

# Titan T2000 VMware Horizon



# Dell PowerVault ME5 Series: VMware Horizon VDI Best Practices

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## White Paper

### Abstract

This document provides best practices for deploying VMware Horizon virtual desktops with Dell PowerVault ME5 storage. It also includes recommendations for performance, availability, scalability, and integration.

Dell Technologies

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## Executive summary

### Overview

This document provides best practices for using Dell PowerVault ME5 with VMware Horizon virtual desktops.

Although the guidance in this paper is specific to VMware Horizon, it applies to most VDI environments. Each environment is unique, and not all best-practices guidance that is provided in this paper may apply.

The information in this document is based on the guidelines in the paper *Dell PowerVault: VMware vSphere Best Practices* on the [Dell Technologies Storage Info Hub](#). This document includes supplemental information regarding VDI-specific details when running VMware Horizon.

### Audience

This document is intended for IT administrators, storage architects, partners, and Dell Technologies employees. This audience also includes any individuals who may evaluate, acquire, manage, operate, or design a Dell networked storage environment using PowerVault systems.

### Revisions

Date	Description
February 2022	Initial release

### We value your feedback

Dell Technologies and the authors of this document welcome your feedback on this document. Contact the Dell Technologies team by [email](#).

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**Note:** To view additional PowerVault ME5 documentation, go to the [Dell Technologies Storage Info Hub](#).

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## Introduction

### PowerVault overview

The PowerVault ME5 is a next-generation, entry-level storage appliance. ME5 is purpose-built and optimized for SAN and DAS virtualized workloads. ME5 is available in a 2U or 5U base system. ME5 simplifies the challenges of server storage capacity expansion and small-scale SAN consolidation.



**Figure 1.** Dell PowerVault ME5 appliance

PowerVault provides the following features:

**Ease of Management:** PowerVault Manager is an intuitive, all-inclusive HTML5-based management UI that is integrated on each ME5 appliance.

**Simplicity:** ME5 storage is simple and quick to install and configure.

**Performance:** Compared to the predecessor ME4, the ME5 offers increased power and scale with updated Intel processors. The ME5 processing power delivers significant performance gains over the ME4. ME5 also delivers increased capacity and bandwidth.

**Connectivity:** ME5 storage offers robust and flexible connectivity. ME5 supports the following connectivity options:

- 12 Gb SAS (four ports per controller)
- 16/32 Gb FC (four ports per controller)
- Two iSCSI options:
  - 10 GbE BaseT (four ports per controller), or
  - 25 GbE optical (four ports per controller)

**Scalability:** PowerVault ME5 comes in a 2U or 5U base system. The 2U systems (ME5012 and ME5024) support either 12 or 24 drives respectively in the base system. The 5U system (ME5084) supports 84 drives in the base system. ME5 2U and 5U base systems also support adding optional expansion enclosures of 12, 24, and 84 drives.

**All-inclusive software:** ME5 supports the following features:

- Volume copy
- Snapshots
- IP/FC replication
- VMware vCenter Server and VMware Site Recovery Manager integration
- SSD read cache
- Thin provisioning

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- Three-level tiering
- Controller-based encryption (SEDs) with internal key management

See the ME5 product page at [Dell Technologies Storage](#) for more information about ME5 options and features.

To view additional PowerVault ME5 documentation, go to the [Dell Technologies Storage Info Hub](#).

## VMware Horizon overview

VMware Horizon 8 provides secure delivery of virtual desktops and applications. Horizon enables end users to access their workspaces anywhere, anytime, and on any device. With Horizon, you can deploy and scale virtual desktops with rapid provisioning, automation, and simplified management to provide a modern workspace experience to end users.

## Prerequisite reading

The following documents provide essential guidance for the planning, configuration, and deployment of PowerVault ME5. These and other documents can be found at [Dell Technologies Support](#).

- *Dell PowerVault ME5 Owner's Manual*
- *Dell PowerVault ME5 Deployment Guide*
- *Dell PowerVault ME5 Admin Guide*
- *Dell PowerVault ME5 Release Notes*
- *Dell PowerVault ME5 Support Matrix*
- *Dell PowerVault Host Configuration Guide*

Apply VMware best practices by following the guidance in the document *Dell PowerVault: VMware vSphere Best Practices* on the [Dell Technologies Storage Info Hub](#):

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**Note:** Applying VMware best practice settings for network and MPIO are critical to optimizing the resiliency and performance of a VDI workload at scale.

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# Connectivity

**Introduction** PowerVault supports a DAS or SAN configuration depending on the installed modules. 12 Gb SAS, 10/25 GbE iSCSI, and 16/32 Gb Fibre Channel (FC) are supported configuration options for front-end connectivity to hosts. DAS may not be a practical option for VDI in your environment because DAS supports a limited number of hosts.

