Dell EMC Unity Storage with VMware vSphere

All-flash arrays

Abstract

Best practices guide for deploying VMware vSphere with Dell EMC Unity All-Flash arrays including settings or configuration recommendations for vSphere hosts to achieve an optimal combination of performance and resiliency.

July 2017

Revisions

Date	Description
July 2017	Initial release for Dell EMC Unity OE version 4.2

Acknowledgements

This paper was produced by the following members of the Dell EMC storage engineering team:

Author: Chuck Armstrong

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Executive summary

The Dell EMC™ Unity storage with VMware vSphere® best practices guide delivers straightforward guidance to customers using Dell EMC Unity All-Flash storage systems in a VMware vSphere environment. The focus is on system performance and maximizing the ease of use of the Dell EMC Unity automated storage features when used with VMware vSphere. For general best practices on using Dell EMC Unity, please see the *Dell EMC Unity Best Practices Guide*.

These guidelines are intended to cover the majority of use cases. They are strongly recommended by Dell EMC, however, they are not strictly required.

This paper was developed using the 550F Dell EMC Unity All-Flash array, but is also applicable when using the 350F, 450F, or 650F Dell EMC Unity All-Flash arrays.

If you have questions about the applicability of these guidelines in your environment, contact your Dell EMC representative to discuss the appropriateness of the recommendations.

Audience

This document is intended for Dell EMC customers, partners, and employees who are installing and/or configuring Dell EMC Unity storage systems. Some familiarity with Dell EMC unified storage systems is assumed.

We welcome your feedback along with any recommendations for improving this document. Send comments to StorageSolutionsFeedback@dell.com.

1 Storage configuration

Dell EMC Unity is a virtually provisioned, flash optimized storage system designed for ease of use. This paper covers the all-flash array models. This section provides foundational array technologies that support the application-specific sections that follow. Additional information for this section can be found in the *Dell EMC Unity Best Practices Guide*.

1.1 Storage pools

As of Dell EMC Unity OE version 4.2, Dell EMC Unity supports two different types of storage pools on all-flash storage systems: Traditional pools and dynamic pools. Traditional pools apply RAID protection to discrete groups of drives within the storage pool. Dynamic pools apply RAID to groups of drive extents from drives within the pool and allow for greater flexibility in managing and expanding the pool. Dynamic pools must be configured from all-flash drives; dynamic pools cannot be built with HDDs.

In general, it is recommended to use a small number of storage pools within Dell EMC Unity to reduce complexity and increase flexibility. However, it may be appropriate to configure additional storage pools in order to:

- Separate workloads with different I/O profiles
- Dedicate resources to meet specific performance goals
- Separate resources for multi-tenancy
- Create smaller failure domains

Additional information can be found in the *Dell EMC Unity: Dynamic Pools* white paper.

1.1.1 Storage pool capacity

Storage pool capacity is used for multiple purposes:

- To store all data written into storage objects (LUNs, file systems, and datastores, and VVols) in that pool
- To store data that is needed for snapshots of storage objects in the pool
- To track changes to replicated storage objects in that pool

Storage pools must maintain free capacity in order to operate properly. By default, Dell EMC Unity will raise an alert if a storage pool has less than 30% free capacity, and will begin to automatically invalidate snapshots and replication sessions if the storage pool has less than 5% free capacity. Dell EMC recommends that a storage pool always have at least 10% free capacity.

1.1.2 All-flash pool

All-flash pools provide the highest level of performance in Dell EMC Unity. Use an all-flash pool when the application requires the highest storage performance at the lowest response time.

- Dell EMC FAST™ Cache and FAST VP are not applicable to all-flash pools.
- Compression is only supported on an all-flash pool.
- Snapshots and replication operate most efficiently in all-flash pools.
- Dell EMC recommends using only a single drive size and a single RAID width within an all-flash pool.

  Example: For an all-flash pool, use only 1.6TB SAS flash 3 drives and configure them all with RAID 5 8+1.

1.1.3 Hybrid pool

Hybrid pools are not applicable when using Dell EMC Unity All-Flash arrays.

2 Dell EMC Unity features

This section describes some of the native features available on the Dell EMC Unity platform. Additional information on each of these features can be found in the *Dell EMC Unity Best Practices Guide*. Features not applicable to the all-flash array models covered by this paper are noted.

