Configuration and Deployment Best Practices for SAP HANA on Dell PowerFlex Hyperconverged Infrastructure

May 2022

H17751.3

Design Guide

Abstract

This design guide provides best-practice configuration guidelines for SAP HANA deployments on Dell PowerFlex hyperconverged systems. The solution incorporates Dell PowerEdge servers, the VMware vSphere hypervisor, and PowerFlex software-defined storage.

Dell Technologies Solutions

Dell
Validated Design

Copyright

Contents

Introduction 4

Dell PowerFlex overview 6

PowerFlex system hardware requirements for SAP HANA 9

Configuring the PowerFlex system for SAP HANA 12

Configuration recommendations for SAP HANA virtual machines 19

Support requirements and considerations 25

References 28

Introduction

Executive summary

SAP HANA and S/4HANA are disrupting IT

SAP HANA is foundational for next-generation data-driven intelligent enterprise applications and processes. Consider the momentum of SAP HANA:

- Since the 2011 release of the SAP HANA platform for real-time computing, 28,000 customers have adopted the platform.
- With the 2027 end of maintenance and support for SAP Business Suite 7 applications, IT departments must begin planning a strategy and architecture to run on the SAP HANA platform.

IT departments require a modern infrastructure to deliver the performance, scale, protection, and availability to power new mission-critical, data-driven intelligent applications with SAP S/4 HANA and SAP Leonardo.

Dell Technologies has invested in the SAP HANA certification program for hardware to help customers accelerate implementations with reduced risk. Dell first partnered with SAP in 2011, when they announced the SAP HANA appliance model for targeted workloads. Since then, the Dell Technologies portfolio has expanded to include SAP's tailored data center integration (TDI), converged infrastructure (CI), and hyperconverged infrastructure (HCI) models, creating a path to run SAP HANA like any other database on shared infrastructure.

In 2018, SAP extended their SAP HANA platform support to include a certification and validation process for hyperconverged platforms, including a software-defined storage platform and a software stack for the hypervisor. SAP has certified the PowerFlex HCI deployment model, where compute and storage reside in the same server, for SAP HANA deployments.

Dell PowerFlex is a software-defined infrastructure that delivers an exceptional combination of performance, resiliency, and flexibility to meet the needs of the modern enterprise data center. PowerFlex HCI includes the VMware vSphere hypervisor and the PowerFlex platform. This validation guide describes PowerFlex configurations for running SAP HANA workloads.

Change history

Publication date	Change description
May 2022	Recertification and software version updates

Solution overview

This hyperconverged solution for SAP HANA on PowerFlex infrastructure incorporates Dell PowerFlex nodes with the vSphere hypervisor, integrated networking, and the PowerFlex software. The solution encompasses design configurations and deployment options. Customers use SAP sizing tools to size SAP systems on VMware virtualized infrastructure, and then work with Dell Technologies representatives to determine the PowerFlex HCI requirements and configure and deploy the PowerFlex solution.

Key benefits

This PowerFlex HCI solution enables organizations to innovate faster and accelerate their IT operations. Customers implementing the solution can expect the following benefits:

- **Agility**—A modern SAP landscape management experience that delivers PowerFlex infrastructure for SAP applications including SAP HANA. The solution provides a faster time-to-value and the ability to rapidly respond to changing business requirements.
- **Engineering**—Compute, networking, storage, hypervisor, and management components that are integrated, manufactured, supported, and sustained as a single product to deliver a seamless solution experience.
- **Performance**—Supreme I/O performance, high bandwidth, and submillisecond latencies with PowerFlex software. Throughput and IOPS scale in direct proportion to the number of nodes that are added to the system.
- **Simplicity**—Simplified and unified PowerFlex management with management and operations software, making it easier to implement, consume, and manage resources.
- **Flexibility**—The ability to design and implement software-defined data centers that are based on your applications, budget, and growth demands. Add units incrementally and adjust compute and storage resources linearly or independently based on your needs.

Document purpose

This guide provides validated best practices for the design and configuration of virtualized SAP HANA deployments on PowerFlex hyper-converged infrastructure leveraging vSphere hypervisor .

The guide does not replace the requirement for PowerFlex implementation services by Dell Technologies Professional Services. Detailed PowerFlex installation and implementation documentation is available for Dell Technologies service personnel only.

Audience

This guide is intended for SAP Basis, system, and storage administrators and presales architects who design mission-critical SAP HANA systems for deployment on PowerFlex hyperconverged systems. Some knowledge of PowerFlex systems, PowerEdge servers, and VMware vSphere hypervisor is recommended.

We value your feedback

Dell Technologies and the authors of this document welcome your feedback on the solution and the solution documentation. Contact the Dell Technologies Solutions team by email .

Authors: Donagh Keeshan, Vinutha Shenoy

Contributor: Aighne Kearney

Note: For links to additional documentation for this solution, see the Dell Technologies Solutions Info Hub for SAP.

Dell PowerFlex overview

Introduction

PowerFlex is a software-defined infrastructure platform that reduces operational and infrastructure complexity. PowerFlex empowers organizations to move faster by delivering flexibility, elasticity, and simplicity with predictable performance for mission-critical workloads, while also providing resiliency at scale. The PowerFlex family provides a foundation that combines compute and high-performance storage resources in a managed, unified fabric.

PowerFlex benefits

PowerFlex aggregates resources across a broad set of nodes, unlocking massive input, output, and throughput performance while minimizing the latency. Its self-balancing architecture eliminates any hotspots and ensures consistency and simplicity over time. You can scale the system while linearly scaling performance from a minimum of four nodes to thousands of nodes, on-demand, and without any disruption. With its self-healing architecture, PowerFlex can handle outages, upgrades, and maintenance without downtime, resulting in near-total availability.

Flexible and dynamic architecture

PowerFlex offers flexibility to mix and match the storage, compute, and hyperconverged nodes in a dynamic deployment, enabling you to scale storage and compute resources together or independently, one node at a time, in line with your requirements.

Shared platform for heterogeneous workloads

The PowerFlex platform can support a broad range of operating environments simultaneously, including bare-metal operating systems, hypervisors, and container platforms with a unified underlying infrastructure and management. You can also support heterogeneous workloads with varying requirements on a shared infrastructure platform and modernize your application architectures on your schedule.

Extensive automation for predictability and simpler workflows

PowerFlex offers full-stack IT Operations Management (ITOM) and Life Cycle Management (LCM) with PowerFlex Manager. It provides extensive automation capabilities with PowerFlex Manager REST APIs and custom Ansible modules to integrate with your infrastructure, application, and DevOps workflows. PowerFlex Manager enables automated deployments and expansions with minimal intervention for the IT team.

Broad ecosystem of workload solutions

PowerFlex is designed to deliver superior outcomes at any scale for the most demanding mission-critical environments. It is optimized for a wide range of validated workload solutions, ranging from traditional relational databases and modern cloud-native NoSQL databases to throughput-intensive analytics workloads.