**Block storage** PowerVault presents storage to external hosts through block interfaces. Block storage is the most commonly used datastore path for virtual machines due to the various speeds and protocols that are offered, making it ideal for performance. PowerVault supports 12 Gb SAS, 10/25 GbE, and 16/32 Gb FC connections for broad compatibility and performance requirements.

**Network** Multipathing (MPIO) is critical to achieving the best performance from VMware hosts and should be configured properly. Apply VMware MPIO best practices by following the guidance in the document *Dell PowerVault: VMware vSphere Best Practices* on the [Dell Technologies Storage Info Hub](#).

## iSCSI

Using iSCSI for block storage allows convergence of storage and networking infrastructure though it does require careful planning for bandwidth requirements and fault isolation. Redundant networks are preferred for data availability.

With iSCSI, Jumbo frames are also recommended. They allow greater packet efficiency for higher bandwidth. Using Jumbo frames is not a requirement but should be considered. Combined with the 25 GbE connectivity available in PowerVault, iSCSI can handle demanding workloads and high throughput requirements.

## Fibre Channel

Use of 16/32 Gb FC is also supported. Dual fabrics are recommended for redundancy.



## Storage design

**Introduction** The size and type of traffic that is generated from a VDI environment are noticeably different from most business applications. The difference in the size and pattern of VDI traffic is consistent but requires a few changes to the storage design for proper management.

**VMware best practices** Most VMware best practices apply to VDI environments, but there are a few changes required due to the nature of high-density VM configurations. For VMware best practices, see the document *Dell PowerVault: VMware vSphere Best Practices* on the [Dell Technologies Storage Info Hub](#).

### Volume count

There are several factors that determine the optimal volume count with Horizon on PowerVault ME5. There is not a single volume count that fits all scenarios. Performance and management overhead are typically the two most important factors.

For performance reasons, a minimum of 16 volumes is recommended for a VDI workload. This configuration ensures good queue balancing and reduces I/O bottlenecks.

Balance this volume recommendation with the goal of keeping the volume count low for minimized management. The VMware guidance for volume count should also be considered. Using array-based snapshots reduces recovery time and minimizes the impact of higher user-per-volume counts.

**I/O size** The average I/O size of storage traffic in a VDI environment typically ranges from 24k to 32k. This size can vary if host-based caching is enabled or allowed. Some VM configurations do not allow host-based caching.

**Heavy writes** With most applications, storage traffic is typically 70% reads. There are applications that generate all reads or all writes, but the average tends to be a 70% read to 30% write ratio.

VDI environments are typically heavily biased towards writes. This bias occurs because once the VMs are booted, the I/O traffic includes mostly changes from each VM. The traffic consists of file changes, swap file writes, memory paging, and updates to user preferences. This traffic pattern makes VDI one of the more demanding applications.

The heavy write ratio of VDI requires more attention to be focused on the number of writes that are generated and the rate of change to the environment. For environments that are persistent, these factors should be accounted for when snapshots are taken. The average snapshot size is larger because of the rate of change occurring.

If persistence is maintained at the VM level and profile redirection technology is not used, the VM volumes must be larger. The snapshot growth is larger as well.

### Instant clone pools

Instant clones generate a large volume of traffic during the provisioning process due to the method used to create the VMs. Since the in-memory VMFork technology creates the machines quickly, the volume of traffic is significant. The I/O required to complete the

creation is brief but large. Plan for bursts of high traffic when creating or refreshing large pools of instant clone machines. These bursts of high traffic may impact other workloads if a PowerVault ME5 appliance is not dedicated to VDI. For a large VDI implementation, a PowerVault ME5 appliance should be dedicated to VDI.

Instant clone VMs reset on logout. As users log off, their virtual desktops refresh automatically. This action occurs throughout the workday and should be considered in the design. Virtual desktop refreshes cause a brief spike in IO that is proportional to the number of desktops refreshing at any given time. If many desktops refresh simultaneously, the I/O demand will spike as they refresh.

## Capacity

The density of data on VDI tends to be high because many Horizon VDI environments use data-reduced clones.

The advantages of small virtual desktops include faster boot times, reduced capacity requirements, reduced pool creation time, and fewer updates required. With instant clones, the administrative overhead is reduced even further with the automatic refresh of virtual desktops on logout. Any misconfiguration in a VM is cleared when the user logs out and the machine is refreshed.

Drive counts for block-only VDI are more a function of IOP requirements than capacity. Since the VMs generate many IOPS for each TB of storage that is consumed, performance is more of a concern than capacity. With VDI, SSDs are recommended to optimize performance.