2.1 FAST VP

FAST VP accelerates performance of a specific storage pool by automatically moving data within that pool to the appropriate drive technology based on data access patterns. FAST VP is only applicable to hybrid pools within a Dell EMC Unity Hybrid flash system.

2.2 FAST Cache

FAST Cache is a single global resource that can improve performance of one or more hybrid pools within a Dell EMC Unity Hybrid flash system. FAST Cache can only be created with SAS flash 2 drives, and is only applicable to hybrid pools.

2.3 Compression

Dell EMC Unity compression is available for block LUNs and VMFS datastores in an all-flash pool starting with Dell EMC Unity OE version 4.1. Compression is available for file systems and NFS datastores in an all-flash pool starting with Dell EMC Unity OE version 4.2.

Be aware that compression increases the overall CPU load on the system when storage objects service reads or writes of compressible data, and may increase latency when accessing the data. Before enabling compression on a storage object, it is recommended to monitor the system and ensure the system has available resources to support compression. (Refer to the “Hardware Capability Guidelines” section and Table 2 in the *Dell EMC Unity Best Practices Guide*.) Enable Compression on a few storage objects at a time and then monitor the system to be sure it is still within recommended operating ranges, before enabling compression on more storage objects. Additional information regarding compression can be found in the *Dell EMC Unity: Compression* white paper.

Compression will only provide space savings if the data on the storage object is at least 25% compressible. Before enabling compression on a storage object, determine if it contains data that will compress; do not enable compression on a storage object if there will be no space savings. Contact your Dell EMC representative for tools that can analyze the data compressibility. Additional information regarding compression can be found in the *Dell EMC Unity: Compression* white paper.

2.4 Data at Rest Encryption (D@RE)

D@RE is controller based encryption that does not impact system performance; therefore Dell EMC recommends ordering Dell EMC Unity systems as encryption-enabled, if appropriate for your environment.

Note: Encryption can only be enabled at the time of system installation with the appropriate license.

If encryption is enabled, Dell EMC recommends making external backups of the encryption keys after system installation as well as immediately following any change in the system's drive configuration (such as creating or expanding a storage pool, adding new drives or replacing a faulted drive). Additional information regarding Data at Rest Encryption can be found in the *Dell EMC Unity: Data at Rest Encryption* white paper.

2.5 Host I/O limits

Dell EMC recommends setting Host I/O limits on workloads that might monopolize pool resources and starve other applications of their required performance.

> Example: Limit the bandwidth available to large-block applications that may be increasing the latency on other small-block workloads.

Additional information can be found in the *Dell EMC Unity: Unisphere Overview* white paper.

3 VMware vSphere considerations

This section provides configuration recommendations and storage access guidelines for integrating VMware vSphere 6.x hosts with the Dell EMC Unity All-Flash array models.

3.1 Fibre Channel switch zoning

Zoning Fibre Channel switches to connect vSphere hosts to a Dell EMC Unity array is similar to most zoning processes. This section explains the fundamentals of recommended zoning.

3.1.1 Single initiator zoning

Each Fibre Channel zone created should contain a single initiator (host HBA port) and all applicable storage target ports. In other words, each HBA port on the host requires its own zone; containing itself and the applicable storage ports. For resiliency and availability, two fabrics should be used, each containing half of the ports on each host and half of the ports on each storage processor on the Dell EMC Unity array.

3.1.2 WWN zoning

World Wide Name (WWN) zoning provides the most flexible zoning configuration as it is based on the WWN of each port, regardless of the physical port on the switch where it is connected. For single initiator zoning with WWNs, the WWN of each host port would have its own zone, and would also contain the applicable storage port WWNs.