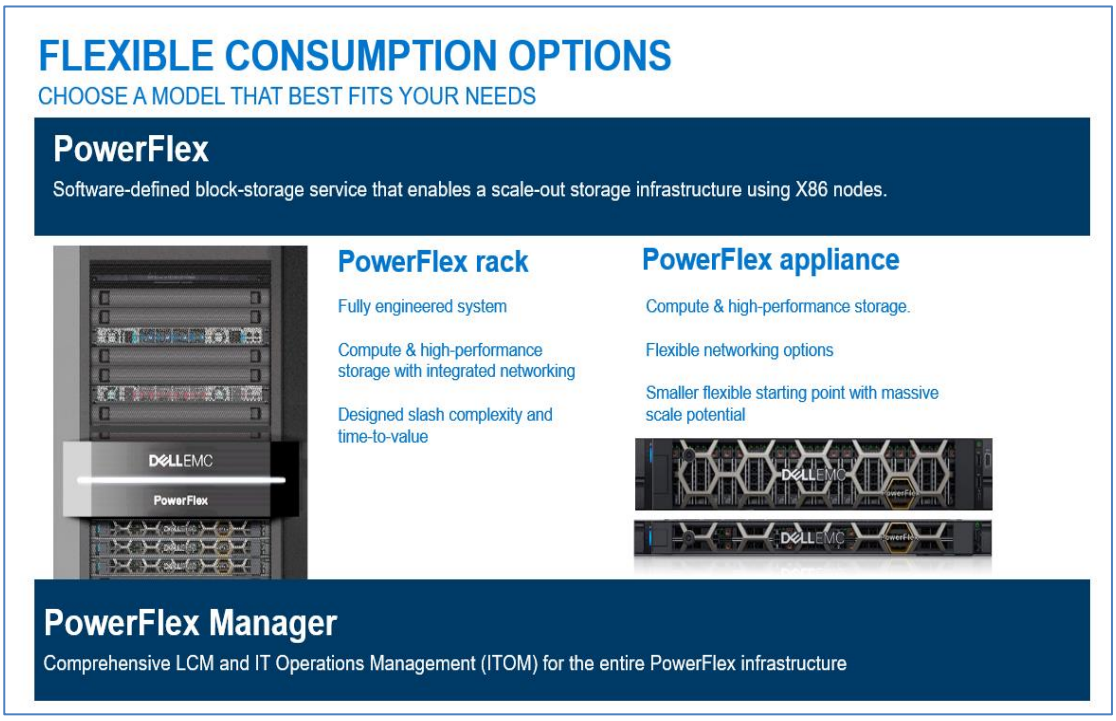

Figure 1. PowerFlex family

PowerFlex software components

PowerFlex software components provide software-defined storage services. The software components help to simplify the infrastructure management and orchestration with comprehensive ITOM and LCM capabilities that span compute and storage infrastructure, from BIOS and firmware to nodes, software, and networking.

PowerFlex

PowerFlex, the software foundation of the PowerFlex platform, delivers high performance with a highly resilient block storage service that can scale to thousands of nodes.

PowerFlex Manager

PowerFlex Manager is the PowerFlex software component that enables ITOM automation and LCM capabilities while enabling flexible APIs and extensive automation.

PowerFlex consumption options

PowerFlex is available in multiple consumption options to help customers meet their project and data center requirements. The PowerFlex appliance and PowerFlex rack give customers the flexibility to choose a deployment option to meet their exact requirements.

PowerFlex rack

The PowerFlex rack is a fully engineered system with integrated networking that enables customers to simplify deployments and accelerate time to value.

PowerFlex appliance

The PowerFlex appliance allows customers the flexibility and savings to choose their own compatible networking. The PowerFlex appliance offers customers a smaller starting point of four nodes, while enabling them to use their existing network infrastructure.

Using PowerFlex, customers can deploy to match their initial needs and easily expand with massive scale potential, without having to compromise on performance and resiliency.

Flexible consumption-based billing options

PowerFlex is available through APEX custom solutions by the APEX Flex on Demand and APEX Datacenter Utility for customers who are looking to adopt consumption-based OpEx models.

APEX Flex on Demand

APEX Flex on Demand lets you pay for technology as you use it and provides immediate access to buffer capacity. Your payment adjusts to match your usage.

APEX Datacenter Utility

APEX Datacenter Utility provides the leading product portfolio from Dell Technologies that is coupled with your choice of professional services and support to manage your data center and its operations. A simple and single invoice provides monthly payments that are based on a predictable rate and vary based on your usage.

SAP HANA-certified PowerFlex system components

The following table shows the PowerFlex system components that are certified for SAP HANA:

Table 1. SAP HANA-certified PowerFlex components

Components	Configuration
Consumption model	Dell PowerFlex integrated rack Dell PowerFlex appliance
Compute	Dell PowerFlex nodes: PowerFlex-R640, PowerFlex-R740xd, PowerFlex-R840
CPU architecture	Intel® Xeon® Scalable Processors (Skylake and Cascade Lake): Silver, Gold, Platinum
Storage	Local SSD/NVMe drives
Storage virtualization	PowerFlex 2.6, 3.0, and 3.6.x
Networking	Cisco Nexus switches
Hypervisor support	VMware vSphere 6.5, 6.7, and 7.0.x
Bare-metal support	Not supported; SAP certification applies only to PowerFlex HCI nodes running VMware vSphere
Management infrastructure	PowerFlex Manager, PowerFlex UI, VMware vCenter

PowerFlex deployment models

Two deployment options are available with PowerFlex systems:

- **HCI/single-layer architecture**—A model in which compute and storage reside in the same server, creating a single-layer architecture.
- **Two-layer model**—A model resembling a traditional SAN architecture, with compute and storage nodes managed independently.

The SAP rules for SAP HANA HCI certification enable deployment of SAP HANA only in an HCI/single-layer architecture. The two-layer model is not supported.

PowerFlex system hardware requirements for SAP HANA

Introduction

You can deploy SAP HANA on an existing or new PowerFlex hyperconverged system if your environment meets these hardware requirements.

SAP HANA HCI certification

SAP has certified SAP HANA on PowerFlex HCI systems. PowerFlex nodes with Intel Skylake and Cascade Lake are supported and listed separately on the Certified and Supported SAP HANA hardware directory. Both PowerFlex certifications encompass:

- HCI/single-layer architecture with a vSphere hypervisor and the PowerFlex system. The SAP certification includes support for PowerFlex PowerEdge systems and both dual-socket R640 and R740xd servers and the four-socket R840 server.
- Support for half-socket and full-socket SAP HANA virtual machines (VMs). Half-socket deployments provide better use of CPU resources for smaller SAP HANA systems and enable two SAP HANA VMs to run on a single CPU socket, with each VM using 50 percent of the available physical cores. Full-socket SAP HANA VMs use a single socket (or multiple sockets) and all physical cores exclusively.

Note: The SAP HANA HCI certification for PowerFlex systems does not include support for the two-layer deployment model, bare-metal deployments, or any hypervisors other than vSphere.

SAP HANA sizing considerations

Before you deploy SAP HANA on a PowerFlex system, determine the number of production and nonproduction SAP HANA systems that you require and the CPU, memory, and disk capacity requirements for these systems.

With SAP HANA TDI Phase 5, SAP introduced customer-workload-driven SAP HANA system sizing. SAP application performance standard (SAPS) requirements for specific customer workloads are used to determine the type and number of processors that are required to run SAP HANA. Customers use the SAP HANA Quick Sizer tool and sizing reports to determine the optimal number and types of PowerFlex nodes, CPU types, and memory sizes and disks for their SAP HANA environment, and then communicate the results to Dell.

For more information about SAPS, see SAP Standard Application Benchmarks.

For more information about the Quick Sizer tool, see Quick Sizer.

CPU considerations

In addition to the CPU and memory requirements for the SAP HANA VMs, consider the CPU and memory requirements for the vSphere hypervisor and PowerFlex system. For the hypervisor, add 10 percent of the CPU resources to the SAP HANA CPU requirements to account for the vSphere overhead. The PowerFlex platform requires one CPU socket on each physical node for the PowerFlex storage VM (SVM). SAP does not allow sharing of this socket with production SAP HANA VMs.

Customers can order PowerFlex systems with four-socket nodes (the R840 server) and two-socket nodes (R640 and R740xd servers).

- On a four-socket node, three sockets are available for SAP HANA (75 percent).
- On a two-socket node, one socket is available for SAP HANA (50 percent).

These restrictions apply to production SAP HANA VMs only. Nonproduction SAP HANA VMs or non-SAP HANA VMs can share a CPU socket with the PowerFlex SVM.

Note: SAP might review these restrictions in the future and allow the running of production SAP HANA VMs on the same socket as the PowerFlex SVM. Refer to the latest SAP Notes when planning your SAP HANA on PowerFlex solution (access requires login credentials).