## Data redirection

VMware App Volumes can be used with a VDI configuration on ME5 to assign each user their own writable volume. A writable volume is a read/write volume that stores user-specific changes written in the session. Changes persisted include user-installed applications and user profile information.

- App Volumes can also be used with Horizon to optimize application delivery by managing assignments of application volumes to users, groups, and target computers.
- To learn more, see the [VMware App Volumes](#) product page.

## Guests

VMware Horizon supports two guest operating systems for desktop pools. Not all features are available with both operating systems because of the architecture of the individual operating systems. While only one image can be used for each pool, multiple pools can be created, one for each virtual machine role.

### Windows

The behavior of Windows desktops in a VDI environment can vary greatly. Because of the number of services and process in Windows, the host load can vary based on customizations that are applied to the guest operating system.

One of the best ways to reduce CPU and disk load from a Windows virtual machine is to use the [VMware OS Optimization Tool](#). This tool is a consolidated interface that can be used to change the behavior of virtual machines to reduce their hardware requirements. Be careful if choosing the most-restrictive configurations, which can cause applications or

even Windows features to stop working. This tool is designed to reduce the effort of optimizing Windows, but it requires testing of the configuration for all user applications.

### Linux

Horizon supports virtual desktops on Linux with some caveats and restrictions on versions and distributions. For details, see the VMware product documentation about the [System Requirements for Horizon for Linux](#). The storage requirements are determined more by the applications that are supported than the base operating system. This document does not address the variations in Linux configurations.

### Networking

PowerVault has options to support diverse network designs and protocols. The abstraction between the storage and front-end connectivity enables great flexibility in design. PowerVault supports 12 Gb SAS, 10/25 GbE, and 16/32 Gb FC connections for broad compatibility and performance requirements.

### Management

PowerVault is managed through the **Network** ports on the back of the appliance. Controller A and controller B each have a network port for redundancy.

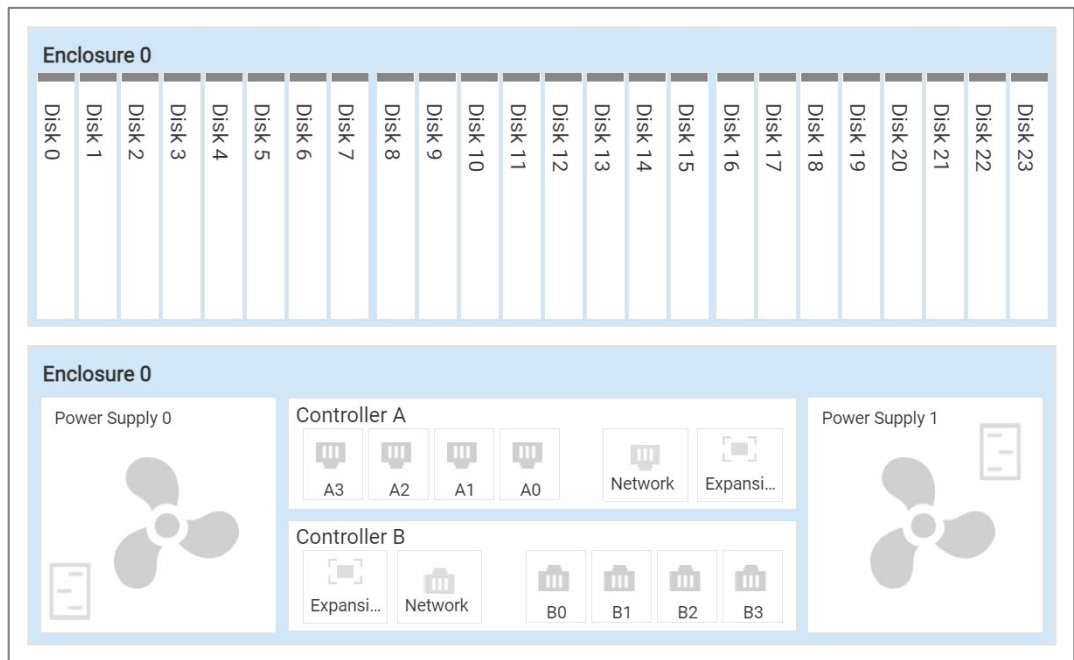


Figure 2. PowerVault front and rear views (PowerVault Manager)

