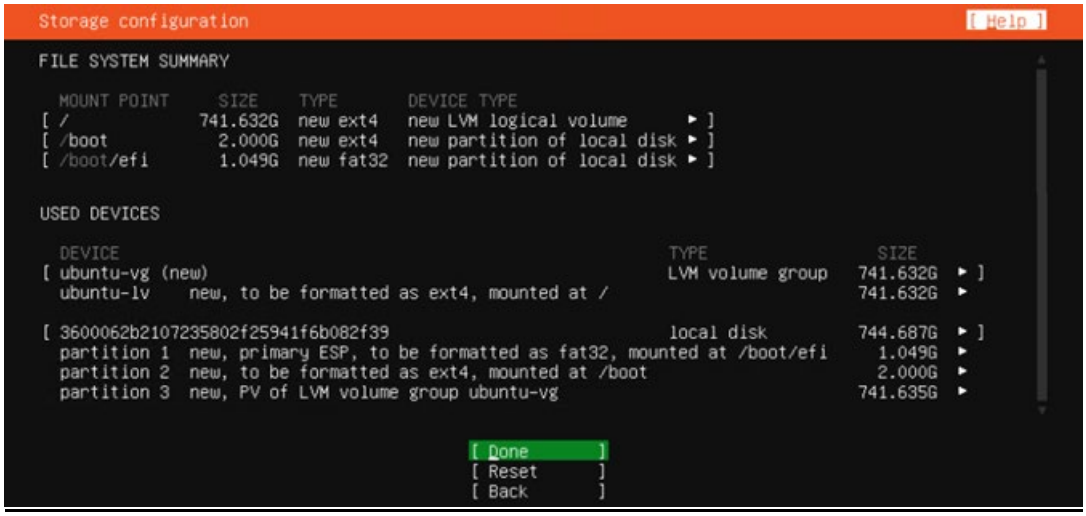


Figure 19. Ubuntu OS Partition Setup

Configure NTP

1. To configure NTP on the Ubuntu server, open the /etc/systemd/timesyncd.conf file on each Ubuntu node and uncomment the following mentioned parameters to assign the IP address of the NTP server.

```
NTP=<ntp server ip>
FallbackNTP=<ntp server ip>
```

2. Restart the NTP service by running the following command on each Ubuntu node.

```
#sudo systemctl restart systemd-timesyncd.service
```

3. Run the following command to check the status of NTP configuration. The output shows the sample output for the NTP server successfully set.

```
#timedatectl timesync-status
Server: <<ntp-server-ip-address>>
Poll interval: 4min 16s (min: 32s; max 34min 8s)
Leap: normal
Version: 4
Stratum: 2
Reference: D8753B5D
Precision: 1us (-24)
Root distance: 6.805ms (max: 5s)
Offset: +86us
Delay: 25.201ms
Jitter: 719us
Packet count: 4
Frequency: -6.761ppm
```

Patch Ubuntu

1. It is recommended to keep all the packages and its dependencies up to date on the Ubuntu nodes. Update the Ubuntu node by executing the following command:

```
#sudo apt-get update
```

2. To ensure all installed packages are brought up to their latest available versions, run the following command:

```
#sudo apt-get upgrade
```

3. This upgrades the current packages without removing or installing any new dependencies.

Deploy HPE Morpheus VM Essentials manager

HPE Morpheus VM Essentials Software is a lightweight Debian package that enables virtualization capabilities on cluster hosts by installing components such as KVM, OVS, and other necessary dependencies. This package should be installed on a single Ubuntu node that will be part of the HVM cluster.

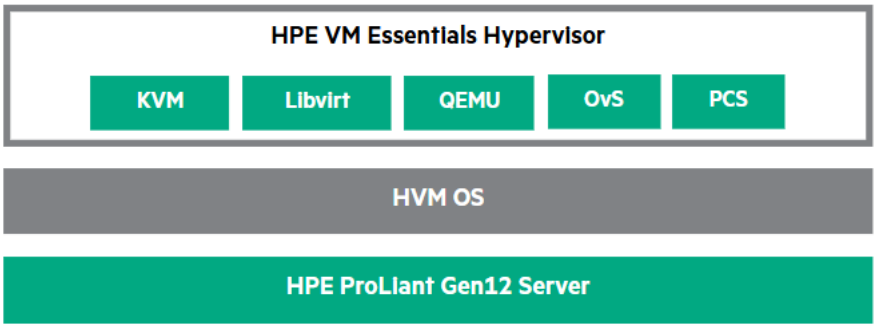


Figure 20. Install HPE VM Essential Software

1. Copy the downloaded HPE Morpheus VM Essentials software to any one of the ubuntu server. The software can be transferred to Ubuntu server using any of the file transfer utility such as WINSCP.

```
#ls -l *iso

-rw-rw-r-- 1 root root 6753976320 Jan 20 10:06 HPE_VM_Essentials_SW_image_v8.0.12_2_S5Q83-
11043.iso
```

2. Create a mount point /mnt/iso on the HVM host and mount the transferred HPE Morpheus VM Essentials software bundle.

```
#mkdir /mnt/iso
#mount -o ro HPE_VM_Essentials_SW_image_v8.0.12_2_S5Q83-11043.iso /mnt/iso
#cd /mnt/iso
#ls -l

-r--r--r-- 1 root root 6718616318 Jan  7 02:18 hpe-vm-essentials-8.0.12-2.qcow2.gz
-r--r--r-- 1 root root   34477156 Nov 13 09:38 hpe-vm_1.0.13-1_amd64.deb
```

3. The HPE Morpheus VM Essentials Manager image (hpe-vm-essentials-8.0.12-2.qcow2.gz) is required to create HPE Essentials Manager VM.
4. The .deb package does not require installation because it is already included and installed as part of the HVM host image delivered through the HVM OS Install ISO (HVM_Install_24.04.ISO).
5. To launch the hpe-vm console, switch to the root user by running sudo -i.

6. Enter the `hpe-vm` console by running the following command:

```
#hpe-vm
```

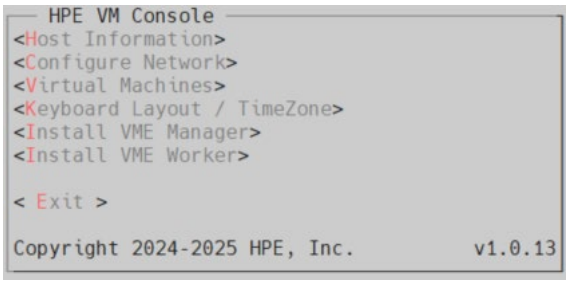


Figure 21. HPE-VM console

7. First, enter the section for keyboard layouts and time zone. Set the time zone and make any changes to the keyboard layout, if needed.
8. Next, enter the section named **configure network** to set the MTU to 9000 for all network interfaces. Setting the MTU to 9000 improves efficiency and reduces latency.
9. From the **Device Type** drop-down list, select **vlan** and select the virtual network adapters configured for management and compute traffic. Select the checkbox next to **mtu** and enter 9000 in the resulting box. Finally, save changes.

Note

Make sure the respective VLAN interfaces and physical interfaces on Aruba 8325 switches are also enabled for jumbo frames i.e., MTU 9000

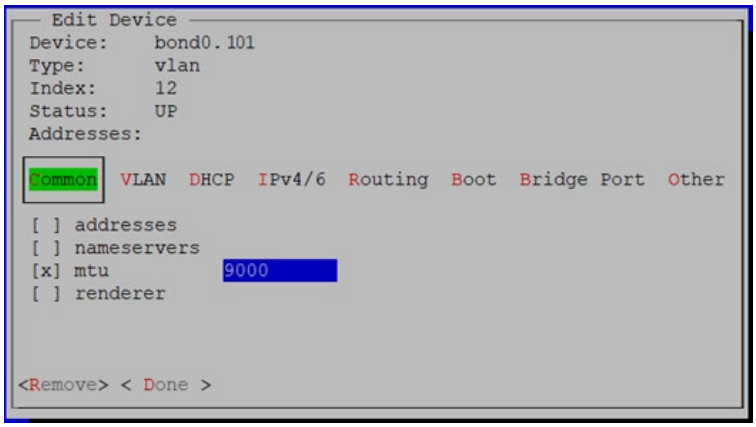


Figure 22. Update MTU on Device

HPE Morpheus VM Essentials Manager software will be available on the Ubuntu host at the mount directory of HPE Morpheus VM Essentials software.

```
#cd /mnt/iso
#ls -l  *gz

-r--r--r-- 1 root root 6718616318 Jan  7 02:18 hpe-vm-essentials-8.0.12-2.qcow2.gz
```

The following information should be readily available to deploy the HPE Morpheus VM Essentials Manager:

— IP address for the HPE Morpheus VM Essentials manager

— IP address for the DNS Server

— URL for the web server

— DNS resolution for the URL (points the URL to the manager IP address)

— Management interface name

— The absolute path of HPE VM Essentails Manager software on the Ubuntu host.

Install HPE Morpheus VM Essentials manager

1. To install the manager, run the command hpe-vm.
2. Select an option labelled Install VME Manager.

Figure 23. HPE-VM console

3. Enter the following configuration values:
    a. IP Address
    b. Subnet Mask
    c. Gateway
    d. DNS Server

— **Appliance URL** (the HTTPS URL the appliance administrator and vme manager agents will connect to)

— **Hostname** (same as Appliance URL without the FQDN)

— **Image URI:** Since the path begins with a leading /, the final value will look like: file:///mnt/iso/hpe-vm-essentials-8.0.12-2.qcow2.gz

4. Enter an admin username and password for an SSH user that can access the VME manager.
5. If necessary, configure proxy details.
6. Specify the size of the HPE Morpheus VM Essentials Manager appliance vm to install. Defaults to S:
    a. **Small:** 2 vCPUs / 12 GB RAM (POC, Lab, test or small environments)
    b. **Medium:** 4 vCPUs / 16 GB RAM (Production with moderate workloads)
    c. **Large:** 4 vCPUs / 32 GB RAM (recommended for production environments with high workload)
7. Specify the following:
    a. Management interface
    b. Compute interface (optional)
    c. Compute VLAN tag (optional)

Note

At this stage, configuring the **compute interface** and **VLAN** is optional. These settings can be specified later during cluster creation through the **HPE Morpheus VM Essentials Manager.** Click **Install** to begin the installation process.

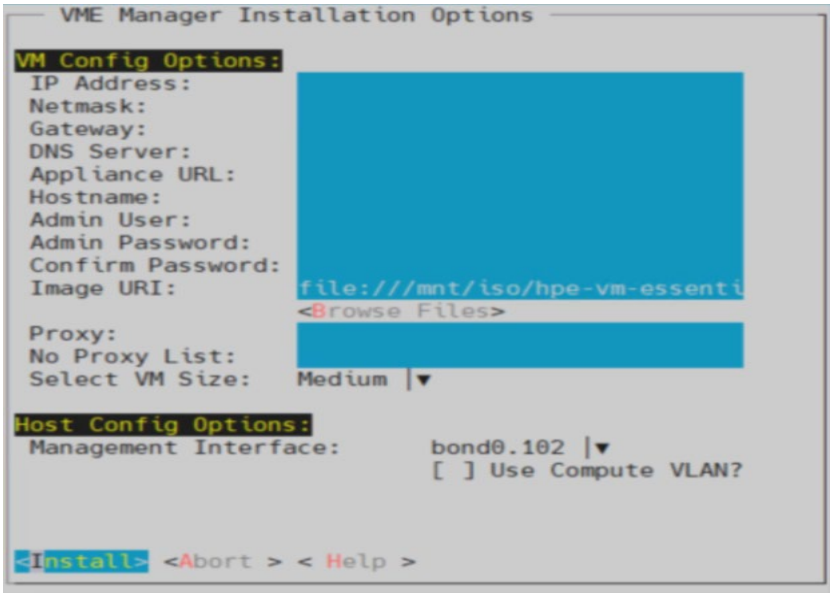


Figure 24. HPE Morpheus VM Essentials Manager Setup

Monitor HPE Morpheus VM Essentials manager installation progress

1. During installation, look for the message: **Starting Morpheus Services...**
2. Navigate to the **Appliance URL** in a browser. If a page loads or displays a loading message, services are active.
3. After the message "Starting Morpheus Services..." appears in the installation progress bar, you may open a web browser and go to the Appliance URL. If the browser returns a response—even if it says the appliance is still loading—it indicates that the web server is installed and working. After full initialization, you will reach the setup page.

HPE Morpheus VM Essentials manager initialization

After the HPE Morpheus VM Essentials Manager successfully deployed, access the UI by navigating to the **Appliance URL** in a web browser. You will be directed to the registration screen as shown in the following figure:

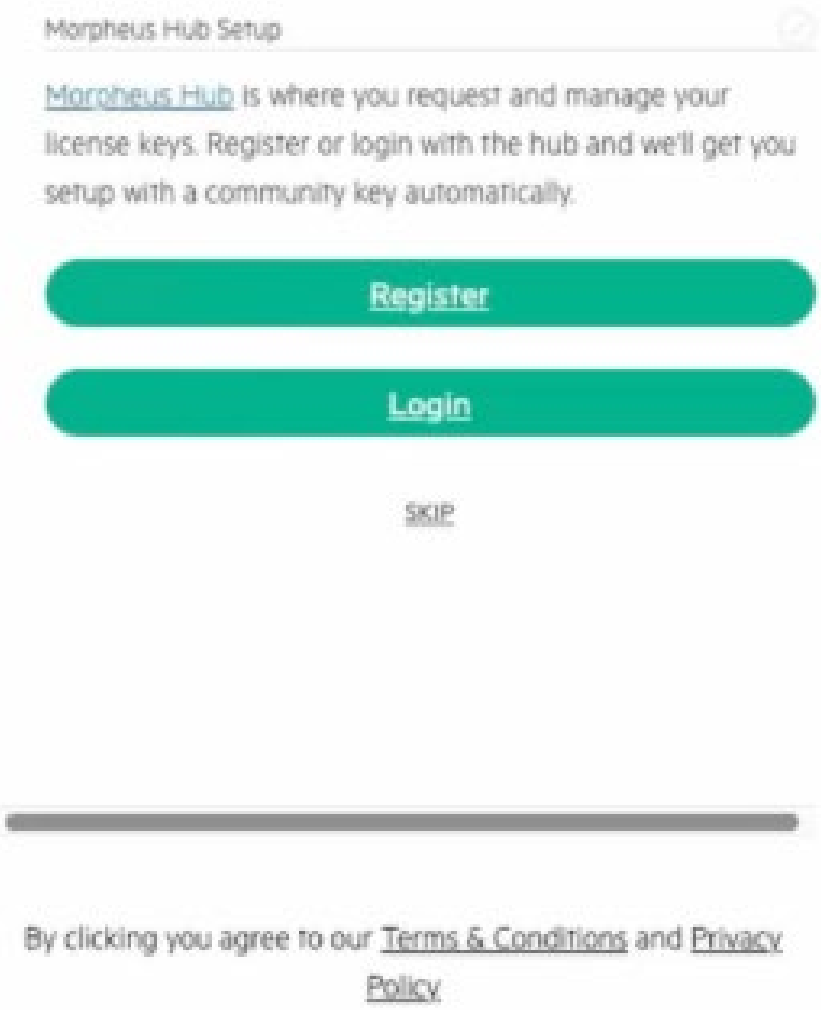


Figure 25. VME Manager Setup

To continue the setup, a valid license key is required as listed in prerequisites:

Continue the setup by performing the following:

1. Define the **account name** for the manager.
2. Provide credentials for the **initial administrator user**.
3. Assign a **name** to the appliance.
4. Confirm the **Appliance URL** is accurate.
5. Select from available global features such as **Backups, Monitoring**, and **Logs based on requirements**.