PowerFlex nodes for SAP HANA require Intel Silver, Gold, or Platinum CPU models offering different clock speeds and core counts. PowerFlex allows the installation of half-socket SAP HANA VMs, while the smallest configurable SAP HANA VM requires at least eight physical cores. Consider using CPUs with at least 16 cores in the PowerFlex nodes for half-socket SAP HANA VM deployments.

Memory requirements

SAP has restrictive requirements for the physical memory configuration of an SAP HANA server. These restrictions also apply to virtualized servers such PowerFlex nodes. A symmetric, homogeneous assembly of Dual In-Line Memory Modules or DIMMs (the memory chips in the server) with maximum utilization of all memory channels per processor is required. Figure 2 and Figure 3 show the permitted configurations of the PowerFlex nodes for SAP HANA.

The following figure shows the supported DIMM/memory configurations for R640 and R740xd servers:

Two Socket Systems								
DIMM Size/System Memory	192 GB	384 GB	576 GB	768 GB	1,152 GB	1,536 GB	2,304 GB	3,072 GB
8 GB DIMMs	24							
16 GB DIMMs	12	24	12 + 12					
32 GB DIMMs		12		24	12 + 12			
64 GB DIMMs				12		24	12 + 12	
128 GB DIMMs						12		24

Figure 2. DIMM/memory configurations for R640 and R740xd servers

The following figure shows the supported DIMM/memory configurations for R840 servers:

Four Socket Systems									
DIMM Size/System Memory	192 GB	384 GB	768 GB	1,152 GB	1,536 GB	2,304 GB	3,072 GB	4,608 GB	6,144 GB
8 GB DIMMs	24	48							
16 GB DIMMs		24	48	24 + 24					
32 GB DIMMs			24		48	24 + 24			
64 GB DIMMs					24		48	24 + 24	
128 GB DIMMs							24		48

Legend	
	Recommended
	Neutral (Mixed DIMM Configuration)
	Not allowed by SAP HANA memory population rules
	Not supported by PowerEdge platform

Figure 3. DIMM/memory configurations for R840 servers

Disk considerations

The PowerFlex system organizes the storage cluster into protection domains and storage pools.

Protection domains

A protection domain is a subset of storage data servers (SDS), the functionality of the PowerFlex SVM that runs on each host. At least four hosts are required in a protection domain. All the hosts in the domain must have the same configuration—for example, one protection domain for the four-socket R840 nodes and another protection domain for the two-socket R640 nodes.

Storage pools

A storage pool is a subset of the physical storage devices in a protection domain. The persistent devices (data and log) of the SAP HANA production nodes require the capacity to be allocated on SSD storage pools. Each PowerFlex node requires at least eight SSDs. The size and number of SSDs depend on the capacity requirements, as described in the following section.

Capacity requirements

If the data that is written to the PowerFlex cluster is configured within a protection domain, it is mirrored on two different physical nodes (SDSs). Therefore, it is necessary to double the estimated capacity that is required for the SAP HANA deployments and add the spare capacity requirement to determine the final capacity requirements. If vSphere VM snapshots or PowerFlex storage snapshots are used, this capacity must also be considered.

Spare capacity

In a PowerFlex cluster, spare capacity is reserved for the PowerFlex system to use when recovery from a failure is required. The spare capacity stores rebuilt data after a component failure and cannot be used for storage allocations. The spare capacity must be at least the size of the largest node.

Network

To support the SAP HANA bandwidth requirements, Dell requires 25 GbE network connectivity of the PowerFlex nodes.

In addition to the system networks required for vSphere and PowerFlex, configure the following networks for SAP HANA when the function is used:

- App server
- Clients
- System replication
- Internode
- Backup

We recommend creating a vSphere distributed switch (VDS) for the networks that you require for SAP HANA and assigning additional 2 x 25 GbE network cards as uplinks to this new distributed switch. To meet the performance requirements of the SAP HANA internode network communication, set an MTU size of 9,000 on this distributed switch and in the operating system network settings of the SAP HANA VM for the internode network. For information about configuring networks on a distributed switch, see Dell EMC PowerFlex Networking Best Practices and Design Considerations.

Configuring the PowerFlex system for SAP HANA

PowerFlex benefits

PowerFlex software uses the local disks and LAN of existing servers to create a virtual SAN that has all the benefits of external storage at a fraction of the cost and complexity. PowerFlex turns the existing local storage devices into shared block storage. For many workloads, PowerFlex storage is comparable to, or better than, external shared block storage.

PowerFlex software enables administrators to add or remove servers and capacity on-the-fly. The software immediately responds to the changes by rebalancing the storage distribution and achieving a layout that optimally suits the new configuration.

PowerFlex is designed and implemented with enterprise-grade resilience. In addition, the PowerFlex software features an efficient distributed self-healing process that overcomes media and server failures without requiring administrator involvement.

PowerFlex virtual SAN components

The PowerFlex virtual SAN consists of the following software components:

- **Meta Data Manager (MDM)**—Configures and monitors the PowerFlex system.
- **Storage Data Server (SDS)**—Manages the capacity of a single server and acts as a back-end for data access. The SDS is installed on all servers that are contributing storage devices to the PowerFlex system. These devices are accessed through the SDS.
- **Storage Data Client (SDC)**—A lightweight device driver that resides in the ESXi kernel that exposes PowerFlex volumes as block devices to the vSphere hypervisor.

PowerFlex software in an ESXi-based system

In the VMware environment, the MDM and SDS components are installed on a dedicated SVM, while the SDC is installed directly on the ESXi host. The following figure shows the architecture:

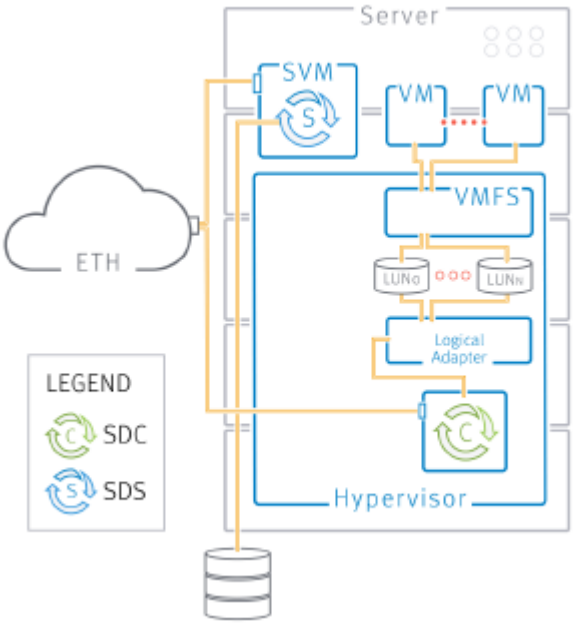

Figure 4. PowerFlex on VMware ESXi

PowerFlex checksum feature

The PowerFlex system uses checksums to protect data that transits through the system. You can enable the checksum feature at the protection domain level and define it at the storage pool level. Depending on the type of workload, the checksum feature can have a significant impact on the performance.

SAP does not require a checksum feature for SAP HANA on the storage subsystem—in this case, the PowerFlex system. SAP HANA uses its own checksums to protect data that is stored on the persistence layer.

For the highest data protection requirements, the PowerFlex checksum feature is supported and can be enabled on the storage pool that is used for the SAP HANA persistence.

Note: The SAP HANA performance criteria for the persistence are met even with the checksum enabled.

PowerFlex management tools

You can provision, maintain, and monitor the PowerFlex system by using the following management clients:

- **Command Line Interface (CLI)**—The CLI enables you to perform the entire set of configuration, maintenance, and monitoring activities in the PowerFlex system. The CLI is available on the MDM node.
- **User Interface (UI)**—The PowerFlex UI is a web application that enables you to perform standard configuration and maintenance activities and to monitor the health and performance of the storage system. You can use the UI to view the entire

system and examine different elements as well as provision and modify many of the PowerFlex front-end and back-end components and features.

