

Dell Validated Platform for Red Hat OpenShift
with PowerFlex

September 2022
H19307

White Paper

Abstract
This Dell validated white paper gives an overview of the Red Hat OpenShift Container Platform 4.10 using OpenShift Assisted Installer on Dell PowerFlex. This paper also explains the reference deployment with real-world workloads performance benchmark, demonstrating simplicity of deployment and performance capabilities of the Validated Platform.

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This Dell validated white paper gives an overview of the Red Hat OpenShift Container Platform 4.10 using OpenShift Assisted Installer on Dell PowerFlex. This paper also explains the reference deployment with real-world workloads performance benchmark, demonstrating simplicity of deployment and performance capabilities of the Validated Platform.

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Chapter 1 Executive summary

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Solution overview

Enterprises are digitally transforming to meet their business goals and deliver cutting-edge technology, products, and services. A cloud native architecture enables rapid development and deployment of agile applications at scale and with integrated resiliency. One of the most powerful tools in this new cloud native architecture is containerization that which is leading to new workloads and use cases. Cloud native applications, including databases, require supporting tools that have the capabilities to deal with scheduling, load balancing, resource monitoring, scaling, and job isolation within complex environments. Kubernetes is an open-source container orchestration system capable of automatic scaling and managing containerized applications.

Dell PowerFlex software-defined infrastructure is designed to enable customers to modernize without constraints with features that allow consolidation and flexibility. It enables them to automate their infrastructure and processes to boost IT agility with intelligent software-driven automations that streamlines operations. It is designed to optimize IT outcomes with software-driven storage optimization that ensures extreme workload results.

Red Hat OpenShift Container Platform offers enterprises full control over their Kubernetes environments, whether they are on-premises or in the public cloud, providing teams with the freedom to build and run containerized applications anywhere. Deploying OpenShift on-premises can be sometimes complex, time consuming, and requires a lot of manual effort. The Assisted Installer is a SaaS (Software-as-a-Service) solution that introduces a new way to deploy an OpenShift cluster on an on-premises environment.

The Dell Validated Platform for red Hat OpenShift combined PowerFlex software-defined foundation with Red Hat OpenShift Container Platform to simplify and streamline OpenShift deployments while ensuring stringent application SLAs and boosting IT agility and DevOps productivity.

Document purpose

This white paper describes the use of Red Hat OpenShift Container Platform 4.10 with OpenShift Assisted Installer on a Dell PowerFlex platform.

Audience

This white paper is intended for sales engineers, field consultants, IT administrators, customers, and anyone else interested in configuring and deploying OpenShift on the Dell PowerFlex family.

Readers are also expected to have an understanding and working knowledge of containers, Kubernetes, Red Hat OpenShift, PowerFlex, Red Hat Enterprise Linux CoreOS (RHCOS), PowerFlex family, and iDRAC.

Terminology

The following table provides definitions for some key terms that are used in this document:

Table 1. Terminology

Term	Definition
PFxM	PowerFlex Manager
RHCOS	Red Hat Enterprise Linux CoreOS
RHEL	Red Hat Enterprise Linux
SDC	Storage Data Client for PowerFlex
SDS	Storage Data Server for PowerFlex
TOR	Top of Rack
VLAN	Virtual Local Area Network
VM	Virtual Machine

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](#) or provide your comments by completing our [documentation survey](#).

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Chapter 2 Product overview

This chapter presents the following topics:

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PowerFlex product overview

PowerFlex software-defined infrastructure

PowerFlex software-defined infrastructure is designed to enable customers to modernize without constraints with features that allow extreme consolidation and flexibility. It enables the customers to automate their infrastructure and processes to boost IT agility with intelligent software-driven automation that streamlines operations. It is designed to optimize IT outcomes with software-driven storage optimization that ensures extreme workload results.

PowerFlex software components and consumption options

PowerFlex software components

Software is the key factor of success in the PowerFlex offering. PowerFlex software components provide software-defined storage services. The software-driven optimizations in the PowerFlex software enable extreme performance, linear scalability, and mission-critical availability, empowering you to simplify most demanding workloads. The software components also help to simplify the infrastructure management and orchestration with comprehensive IT Operations Management (ITOM) and life cycle management (LCM) capabilities that span compute and storage infrastructure, from BIOS and firmware to nodes, software, and networking.