After configuring these settings, paste in the license key when prompted and click **Complete Setup.**

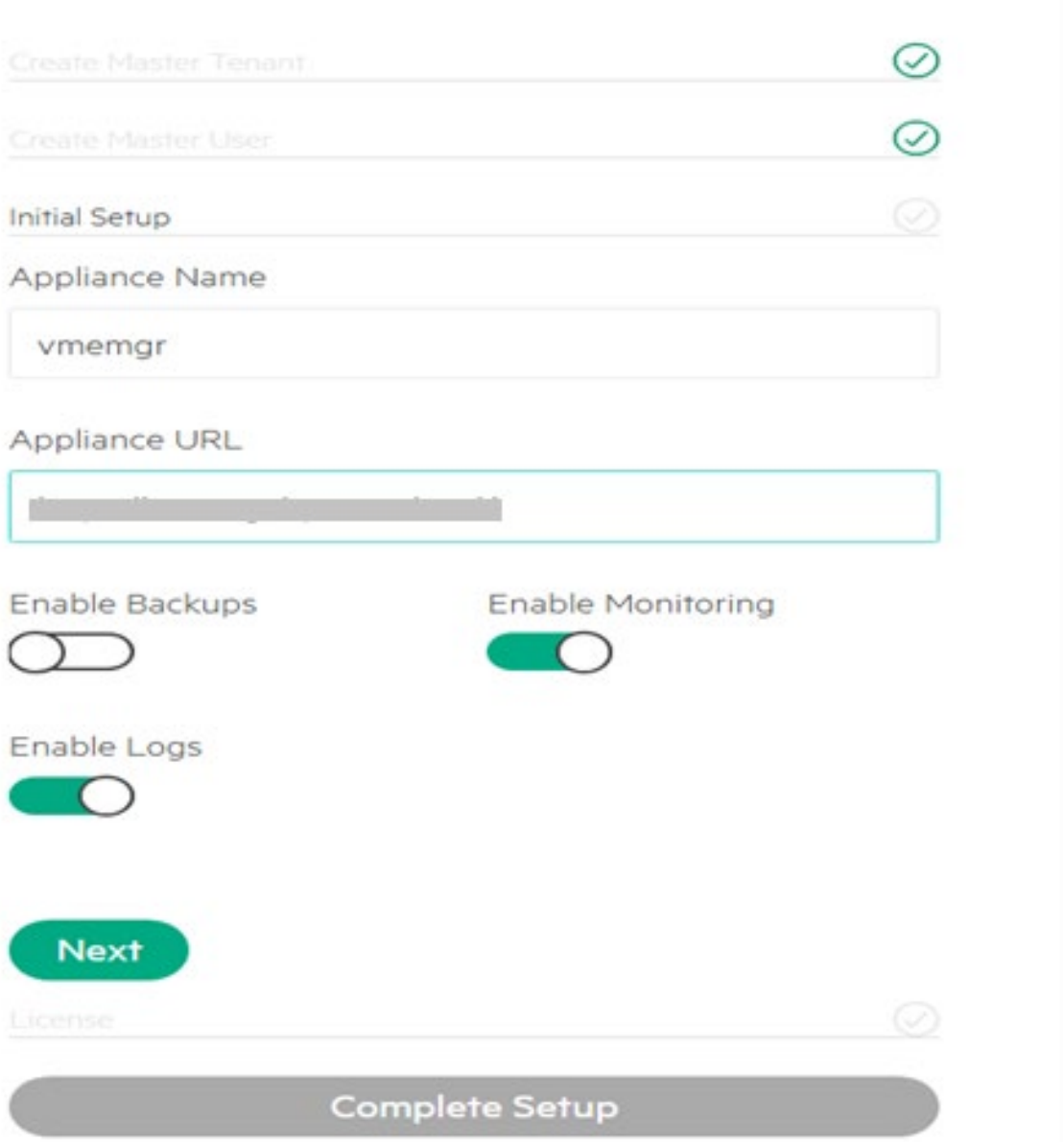


Figure 26. Complete setup

6. Upon completion, you will be directed to the HPE Morpheus VM Essentials Manager dashboard. At this point, installation is complete.

Create HPE Morpheus VM Essentials cluster

Perform the following steps to create a VME cluster:

1. Log into the VME Manager using admin username and password.
2. Navigate to the Infrastructure tab.
3. Create a Group.
    a. Go to **Infrastructure > Groups**.
    b. Click **+ CREATE**

c. Provide the required details to create the group.

4. Create a Cloud
   a. Navigate to **Infrastructure > Clouds**.
   b. Click **+ ADD** Select Morpheus
5. Click **Next** and provide the required details.

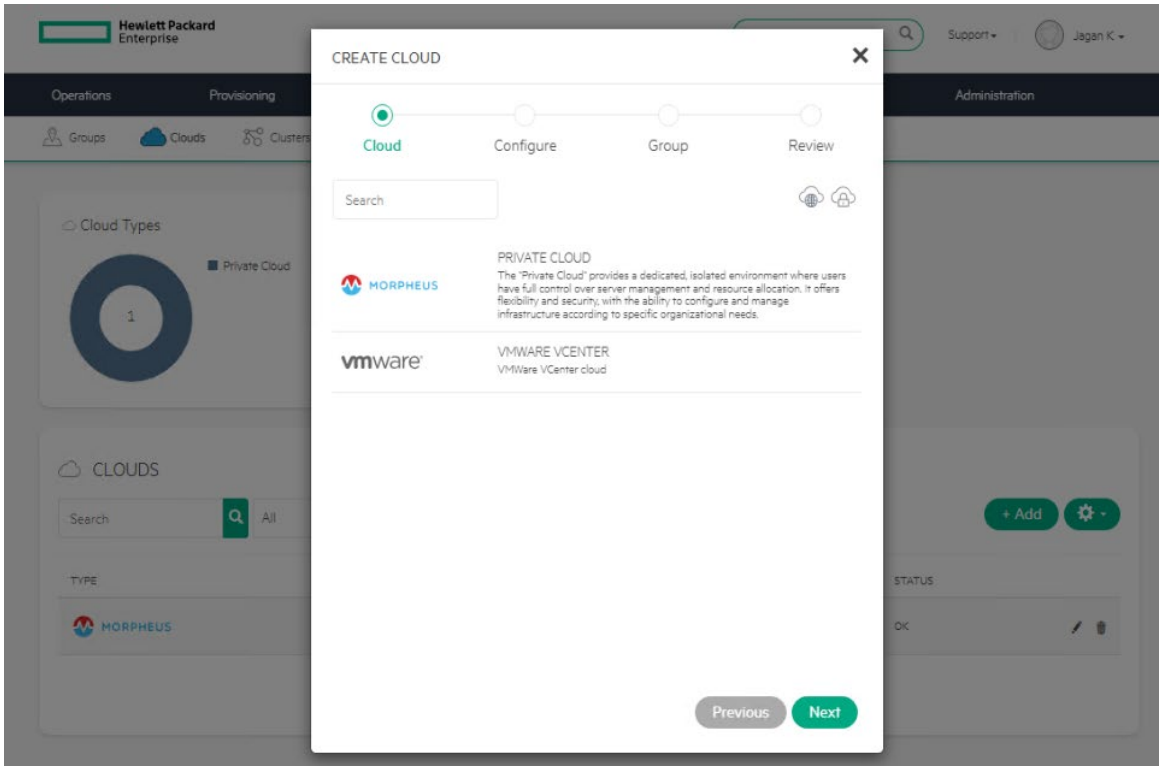


Figure 27. Create Cloud

Create an HPE Morpheus VM Essentials Cluster.

1. Navigate to Infrastructure > Clusters.
2. Click + ADD CLUSTER. Currently, the only available cluster type is “HPE VM”.
3. Select the HPE VM as the cluster type and click NEXT. On the Group tab, select the group created earlier and click Next.
4. On the **Name** tab, select the cloud created earlier and enter a name for the cluster. Click **Next**.

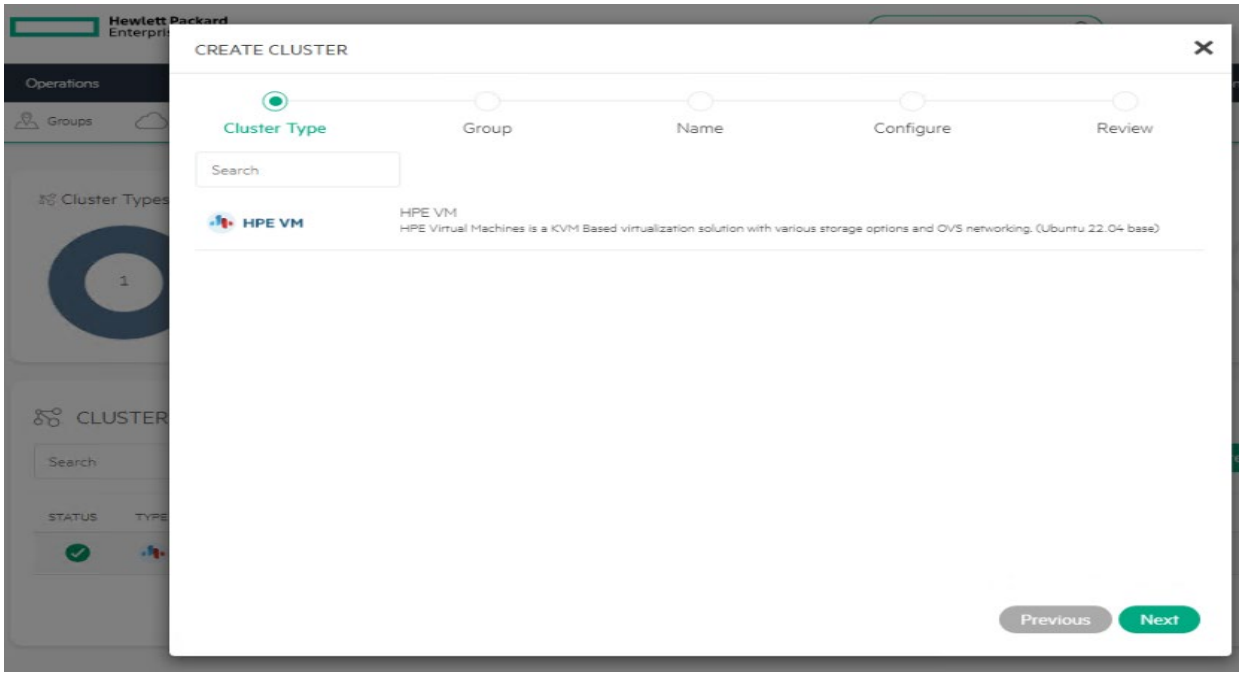


Figure 28. Create Cluster

Under Configuration Options, select the layout "HPE VM 1.2 cluster on Existing Ubuntu 24.04". Provide the required HVM host details, including the fully qualified domain name (FQDN), IP address, SSH username and password, the management interface (a bonded interface with the management VLAN tag, for example, bond0.<management-vlan-id>), and for the compute interface assign bond0 i.e., the bonded compute network interface , and under compute VLANs, specify the compute VLANS as a compute-vlan-id or a range of VLAN IDs if multiple VLANs are used. Click **Next** to proceed with the creation of the HPE Morpheus VM Essentials cluster.

Note

This reference architecture does not cover the " HVM cluster 1.2 HCI Ceph Cluster on HVM/Ubuntu 24.04" layout option, which leverages Ceph-based storage.

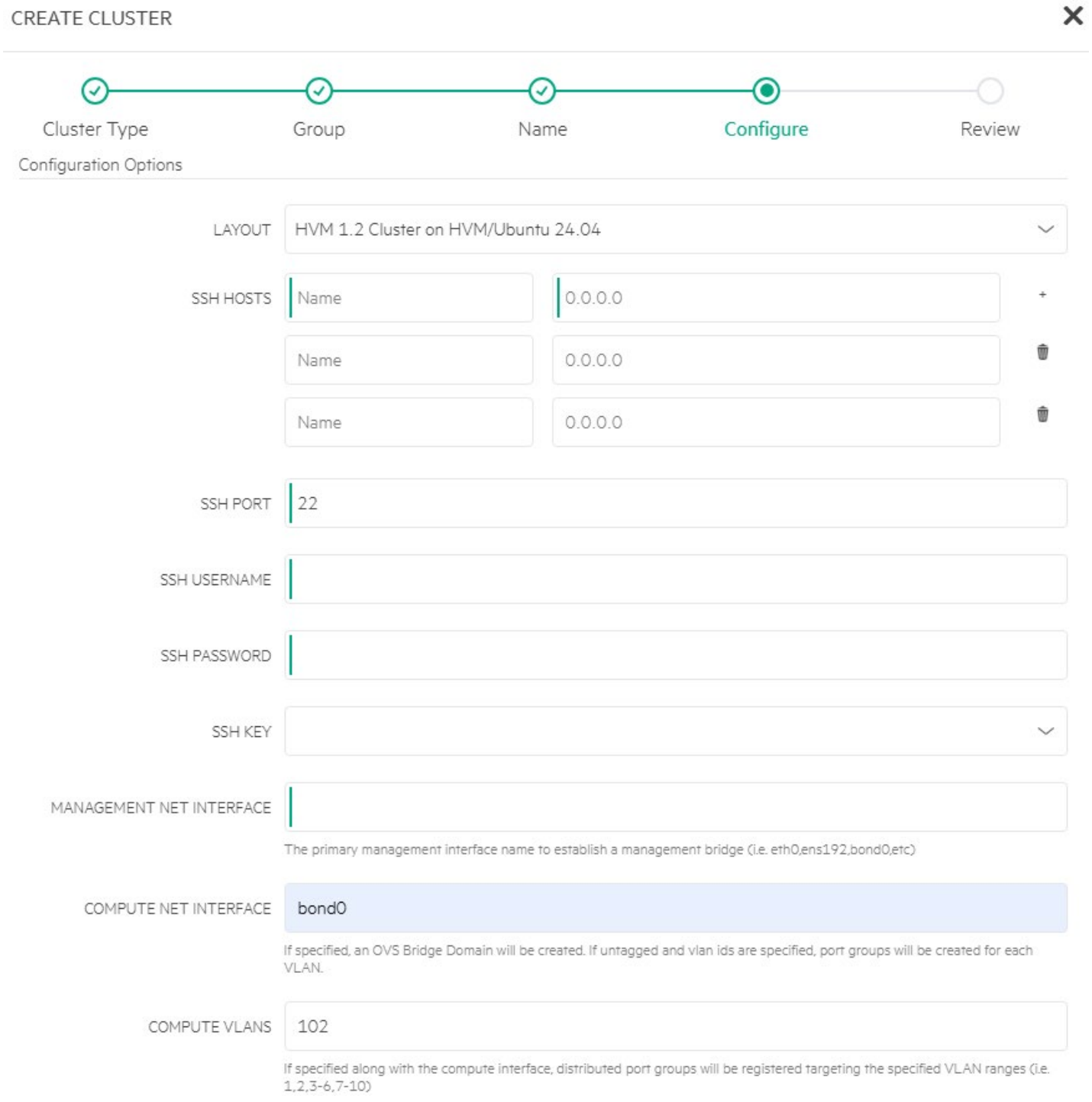


Figure 29. Create Cluster

Adding Additional VLANs and Configuring Networks on an HVM Cluster

This procedure describes how to create additional VLANs and configure networks on an HVM cluster to segment VM workload traffic across distinct network paths.

Prerequisites

Ensure the following requirements are met before beginning the configuration:

— The required VLANs and networks are already created on the physical switch.

— The VLANs are **properly trunked or assigned** to the switch ports connected to all HVM cluster nodes.

Procedure

1. Navigate to the **HVM cluster** in the management console.
2. Open the **Network** section.
3. Click **Add** and select **OVS Port Group**.
4. Complete the network configuration fields:
    - **Name**: Enter a unique identifier for the network.
    - **Display Name**: Provide a user-friendly name to display in the console.
    - **Enable IPv4**: Check this option to enable IPv4 addressing.
    - **CIDR**: Specify the network CIDR.
    - **Gateway**: Provide the default gateway for the subnet.
    - **DNS Primary / Secondary**: Enter DNS server addresses if required.
    - **Router**: Select **Compute** to route VM workload traffic.
    - **VLAN ID**: Enter the VLAN ID that corresponds to the VLAN configured on the physical switch.
5. Click **Save** to apply and create the network.

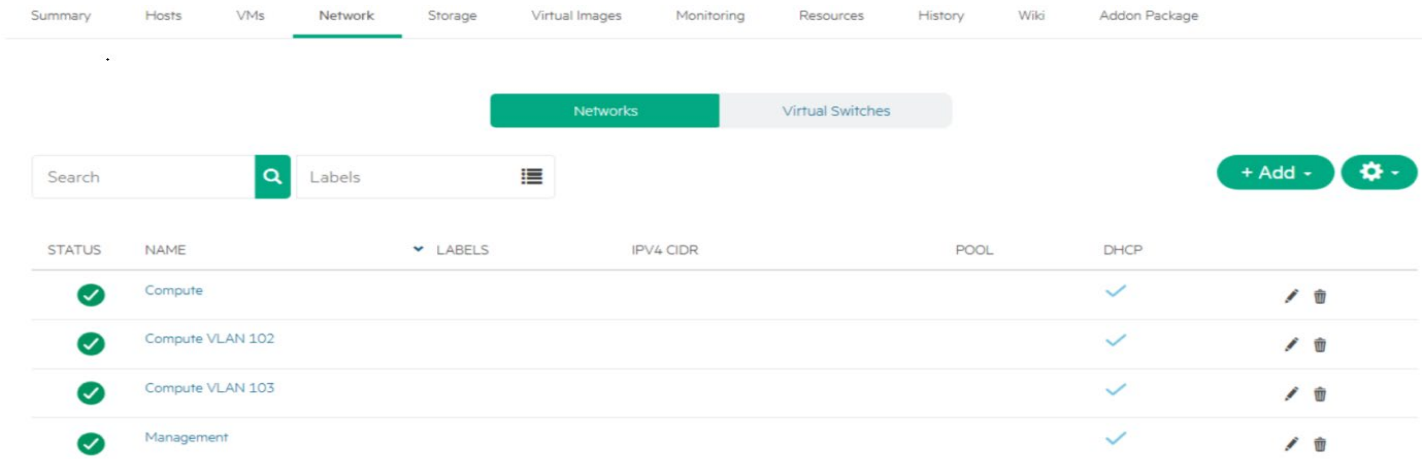


Figure 30. Verify Network status

High Availability, Live Migration and Dynamic Placement

HPE Morpheus VM Essentials provides capabilities to manage **availability**, **live migration** and **dynamic placement** at both the **cluster level** and the **virtual machine (VM) level**.

— **Cluster-level settings** define the default behavior for all VMs within a cluster.

— **VM-level settings** allow more granular control for individual workloads.

Cluster Configuration - High Availability and Dynamic Placement

Cluster-level settings determine default VM placement, load balancing, and host failover behavior for all VMs in a cluster.

1. Navigate to **Infrastructure → Clusters** in the VM Essentials UI.
2. Select the target HVM cluster.
3. Click Actions → Edit.
4. Locate the Placement section.
5. Configure the following options:

   Dynamic Placement

   — **On –** Enables automatic optimization of VM placement across hosts. VMs may be live migrated to balance resource utilization**.**

   — **Off –** Disables automatic VM movement. VMs remain on their current hosts unless manually migrated.