- **VMware plug-in**—The plug-in enables you to perform basic provisioning and maintenance activities in the VMware environment. The plug-in also provides a wizard to help you deploy the PowerFlex system in the VMware environment.
- **PowerFlex Manager**—With PowerFlex Manager, which automates the complex LCM and ITOM for the storage infrastructure, PowerFlex offers a robust tool set for simplifying IT operations for the entire infrastructure. PowerFlex Manager is deployed as a virtual appliance on the PowerFlex Management cluster.

Note: You can perform many PowerFlex activities using more than one management tool.

SVM with SAP HANA VMs

The PowerFlex SVM is a Linux-based VM that is dedicated to the PowerFlex system. The PowerFlex SVM must run on a single CPU socket on each physical node in the PowerFlex cluster. The SVM requires a minimum of eight vCPUs (cores). Although the CPU socket might have additional cores available, sharing this socket with production SAP HANA VMs is not permitted. The remaining cores on the socket can be used for nonproduction SAP HANA VMs and non-SAP HANA VMs.

Configuring PowerFlex SVM on the first CPU socket

For performance reasons, you must associate the PowerFlex SVM to the first CPU socket (CPU 0) of each physical node.

Note: Before you power off the SVM, put the PowerFlex node (SDS) into maintenance mode.

To associate the SVM with CPU 0 (the first CPU socket):

1. Log in to the PowerFlex GUI using the username (the default is *admin*) and password that you specified during installation.
2. Select **SDS** in the **Configuration** menu, as shown in the following figure:

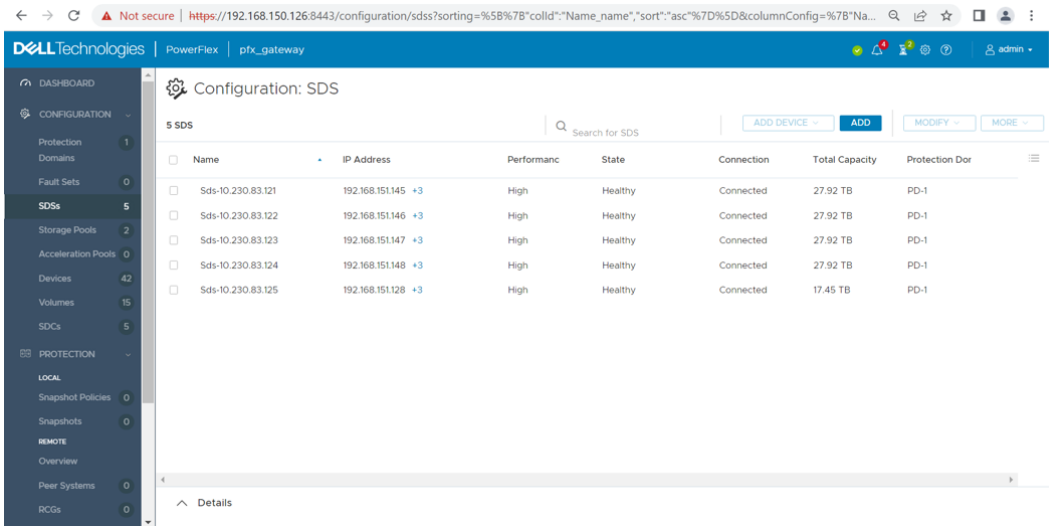

Figure 5. PowerFlex UI: SDS view in Configuration menu

3. Right-click the SDS node with the SVM you are powering off, and then select **MORE** > **Enter Maintenance Mode**. Confirm this step.

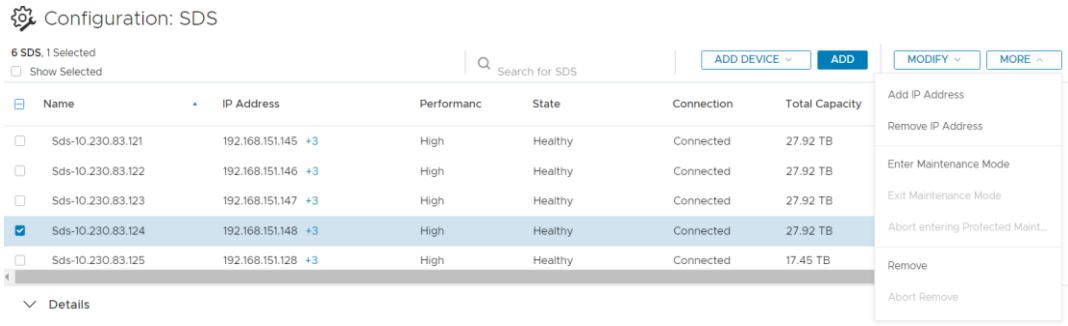

Figure 6. PowerFlex UI: Entering Maintenance Mode for SDS

4. Log in to the vCenter through the vSphere web client and locate the vSphere server.
5. Select the PowerFlex SVM, and then select **Actions** > **Power** > **Shut Down Guest OS**.
6. Select the SVM, and then select **Actions** > **Edit Settings**.
7. On the **VM Options** tab, expand **Advanced** and select **Configuration Parameters** > **Edit Configuration**.
8. Click **Add Row** to add an option, and then:
   a. In the **Name** column, enter **numa.nodeAffinity**.
   b. In the **Value** column, enter **0** to associate the VM with the first NUMA node (CPU socket 0).
9. Click **OK** twice.
10. Select the SVM and power it on manually.
11. Select **SDS** in the **Configuration** menu, right-click the SDS, and then select **Exit Maintenance Mode**. Confirm this step.
12. Repeat steps 2 to 12 for every SDS in the cluster to associate all SVMs to the first NUMA node.

PowerFlex storage provisioning

This section describes:

- Storage pools
- Creating and mapping volumes
- How to create a VMFS datastore

Storage pool

Storage pools in protection domains are preconfigured at the factory. Each time that you add devices to the system, you must map the devices to storage pools. Additional storage pools can be created both from the CLI and from the UI.

Note: PowerFlex recommends having a minimum of two storage pools in a protection domain.

Creating and mapping volumes

Volumes are created from storage pools and can be exposed to the hypervisor as a local storage device using the storage data client (SDC). When a volume is configured from a storage pool, it is distributed over all devices residing in that pool. Each volume block has two copies on two different SDSs, enabling the system to maintain data availability following a single point of failure.

Creating volumes

Volumes can be:

- **Thick**—Capacity is allocated immediately, even if it is not used.
- **Thin**—Capacity is on reserve but not allocated until it is used.

Dell Technologies recommends using thick provisioning for creating PowerFlex volumes that will be used as datastores for the SAP HANA persistence.

As an administrator, add volumes as follows:

1. In the PowerFlex UI, select **Volumes** in the **Configuration** menu.
2. Click **Add**, as shown in the following figure:

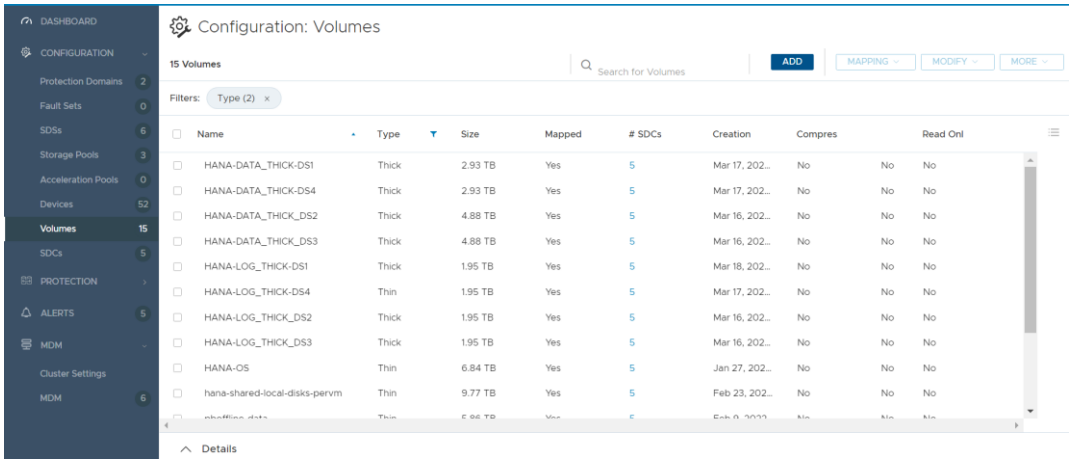

Figure 7. Adding a volume using the PowerFlex UI

3. Enter the volume details and storage pool name, as shown in the following figure:

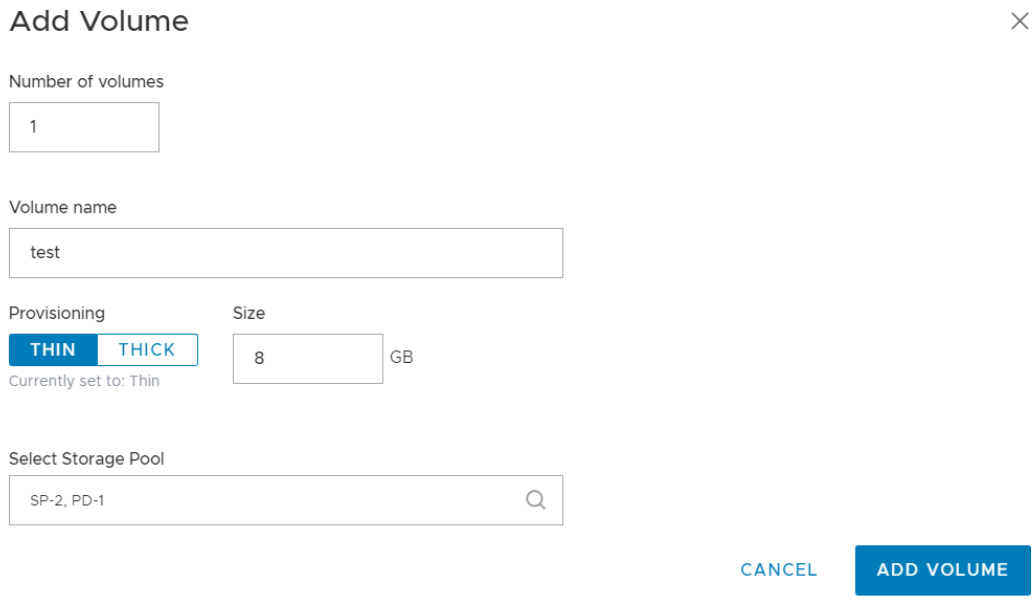

Figure 8. Adding volume details using the PowerFlex UI

4. To create more than one volume, enter the number of volumes and a prefix for each volume under **Add Volume**.

   Multiple volumes are created with the same name, but with a different number appended to each volume.

Mapping volumes

Map PowerFlex volumes to all vSphere servers in the cluster before you create a datastore on the volumes. The PowerFlex SDC on the vSphere server presents the volumes to the ESXi operating system.

To map volumes using the PowerFlex UI:

1. Select the volumes in **Configuration >Volumes.**
2. Click **Mapping** and select **Map Volumes**.

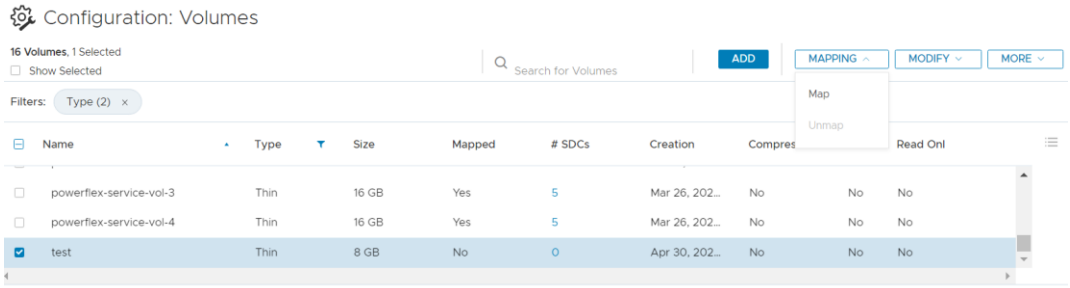

Figure 9. Mapping volumes to servers using the PowerFlex UI

3. Select one or more SDCs to which you want to map the volumes and click **Map** and **Apply**.
4. After you create a volume and map it to the desired SDCs, use the volume to provide storage capacity for the vSphere hypervisor. You can expand an existing

datastore or create a VMFS datastore on the hypervisor, as described in the following section.

Creating a VMFS datastore

To create a VMFS datastore on a PowerFlex volume:

1. In the vSphere Web Client, select the cluster in the left navigation pane, and then select the **New Datastore** icon on the **Datastores** tab.

   Each PowerFlex device is shown as an EMC Fibre Channel Disk followed by an ID number that has `eui` as a prefix.

   The following figure shows the New Datastore page before completion of the create operation:

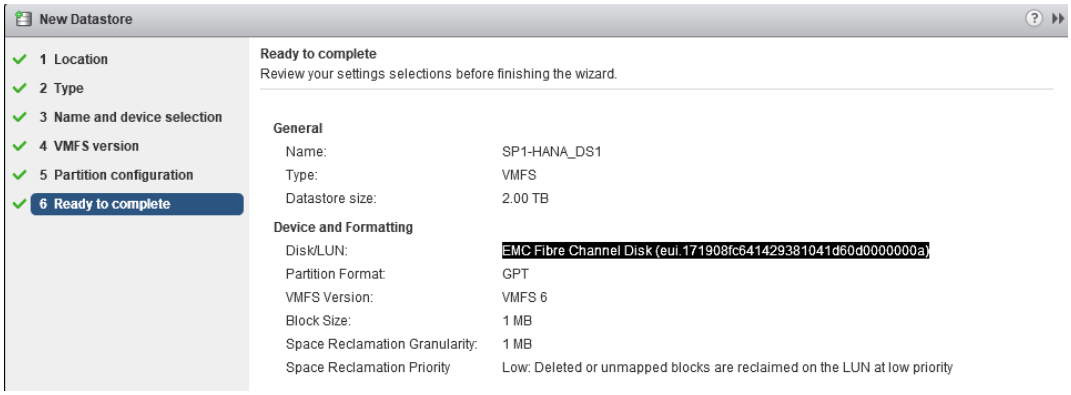

Figure 10. Creating a vSphere datastore on a PowerFlex volume

2. Click **Finish**.

   The datastore that you created is connected to all the vSphere servers in the cluster and is available to all VMs.

Configuration recommendations for SAP HANA virtual machines

Overview

The following section describes the configuration considerations and recommendations that apply to PowerFlex systems.

VMware best practices for SAP HANA deployments

VMware provides comprehensive information about best practices, requirements, and limitations for deploying SAP HANA VMs on the vSphere hypervisor. Refer to Architecture Guidelines and Best Practices for Deployments of SAP HANA on VMware vSphere when deploying SAP HANA VMs on PowerFlex systems with HCI nodes that are running vSphere.

SAP HANA deployment options

Scale-up (single-node) SAP HANA deployments are supported on PowerFlex systems that are running the vSphere hypervisor. Scale-up deployments are supported on both two-socket (R640/R740xd) and four-socket (R840) systems.

PowerFlex support for scale-out SAP HANA deployments is planned for the near future.

CPU and memory

Use SAP and VMware sizing guidelines to size CPU and memory requirements for the SAP HANA VMs. For more information, see SAP HANA sizing considerations. Overcommitment of CPU and memory resources is not permitted.

The SAP HANA HCI certification for PowerFlex systems includes support for half-socket and full-socket SAP HANA VMs. The differences are as follows:

- Half-socket deployments allow two SAP HANA VMs to run on a single CPU socket, with each VM using 50 percent of the available physical cores.
- Full-socket SAP HANA VMs use a single socket (or multiple sockets) and all physical cores exclusively.