Table 1 Example of a single hosts zones in each of the two Fibre Channel fabrics

Zone Name	WWN	Description
HOST1-HBA1	20:01:00:0E:1E:C2:6A:94	Host1 HBA port 1
	50:06:01:60:47:E4:1E:49	Dell EMC Unity SPA FC Port 0
(fabric 1 zone)	50:06:01:61:47:E4:1E:49	Dell EMC Unity SPA FC Port 1
	50:06:01:68:47:E4:1E:49	Dell EMC Unity SPB FC Port 0
	50:06:01:69:47:E4:1E:49	Dell EMC Unity SPB FC Port 1
HOST1-HBA2	20:01:00:0E:1E:C2:6A:95	Host1 HBA port 2
	50:06:01:62:47:E4:1E:49	Dell EMC Unity SPA FC Port 2
(fabric 2 zone)	50:06:01:63:47:E4:1E:49	Dell EMC Unity SPA FC Port 3
	50:06:01:6A:47:E4:1E:49	Dell EMC Unity SPB FC Port 2
	50:06:01:6B:47:E4:1E:49	Dell EMC Unity SPB FC Port 3

3.1.3 Port zoning

Port zoning refers to including physical ports on the Fibre Channel switch in each zone rather than the WWN as described above. Unless your environment requires the use of port zoning, WWN zoning is the recommended method.

3.2 Mapping storage to a vSphere host

Dell EMC Unisphere, the graphical management interface for Dell EMC Unity, can be used to present storage to all host servers. For vSphere hosts, Unisphere utilizes integration points to reduce required steps and perform several host-side functions. To take advantage of the integration point, the vSphere host, or vCenter environment must be imported into the Unisphere interface (this requires credentials for the vSphere host or the vCenter server). Once imported, the presentation of VMware VMFS, NFS, or VVOL Datastore storage from Unisphere results in mounted Datastore(s) on the hosts. Additional information and detail can be found in the *Dell EMC Unity: Unisphere Overview* and *Dell EMC Unity: Virtualization Integration* white papers.

3.3 Multipathing

Block storage (both iSCSI and FC) presented to vSphere hosts from Dell EMC Unity has the native Path Selection Policy (PSP) of round robin (RR) applied by default. While RR is the recommended PSP to apply to Dell EMC Unity block storage, the default number of I/Os between switching paths is 1000. By reducing this value, all paths are more efficiently utilized. Table 2 shows the best practice recommendations for each block storage type, as well as the resulting increase in performance over the default setting. Increases in performance are dependent on specific workloads. The workloads used for this paper are described in section A.1 Referenced test data. Additional information on this topic can be found in the Adjusting Round Robin IOPS limit from default 1000 to 1 article in the VMware Knowledge Base.

The CLI command to make this change for all Dell EMC Unity LUNs on each vSphere host is:

```
for i in `esxcfg-scsidevs -c |awk '{print $1}' | grep naa.xxxx`; do esxcli
storage nmp psp roundrobin deviceconfig set --type=iops --iops=# --device=$i;
done
```

Where **xxxx** = the first four digits of the Dell EMC Unity disk (or endpoint) devices found using:

```
esxcli storage nmp device list
```

And **#** = the number of desired I/Os between the switching of paths

Additionally, a claim rule can be created to automatically set this value on future LUNs mapped to the host by executing the following command in the CLI:

```
esxcli storage nmp satp rule add -s "VMW_SATP_ALUA_CX" -V "DGC" -P "VMW_PSP_RR"
-O "iops=1"
```

Table 2 Recommended block storage types and results

Block Storage Type	RR IOPS Value	Increase in IOPS	Decrease in Latency
Fibre Channel LUN	1	15.43%	13.45%
Fibre Channel Block VVol	1	35.42%	26.24%
iSCSI LUN	1	11.87%	10.72%
iSCSI Block VVol	1	41.54%	29.45%

3.4 iSCSI LUNs

Dell EMC Unity LUNs presented to vSphere hosts via iSCSI should utilize the following recommended best practices:

3.4.1 Enabling jumbo frames

On the Dell EMC Unity array (**Settings** > **Access** > **Ethernet from Unisphere**), as well as on all vSphere hosts accessing its iSCSI storage, the MTU size should be set to 9000 to enable the transmission of large blocks of data, which is more efficient than the default MTU size with block-based storage. Additionally, all Ethernet switches in the iSCSI data path must support jumbo frames. Refer to the specific switch configuration guide for instructions on enabling jumbo frames.

3.4.2 Disable delayed ACK

In some environments, periods of high network congestion can cause iSCSI transfer latency to exceed acceptable levels. To avoid this, VMware recommends disabling delayed ACK following the steps provided in the VMware Knowledge Base article: ESX/ESXi hosts might experience read or write performance issues with certain storage arrays.