   Power Policy

   — **Balanced (default) –** Optimizes overall resource utilization and allows VM movement to maintain balanced workloads.

   — **Performance –** Prioritizes workload stability by minimizing VM movement; VMs are more likely to remain on their current hosts.

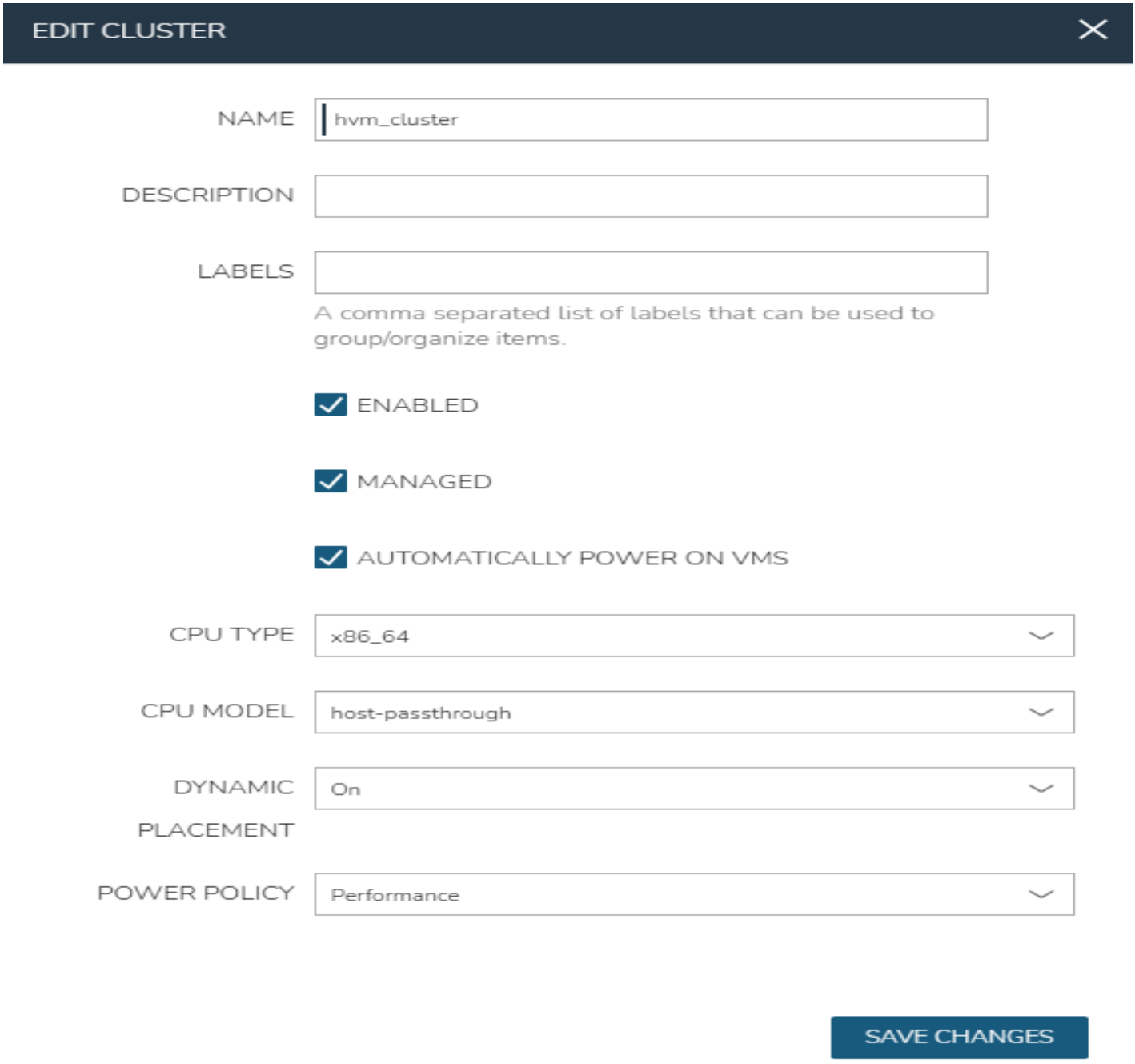


Figure 31. Cluster DYNAMIC PLACEMENT

6. Click **Save Changes.**

Virtual machine - High Availability and Placement Strategy

VM-level placement settings allow administrators to override cluster-level defaults for individual workloads using **Manage Placement**.

1. Navigate to **Infrastructure → Compute → Virtual Machines**.
2. Select the target VM within the HVM cluster.
3. From the **Actions** menu, select **Manage Placement**.
4. Choose the appropriate Placement Strategy:

— Auto

- VM placement is managed automatically by HPE Morpheus VM Essentials using dynamic placement.
- Enables live migration and automatic VM relocation based on resource availability and host status.

— Failover

- The VM is relocated only if the current host fails or enters maintenance mode. No automatic placement optimization or load-balancing migrations occur.

— Pinned

- The VM remains on its current host.
- Automatic migration and host-based relocation are disabled.
- Manual intervention is required if the host becomes unavailable.

5. Click Execute or Save.

Storage Provisioning

In HPE Virtual Machine Essentials, storage can be provisioned using two supported methods:

1. **GFS2 over HPE Alletra Storage MP with HPE Morpheus VM Essentials:** GFS2 (Global File System 2) is a clustered file system that enables shared datastore access across multiple hosts within an HPE Morpheus VM Essentials cluster. In this architecture, storage is provisioned from HPE Alletra Storage MP B10000 and accessed using Fibre Channel (FC) connectivity. This design ensures high availability, consistent data access and coordinated file locking across cluster nodes, making it well-suited for shared and clustered workloads running on HPE Morpheus VM Essentials.
2. **HPE Alletra Storage MP Plugin for HPE Morpheus VM Essentials:** The **HPE Alletra Storage MP plugin for HPE Morpheus VM Essentials** provides seamless integration between HPE Morpheus VM Essentials Manager and HPE Alletra Storage MP arrays. The plugin enables administrators to provision, manage, and monitor storage volumes directly from the VM Essentials Manager UI. With this integration, virtual machines can be created with virtual disks (vDisks) backed by HPE Alletra–provisioned volumes. Each virtual machine is mapped to a dedicated storage volume, simplifying storage management while improving performance isolation and operational efficiency.

Note

As listed in the prerequisites - The storage provisioning process requires that physical connectivity is properly established between the HPE Morpheus VM Essentials nodes, the HPE Alletra MP B10000 storage array, and the associated HPE network switches. In Fibre Channel configurations, appropriate zoning must be configured on the Fibre Channel switches to ensure secure and isolated communication paths between each host and the storage array. Additionally, the storage array must be initialized and accessible via the **HPE Data Services Cloud Console (DSCC)** to enable configuration management, monitoring, and lifecycle operations.

Configuring HPE Alletra MP B10000 Fibre Channel

Prerequisites

1. HPE Alletra MP storage and HVM cluster hosts are cabled to SAN switches ensuring FC port redundancy on hosts and controller node redundancy on Alletra MP Storage.
2. HPE Alletra MP storage backend cabling to HPE Aruba 8325 MP switches and disk enclosure is as per https://infosight.hpe.com/welcomecenter/cabling/?family=hfblock&mode=csi.
3. The storage provisioning process requires that physical connectivity is properly established between the HPE Morpheus VM Essentials nodes, the HPE Alletra MP storage B10000 array, and the associated HPE network switches. Additionally, the storage array must be initialized and accessible via the HPE Data Services Cloud Console (DSCC) to enable configuration management, monitoring, and lifecycle operations.

   To perform HPE Alletra Storage MP B10000 initialization and configuration, refer to HPE Alletra Storage MP B10000: Installing and configuring.

SAN Zoning

1. Access the SAN switch through serial console, and set the password for 'admin' user.
2. Initialize the SAN switch with management network and time zone details.
3. Create aliases for HPE Alletra Storage MP host ports:
   a. SSH to the HPE Alletra management IP and capture the port WWNs of controller nodes by executing % **showport**
   b. Construct array host port aliases as per PCE standard policy: "SiteNumber+Rack_array-hostname_Node:Slot:Port_SANSwitchPort"
   c. SSH to the SAN switch using management IP and appropriate login credentials. Configure the aliases using the below cli syntax and associate the storage host port with the WWPN captured from the array's showport output:

      ```
      #alicreate "<standard_naming_convention>", "<WWPN from Alletra host port>>"
      ```

      For example:

      ```
      #alicreate "S1R1_array2_NOS3P1_P10", "XX:XX:XX:XX:XX:XX:XX:XX"
      ```

Note

An alias must be created for every HPE Alletra port that is cabled to SAN switch and is online.

---

   d. Save the configuration by running cfgsave on the SAN switch and verify the aliases created by running alishow
   e. SSH to another SAN switch and repeat steps c and d as applicable

Table 4. Alletra ports cabled to SAN switch for two-node and four-node configurations

Array	MP B10000 Slot 3 ports		MP B10000 Slot 4 ports	
Two-node	0:3:1	1:3:1	0:4:1	1:4:1
	0:3:2	1:3:1	0:4:2	1:4:2
	0:3:3	1:3:3	-	-
	-	-	0:4:4	1:4:4
Four-node	2:3:1	3:3:1	2:4:1	3:4:1
	2:3:2	3:3:2	2:4:2	3:4:2
	2:3:3	3:3:3	-	-
	-	-	2:4:4	3:4:4

4. Create aliases for WWPNs of HVM cluster hosts.
   a. Login to the iLO IP of each HP-VM host and capture the port WWNs (WWPN) of FC adapters under **System Information > Network**
   b. SSH to the SAN switch using management IP and appropriate login credentials. Construct HP-VM aliases as per data centers standard policy.

      Example: “SiteNumber+Rack_server-serialnumber_Slot:Port_SANSwitchPort”
   c. Configure the aliases using the below cli syntax and associate the storage host port with the WWPN captured from the array’s showport output:

```
#alicreate “<standard_naming_convention>”, “<WWPN from HP-VM host port>>”
For example:
#alicreate “S1R1_3M1D1X110P_S1P1_P0”, "XX:XX:XX:XX:XX:XX:XX:XX "
```

Note

An alias must be created for every host port that is cabled to SAN switch and is online.

   c. Save the configuration by running cfgsave on the SAN switch and verify the aliases created by running alishow.
   d. SSH to another SAN switch and repeat steps c and d as applicable.

5. Configure SAN zoning as per the below table.

Table 5. Mapping of Alletra ports and workload server ports for two node and four node configurations

Host Grouping	Source Port	Workload servers	HPE Alletra Storage MP B10000 port mapping
1	PCIe HBA prt 1	<1,3,5,7,9,11, 13,15,17 … fx = last host # in range +2>	N0:S3:P1, N1:S3:P1, N2:S3:P1 & N3:S3:P1
	PCIe HBA prt 2		N0:S3:P2, N1:S3:P2, N2:S3:P2 & N3:S3:P2
2	PCIe HBA prt 1	<2,4,6,8,10,12,14,16,18… fx = last host # in range +2>	N0:S4:P1, N1:S4:P1, N2:S4:P1 & N3:S4:P1
	PCIe HBA prt 2		N0:S4:P2, N1:S4:P2, N2:S4:P2 & N3:S4:P2

a. SSH to the SAN switch using management IP and appropriate login credentials.

b. Configure the zone using the following cli syntax:

```
#Zonecreate “SiteNumber+Rack_server-serialnumber_array-hostname_SlotPorts”,  “<server_alias>; <HPE Alletra MP Node#_port_alias>; <HPE Alletra MP Node#_port_alias>; <HPE Alletra MP Node#_port_alias>;<HPE Alletra MP Node#_port_alias>”

For example:

#zonecreate  ”S1R1_3M1D1X11OP_array2_S3P2”, ”S1R1_3M1D1X11OP_S1P2_P0;S1R1_array2_N0S3P2_P10;S1R1_array2_N1S3P2_P14”
```

Note

Zone creation must be done for all the HVM hosts in the HVM cluster as per the zone mapping information provided in the above table.

2. Save the configuration by executing cfgsave on the SAN switch.
3. Create and activate the configuration by running below commands on SAN switch:

```
# cfgcreate  “<<SAN-A-config-file-name”, “zones”

For example:

cfgcreate ”GLPCE_VME_SAN_A_cfg”, ”S1R1_3M1D1X11OP_array2_S3P1;S1R1_3M1D1X11OM_array2_S4P1;S1R1_3M1D1X11ON_array2_S3P1;S1R1_3M1D1X11OL_array2_S4P1”

# cfgenable  “<<SAN-A-config-file-name”
```

4. Verify the effective configuration on the SAN switch by executing **`cfgactvshow.`**
5. SSH to another SAN switch and repeat steps b to e as applicable.

Provisioning datastore via HPE Alletra Storage MP Plug-in

The HPE Alletra MP Storage Plugin enables integration between HPE Alletra Storage MP and HPE Morpheus VM Essentials. With the help of this plugin included in VM Essentials Manager, customers can create virtual machines with their virtual disks backed by volumes provisioned on HPE Alletra Storage MP.

1. Ensure all FC paths are active and reachable from each of the cluster hosts, and verify that the multipath configuration file (/etc/multipath.conf) includes the following default settings for every HPE Morpheus VM Essentials node:

```
Defaults

 {

find_multipaths yes

user_friendly_names no

}
```

2. Restart the multipath service if values are changed:

```
#sudo systemctl restart multipathd
```

Add Storage server

To add a storage server in **HPE Morpheus VM Essentials Manager**, perform the following steps:

1. Log in to the **HPE Morpheus VM Essentials Manager** user interface.
2. Navigate to **Infrastructure > Storage**.
3. Select the **Server** tab.
4. Click **Add**.
5. On the **Add Storage Server** screen, perform the following actions:

- In the **Name** field, enter a name for the storage server.
- From the **Type** drop-down list, select **HPE Alletra MP**.
- In the URL field, enter the Alletra management IP address.
- In the **Username** and **Password** fields, enter the credentials of a user account with **superuser privileges**.

Note

For information about HPE Alletra user access, refer to the HPE Support documentation: https://support.hpe.com/hpesc/public/docDisplay?docId=a00118628en_us&page=GUID-078E0F9B-1E7B-488D-A73D-90B0378BEBB4.html

---

6. Click **Save Changes**.

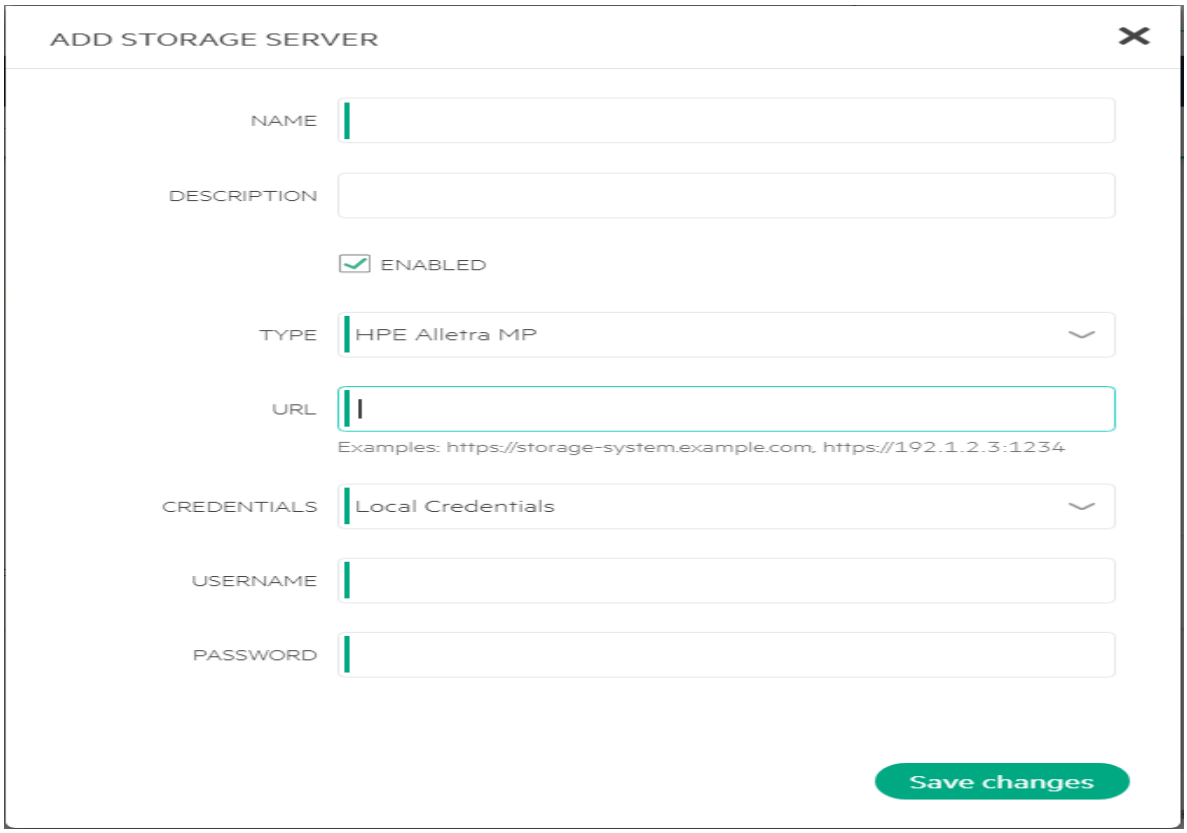


Figure 32. Alletra Storage MP plug-in

Create Alletra datastore

To create an Alletra datastore in **HPE Morpheus VM Essentials Manager**, perform the following steps:

1. In the HPE Morpheus VM Essentials Manager user interface, navigate to **Infrastructure > Clusters**.
2. Click on the name of the HPE Morpheus VM Essentials cluster where you want to add the datastore.
3. Select the **Storage** tab.
4. Under **Data Stores**, click Add.
    a. On the Add Data Store screen, perform the following actions:
    b. In the **Name** field, enter a name for the datastore.
    c. From the **Type** drop-down list, select **HPE Alletra Block Storage HVM**.
    d. From the **Storage Server** list, select the previously created storage server.
    e. From the **Protocol Type** list, select the appropriate protocol (**iSCSI or FC**).
    f. (Optional) To enable ransomware protection, select the **Ransomware Detection** checkbox. This enables ransomware detection for all virtual machines created on this datastore.
3. Click the CPG drop-down list to select a **CPG**.The list displays all CPGs available on the selected HPE Alletra storage system.
4. Click Save.