Because CPU socket 0 (the first NUMA node) is reserved for the PowerFlex SVM, the remaining CPU sockets can be used for SAP HANA VMs. To prevent the SAP VMs from running on CPU 0, add the `numa.nodeAffinity` parameter to the configuration of the SAP HANA production VMs.

To add this parameter for each SAP HANA production VM:

1. Log in to the vCenter through the vSphere Web Client, and then select the SAP HANA VM.
2. From the **Power** menu, select **Actions** > **Shut Down Guest OS**.
3. After the guest operating system has shut down, select the SAP HANA VM again.
4. From the **Actions** menu, select **Edit Settings**.
5. On the **VM Options** tab, select **Advanced**.
6. Under **Configuration Parameters**, click the **Edit Configuration** button.
7. Click **Add Row** to add an option, and then:
   a. In the **Name** column, enter `numa.nodeAffinity`.
   b. In the **Value** column, enter `1` for an SA P HANA VM running on a two-socket host or `1,2,3` for an SAP HANA VM running on a four-socket host. The

numbers **1,2,3** enable the vSphere CPU scheduler to allocate CPU resources for a given SAP HANA virtual machine.

8. Click **OK** twice to close the Edit VM dialog box.
9. Power on the SAP HANA VM.

Note: When assigning memory to a production SAP HANA VM, select the **Reserve all guest memory (All locked)** box.

CPU and memory sizes for SAP HANA VMs

With the NUMA architecture, each CPU in a server (NUMA node) has local memory assigned but can also access the nonlocal memory assigned to the other CPUs on the server. Because access to local memory is faster, we recommend configuring SAP HANA production VMs with the NUMA architecture in mind to avoid access to nonlocal memory.

The following table provides guidelines for configuring vCPU and memory for an SAP HANA production VM:

Table 2. Configuration guidelines for vCPU and memory for an SAP production VM

SAP HANA VM size	vCPU (cores)	Memory	Maximum number of SAP HANA VMs per host
Small (half-socket)	50 percent of the cores of a NUMA node	Two-socket: 25 percent of the total RAM of the server Four-socket:12.5 percent of the total RAM of the server	Two-socket host: 2 Four-socket: 6
Medium (full-socket)	100 percent of the cores of a NUMA node	Two-socket: 50 percent of the total RAM of the server Four-socket: 25 percent of the total RAM of the server	Two-socket: 1 Four-socket: 3
Large (four-socket only)	All cores of two NUMA nodes	50 percent of the total RAM of the server	Four-socket: 1
X-Large (four-socket only)	All cores of three NUMA nodes	75 percent of the total RAM of the server	Four-socket: 1

Example:

A physical four-socket PowerEdge R840 server has a fully populated memory configuration with:

- 48 x 128 GB DIMMs (6 TB RAM), as shown in Figure 3.
- Intel Xeon Platinum 8180M CPUs with 28 cores per socket

The following table described the production SAP HANA VM sizes that are recommended:

Table 3. Recommended SAP HANA VM sizes

VM	Configuration
Small	14 vCPUs, 1 socket, 768 GB RAM
Medium	28 vCPUs, 1 socket, 1,536 GB RAM
Large	56 vCPUs, 2 sockets (28 cores per socket), 3,072 GB RAM
X-Large	84 vCPUs, 3 sockets (28 cores per socket), 4,608 GB RAM

The following figure shows a four-node PowerFlex cluster with the supported SAP HANA VM deployment options.

- Server 1 hosts a single X-Large SAP HANA VM using three sockets (NUMA nodes) and 75 percent of the available memory.
- Server 2 hosts one large and one medium VM.
- Server 3 hosts small half-socket VMs.

Note: The SAP HANA VMs must use either full-sockets or half-sockets. Configurations with 1.5 or 2.5 sockets are not permitted.

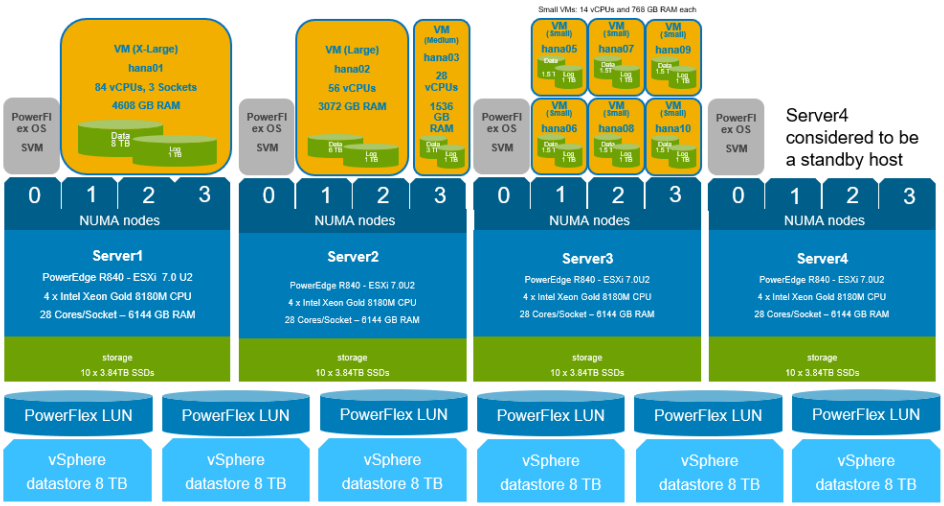

Figure 11. Four-node PowerFlex cluster with SAP HANA VM deployment options

vCPUs and hyperthreading

When hyperthreading is enabled on a physical PowerFlex node, the number of available vCPUs for a VM is twice the number of available physical cores. This technology allows a single processor core to run two independent threads simultaneously. Hyperthreading does not double the performance of a system; instead, it increases the system performance by better utilizing idle resources.

When you assign vCPUs to a production SAP HANA VM, always use the physical core count even though the vSphere Web Client may allow twice that number when hyperthreading is enabled. The VMware VMkernel CPU scheduler is designed to use scheduled threads against physical cores only.

Prepare the SAP HANA VM

This section describes how to prepare the following:

- Operating system virtual disk
- SAP HANA persistence (data and log)
- Shared file system
- Formatting and mounting of the SAP HANA persistence

Operating system virtual disk

The virtual disk on which the operating system is installed can reside on any datastore that meets the functional requirements, specifically, support for vSphere vMotion.

SAP HANA persistence

Create the persistence of production SAP HANA VMs on a datastore that resides on PowerFlex volumes on an SSD storage pool.

Use the SAP Quick Sizer tool to determine the required capacity for the SAP HANA persistence. If the sizing details are not available, we recommend configuring the data and log device sizes based on the memory size of the SAP HANA VM:

- For data, configure 2 x RAM.
- For log, configure 0.5 x RAM (the maximum size is 1,024 GB).

For more information, see the Quick Sizer web page.

Note: Each SAP HANA VM uses its own data and log device and has access only to its pair of devices.

SAP HANA shared file system

SAP HANA installations require a file system to store the SAP HANA binary files, trace files, and configuration files. This file system is mounted under the `/hana/shared` mount point.

Scale-up deployments

In SAP HANA scale-up deployments, this mount point can reside on the local system device. Alternatively, you can create a disk on a datastore, format the disk using the XFS file system, and then mount it under the `/hana/shared` mount point. SAP HANA requires approximately 1 x the RAM memory capacity for the `/hana/shared` file system.

Formatting and mounting the SAP HANA persistence in the VM

After the SAP HANA VM starts, you must format and mount the persistence before you install the SAP HANA software.