3.5 LUN sizing and creation

Determining the size and number of LUNs to create and present to your vSphere environment is a complex task. While there is no single right answer to the size and number of LUNs, because every environment is different, this section provides guidance for identifying the most effective answer for your environment.

3.5.1 LUN size

VMware currently supports a maximum datastore size of 64 TB. However, in most circumstances, a much smaller, more manageable size would be recommended to accommodate a reasonable number of virtual machines per datastore (more on this in section 3.5.2). Since LUNs and vSphere datastores can be expanded to address future growth, the recommendation is to create LUNs and datastores with sizes in the range of 500-750GB for most environments. This size datastore accommodates 10-15 virtual machines with a 40 GB virtual disk and provides the additional capacity required for the various overhead files for each virtual machine.

Note: This sizing recommendation supports limitations on the number of virtual machines on each Datastore to keep performance optimal. This recommendation does not take into consideration high-capacity virtual machines. Virtual machines requiring a large virtual disk would require a larger LUN/datastore size, and would not fall outside of these best practices.

3.5.2 Virtual machines per datastore

VMware currently supports a maximum of 2048 powered on virtual machines per VMFS datastore. However, in most circumstances and environments, a target of 15-25 virtual machines per datastore is the conservative recommendation.

By maintaining a smaller number of virtual machines per datastore, potential for I/O contention is greatly reduced, resulting in more consistent performance across the environment. For this reason, the recommended LUN/datastore size is 500-750 GB (as mentioned in section 3.5.1).

Note: The virtual machines per datastore recommendation should be adjusted to support your particular environment. The appropriate number should be based on the I/O and capacity requirements for your specific environment.

3.5.3 VMFS partition alignment

Dell EMC Unity block LUNs where VMFS datastores are created do not require alignment, as VMFS automatically aligns the partition at creation time.

3.6 Guest virtual SCSI adapter selection

When creating a new virtual machine (VM), vSphere automatically selects the recommended virtual SCSI controller based on the operating system being installed to the VM. The best practice is to maintain the automatically selected virtual SCSI controller under most circumstances. In some cases, changing to the VMware Paravirtual SCSI controller may result in better I/O performance as well as reduced CPU utilization on the VM. Additional information and limitations can be found in the *vSphere Virtual Machine Administration Guide* at VMware vSphere 6.x documentation, in the “About VMware Paravirtual SCSI Controllers” section.

3.7 Thin provisioning and virtual disks

Thin provisioning of storage, from both Dell EMC Unity and virtual disks created as part of a virtual machine, allows for increased space efficiency in the storage environment. Thinly provisioned storage can be configured with substantial sizes, but will only occupy the storage capacity required to accommodate the actual storage needs. This ability reduces upfront storage costs in many cases, and allows for a more manageable and predictable storage growth over time.

3.7.1 Virtual disk formats

When creating a virtual machine, one or more virtual disks are created as part of the virtual hardware of that virtual machine. There are three virtual disk formats from which to choose:

- Thick provision lazy zeroed

  A small amount of space is used for the virtual disk at the time of creation. New blocks of data are only allocated during write operations. However, before data is written to new blocks, vSphere will first zero the block to ensure write integrity. This process introduces additional I/O and latency when writes occur, and could potentially affect latency sensitive applications.

- Thick provision eager zeroed

  Space required for the virtual disk is fully allocated at the time of creation. All data blocks for the virtual disk are zeroed during creation. This format will take longer to prepare than other formats, but because all data blocks have been zeroed, there are no I/O penalties as found with other formats. However, there is no realized space efficiency with this format either, as all space has been consumed in the zeroing process.

- Thin provisioned

  Thin provisioned does not allocate all of the logical space for the virtual disk at creation. Rather, logical space is allocated on demand during the first write issued to the block. Like the thick provision lazy zeroed disk, blocks are zeroed prior to first write, introducing additional I/O and latency.

The default virtual disk format is thick provision lazy zeroed. Best practice is to use the default virtual disk format unless specific needs dictate the use of thick provisioned eager zeroed for performance or availability needs including Microsoft Cluster Service (MSCS) and VMware Fault Tolerance (FT).