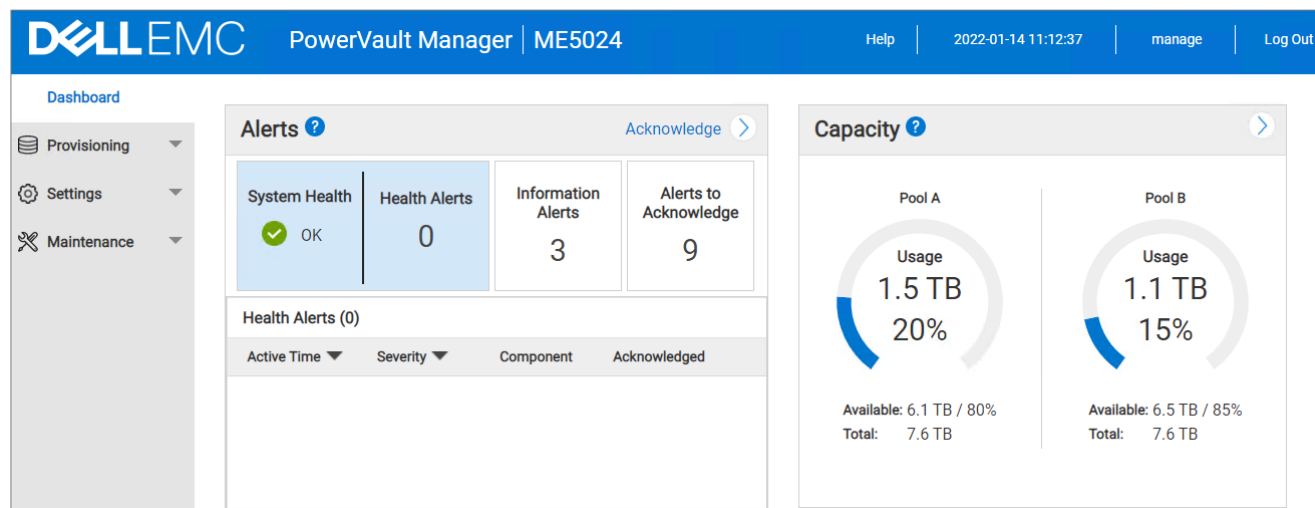
These ports provide connectivity through several protocols and storage methods such as a web interface (HTTPS), and CLI.

### PowerVault Manager

PowerVault Manager is the integrated HTTPS web UI that is accessible through either network port.

Most storage management functions for a Horizon VDI environment can be done through the PowerVault Manager. Some advanced functions may require use of the CLI.

PowerVault Manager is used for day-to-day management tasks, monitoring, and storage alerting. Automated notification can be configured for remote alerting as well.



**Figure 3. PowerVault management web-based interface**

## ADAPT

ME5 provides ADAPT as a RAID-based data protection level that:

- Maximizes flexibility
- Provides integrated spare capacity
- Optimizes performance
- Allows for fast rebuilds, large storage pools, and simplified expansion

ADAPT is recommended for a VDI environment.

## Horizon configuration

Horizon does not require any special configuration to work with PowerVault ME5. The storage is presented as block storage volumes discoverable through VMware vCenter. When the pool is created, the volumes are visible as usable disk.

Volumes that are presented through PowerVault can grow dynamically. If the original volumes must grow as the virtual machine requirements change, they can be expanded using the standard management methods. PowerVault Manager is used to expand a single volume.

## Replication

The nature of instant clone VDI environments is to create pools of VMs that are not necessarily tied to a specific user. This ability reduces the administration of the environment and reduces the need for backups, disaster recovery, and data-loss mitigation.

This design also reduces the need for replication. Since data is typically not stored in the user VMs, the VMs do not need to be copied offsite. A VM pool can quickly be created offsite if the infrastructure is available, including the template VMs.

**Secondary pools** One simple way to help users quickly return to work is to keep additional VMs ready in a recovery pool. This pool can be assigned to end users if the primary systems are down. This pool may not have the same performance characteristics but can aid in business continuity.

**Data encryption** Many applications have data encryption requirements on data at rest.

Full Disk Encryption (FDE) is a PowerVault feature that secures all the user data on a storage system. FDE is a method by which you can secure the data residing on the disks. It uses self-encrypting drives (SED), which are also referred to as FDE-capable disks. When secured and removed from a secured system, FDE-capable disks are unreadable by other systems. FDE is supported and recommended for VDI environments.

## Management and monitoring

**Introduction** PowerVault offers multiple features for managing and monitoring storage. There are several methods to gather and process alerts and statistics.

### Alerting

Email alerting is an integrated function for using external notification systems. By configuring email addresses for notification events, exceeding-notification criteria generates an email.

### SupportAssist

Dell SupportAssist can provide an extra level of support by automatically contacting support resources when events occur. This feature can speed up the resolution process by transmitting critical log and event information to escalation resources.

## References

### 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.

- [Dell Technologies Storage Info Hub](#)
- [Dell Technologies VDI Info Hub](#)
- [Dell Technologies Support](#)

### VMware documentation

For VMware documentation, see the following resource:

- [VMware Documentation](#)