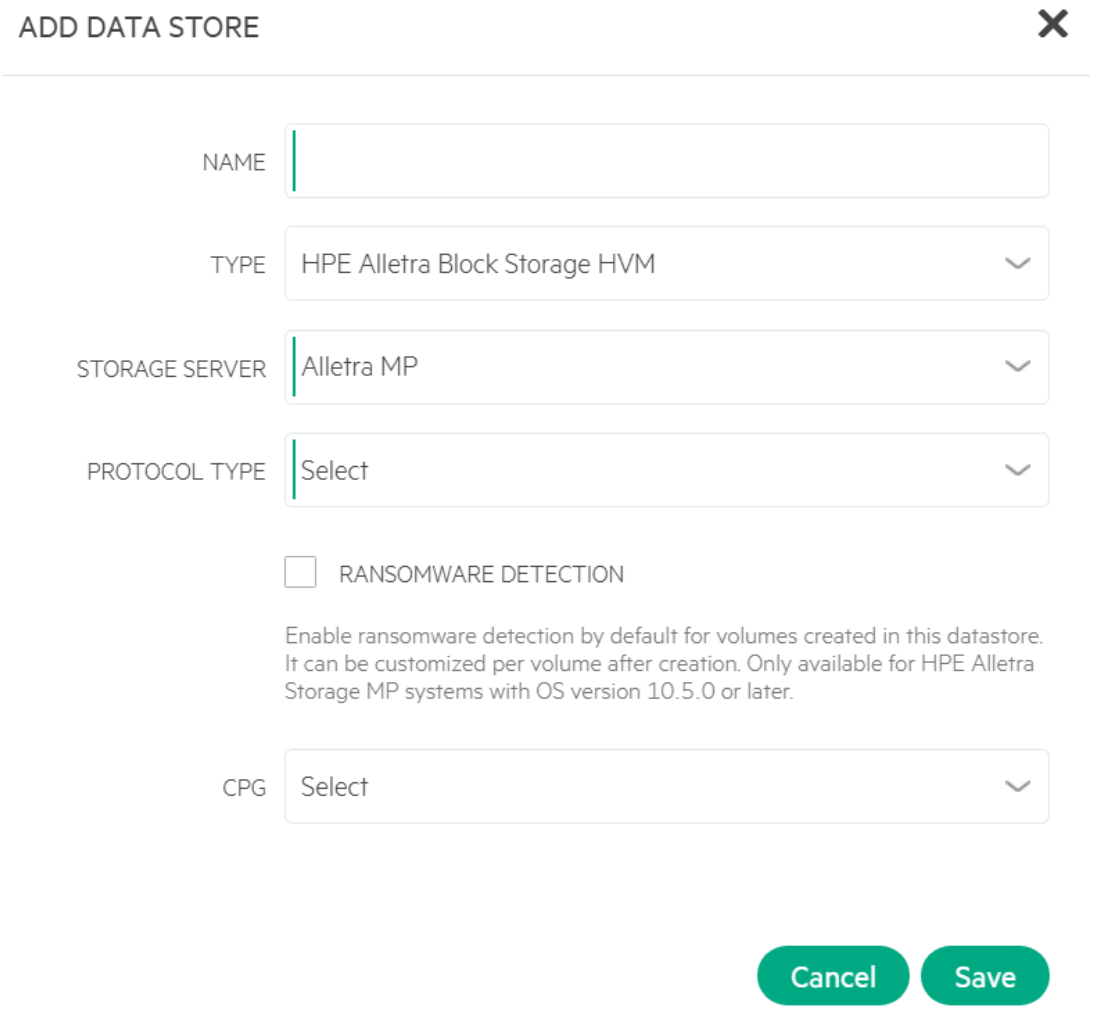


Figure 33. Alletra Storage MP datastore

Verifying the HPE Alletra datastore status

After the datastore is created, it is added and displayed under the Datastore tab.Verify the status of the newly created datastore in the HPE Morpheus VM Essentials Manager user interface. The datastore status should indicate that it is online and display the correct capacity information.

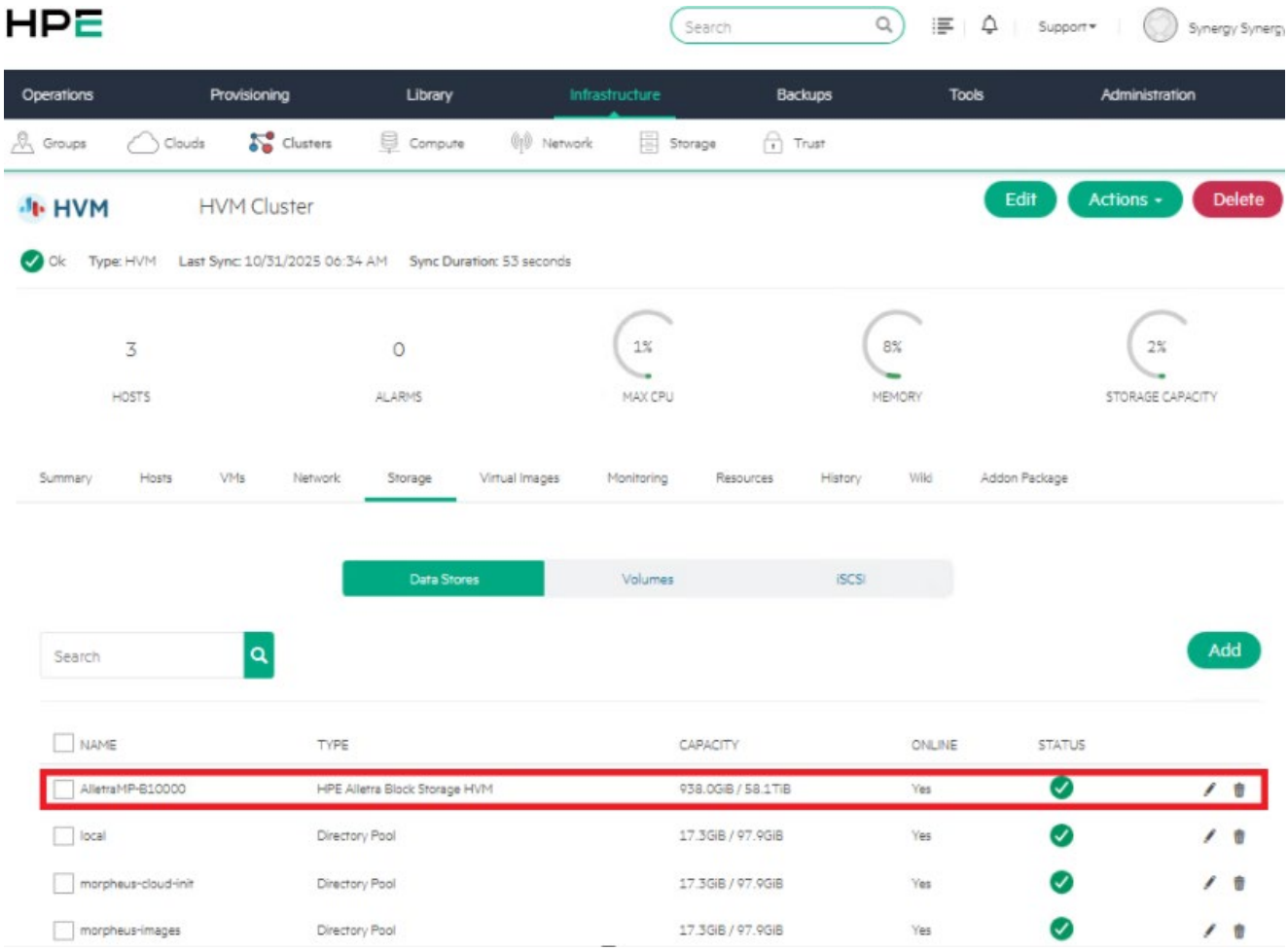


Figure 34. Alletra Storage MP datastore created on VM Essentials Cluster

Create a GFS2 Datastore on an HPE Morpheus VM Essentials Cluster

Overview

GFS2 (Global File System 2) is a clustered file system that allows multiple hosts in an **HPE Morpheus VM Essentials cluster** to simultaneously read from and write to the same shared block storage device.

To create a GFS2 datastore, a **shared Fibre Channel (FC) LUN** must first be provisioned and presented to all cluster hosts. This shared LUN is then formatted and managed as a **GFS2 datastore** by HPE Morpheus VM Essentials.

Prerequisites for creating a GFS2 datastore

Before creating a GFS2 datastore in HPE Morpheus VM Essentials, the required shared storage infrastructure must be configured and presented to all cluster hosts.

The following prerequisites must be completed:

— A Host Group exists in Data Services Cloud Console (Data Ops Manager) to present the same FC LUN to all cluster hosts.

— All HPE Morpheus VM Essentials hosts are added to the Host Group with the correct FC initiator WWNs.

— A Volume (LUN) is created on the HPE Alletra storage system and mapped to the Host Group.

— The LUN is unused and unformatted.

All hosts have FC connectivity and proper multipathing to access the LUN.

Host Group and Volume Creation in Data Services Cloud Console

Creating a Host Group in Data Services Cloud Console

1. In **Data Services Cloud Console**, launch **Data Ops Manager**.
2. From the **Menu**, select **Data Access**, then click **+** under **Host Groups**.
3. In the **Create Host Group** section, click **+ Create** to add a host to the host group.
4. In the **Create Host** dialog:
    - Enter a **host name**.
    - Select **FC** as the protocol.
    - Choose **Ubuntu** as the operating system.
    - Click **Next**.
5. In the **Initiators** section:
    - Click **+ Create**.
    - In the **Add FC Initiator** dialog, enter the **FC Qualified Names (WWNs)** for the host.
    - Click **Add**, then click **Done**.
6. Click **Next**, then click **Create** to complete the host creation.
7. Repeat steps **3–6** to add all **HPE Morpheus VM Essentials hosts** to the host group.
8. In the **Create Host Group** dialog, click **Next** to review the host details, then click **Create** to finish.

Creating a Volume in Data Services Cloud Console

1. In **Data Services Cloud Console**, launch **Data Ops Manager**.
2. From the **Menu**, select **Data Access**, then click **+** under **Volumes**.
3. In the **Create Volume** dialog, provide the following details:
    - **Volume Name**: Enter a name for the volume.
    - **Storage System**: Select the appropriate **HPE Alletra storage system**.
    - **CPG**: Select the required **Common Provisioning Group (CPG)**.
    - **Size**: Specify the volume size.
4. Under **Access**, select **Host Group**, then choose the previously created **Host Group**.
5. Verify that the **protocol** (FC) is selected automatically based on the host group configuration.
6. Review the volume configuration details.

7. Click **Create** to complete the volume creation process.

Verify Provisioned Volumes(LUNs) on Hosts of HPE Morpheus VM Essentials Cluster

1. Scan the FC host bus adapters on each host of the HPE Morpheus VM Essentials cluster using the commands following:

```
#ls /sys/class/fc_host/                                                    -- lists the
FC HBAs on the host

# echo "- - -" > /sys/class/scsi_host/<<hostx>>/scan        -- scans the host HBAs to detect
LUNs. Replace <<hostx>> with FC HBA name.
```

2. Display the FC disks on the hosts using the command:

```
#lsblk
```

3. Display the multipath target devices using the following command. Expected sample output is also shown here. The following data in the ouput indicates the datastore from HPE Alletra storage MP is successfully provisioned.

   a. 3PARdata,VV – The volume comes from an HPE Alletra Storage MP B10000 array and is a virtual volume (VV)

   b. size=XYZT – indicates XYZ TB has been provisioned

```
#multipath -ll

360002ac0000000000000000620002c335 dm-2 3PARdata,VV

size=10.0T features='1 queue_if_no_path' hwhandler='1 alua' wp=rw

|-+- policy='service-time 0' prio=50 status=active

| |- 2:0:0:1 sdk 8:160 active ready running

| |- 3:0:0:1 sdl 8:176 active ready running

`-+- policy='service-time 0' prio=10 status=enabled

  |- 4:0:0:1 sdm 8:192 active ready running

  |- 5:0:0:1 sdn 8:208 active ready running
```

Create a GFS2 Datastore in HPE Morpheus VM Essentials

1. Log into the HPE Morpheus VM Essentials Manager UI and navigate to the **HPE Morpheus VM Essentials cluster's Storage** tab.

2. Navigate to **Infrastructure > Clusters**.

3. Click the name of **HPE Morpheus VM Essentials cluster**.

4. Select **Storage** tab.

5. On **Data Stores** option, click **ADD**.

6. Add a GFS Datastore to the HPE Morpheus VM Essentials Cluster.

7. Under **Add Data Store** screen, enter a name for the datastore and set the type to GFS2 Pool.

8. Choose the block device name for the shared Alletra Fibre Channel LUN.

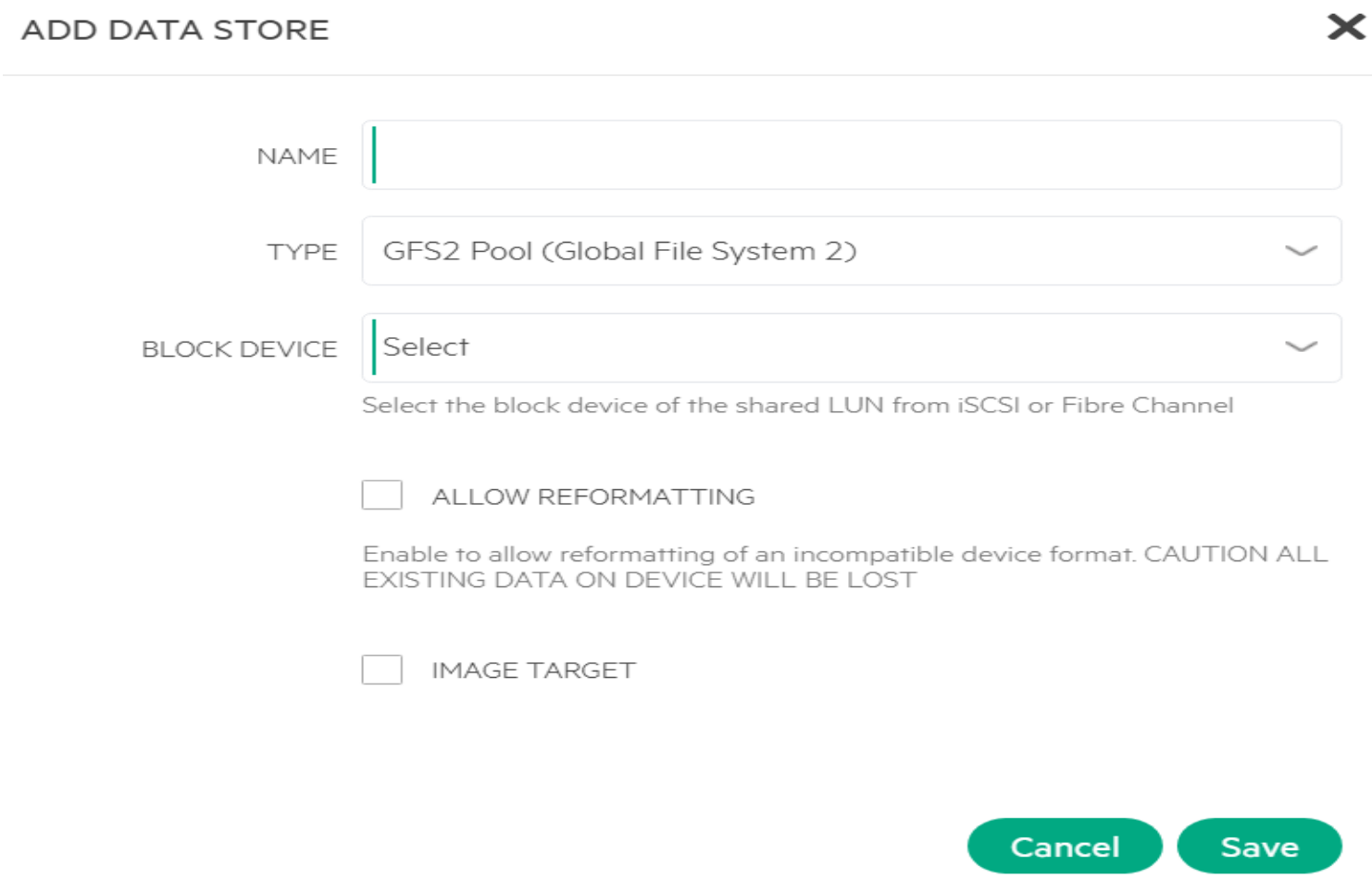


Figure 35. Add GFS2 Data store

7. Verify the status of the newly created datastore on the HPE Morpheus VM Essentials Manager. The status should show the correct capacity of the datastore and should be online.