3.7.2 Dell EMC Unity thin provisioning or VMware thin provisioning

Dell EMC Unity offers thin provisioning as a recommended option when creating block storage and requires thin provisioning to enable compression. Utilizing thin provisioning within VMware on virtual disks does not initially result in additional space efficiency when thin provisioning is enabled on the array. However, the ability to reclaim space from within a compatible guest OS DOES require thin provisioning be used on both the storage and the virtual disks. Additional requirements for space reclamation within the guest include:

Virtual machines on VMFS 6 datastores

- Reclaiming space on guest operating system is only processed when the space to reclaim is equal to 1MB or a multiple of 1MB

Virtual machines on VMFS 5 datastores

- Virtual machine hardware must be version 11 (ESXi 6.0) or greater
- The advanced setting EnableBlockDelete must be set to 1
- The guest operating system must be able to identify the virtual disk as thin

3.8 VMware NFS datastores

When creating NFS-based storage for vSphere in a Dell EMC Unity environment, Dell EMC recommends creating VMware NFS datastores, using the VMware-specific tools within Unisphere, rather than general-purpose NFS file systems. VMware NFS datastores are optimized to provide better performance with vSphere. Additionally, creating two NAS servers (one on each SP) on the Dell EMC Unity platform where NFS Datastores are served is recommended for both availability and increased performance. Dell EMC also recommends using the default 8K Host I/O Size for VMware NFS datastores. Only choose a different Host I/O Size if all applications that will be hosted in the NFS datastore primarily use the selected I/O size. Additional NFS tuning information can be found in *Best Practices for Running VMware vSphere on Network-Attached Storage (NAS)*.

3.9 Virtual Volumes (VVOL)

When configuring block VVol Datastores over Fibre Channel or iSCSI, protocol endpoint devices are presented to the vSphere hosts rather than disk devices. These protocol endpoint devices are used for tuning as described in section 3.3. Best practices regarding block VVol datastores mirror those of the standard block storage described previously in this paper.

When configuring file-based (NFS) VVol datastores in a Dell EMC Unity environment, it is recommended to create at least two VVol-enabled NAS servers: one on SPA and the other on SPB. Additionally, committing two or more interfaces per SP can result in better performance, but follows the same guidelines and limitations as NFS datastores found in *Best Practices for Running VMware vSphere on Network-Attached Storage (NAS)*.

4 Data protection

This section covers features or products used for data protection. It also covers how application data protection features may be used or are integrated. These items would be actionable for someone in either the storage administrator or application administrator role.

4.1 AppSync

Dell EMC AppSync™ is software that enables integrated Copy Data Management (iCDM) with the Dell EMC primary storage systems, including Dell EMC Unity arrays.

AppSync simplifies and automates the process of creating and using snapshots of production data. By abstracting the underlying storage and replication technologies, and through application integration, AppSync empowers application owners to manage data copy needs themselves. The storage administrator, in turn, need only be concerned with initial setup and policy management, resulting in a more agile environment. Additional information on AppSync can be found in the *AppSync User and Administration Guide* and the *AppSync Performance and Scalability Guidelines*.

4.2 Snapshots

Be aware that snapshots increase the overall CPU load on the system, and increase the overall drive IOPS in the storage pool. Snapshots also use pool capacity to store the older data being tracked by the snapshot, which increases the amount of capacity used in the pool until the snapshot is deleted. Consider the overhead of snapshots when planning both performance and capacity requirements for the storage pool.

Before enabling snapshots on a storage object, it is recommended to monitor the system and ensure that existing resources can meet the additional workload requirements. (Refer to the “Hardware Capability Guidelines” section and Table 2 in the *Dell EMC Unity Best Practices Guide*.) Enable snapshots on a few storage objects at a time, and then monitor the system to be sure it is still within the recommended operating ranges before enabling more snapshots. Additional information can be found in the *Dell EMC Unity: Snapshots and Thin Clones* white paper.

4.3 Asynchronous replication

Dell EMC recommends including a flash tier in a hybrid pool where asynchronous replication will be active. This is applicable to both the source and the destination pools.