Format the data and log devices as follows:

1. Run the following command, where `/dev/sdb` and `/dev/sdc` are the Linux devices for the persistence:

   ```
   mkfs.xfs /dev/sdb;mkfs.xfs /dev/sdc
   ```

2. Create the mount points by running:

```
mkdir -p /hana/data /hana/log

mount /dev/sdb /hana/data;mount /dev/sdc /hana/log
```

3. Add the SAP HANA mount points to the `/etc/fstab` file to ensure that the SAP HANA data and log volumes are mounted after a VM reboot.

High availability

The following VMware vSphere features support high availability (HA) in the SAP HANA system.

Automatic restart of SAP HANA VMs

Enable the vSphere HA feature in a vSphere cluster with SAP HANA. If one of the hosts in the cluster fails, this feature restarts a VM on another host that has enough free resources.

You can enable the SAP HANA service autostart feature in the SAP HANA software at the time of the SAP HANA installation or by setting the autostart option to **1** in the `/hana/shared/<SID>/profile/<SID>_HDB<InstNo>_<hostname>` file.

Ensure that the minimum vSphere HA settings are in place, as shown in the following figure:

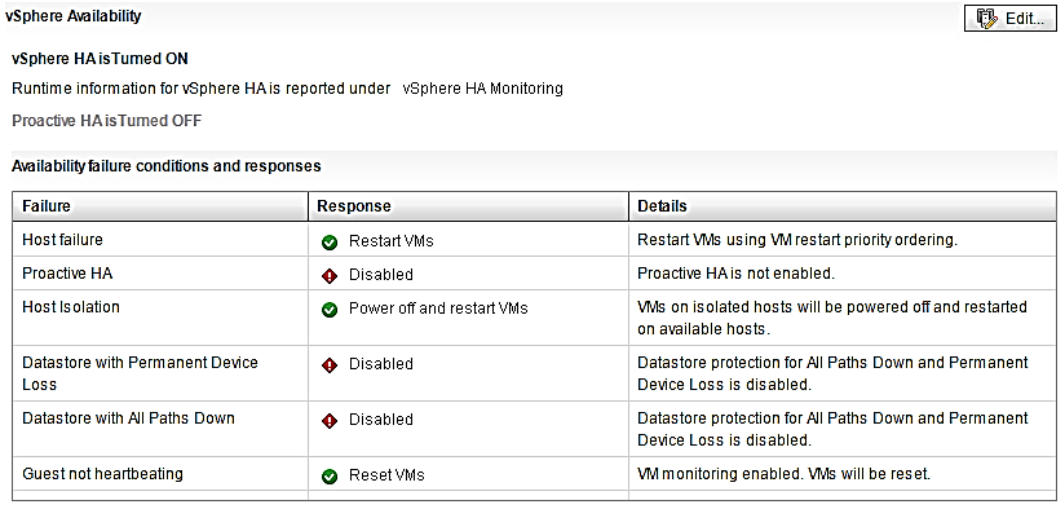

Figure 12. vSphere HA settings

High availability for SAP HANA VMs

The SAP HANA auto-restart watchdog function automatically detects a failure and restarts the corresponding SAP HANA process: nameserver, indexserver, and so on. This service monitors the SAP HANA application and the associated services in a VM.

The VMware HA VM monitoring feature “Guest not heartbeating” restarts the VM guest operating system and SAP HANA on the same host. This feature manages operating system crashes if the SAP HANA autostart options are enabled.

Enable the heartbeat monitoring feature when you enable vSphere HA. We recommend setting **Heartbeat monitoring sensitivity** to **High**, as shown in the following figure:

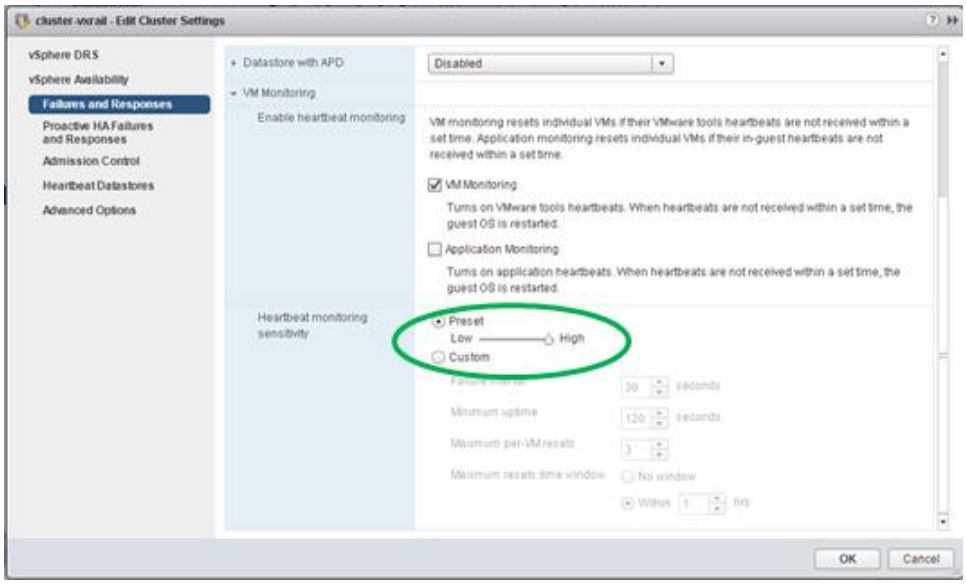

Figure 13. vSphere heartbeat monitoring

VMware Tools must be installed and running in the VM. You can install VMware Tools as part of the operating system (`open-vm-tools`) or by using the vSphere web client and selecting **Guest OS** > **Install VMware Tools** in the VM context menu.

Optimizing file I/Os after the SAP HANA installation

Configure the SAP HANA file I/O layer with certain parameters to optimize file I/Os for a given storage solution and file system. The Linux XFS file system is used on all storage volumes for the SAP HANA persistence.

Setting file I/O layer parameters in SAP HANA 1.0

For SAP HANA 1.0 installations, run the SAP HANA `hdbparam` command as `<sid>adm` in the Linux shell:

```
su - <sid>adm
hdbparam -p        # lists current parameter setting
hdbparam --paramset fileio [DATA].max_parallel_io_requests=128
hdbparam --paramset fileio [LOG].max_parallel_io_requests=128
hdbparam --paramset fileio [DATA].max_submit_batch_size=128
hdbparam --paramset fileio [LOG]. max_submit_batch_size=128
```

Setting file I/O layer parameters in SAP HANA 2.0

For SAP HANA 2.0 installations, use either `hdbsql` or the SQL function in SAP HANA Studio or cockpit and run the following SQL commands:

```
ALTER SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET
('fileio', 'max_parallel_io_requests[Data]') = '128' WITH
RECONFIGURE;
ALTER SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET
('fileio', 'max_parallel_io_requests[Log]') = '128' WITH
RECONFIGURE;
ALTER SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET
('fileio','max_submit_batch_size[DATA]') = '128' WITH RECONFIGURE;
```

```
ALTER SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET
('fileio','max_submit_batch_size[LOG]') = '128' WITH RECONFIGURE;
```

For more information, see SAP Note 2399079: Elimination of hdbparam in HANA 2 (access requires an SAP username and password).

Support requirements and considerations

SAP support calls

This section describes the checks that you can perform before you report an SAP HANA issue with your PowerFlex HCI SAP HANA solution to SAP Support.

Identify a certified HCI solution

As part of the SAP HANA HCI certification requirements, SAP requires a method to detect if an SAP HANA VM is running in a certified hyperconverged environment on the vSphere hypervisor and the PowerFlex platform. It is important to report to SAP that SAP HANA is running on a PowerFlex HCI system. SAP HANA Studio and the SAP HANA cockpit cannot report the hardware vendor and type when SAP HANA is running under VMware.