PowerFlex

PowerFlex is the software foundation of the PowerFlex platform. It delivers high performance, highly resilient block storage service that can scale to thousands of nodes while ensuring enterprise-grade mission-critical availability.

PowerFlex Manager

PowerFlex Manager is the software component in the PowerFlex family that enables IT operations and LCM automation 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. PowerFlex appliance and PowerFlex rack provide customers the flexibility to choose a deployment option to meet their exact requirements.

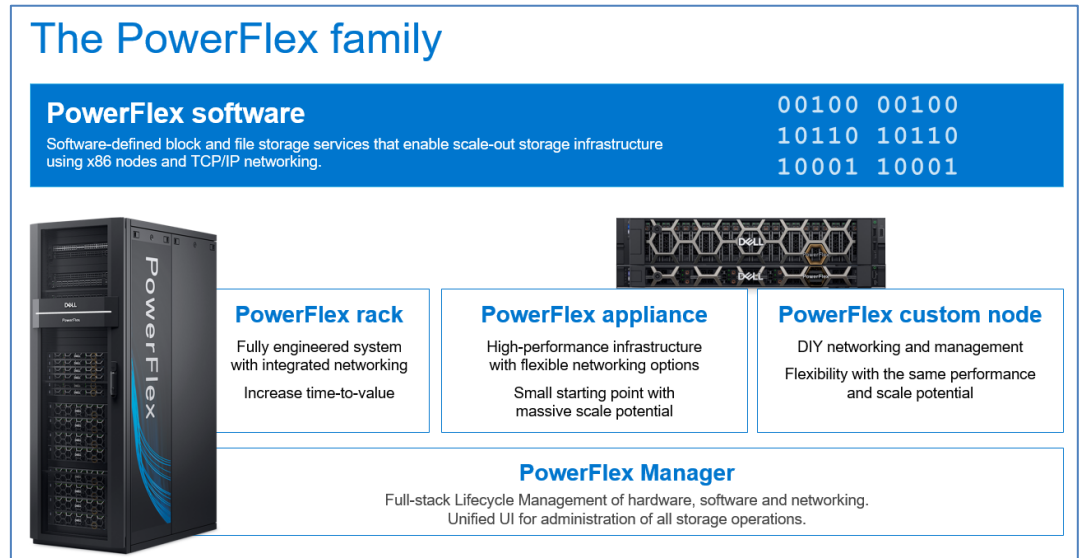


Figure 1. PowerFlex family

PowerFlex rack

PowerFlex rack is a fully engineered system, with integrated networking that enables the customers to simplify deployments and accelerate time to value. PowerFlex Manager provides IT operations and life cycle management automation.

PowerFlex appliance

PowerFlex appliance offers customers a smaller starting point of four nodes, while enabling them to use their existing network infrastructure. PowerFlex Manager provides IT operations and life cycle management automation.

PowerFlex custom nodes

PowerFlex custom nodes offer broad configuration options and provide customers the choice of IT operations and life cycle management tools. PowerFlex Manager is not supported with PowerFlex custom nodes.

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

Note: The Validated Platform for Red Hat OpenShift is supported only on the PowerFlex appliance deployment option.

Red Hat OpenShift

Overview

Red Hat OpenShift Container Platform provides developers and IT organizations with a hybrid cloud application platform for deploying both new and existing applications on secure, scalable resources with minimal configuration and management overhead. It provides enterprise-grade Kubernetes environments for building, deploying, and managing container-based applications, alongside virtualized workloads, across any on-premises data center where Red Hat Enterprise Linux is supported.

For more information, see [Red Hat OpenShift Container Platform 4.10 documentation](#).