Asynchronous replication takes snapshots on the replicated storage objects in order to create the point-in-time copy, determining the changed data to transfer and maintain consistency during the transfer. Consider the overhead of snapshots when planning performance and capacity requirements for a storage pool that will have replication objects.

Setting smaller RPO values on replication sessions will not make them transfer data more quickly, but smaller RPOs will result in more snapshot operations. Choosing larger RPOs, or manually synchronizing during non-production hours, may provide more predictable levels of performance. Additional information can be found in the *Dell EMC Unity: Replication Technologies* white paper.

4.4 Synchronous replication

Dell EMC recommends including a flash tier in a hybrid pool where synchronous replication will be active.

Synchronous replication transfers data to the remote system over the first Fibre Channel port on each SP. When planning to use synchronous replication, it may be appropriate to reduce the number of host connections on this port. When the CNA ports are configured as FC, CNA port 4 is defined as the synchronous replication port. If the CNA ports are configured as 10GbE, then port 0 of the lowest numbered FC I/O Module is the replication port. Additional information can be found in the *Dell EMC Unity: Replication Technologies* white paper.

A Technical support and resources

The Dell EMC Data Center Transformation site is focused on enabling customers to gain understanding regarding the transformation of their IT infrastructure utilizing new technologies.

Dell EMC Unity Info Hub is a source providing helpful links to document and tools to customers.

Hardware and software support for the Dell EMC Unity platform is found at: Dell EMC Support.

Dell TechCenter is an online technical community where IT professionals have access to numerous resources for Dell EMC software, hardware and services.

A.1 Referenced test data

Performance comparison testing to determine increase in IOPS and decrease in latency were executed against the following configuration. These performance tests were not designed to obtain maximum performance, rather to identify the increase in performance for a given workload as a result of the round robin IOPS setting changes.

A.1.1 Block testing

Fibre Channel and iSCSI block environment testing was performed on two vSphere hosts, using two Windows Server virtual machines on each host.

Component	Quantity	Notes
vSphere Hosts	2	Dell R620
CPU	2	Intel Xeon E5-2620
RAM	32 GB	
FC HBA	2 (ports)	Qlogic 2670
iSCSI - 10Gb	2 (ports)	Qlogic 3400

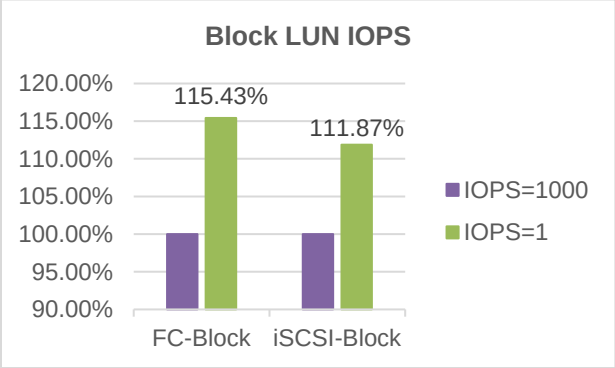
Each virtual machine tested against two virtual disks (each on its own Fibre Channel or iSCSI LUN/Datastore).

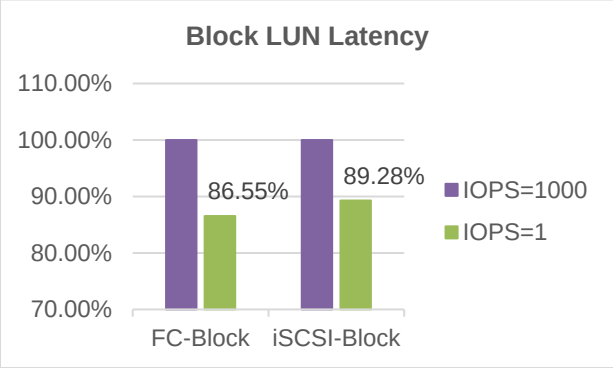
Component	Quantity	Notes
Virtual Machines	4	2 virtual machines on each vSphere host
vCPUs	4	2 sockets / 2 cores per socket

RAM	16 GB	
vDisk	2	Each vDisk on its own LUN/Datastore
vSCSI Controllers	2	1 vSCSI controller for each vDisk

Vdbench was the testing application used on each virtual machine, and executed a 67% / 33% (read / write), random data profile with a transfer size of 8K, with 12 threads, for 30 minutes, with data points taken every five seconds.