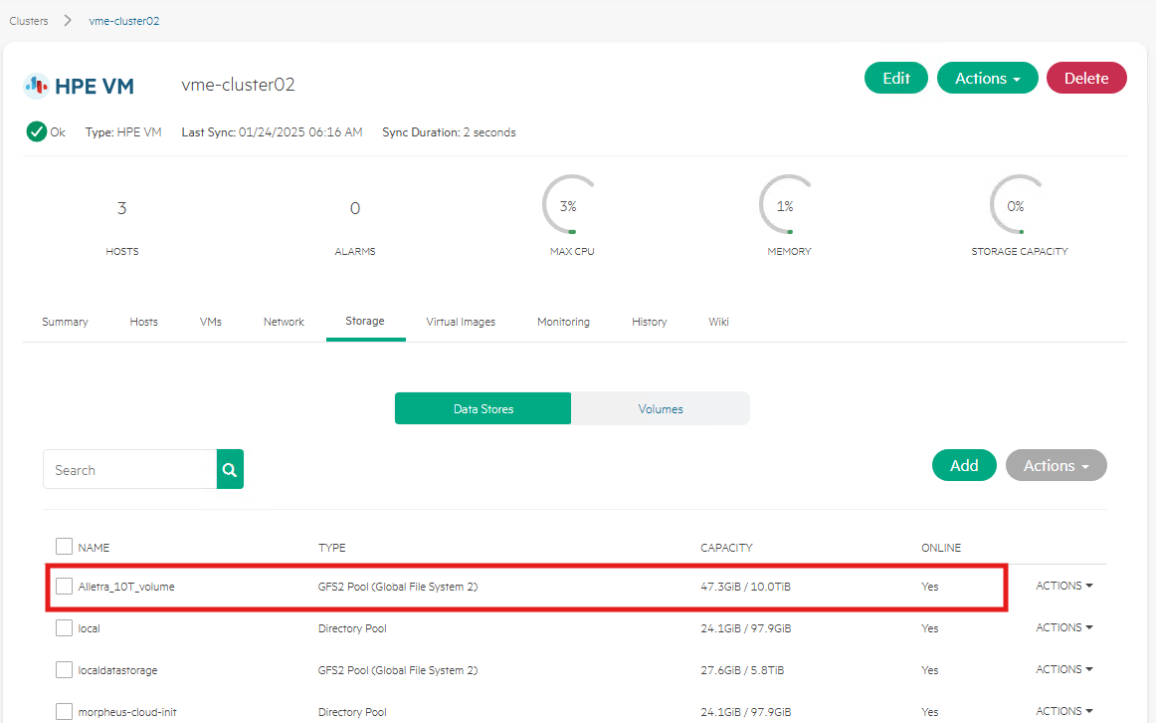


Figure 36. Verify Data Store VM Provisioning on HPE Morpheus VM Essentials Cluster

Deploy a VM on HPE Morpheus VM Essentials clusters

Before the VM is provisioned, operating system image needs to be made available to the HPE Morpheus VM Essentials Manager.

Upload OS Images to HPE Morpheus VM Essentials Manager

1. Log into the VM Essentials Manager.
2. Navigate to **Library > Virtual Images**.
3. Click **Add+** and provide the name of the virtual image.
4. Select the operating system of the virtual image and the required memory.

Note

The supported formats of the virtual images are ISO, QCOW2, RAW and VMware (vmdk/ovf/ova).

---

5. Click Add File to upload the operating system image and then click **Save** changes. The following figure shows the virtual images uploaded to HPE Morpheus VM Essentials Manager.

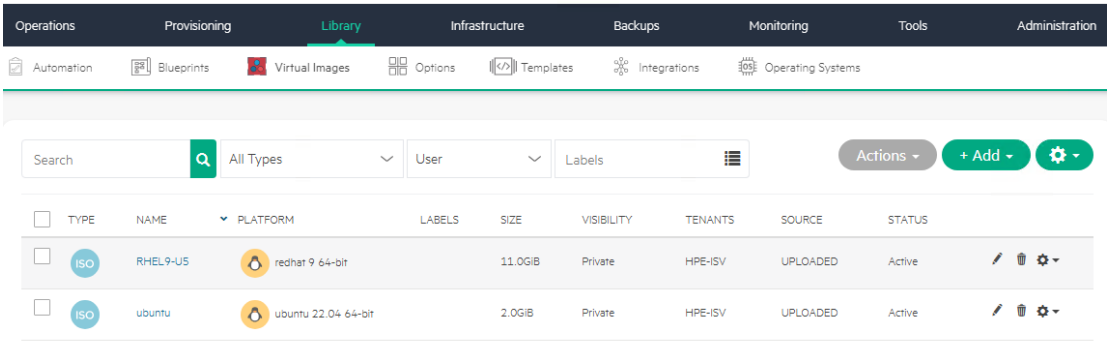


Figure 37. Virtual images

Deploy a VM on HPE Morpheus VM Essentials cluster

1. Navigate to **Provisioning > Instances**.
2. Click +Add and select HPE-VM as the instance type. Click Next.

Note

Only HPE-VM is the supported instance type on HPE Morpheus VM Essentials Manager for now.

---

3. Choose the required **Group, Cloud,** and **Environment** for the instance. Provide the Instance name.
4. Under **Configuration Options**, choose the CPU, Memory, cluster, volume, network, Host, and the VM's image.

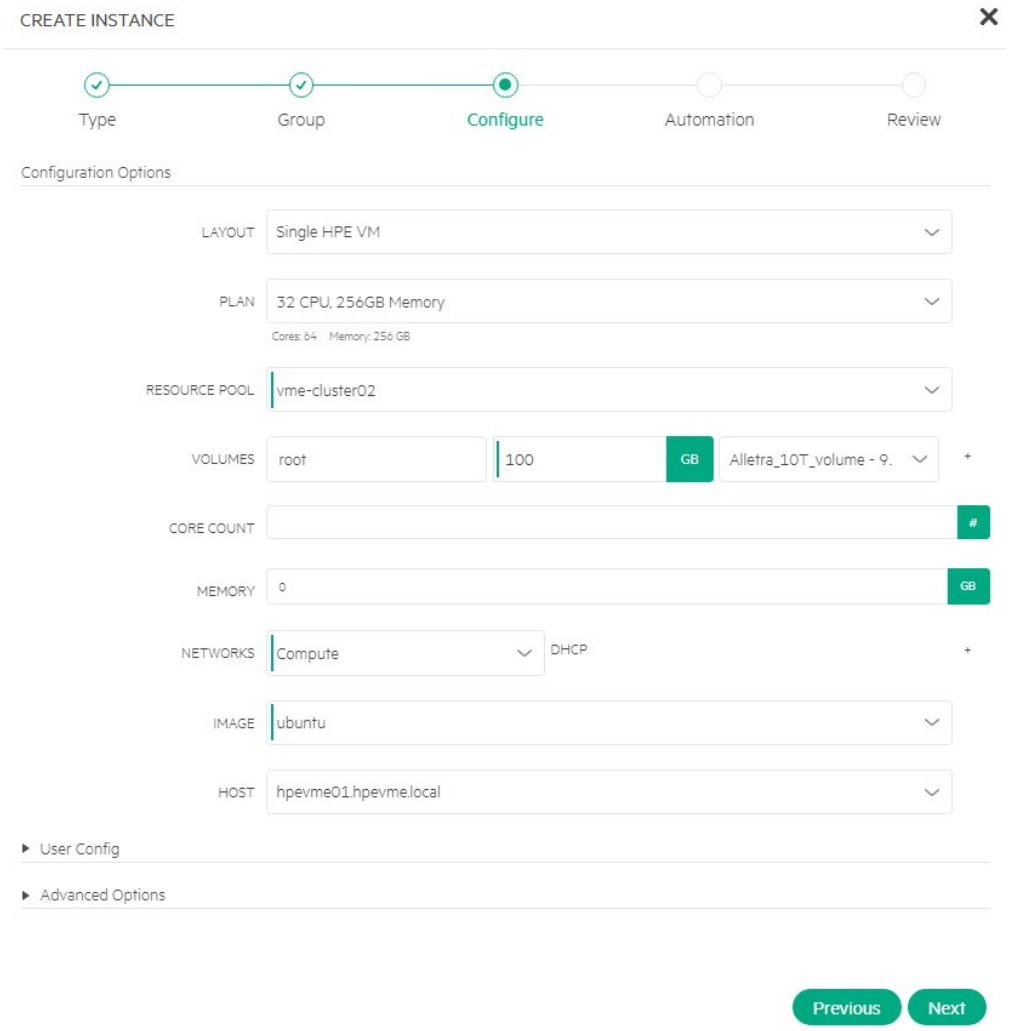


Figure 38. Create Instances

5. Click **Next** and click **Complete.**
6. After the VM gets **provisioned**, click on the **VM**.
7. Under **Actions**, select **Open Console** to start the deployment of the VM. The following figure shows the sample Ubuntu VM deployed on the HPE Morpheus VM Essentials cluster.

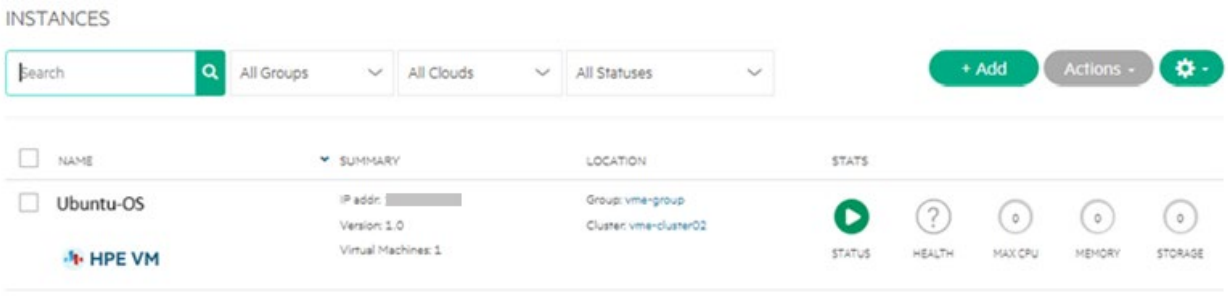


Figure 39. Verify Virtual machine deployed

HPE Morpheus VM Essentials – VMware vCenter Cloud Integration

VMware vCenter is one of the most widely adopted virtualization platforms and is fully supported as a cloud integration in HPE Morpheus VM Essentials Manager. VMware provides a mature, enterprise-grade virtualization foundation, while HPE Morpheus VM Essentials Manager extends these capabilities with centralized management, multitenancy, automation and hybrid cloud operations.

This document https://support.hpe.com/hpesc/public/docDisplay?docId=sd00007230en_us&page=GUID-30D62FE4-33A5-4AD6-8DE8-CBA6DE904A9B.html describes the supported features, prerequisites and the step-by-step process required to integrate a VMware vCenter environment with HPE Morpheus VM Essentials.

Prerequisites

Before adding a VMware cloud in HPE Morpheus VM Essentials Manager, ensure the following prerequisites are met:

vCenter Requirements

— vCenter Server reachable from the HPE Morpheus VM Essentials Manager appliance

— HTTPS (TCP 443) access from Morpheus to vCenter

— vCenter API endpoint available

Credentials

— Username and password with Datacenter-level privileges in vCenter

— Sufficient permissions to discover and manage:

- Datacenters
- Clusters
- Resource Pools
- Datastores
- Networks

VMware Cloud Integration process

This section describes the steps to add a VMware vCenter based cloud in **HPE Morpheus VM Essentials Manager** and configure its settings for integration.

Step 1: Add VMware Cloud

1. Navigate to **Infrastructure → Clouds → Add Cloud**
2. Select **VMware** as the cloud type.

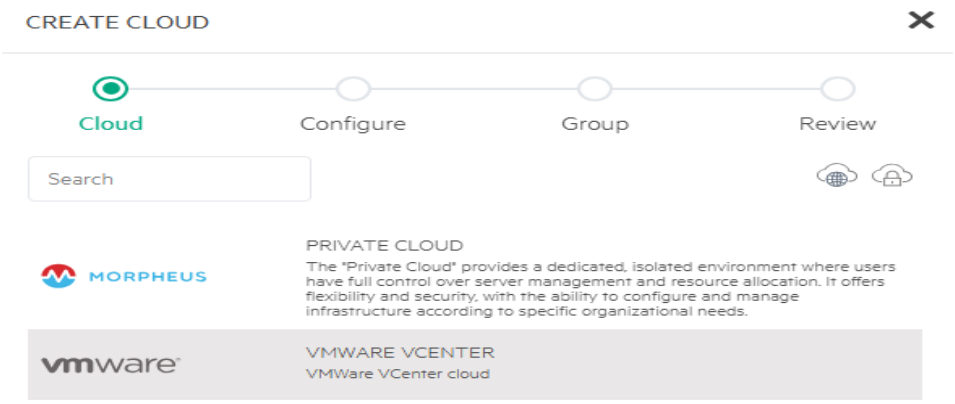


Figure 40.Create Cloud

3. Click **Next.**

Step 2: Configure Basic Cloud details

Fill in the following fields:

— **Name:** Enter a unique name for the cloud.

— **Code:** Provide a short identifier for internal reference.

— **Labels**: Add a comma-separated list of labels to group or organize items.

— **Location**: Specify the physical or logical location.

— **Automatically Power On VMs**: Enable this option if VMs should start automatically after provisioning.

Step 3: VMware Vcenter Cloud Connection details

1. **API URL**: Enter the vCenter API endpoint (e.g., https://vcenter.domain.com/sdk).
2. Enter **Username and Password** with Datacenter-level access
3. **Version**: Ensure vCenter version is **7.0+**.
4. Datacenter Selection:
   a. Select the required **Datacenter** from the drop-down.
   b. Leave **Cluster** and **Resource Pool** unscoped (default).
   c. This allows HPE Morpheus VM Essentials to automatically manage all available resources.
   d. RPC Mode:The **RPC Mode** feature allows HPE Morpheus VM Essentials Manager to install its agent on the guest operating system using one of the following methods:
      I. SSH / WinRM: Recommended for most environments because it provides reliable remote execution for Linux (SSH) and Windows (WinRM) VMs.
      II. VMware Tools Guest Process Execution: Uses the VMware Tools Guest Execution API to run commands inside the VM without requiring network access to SSH or WinRM ports.
5. Additional Configuration Options:

a. **Hide Host Selection From Users:** Ensures automated, policy-based VM placement and simplifies user experience.

b. **Inventory Existing Instances:** Brings existing VMs under HPE Morpheus VM Essentials manager for visibility and governance.

c. **Enable Hypervisor Console:** Provides secure console access for troubleshooting when network access is unavailable.

6. Click NEXT.

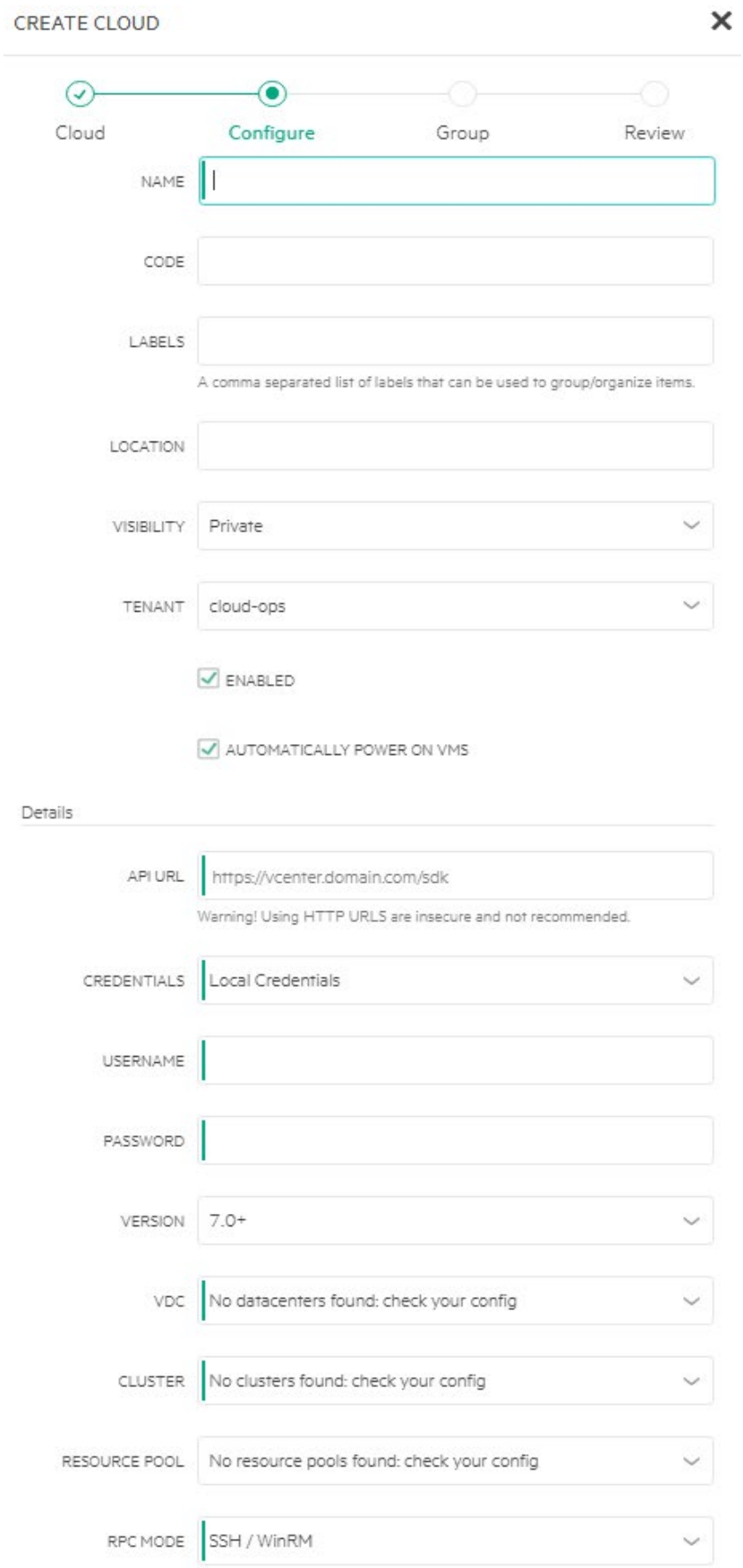


Figure 41. Create Cloud

Step 4: Assign Group

When adding a cloud, you can create a new group or add the cloud to an existing group.