OpenShift Assisted Installer

OpenShift Assisted Installer provides a simple way to deploy OpenShift on on-premises nodes from the Red Hat Hybrid Cloud Console. The installer is a SaaS-based managed service to install OpenShift clusters on bare metal (although it is possible to use Assisted Installer for a wide variety of platforms). Before installing a cluster, you do not require a dedicated bootstrap node, and you do not need to preinstall Red Hat CoreOS on the nodes. Cluster deployment parameters are populated within the web UI and nodes are booted with a downloaded ISO image to complete the cluster deployment.

For more information about assisted installer, see [OpenShift Assisted Installer blog](#).

Dell Validated Platform for Red Hat OpenShift

The Validated Platform for Red Hat OpenShift (Validated Platform or Platform) delivers validated, optimized designs with documented deployment and configuration guidance to help the customers rapidly implement and predictably operate Red Hat OpenShift environments on the Dell PowerFlex software-defined infrastructure. The following figure shows the Dell validated platform design for Red Hat OpenShift:

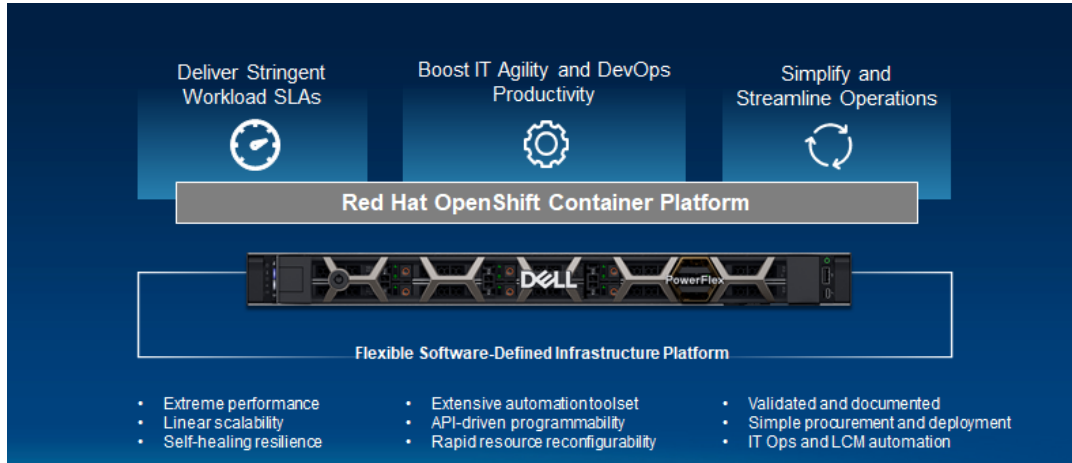


Figure 2. Red Hat OpenShift on Dell PowerFlex

The Platform is a result of collaboration between Dell Technologies and Red Hat, and is engineered to use both Dell and Red Hat technologies exclusively while accelerating the cloud native initiatives for our customers. It is designed to:

- **Deliver stringent SLAs for modern apps:** The Dell PowerFlex software-defined infrastructure foundation enables massive transactional and through put performance for cloud native applications, and scales these application deployments linearly ensuring high availability through its self-healing architecture.
- **Boost IT agility and DevOps productivity:** With extensive automation toolset and open APIs, IT can automate many application, infrastructure, and DevOps processes that help to boost agility and productivity.
- **Simplify and streamline infrastructure operations:** The validated and documented platform, which is delivered through Dell, radically simplifies deployment and operations for greater predictability and efficiency. The platform also offers life cycle management capabilities for the PowerFlex nodes.

Chapter 3 Solution overview

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Overview

This section provides an overview of the Red Hat OpenShift architecture on a PowerFlex system. The environment that is used for testing uses a two-tier PowerFlex appliance architecture. This splits the storage and compute into two separate resources allowing for independent scaling of both.

This section shows the logical architecture used in the validated design and the network architecture. The section concludes with some architecture considerations that are specific to this design and create an optimum OpenShift environment.