The baseline for these tests use the IOPS setting of 1000 (the default) in the Path Selection Policy settings. The comparison performance was the result of changing the IOPS setting from 1000 to 1.





A.1.2 Block VVol testing

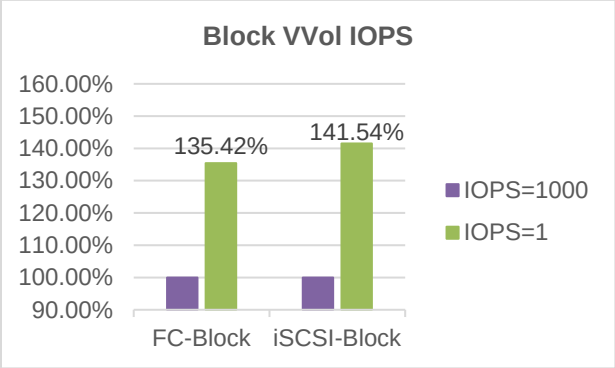
Fibre Channel and iSCSI block VVol environment testing was performed on two vSphere hosts, using two Windows Server virtual machines on each host.

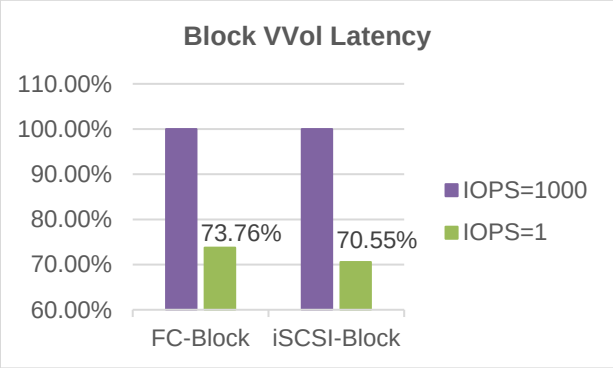
Component	Quantity	Notes
vSphere Hosts	2	Dell R620
CPU	2	Intel Xeon E5-2620
RAM	32 GB	
FC HBA	2 (ports)	Qlogic 2670
iSCSI - 10Gb	2 (ports)	Qlogic 3400

Each virtual machine tested against two virtual disks (each on one of two Block VVol Datastores).

Component	Quantity	Notes
Virtual Machines	4	2 virtual machines on each vSphere host
vCPUs	4	2 sockets / 2 cores per socket
RAM	16 GB	
vDisk	2	1 vDisk on each of two VVol Datastores
vSCSI Controllers	2	1 vSCSI controller for each vDisk

Vdbench was the testing application used on each virtual machine, and executed a 67% / 33% (read / write), random data profile with a transfer size of 8K, with 30 threads, for 30 minutes, with data points taken every five seconds.





A.2 Related resources

Dell EMC Publications:

- Dell EMC Unity Best Practices Guide

  https://www.emc.com/collateral/white-papers/h15093-emc-unity-best-practices-guide.pdf

Dell EMC publications – All titles below can be found on Dell EMC Online Support:

- Dell EMC Unity: Compression – Overview
- Dell EMC Unity: Data at Rest Encryption
- Dell EMC Unity: Dynamic Pools - Overview
- Dell EMC Unity: Performance Metrics – A Detailed Review
- Dell EMC Unity: Replication Technologies – A Detailed Review

- Dell EMC Unity: Snapshots and Thin Clones – A Detailed Review
- Dell EMC Unity: Unisphere Overview – Simplified Storage Management
- Dell EMC Unity: Virtualization Integration - Whitepaper

VMware publications:

- Adjusting Round Robin IOPS limit from default 1000 to 1

  https://kb.vmware.com/kb/2069356

- Best Practices for Running VMware vSphere on Network-Attached Storage (NAS)

  http://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/techpaper/vmware-nfs-best-practices-white-paper-en-new.pdf

- ESX/ESXi hosts might experience read or write performance issues with certain storage arrays

  https://kb.vmware.com/kb/1002598

- VMware vSphere 6.x documentation

  https://www.vmware.com/support/pubs/vsphere-esxi-vcenter-server-6-pubs.html