These groups can be given provisioning permission via role-based access control. It is recommended that groups are organized such that one cloud exists in one group unless the networks are set up such that internal routing is possible between the clouds. This is very useful for bursting, or hybrid cloud configurations.

Step 5: Save and Sync

Click Save. HPE Morpheus VM Essentials performs an automatic inventory synchronization and completes the VMware vCenter integration.

Migrate from VMware vCenter Cloud to HVM Cloud

The bulk migration tool in VM Essentials enables the migration of existing virtual machines (VMs) from integrated VMware vCenter Clouds to HVM clusters. To create a migration, at least one VMware vCenter Cloud integration and one operational HVM cluster must already be configured. Migration Prerequisites, Limitations and Recommendations are documented here - https://support.hpe.com/hpesc/public/docDisplay?docId=sd00007230en_us&docLocale=en_US&page=GUID-5451A5D2-E2B9-4654-B082-E0D17F6279FF.html

Instance migration from a VMware vCenter Cloud to an HVM Cloud is performed through the **Migrations** section available under the **Tools** menu (**Tools → Migrations**). All migrations are carried out using **Migration Plans**.

Migration Plans are created in a **Pending** state, allowing them to be configured ahead of time and executed when required. A separate action is needed to initiate the migration. After migration is completed, the corresponding plan remains listed on the Migrations page for future reference or deletion.

Creating Migration Plans

To create a new Migration Plan, navigate to **Tools → Migrations**. This page lists all migration plans, including those that are completed, currently in progress, or pending execution.

1. Click **+ ADD** to start creating a new migration plan.
2. In the **SETUP** tab of the **Create Migration Plan** dialog, configure the following fields:
   a. **Name**: A descriptive name to identify the migration plan
   b. **Source**: The source VMware vCenter Cloud
   c. **Target**: The destination cloud that contains the HVM cluster
   d. **Resource Pool**: The target HVM cluster where the instances will be migrated
   e. **Group**: The group that will own the migrated virtual machines
3. After completing the configuration, click **NEXT** to proceed.

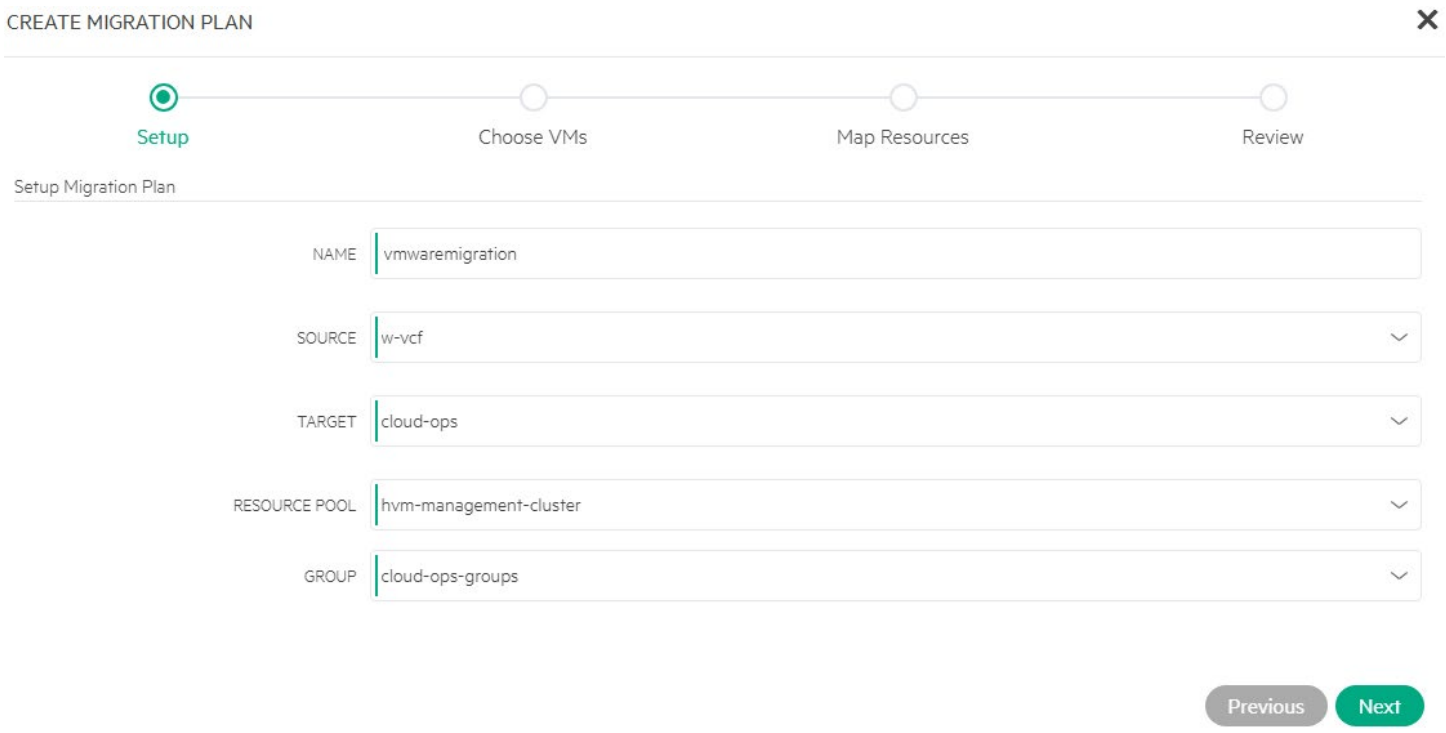


Figure 42. Create Migration plan

4. In the next step, select the virtual machines from the chosen VMware source cloud that you want to migrate. You may select multiple VMs, keeping in mind the recommended limits based on available storage capacity and network bandwidth.
5. The selected VMs will appear in a list at the bottom of the dialog. Once you have finished making your selections, click **NEXT** to continue.

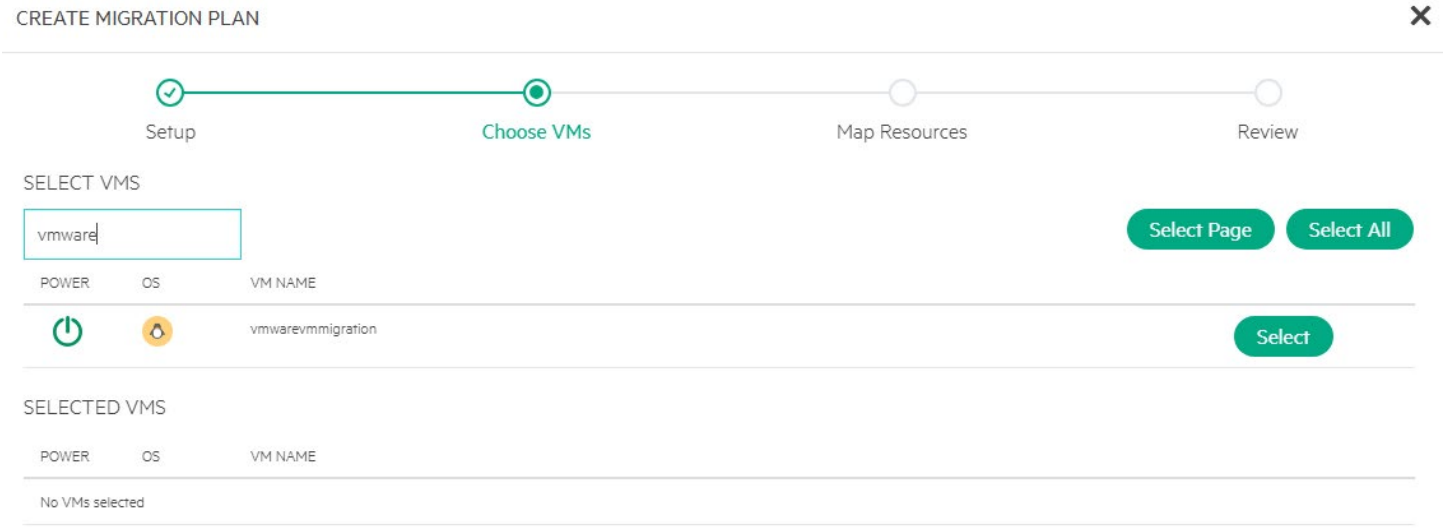


Figure 43. Create Migration plan

6. The next tab is used to configure **resource mapping**. It displays the existing network and storage configurations for the selected virtual machines.

7. For each VM, select the appropriate **destination network** and **destination storage location**. You may optionally provide existing Linux or Windows credentials. The specified user account must be present on all selected VMs and have administrator (Windows) or sudo (Linux) privileges, as these credentials are used to perform migration prechecks and in-guest operations. You may also choose to skip prechecks or guest tools installation, if required.
8. After completing the resource mapping, click **NEXT** to continue.

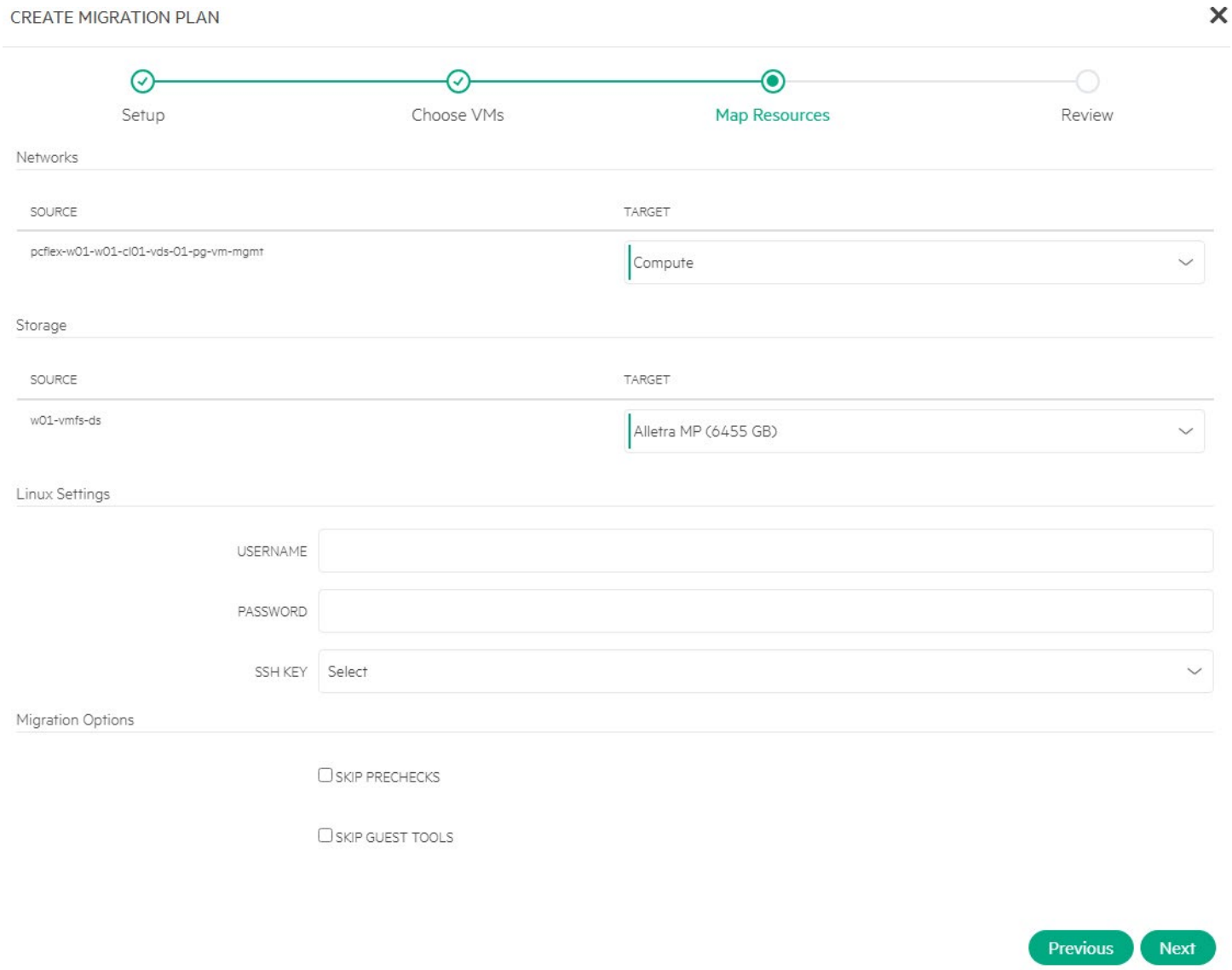


Figure 44. Create Migration plan

9. The final tab is the **Review** tab, where you can verify all configured selections. If any changes are required, you can return to the previous tabs to update your settings.
10. At this stage, the migration plan is created but does not start automatically. The migration remains in a **Pending** state until further action is taken. All configuration details are displayed on this screen.

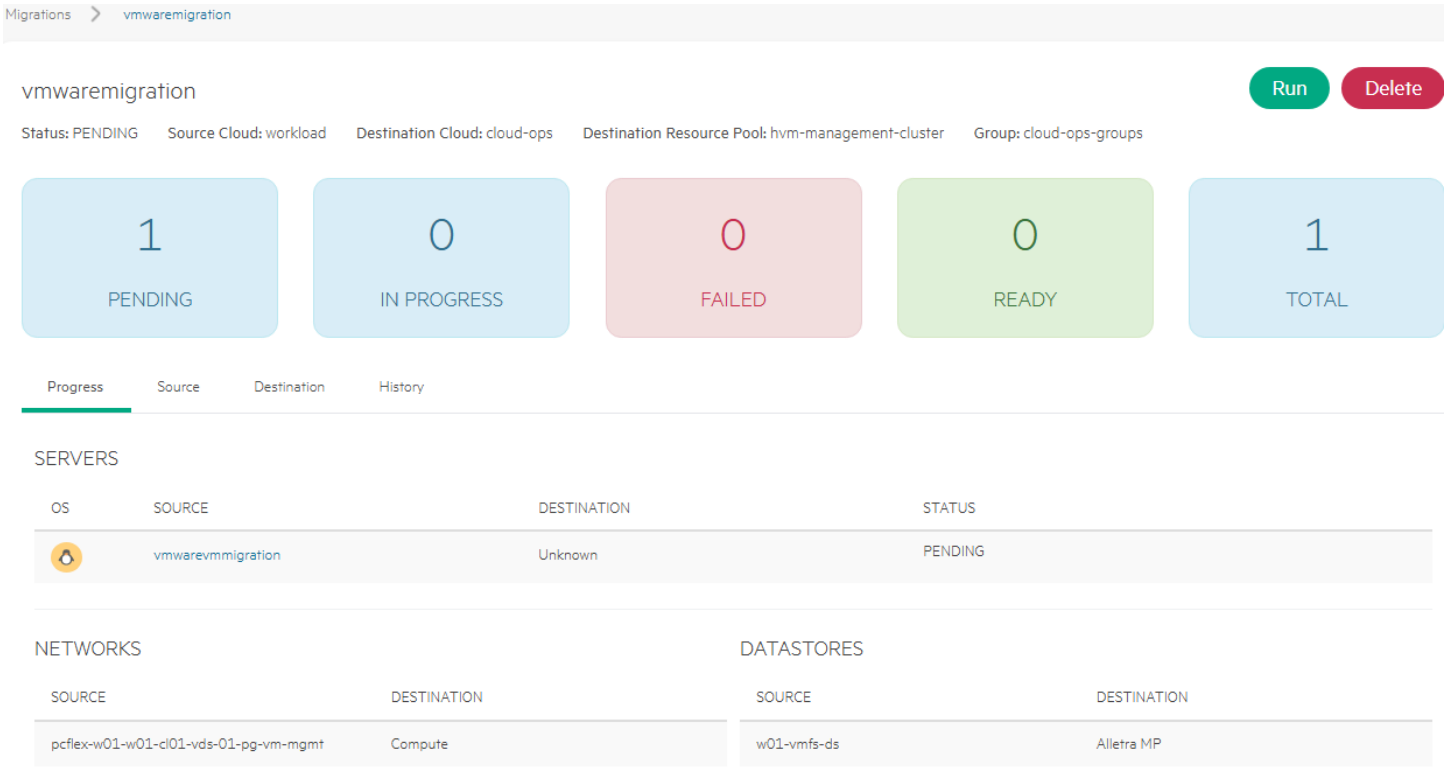


Figure 45. Review Migration plan

11. To begin the migration, click **RUN**. The duration of the migration depends on several factors, including the number of virtual machines, storage size and available network bandwidth.
12. After the migration is running, the **Migration Details** page provides real-time status updates, showing which virtual machines are in progress, completed successfully, or have failed. The **History** tab displays detailed information about both current and past migration activities. The **Destination** tab lists the VMware virtual machines that have been successfully migrated to the HVM cluster.