Logical architecture

The following diagram shows the logical architecture of this solution:

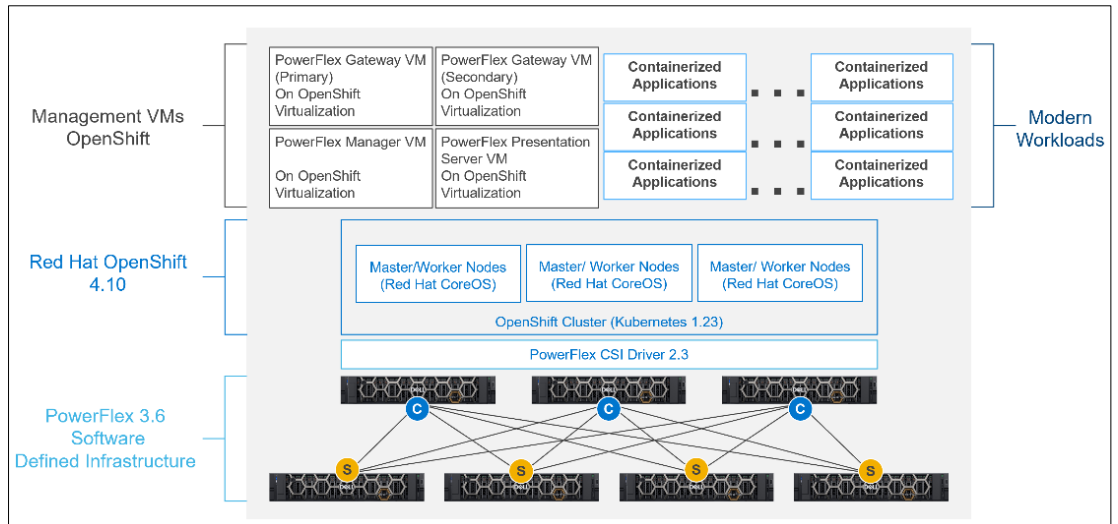


Figure 3. Logical design of OpenShift 4.10 with PowerFlex CSI

In this solution, with the help of Red Hat OpenShift Assisted Installer, an OpenShift compact cluster is deployed on three bare metal servers. When deploying the OpenShift cluster, the OpenShift Virtualization feature is enabled to manage VMs on the OpenShift platform. The required PowerFlex networks are configured on these OpenShift nodes.

The following PowerFlex Management components are deployed as virtual machines on this OpenShift cluster:

- PowerFlex Manager (PFxM)
- PowerFlex Gateway
- PowerFlex Presentation Server

PowerFlex Manager (PFxM) is used to deploy a PowerFlex storage-only cluster on four bare metal servers followed by the deployment of the PowerFlex CSI driver on an OpenShift Cluster, allowing the OpenShift users to provision and manage storage volumes dynamically.

Network architecture

The following diagram shows the network architecture of this solution:

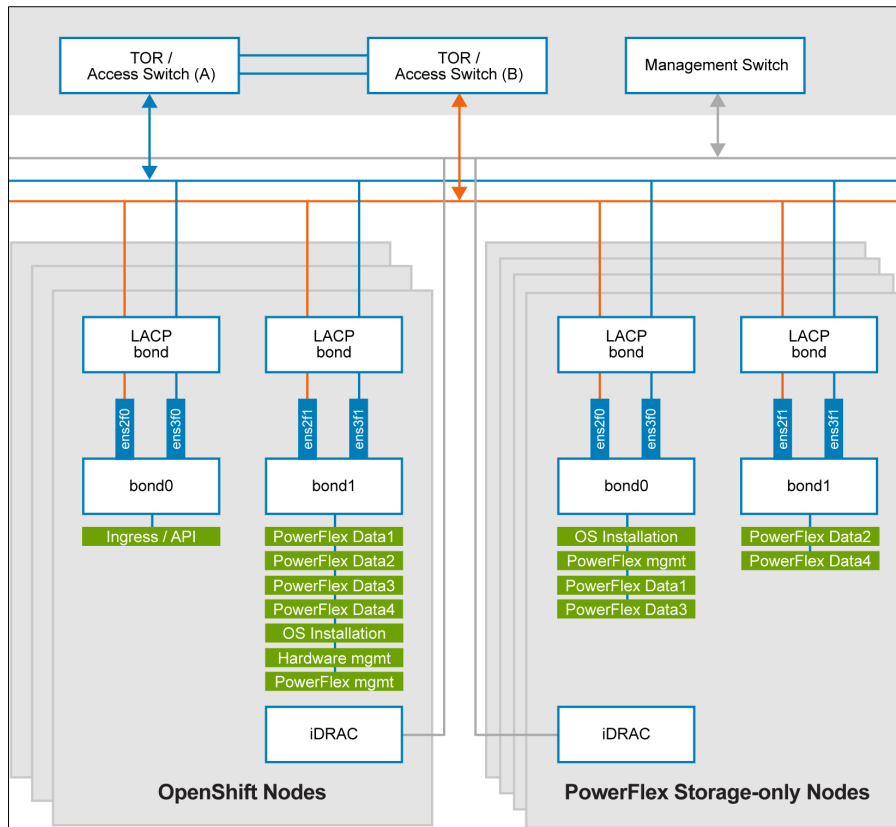


Figure 4. Network design of OpenShift nodes and PowerFlex SO nodes

Each PowerFlex node in the design that is tested in this white paper uses two – dual port 25 Gbps NICs to provide network connectivity and redundancy. One port from each NIC is bonded together providing expanded redundancy.

At the physical layer, two supported Top of Rack (TOR) switches are used for redundancy and load-balancing purposes. A peer link is configured on both the TOR switches. VLANs are created to separate different traffic types on the network bonds.

The following table shows the different networks that are configured for this solution. Each network is required to ensure proper operation:

Table 2. Network details

Network type	VLAN ID
Ingress/API	105
Operating System Installation	104
Hardware Management	101
PowerFlex Management	150
PowerFlex Data 1	152
PowerFlex Data 2	153
PowerFlex Data 3	154
PowerFlex Data 4	155

Architecture considerations

This validated platform is different from many PowerFlex environments. It has been designed for OpenShift deployments. The management components are deployed directly into the OpenShift environment as virtual machines. This architecture has an added advantage of allowing organizations to optimize the skills that are required to manage and maintain the environment.

Note: The validated platform uses a specialty configuration that is designed for OpenShift to take full advantage of the PowerFlex infrastructure and reduce the number of management interfaces.

Beyond optimizations to the management environment, the design is based on the PowerFlex 3.6 architecture. This design allows organizations that already use PowerFlex to have a consistent PowerFlex environment instead of running multiple versions.

Another important design element is that this validated platform is only available as a PowerFlex appliance. This ensures that all the elements of the design components are available to meet the needs of almost all implementations, from a seven node configuration to a scaled out environment with hundreds of nodes.

The design is based on a two-tier architecture. This design allows for independent scaling of compute and storage resources. This also means that PowerFlex storage nodes are only responsible for providing storage in this design. The compute nodes host both the management virtual machines and OpenShift workloads.

Chapter 4 Performance benchmarking

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Overview

This section describes the tests that are done to validate SQL Server 2019 performance on the Validated Platform. HammerDB benchmark tool is used for the database performance tests. HammerDB is a benchmarking tool and load testing software for popular databases. It focuses on schema creation, data loading, and simulating any transactional and analytic workloads. Results of these workload tests derive meaningful information from the environment such as hardware performance comparison and software configurations. For more information, see the [HammerDB official site](#).

Test methodology

To validate the performance of the SQL Server 2019 on the Validated Platform environment, an OLTP workload was simulated by using the HammerDB tool. OLTP workload typically runs a specific set of queries (read and write) against the database. These sets of queries are called database transactions and are measured in TPM (Transaction per minute).

A sample database was populated with 100 GB of data on each SQL Server pod, and multiple virtual user tests were run for a fixed interval of time against each pod to get the optimal TPM numbers.

The HammerDB tool was installed on a dedicated VM. This VM was hosted on a separate ESXi server so that any resources from the worker nodes are not used. Therefore, the load is generated in a client/server model, and the resources of the worker nodes are dedicated for SQL Server pods only.