A proven method to identify a certified PowerFlex system environment is to identify the ESXi host model. All PowerFlex hosts have a model name that starts with the “Dell Inc. PowerFlex-“ prefix. The following hostnames are valid:

- Dell Inc. PowerFlex-R640
- Dell Inc. PowerFlex-R740xd
- Dell Inc. PowerFlex-R840

Look up the hostname of a PowerFlex system in the **Summary** tab of the vSphere UI. The following figure shows an example:

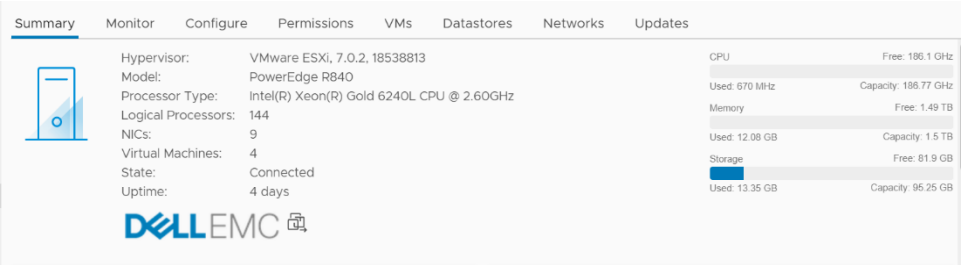

Figure 14. vSphere UI summary page

Ensure that you report the physical host model name (BIOS name) from within the SAP HANA VMs.

The following VM option must be set for all SAP HANA VMs:

```
SMBIOS.reflectHost=TRUE
```

Set this option on the VM as follows:

1. Select **VM Hardware** > **Editing Settings** > **VM Options** > **Advanced** > **Edit Configuration**.
2. Enter `SMBIOS.reflectHost` in the **name** field and `TRUE` in the **value** field.

3. Click **Add**.

Health check with PowerFlex Manager

Before reporting a problem to SAP, check the physical health of the PowerFlex hardware. PowerFlex Manager provides management of IT operations for the PowerFlex system, increasing the system's efficiency by reducing time-consuming manual operations.

PowerFlex Manager includes the following features:

- A dashboard that provides system configuration details and communicates a health status for PowerFlex infrastructure elements and services
- Release Certification Matrix (RCM) compliance monitoring and remediation
- Hardware monitoring and alerting through Secure Remote Services to Dell Technologies Support

Using PowerFlex Manager, you can define and capture infrastructure requirements to support a specific business outcome. After the process is defined, it can be easily repeated through automation.

Health check with iDRAC

You can use the Integrated Dell Remote Access Controller (iDRAC) dashboard to verify the health of the system. The following figure shows an example of an iDRAC health check report:

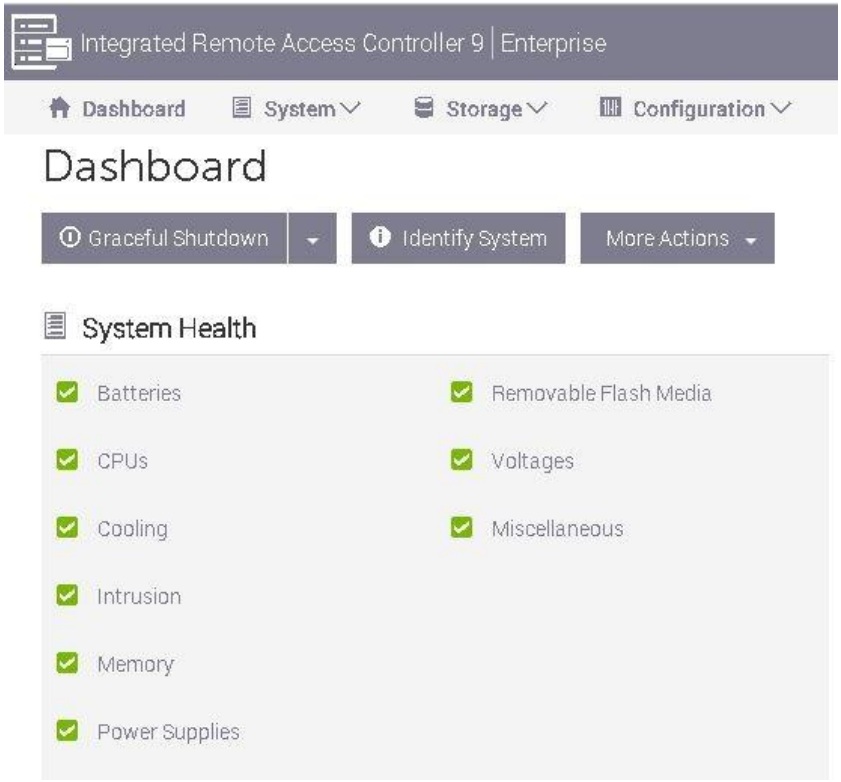

Figure 15. iDRAC health check report example

Ensure that all hardware-related issues are fixed before reporting an SAP HANA problem to SAP.

Dell Technologies support calls

Dell Technologies Online Support provides a single point of support for all PowerFlex hardware issues, PowerFlex-related vSphere hypervisor issues, and PowerFlex software issues.

Generating a troubleshooting bundle

A troubleshooting bundle is a compressed file that contains logging information for components that are managed by PowerFlex Manager. The bundle includes PowerFlex Manager application logs, alert connector logs, PowerFlex gateway logs, and iDRAC lifecycle logs. Send the troubleshooting bundle to Dell Technologies Support for issue debugging.

To generate a troubleshooting bundle:

1. In PowerFlex Manager, select **Settings** > **Virtual Appliance Management**.

   The Virtual Appliance Management page opens, as shown in the following figure:

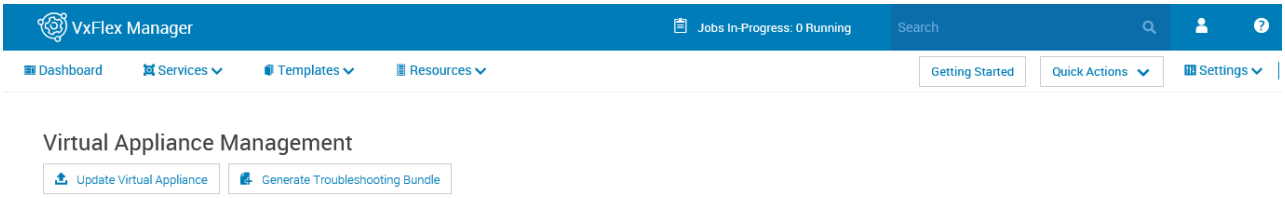

Figure 16. Generating a troubleshooting bundle in PowerFlex Manager

2. Click **Generate Troubleshooting Bundle**.
   - If you are using Secure Remote Services, keep the default **Send to Configured Secure Remote Services** setting. You can configure Secure Remote Services in the Alert Connector section of the page.
   - If you are not using Secure Remote Services, select **Download Locally** to download the troubleshooting bundle to a local file.

References

Dell Technologies documentation

The following documentation and web pages provide additional information. Access depends on your login credentials. If you do not have access to a document, contact your Dell Technologies representative.

- Dell EMC PowerFlex Family Overview
- Dell EMC PowerFlex Architecture Overview
- Dell EMC PowerFlex Specification Sheet
- Dell EMC PowerFlex Networking Best Practices and Design Considerations
- Dell EMC PowerFlex product site
- Dell EMC PowerFlex support

Note: Deploying a PowerFlex system requires Dell Technologies implementation services. Detailed installation documentation is available only to Dell Technologies service personnel.

VMware documentation

The following VMware documentation and web pages provide additional relevant information:

- SAP Community Wiki: SAP HANA on VMware vSphere
- Virtualize Applications: SAP HANA on vSphere
- SAP and VMware: Key Offerings
- *Architecture Guidelines and Best Practices for Deployments of SAP HANA on VMware vSphere*
- *SAP Solutions on VMware Best Practices Guide*

SAP documentation

The following SAP documentation and web pages provide additional information:

- Quick Sizer
- SAP HANA on VMware vSphere
- SAP Help Portal

The following SAP documentation requires an SAP username and password:

- SAP Note 2399079—Elimination of hdbparam in HANA 2