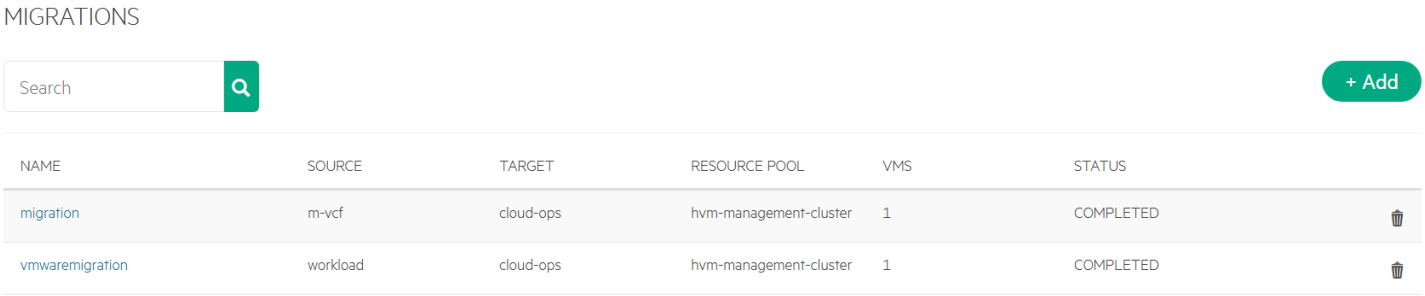


Figure 46. Migration Status

13. Each migration plan can be executed only once but may be retained indefinitely for audit or review purposes. When a migration plan is no longer required, click **DELETE** to remove it.

For more information, see VMware vCenter Clouds to HVM Clusters

Observability – HPE OpsRamp software

HPE OpsRamp is a modern IT Operations Management (ITOM), SaaS-based platform providing IT monitoring and observability, intelligent automation, and AI-driven event and incident resolution to provide end-to-end visibility and control across distributed, hybrid IT environments. For more information, refer to the HPE OpsRamp quic specs - https://www.hpe.com/psnow/doc/a50007014enw

This high-level architecture illustrates how HPE OpsRamp and its observability capabilities integrate across the private cloud environment. It highlights the platform's ability to deliver comprehensive monitoring across the entire infrastructure stack including the HPE VM Manager, HVM clusters, network switches, HPE servers, and HPE Alletra providing unified visibility and operational insights across all components.

At the core of the design is the OpsRamp Gateway, which serves as the secure bridge between on-premises infrastructure and the OpsRamp SaaS platform. The gateway connects key local components such as HPE Alletra B10000, VM Essentials (HVM clusters), Aruba switches, iPDUs, and HPE ProLiant servers to enable continuous monitoring, event ingestion, automation workflows, and dynamic topology mapping.

Within this reference architecture, the integration between HPE Morpheus VM Essentials (HVM) and OpsRamp is illustrated to demonstrate observability and monitoring integration patterns. Detailed configuration steps and feature-level documentation are available in the OpsRamp product documentation - https://docs.opsramp.com/guides/

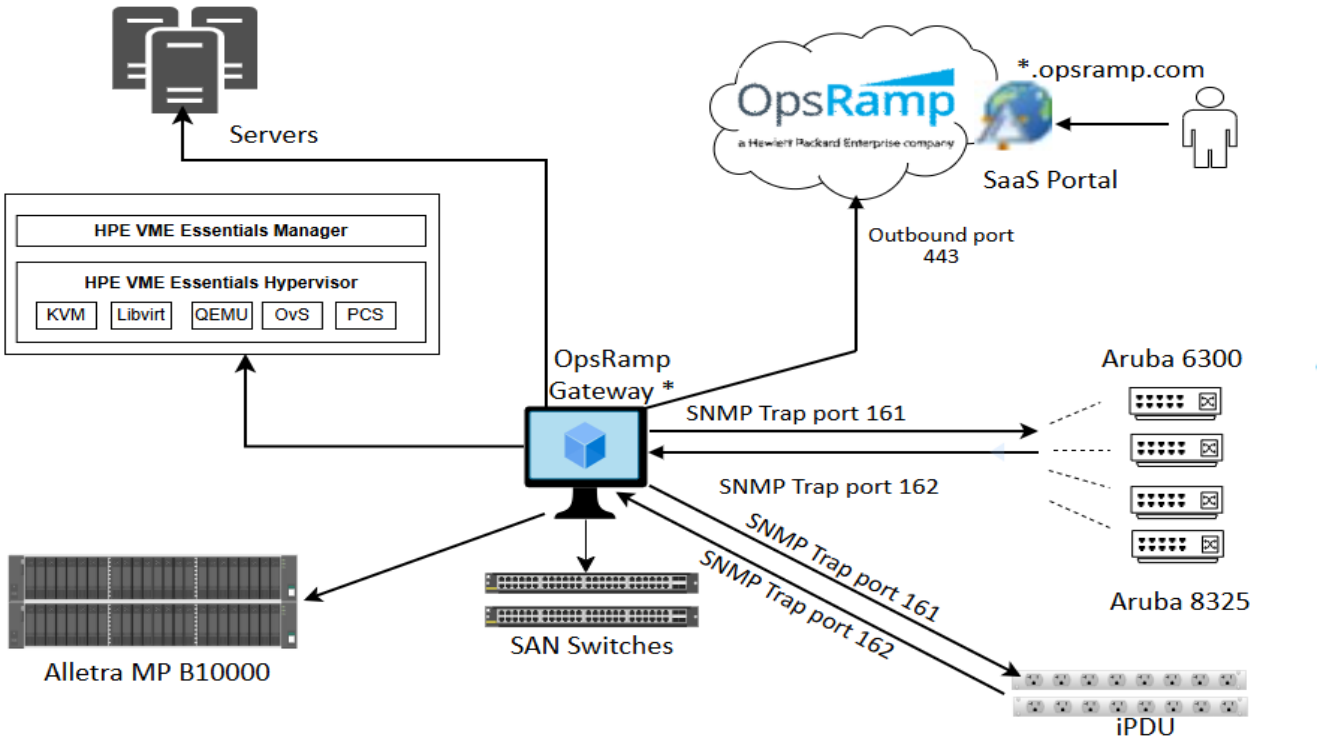


Figure 47. Observability workflow

The steps to configure this Integration in OpsRamp is documented here: https://docs.opsramp.com/integrations/virtualization/vm-essentials/working-with-vm-essentials/#configure-hpe-morpheus-vm-essentials-software. OpsRamp dashboards provides an at-a-glance view of the performance and health of your infrastructure and services. Powered by the UI-based or the advanced Prometheus Query Language (PromQL) and OpsQL queries, you can query metrics for most use cases to quickly identify issues.

After the HPE Morpheus VM Essentials Software Integration has been completed, the Dashboard to view the resources of that integration becomes available. To access the dashboard, follow the instructions below:

1. Navigate to **Dashboards ->Dashboard**.
2. Click on the Dashboard tile to access the dashboards.
3. From the OpsRamp Curated Dashboards available, select the **HPE Morpheus VM Essentials Dashboard** to view it.The sample dashboard is shown as follows.

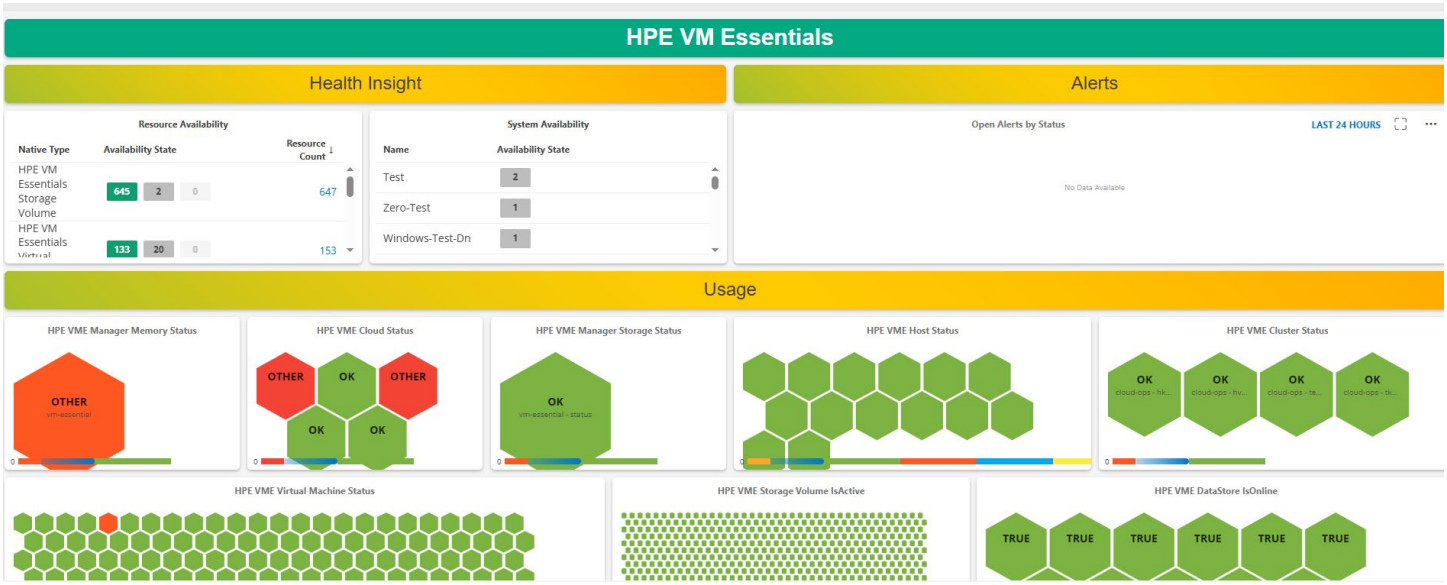


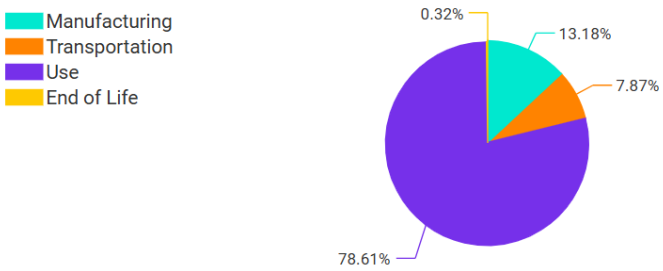
Figure 48. HPE Morpheus VM Essentials Observability Dashboard

Sustainability and Product Carbon Footprint

Hewlett Packard Enterprise helps businesses advance their IT sustainability agendas with a holistic approach to carbon footprints across the IT estate, edge to cloud. As part of this reference architecture, we are providing visibility into the carbon footprint of the IT infrastructure bill of materials for this solution. This product carbon footprint (PCF) estimates the total greenhouse gas (GHG) emissions generated over the hardware products' lifecycle, including raw materials extraction, manufacturing, transportation, use and end of life. The PCF calculation is based on an assumed delivery and use location, estimated power consumption adjusted for anticipated utilization, and an industry-standard data center PUE of 1.55 to account for energy consumption of supporting data center equipment such as power conversion and cooling equipment. This PCF can be used to understand and track the estimated environmental impact of this product.

GHG emissions by product lifecycle stage in kg CO_2e

Manufacturing	Transportation	Use	End of life	Total
8389	5014	50033	208	63644 ± 21%



Due to high customization of HPE devices, the GHG emissions can vary significantly by configuration, country, and utilization so care must be taken when comparing different HPE PCF reports. Furthermore, we are constantly updating and improving the accuracy of our PCF data and calculations. For the most up-to-date PCF estimate, refer to one of HPE configuration tools, such as HPE Power Advisor. Finally, due to differences in PCF calculation methods, PCFs generated by different tools or provided by different vendors cannot be compared. For more information about our methodology, see HPE Methodology for Product Carbon Footprint Calculations (https://www.hpe.com/psnow/doc/a00144176enw).

For questions, refer to the FAQ (https://www.hpe.com/psnow/doc/a50002945enw).

Summary

HPE Morpheus VM Essentials Software delivers a modern, enterprise-ready virtualization solution built on a KVM-based hypervisor and a unified management platform. It empowers organizations to seamlessly manage both HPE-native and existing VMware environments through a single, streamlined interface. Designed to reduce licensing costs and operational complexity, the solution supports live migration, high availability, and integrated data protection—making it an ideal foundation for hybrid infrastructure modernization.

With a flexible upgrade path to HPE Morpheus Enterprise Software, the solution extends beyond virtualization to support full-stack orchestration, automation, governance, FinOps, and integration with a broad partner ecosystem. This evolution makes it suitable for a wide range of customer use cases—from development and test environments to mission-critical production workloads.

Throughout 2026, HPE will continue to expand performance validation and solution engineering efforts to deliver targeted reference architectures and best practices for an increasingly diverse set of operational scenarios. HPE Morpheus VM Essentials leverages the extensible Morpheus integration framework, ensuring seamless interoperability with key ecosystem partners such as Cohesity, Commvault, and Veeam for enterprise-grade data protection and backup.

HPE Morpheus VM Essentials is offered as a term-based subscription, competitively priced on a per-CPU socket basis. There are no additional licensing costs for managing existing VMware clusters, making it an attractive option for organizations aiming to reduce virtualization costs while maintaining operational flexibility and compatibility.

This Reference Architecture demonstrates:

- The deployment of the HPE Morpheus VM Essentials Hypervisor along with centralized management through HPE Morpheus VM Essentials Manager.
- How to build an HPE Morpheus VM Essentials environment using supported HPE ProLiant servers (as listed in the compatibility matrix), with HPE Alletra Storage MP B10000 serving as the primary storage platform over Fibre Channel.
- How to integrate HPE OpsRamp Software to provide infrastructure-level observability across the VM Essentials Manager, HVM clusters, HPE ProLiant servers, networking, and HPE Alletra Storage MP, enabling health monitoring and dashboards.
- VMware vCenter cloud integration with HPE Morpheus VM Essentials Manager to provide unified visibility and provisioning across VMware and HVM environments, plus supported migration workflow from VMware vCenter clouds to HVM clusters.

Appendix

Appendix A: Terminology

Table A1. Terminology

Name	Description
HVM_Install_24.04.ISO	The base operating system for the HPE Morpheus VM Essentials hypervisor is HVM_Install_24.04.ISO. The installation of the base HVM_Install_24.04.ISO operating system is a requirement for deployment of the hypervisor
HPE Morpheus VM Essentials manager	The management server that provides KVM clustering, identity, virtual machine provisioning, monitoring, logging, and more
HPE Morpheus VM Essentials software	The solution software that provides a platform for running virtual machine workloads
HPE Morpheus Enterprise Software	The full solution software that adds orchestration, governance, finops, in addition to virtualization
Morpheus Agent	The software that runs on each hypervisor host that collects system stats, logs, and executes operations received from the management server
Kernel Virtual Machine (KVM)	KVM is the underlying virtualization technology used in the HPE Virtualization solution
QEMU	A generic machine emulator and virtualizer for running Windows and Linux operating systems
Libvirt	A hypervisor independent API for managing platform virtualization
Open vSwitch (OvS)	OvS is the underlying virtual networking technology used in the HPE Virtualization solution
PCS	Pacemaker/Corosync – Service that provides high availability feature for cluster resources and services.