Findings

Three SQL Server pods that are configured with 32 CPUs per pod were deployed across three worker nodes (one pod per node) to maximize the compute capacity of the worker nodes. Three HammerDB instances were deployed to generate the OLTP load simultaneously by running the benchmark. One to one mapping is considered between the HammerDB instance and SQL pods to simulate a production scenario.

The following graph shows the TPM performance for the three SQL Server pods running on the Validated Platform:

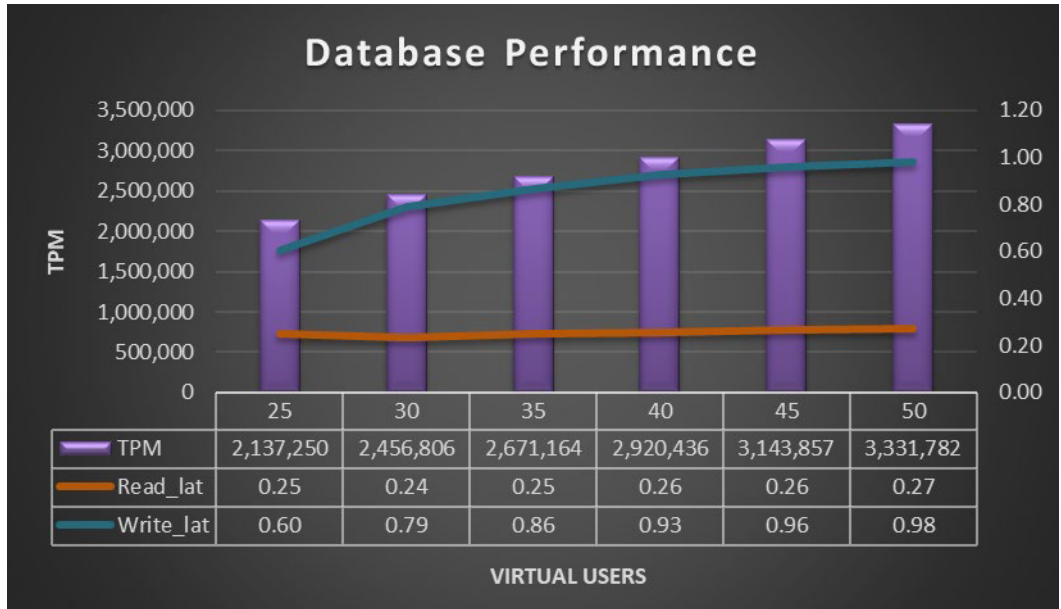


Figure 5. Database performance

As shown in the above test results, 3.3 million+ TPMs were achieved with sub millisecond read and write latency.

Chapter 5 Conclusion

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Summary

PowerFlex software-defined infrastructure is ideally suited as the modern infrastructure foundation of currently increasing mission-critical modern cloud-native applications. The Dell Validated Platform for Red Hat OpenShift is designed to streamline and simplify the deployment and ongoing operations of the Red Hat OpenShift Container Platform while ensuring stringent workload SLAs, enhancing IT agility, and DevOps productivity. This paper explains the reference deployment with real-world workloads performance benchmark, demonstrating simplicity of deployment and performance capabilities of the Validated Platform.

The testing demonstrates that the architecture delivers more than 3.3 million TPM for a containerized Microsoft SQL Server workload while maintaining submillisecond latency. This phenomenal performance clearly shows the benefits of PowerFlex and OpenShift for highly performant compute environments. To find out more about using PowerFlex and OpenShift in your environment contact your Dell representative.

Chapter 6 References

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Red Hat OpenShift documentation	23

Dell Technologies documentation

The following Dell Technologies documentation provides additional information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell Technologies representative.

- [Getting to know Dell PowerFlex](#)
- [PowerFlex 3.6 Release Notes](#)
- [PowerFlex documentation](#)
- [Dell PowerFlex](#)

Red Hat OpenShift documentation

The following Red Hat OpenShift documentation provides additional information:

- [Red Hat OpenShift Documentation](#)
- [Red Hat OpenShift Assisted Installer blogs](#)