Table A2. Terminology

Name	Description
Hypervisor network	The virtual network synced or created from VMware vSphere and HPE Morpheus VM Essentials hypervisor
HPE Morpheus VM Essentials network	The logical construct in HPE Morpheus VM Essentials used to tie together the IPAM, DNS, and the hypervisor network
Network pool	The IP address pool used to assign IP addresses to the provisioned virtual machines Native: HPE Morpheus VM Essentials includes a native IP pools capability to provide a lightweight IPAM solution IPAM Integration: HPE Morpheus VM Essentials supports integrating with third party IPAM solutions such as SolarWinds, BlueCat, Infoblox, and more
Domain	The network domain used to manage the DNS records for the provisioned virtual machines –DNS Integration

Name	Description
	–HPE Morpheus VM Essentials supports integrating with third party DNS solutions such as BlueCat, MS DNS, Infoblox, and more.
Management network	Used for managing the VM environment, including access to the HPE-VME console and hypervisor management
Compute network	Used for VM traffic between compute nodes. This network carries data traffic generated by virtual machines
Storage network	Handles traffic for accessing storage systems like NFS, or iSCSI
Aggregated network	A network model where all traffic types - management, compute and storage (iSCSI) are carried over a set of physical ethernet adapters without traffic segregation
Converged network	A network model where management and compute traffic share bonded adapters (using LACP), while iSCSI traffic is isolated over two dedicated physical ethernet adapters and Fibre Channel traffic is isolated over FC HBA's
Diverged Connectivity	A model where each traffic type management, compute, and storage use its own dedicated physical adapters.
Virtual Machine network Interface	The network interface attached to the virtual machine that is "visible" from within the virtual machine
Tap interface	The virtual connection used to connect the virtual machine to the Open vSwitch Bridge
Open vSwitch port	The virtual port on the Open vSwitch bridge that a network interface connects to
Open vSwitch Bridge	A virtual switch used to connect virtual machines and the physical network
Bonded Network Interface	A "virtual" network interface used to aggregate multiple physical network interfaces into a single "virtual" interface
Physical network interface	The physical network interface that connects to the physical network. Cloud Module instances use CX6 cards
Round Robin	Transmit packets are load balanced in sequential order across the bonded physical network interfaces.
Active-Backup	Only one physical network interface is active at a time while the other network interfaces are only used in the event of a failure.
Balance XOR	Transmit packets are load balanced across the bonded physical network interfaces based upon a hashing algorithm
802.3ad	Dynamic link aggregation mode that transmits and receives on all members in the active aggregator. Requires switch configuration and 802.3ad compliant switches
Balance-TLB (Transmit Load Balancing)	Transmit packets are load balanced across the bonded physical network interfaces based upon the transmit load.
Balance-ALB (Active Load Balancing)	Transmit and receive packets are load balanced across the bonded physical network interfaces

Appendix B: Bill of materials

Note

Part numbers are at time of publication/testing and subject to change. The bill of materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your Hewlett Packard Enterprise Reseller or Hewlett Packard Enterprise Sales Representative for more details. hpe.com/us/en/services/consulting.html

Table B1. Bill of materials

Part number	Quantity	Description
P9K40A	1	HPE 42U 600mmx1200mm G2 Enterprise Shock Rack
P9K40A 001	1	HPE Factory Express Base Racking Service
H4F41A1	3	HPE Factory Express Standard Unit of SVC
H4F42A1	15	HPE Factory Express Complex Unit of SVC
P72176-B21	3	HPE ProLiant Compute DL360 Gen12 10SFF/20EDSFF Hybrid NC Configure-to-order Server
P72176-B21 0D1	3	Factory Integrated
P72176-B21 ABA	3	HPE DL360 G12 10SFF/20EDSFF Hyb CTO Svr
HA454A1-001	3	HPE FE Proliant Svr Pkg 4 SVC
P74571-B21	6	Intel Xeon 6530P 2.3GHz 32-core 225W Processor for HPE
P74571-B21 0D1	6	Factory Integrated
P69727-B21	48	HPE 32GB (1x32GB) Dual Rank x8 DDR5-6400 CAS-52-52-52 EC8 Registered Smart Memory Kit
P69727-B21 0D1	48	Factory Integrated
P72223-B21	3	HPE ProLiant Compute DL3XX Gen12 1U 2SFF x4 Tri-Mode U.3 Stacking Backplane Kit
P72223-B21 0D1	3	Factory Integrated
P25960-B21	3	Mellanox MCX623106AS-CDAT Ethernet 100Gb 2-port QSFP56 Adapter for HPE
P25960-B21 0D1	3	Factory Integrated
R2E09A	3	HPE SN1610Q 32Gb 2-port Fibre Channel Host Bus Adapter
R2E09A 0D1	3	Factory Integrated
P48908-B21	3	HPE ProLiant DL3X0 Gen11 1U High Performance Fan Kit
P48908-B21 0D1	3	Factory Integrated
P03178-B21	6	HPE 1000W Flex Slot Titanium Hot Plug Power Supply Kit
P03178-B21 0D1	6	Factory Integrated
P78145-B21	6	HPE C13 - C14 250V 10Amp 2m FIO Power Cord
E5Y43A	3	HPE OneView for ProLiant DL Server including 3yr 24x7 Support FIO Bundle Physical 1-server LTU
P72211-B21	3	HPE ProLiant Compute DL360 Gen12 2SFF Stacking x4 CPU2 Box1/CPU1 Box1/2 Signal DA Cable Kit
P72211-B21 0D1	3	Factory Integrated

Part number	Quantity	Description
P48922-B21	3	HPE ProLiant DL3XX Gen11 Intrusion Cable Kit
P48922-B21 0D1	3	Factory Integrated
P07818-B21	3	HPE DDR4 DIMM Blank Kit
P07818-B21 0D1	3	Factory Integrated
P08040-B21	3	HPE iLO Common Password FIO Setting
P52343-B21	3	HPE Easy Install Rail 5 Kit
P52343-B21 0D1	3	Factory Integrated
P72209-B21	3	HPE ProLiant Compute DL360 Gen12 10SFF/20EDSFF Hybrid Backplane Power Cable Kit
P72209-B21 0D1	3	Factory Integrated
P73325-B21	3	HPE ProLiant Compute Localization FIO Kit
P74787-B21	6	HPE ProLiant DL3XX Gen12 High Performance Heat Sink Kit
P74787-B21 0D1	6	Factory Integrated
P77198-B21	3	HPE ProLiant Compute DL3XX Gen12 1U NS204i-u Front Enablement Kit
P77198-B21 0D1	3	Factory Integrated
P79558-B21	3	HPE ProLiant Compute 25C System Inlet Ambient Operating Temperature Configuration Tracking
P79633-B21	3	HPE ProLiant Compute DAC ACC Networking Cable Operating Configuration Tracking
P81162-B21	3	HPE NS204i-u v2 960GB NVMe SED Hot Plug Boot Optimized Storage Device
P81162-B21 0D1	3	Factory Integrated
R6B05A	2	HPE SN6700B 64Gb 56/24 24-port 32Gb Short Wave SFP28 Integrated Fibre Channel Switch
R6B05A 0D1	2	Factory Integrated
C7533A	5	HPE 1.2m/4ft CAT5 RJ45 M/M Ethernet Cable
C7533A 0D1	5	Factory Integrated
C7535A	6	HPE RJ45 to RJ45 Cat5e Black M/M 7.6ft 1-pack Data Cable
C7535A 0D1	6	Factory Integrated
C7536A	4	HPE 4.3m/14ft CAT5 RJ45 M/M Ethernet Cable
C7536A 0D1	4	Factory Integrated
QK733A	12	HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 2m Cable
QK733A 0D1	12	Factory Integrated
QK734A	8	HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 5m Cable
QK734A 0D1	8	Factory Integrated
R9F63A	2	HPE Aruba Networking CX 6300M 48G Power-to-Port Airflow 2 Fans 1 Power Supply Unit Bundle
R9F63A 0D1	2	Factory Integrated
R9F63A B2B	2	HPE Aruba Networking CX 6300M 48G Power-to-Port Airflow 2 Fans 1 Power Supply Unit Bundle PDU

Part number	Quantity	Description
R9G06A	2	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable
R9G06A B01	2	HPE Aruba Networking 50G SFP56 to SFP56 0.65m Direct Attach Copper Cable
R9F61A	2	HPE Aruba Networking CX 6300M 12VDC 250W 100-240VAC Power-to-Port Airflow Power Supply Unit
R9F61A B2B	2	HPE Aruba Networking CX 6300M 12VDC 250W 100-240VAC Power-to-Port Airflow Power Supply Unit PDU
R9F61A 0D1	2	Factory Integrated
R9F57A	2	HPE Aruba Networking 1U Universal 4-post Rack Mount Kit
R9F57A 0D1	2	Factory Integrated
R9F59A	2	HPE Aruba Networking 4-post Rack Kit
R9F59A 0D1	2	Factory Integrated
R9F67A	1	HPE Aruba Networking CX 8325-32C Power-to-Port Airflow 6 Fans 2 Power Supply Units Bundle
R9F67A 0D1	1	Factory Integrated
R9F67A B2B	1	HPE Aruba Networking CX 8325-32C Power-to-Port Airflow 6 Fans 2 Power Supply Units Bundle PDU
845416-B21	2	HPE 100Gb QSFP28 to 4x25Gb SFP28 3m Direct Attach Copper Cable
845416-B21 0D1	2	Factory Integrated
R9F77A	1	HPE Aruba Networking 100G QSFP28 to QSFP28 1m Direct Attach Copper Cable
R9F77A B01	1	HPE Aruba Networking 100G QSFP28 to QSFP28 1m Direct Attach Copper Cable
R9F78A	4	HPE Aruba Networking 100G QSFP28 to QSFP28 5m Direct Attach Copper Cable
R9F78A B01	4	HPE Aruba Networking 100G QSFP28 to QSFP28 5m Direct Attach Copper Cable
R9F67A	1	HPE Aruba Networking CX 8325-32C Power-to-Port Airflow 6 Fans 2 Power Supply Units Bundle
R9F67A 0D1	1	Factory Integrated
R9F67A B2B	1	HPE Aruba Networking CX 8325-32C Power-to-Port Airflow 6 Fans 2 Power Supply Units Bundle PDU
845416-B21	2	HPE 100Gb QSFP28 to 4x25Gb SFP28 3m Direct Attach Copper Cable
845416-B21 0D1	2	Factory Integrated
R9F77A	2	HPE Aruba Networking 100G QSFP28 to QSFP28 1m Direct Attach Copper Cable
R9F77A B01	2	HPE Aruba Networking 100G QSFP28 to QSFP28 1m Direct Attach Copper Cable
R9F78A	4	HPE Aruba Networking 100G QSFP28 to QSFP28 5m Direct Attach Copper Cable
R9F78A B01	4	HPE Aruba Networking 100G QSFP28 to QSFP28 5m Direct Attach Copper Cable
S1R06A	1	HPE Alletra Storage MP B10200 Base Configuration
S1R06A 0D1	1	Factory Integrated
581817-B21	1	HPE Configurator Defined Build Instruction Option
R7C75A	1	HPE Alletra Storage MP 10000 2U Chassis
R7C75A 0D1	1	Factory Integrated

Part number	Quantity	Description
R7D02A	2	HPE Alletra Storage MP B10230 Controller Node
R7D02A 0D1	2	Factory Integrated
S2A68A	4	HPE Alletra Storage MP 100GbE 2-port OCP Host Bus Adapter
S2A68A 0D1	4	Factory Integrated
S2S64A	4	HPE Alletra Storage MP 32Gb 4-port Fibre Channel OCP LPm37004 Host Bus Adapter
S2S64A 0D1	4	Factory Integrated
S3N85A	8	HPE 32Gb SFP28 Short Wave 1-pack LP Pull Tab Optical Transceiver
S3N85A 0D1	8	Factory Integrated
R7C76A	2	HPE Alletra Storage MP C14 1600W AC Power Supply
R7C76A 0D1	2	Factory Integrated
S3L68A	1	HPE C13 - C14 250V 10Amp Black 2m WW Power Cord
S3L68A 0D1	1	Factory Integrated
S3L69A	1	HPE C13 - C14 250V 10Amp Gray 2m WW Power Cord
S3L69A 0D1	1	Factory Integrated
S1J10A	1	HPE Alletra Storage MP 10001 NVMe Configure-to-order Expansion Shelf
S1J10A 0D1	1	Factory Integrated
R7C76A	2	HPE Alletra Storage MP C14 1600W AC Power Supply
R7C76A 0D1	2	Factory Integrated
S1R28A	2	HPE Alletra Storage MP 10010 Expansion Shelf Node
S1R28A 0D1	2	Factory Integrated
S2A68A	2	HPE Alletra Storage MP 100GbE 2-port OCP Host Bus Adapter
S2A68A 0D1	2	Factory Integrated
R9H66A	16	HPE Alletra Storage MP 1.92TB NVMe SFF Self-encrypting SSD
R9H66A 0D1	16	Factory Integrated
S3L68A	1	HPE C13 - C14 250V 10Amp Black 2m WW Power Cord
S3L68A 0D1	1	Factory Integrated
S3L69A	1	HPE C13 - C14 250V 10Amp Gray 2m WW Power Cord
S3L69A 0D1	1	Factory Integrated
S1R08A	2	HPE Alletra Storage MP 32-port 100GbE Switch Bundle
S1R08A 0D1	2	Factory Integrated
S3L68A	2	HPE C13 - C14 250V 10Amp Black 2m WW Power Cord
S3L68A 0D1	2	Factory Integrated
S3L69A	2	HPE C13 - C14 250V 10Amp Gray 2m WW Power Cord
S3L69A 0D1	2	Factory Integrated
S3Q00A	1	HPE Alletra Storage ArcusOS per TB 3-year LTU

Part number	Quantity	Description
S3Q00A 0D1	1	Factory Integrated
S0A95A	1	HPE Switch Pair Installation Kit with 4U Cable Tray
S0A95A 0D1	1	Factory Integrated
S0A98A	1	HPE Storage Data Encryption LTU
S0A98A 0D1	1	Factory Integrated
R9F76A	12	HPE Aruba Networking 100G QSFP28 to QSFP28 2m Active Optical Cable
R9F76A B01	12	HPE Aruba Networking 100G QSFP28 to QSFP28 2m Active Optical Cable
P59411-B21	2	Enlogic by nVent G3 Metered 3-phase 8.6kVA/Outlets (30) C13 (6) Combo C13/C19 PDU for HPE
P59411-B21 0D1	2	Factory Integrated
P9L11A	1	HPE G2 Rack Grounding Kit
P9L11A 0D1	1	Factory Integrated
P9L12A	1	HPE G2 Rack Baying Kit
P9L12A B01	1	HPE G2 Rack Baying Kit
P9L16A	1	HPE G2 Rack 42U 1200mm Side Panel Kit
P9L16A 0D1	1	Factory Integrated
P9T01A	1	HPE G2 PDU Environmental Temperature and Humidity Sensor
P9T01A 0D1	1	Factory Integrated
P9T02A	1	HPE G2 PDU Environmental 3 Temperature and 1 Humidty Sensor
P9T02A 0D1	1	Factory Integrated
P9T03A	1	HPE G2 PDU Open Door Sensor
P9T03A 0D1	1	Factory Integrated
120672-B21	1	HPE Rack Ballast Kit
120672-B21 0D1	1	Factory Integrated
BW930A	1	HPE Air Flow Optimization Kit
BW930A B01	1	Include with complete system
Q1H95A	1	HPE Storage 1U Rack Accessories Kit
Q1H95A 0D1	1	Factory Integrated
BW932A	1	HPE 600mm Rack Stabilizer Kit
BW932A B01	1	HPE 600mm Rack include with Complete System Stabilizer Kit
R9J32A	1	HPE Aruba Networking USB-A reversible to USB-C PC-to-Switch 3m Cable
JL448A	1	HPE Aruba Networking X2C2 RJ45 to DB9 Console Cable
H39VPA1	1	HPE Technology Remote Installation and Startup Service
H39VPA1 5A6	3	HPE Proliant DL/ML Remote Startup SVC
HU4A6A5	1	HPE 5Y Tech Care Essential Service

Part number	Quantity	Description
HU4A6A5 SVN	3	HPE One View w/Ilo Support
HU4A6A5OC4U	3	HPE DL360 Gen12 Support
142257-002	4	HPE C13 - C14 WW 250V 10Amp 2.5m Jumper Cord
R9G32AAE	2	HPE Aruba Networking Fabric Composer Device Management Service Tier 3 Switch 3y Subscription E-STU
HA113A1	1	HPE Installation Service
HA113A1 5BY	1	HPE Rack and Rack Options Install SVC
HA113A1 5MW	4	HPE Aruba Networking 6xxxN8xxx Install Swt SVC
R9G27AAE	2	HPE Aruba Networking Fabric Composer Device Management Service Tier 4 Switch 3y Subscription E-STU
H0JD4A5	1	HPE 5Y Service Credits 10 Per Yr SVC
H0JD4A5 WFM	2	HPE 5Y Service Credits Qty 50 SVC
S3Q00AAE	31	HPE Alletra Storage MP B10000 per TB 3-year Software and Support SaaS
HU4A3A3	1	HPE 3Y Tech Care Critical Service
HU4A3A3 Z78	2	HPE SN6700B 64Gb 56/24 Swch Support
HU4A3A3 ZND	2	HPE Aruba Networking 8325-32 SW Support
HU4A3A3 ZSG	2	HPE Aruba Networking 6300M 48 SW Support
HU4A3A3008L	1	HPE Alletra Storage MP 2U Chassis Supp
HU4A3A3008R	16	HPE Alletra Stg MP 1.92TB NVMe SSD Supp
HU4A3A3008W	1	HPE Alletra Stg MP Base Config Supp
HU4A3A3008X	2	HPE Alletra STG MP Block Shelf Node Supp
HU4A3A3008Z	1	HPE Alletra STG MP NVMe CTO Shelf Supp
HU4A3A3009A	6	HPE Alletra STG MP 100GbE 2p OCPHBA Supp
HU4A3A300GM	2	HPE AL STG MP 16c Clstr Blk CntrlNd Supp
HU4A3A300GQ	4	HPE Alletra STG MP 4p FC OCP HBA Support
HU4A3A300HV	2	HPE Alletra STG MP 32p 100G Swh Bdl Supp
H38NHAS	1	HPE Alletra Storage MP B10000 SVC
HA124A1	1	HPE Technical Installation Startup SVC
HA124A1 VZJ	1	HPE AlletraSTG MP B10000 DrvEncl Fld SVC
HA124A1 V1Q	1	HPE Alletra STG MPB10000BkedSwch Fld SVC
HA124A1 VZW	1	HPE Alletra Storage Arcus OS Startup SVC
HA124A1 VZN	1	HPE Alletra STG MPB10000Swch2N Srtup SVC

Resources and additional links

HPE Reference Architectures, hpe.com/info/ra

HPE Servers, hpe.com/servers

HPE Storage, hpe.com/storage

HPE Networking, hpe.com/networking

HPE Morpheus VM Essentials Software Compatibility matrix, https://support.hpe.com/hpesc/public/docDisplay?docId=sd00006551en_us&page=GUID-EA7C0803-E66B-4B17-B994-30D4025A258F.html

OpsRamp,docs.opsramp.com

HPE Alletra MP Cabling Tool- https://infosight.hpe.com/welcomecenter/cabling/?family=hfblock

HPE Alletra Storage MP B10000 quick specs - https://www.hpe.com/psnow/doc/a50006985enw.pdf?jumpid=in_pdp-psnow-qs

HPE Advisory and Professional Services, https://www.hpe.com/us/en/services/consulting.html

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