VMware Virtual SAN Product Information Guide

Notes, Cautions, and Warnings

NOTE: A NOTE indicates important information that helps you make better use of your computer.

CAUTION: A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

WARNING: A WARNING indicates a potential for property damage, personal injury, or death.

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Contents

VMware® Virtual SAN™

Virtual SAN from VMware is a new software-defined storage solution that is fully integrated with vSphere. Virtual SAN aggregates locally attached disks in a vSphere cluster to create a storage solution that can be provisioned and administrated from VMware vCenter™. With Virtual SAN licensing added to a host ESXi server, the combined solution allows you to grow both compute and storage capacity with the same hardware, and manages it from your vCenter Server.

The target use-cases for this technology are virtual desktop deployments and test and development. For other uses, careful consideration of virtual machine performance and margin of error for component failure should be considered for your environment.

Virtual SAN is not recommended for virtual machines with an expected VMware Virtual Disk (VMDK) size of 2TB or greater, nor is it recommended for mission critical virtual machines.

Introduction

The objective of this document is to assist in the deployment of VMware® Virtual SAN™ on Dell PowerEdge Servers. This document provides recommendations on supported configurations, best practices, and additional resources. It should be used in conjunction with other official VMware Virtual SAN documentation from VMware Technical Marketing and VMware Technical Publications.

Hardware Design Considerations

There are number of design parameters that should be considered during a Virtual SAN cluster implementation. The objective of this section is to assist with the selection of Dell hardware for Virtual SAN implementation.

Servers

A minimum of three hosts are required for a Virtual SAN cluster, with at least one disk group a piece, where a disk group is a combination of one SSD and one to seven HDDs.

The minimum configuration only allows for a single host failure (whether due to a crash or loss of network availability). Use the following formula to calculate for the minimum number of hosts needed to allow for additional host failure:

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Minimum servers needed = 2(n)+1 (Where n is the number of servers that can fail)
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This calculation assumes all the nodes have the same amount of disk groups and contribute the same amount of storage (represented by the HDDs), which is also the Dell recommendation for your VSAN environment. If you have a heterogeneous mix of storage capacities, there is no simple calculation to help determine host failure tolerances.

NOTE: If you have compute-only Virtual SAN nodes that are contributing no storage, they should be excluded from the server count for host failure tolerance.

Currently, the maximum number of supported hosts in a Virtual SAN cluster is thirty two.

For creating a Virtual SAN cluster with 16 or more hosts, extra configuration parameters need to be set on each and every host participating in cluster. For more information on how to configure Virtual SAN cluster with more than 16 hosts, please refer VMware KB 2073930.

NOTE: While any ESXi 5.5 U1 compatible server works for Virtual SAN, the current version of Virtual SAN supports internal server storage only. Due to this, Dell *does not recommend* blades for a Virtual SAN deployment, due to the limit on internal storage. Additionally, Dell *does not recommend* VRTX for Virtual SAN, since the compute nodes have the same internal storage limitations, and the VRTX shared storage is considered as external storage. Converged Rack mount servers (PEC 6220 II) provides density along with scalability. Multiple nodes can be accommodated in a 2U rack space with greater local storage options. Depending on the specific configuration, they can be an ideal hardware platform for a Virtual SAN solution.

For total drive considerations, Virtual SAN currently supports a maximum of five disk groups per host and a maximum of eight disk devices per disk group, one flash-based device and seven magnetic disks.

With the intent of Virtual SAN being to grow both compute and storage simultaneously, Dell recommends and has certified the following servers with Virtual SAN:

Table 1. Recommended Dell 2 Socket Servers for Virtual SAN

Server	Maximum Memory	Controller Options	PCIe Slots	Drive Bays
T620	768 GB	H710 H710P LSI 9207-8i	6 PCIe 3.0 and 1 PCIe 2.0	32 x 3.5 or 16 x 2.5
R620	768 GB	H710 H710P LSI 9207-8i	3 PCI 3.0	10 x 2.5
R720	768 GB	H710 H710P LSI 9207-8i	7 PCIe 3.0	8 x 3.5 or 16 x 2.5
R720xd	768 GB	H710 H710P LSI 9207-8i	6 PCIe 3.0	12 x 3.5 or 26 x 2.5
C6220 II	512GB Per Node	LSI9265-8i*	1 8x Mezz, 1 16x PCIe 3.0	24 x 2.5 or 12 x 3.5

NOTE: *: The LSI9265-8i cards might require an installation on-site.

Table 2. Recommended Dell 4 Socket Servers

Server	Maximum Memory	Controller Options	PCIe Slots	Drive Bays
R820	1.5 TB	H710 H710P LSI 9207-8i	7 PCIe 3.0	16 2.5"

For Ready Node recommendations on Dell Server selection, see Dell PowerEdge Ready Node References.

Table 3. Configuration for Single Host Storage with Virtual SAN

Minimum Disks	Maximum Disks	Minimum Disk Groups per Host	Maximum Disk Groups per Host	Minimum Drives per Disk Group	Maximum Drives per Disk Group
2 Disks (1 SSD and 1 HDD)	40 Disks (5 SSD and 35 HDD)	1 Disk Group	5 Disk Groups	2 Drives (1 SSD and 1 HDD)	8 Drives (1 SSD and 7 HDD)

Memory and Processor Requirements

The memory requirements for Virtual SAN are defined based on the number of disk groups and disks that are managed by a hypervisor.

Even though the minimum required memory for Virtual SAN host is 6GB, it is strongly recommended to have a memory configuration greater than 32GB per host to support full storage capacity and scalability capabilities of Virtual SAN.

Virtual SAN is designed to introduce no more than 10 percent of CPU overhead per host in Virtual SAN implementations with high consolidation ratios and CPU-intensive application requirements.

For more information, see the Dell PowerEdge Ready Node References section, which follow the VMware recommendations on target processing and memory configurations.

Storage Controllers

Each vSphere host that contributes storage to the Virtual SAN cluster requires a disk controller. This can be a SAS or SATA host bus adapter (HBA) or a RAID controller. The RAID controller must function in one of two following modes:

- **Pass-through mode:** This mode is commonly referred to as JBOD or HBA mode and is the default VMware recommended configuration for Virtual SAN. It enables Virtual SAN to manage the RAID configuration settings for storage policy attributes based on availability and performance requirements that are defined on a virtual machine. In this mode, Virtual SAN has complete control of local HDDs and SSDs that are connected to the controller.

  NOTE: The Virtual SAN implementation in v5.5 U1 *does not* officially support JBOD or external DAS. For support purposes, all storage used by Virtual SAN must be internal to the host. While the JBOD or external DAS might function, it will not be an officially supported configuration.

- **RAID-0 mode:** In RAID-0 mode, every disk (both HDDs and SSDs) needs to be created as a RAID-0 virtual disk. When the disks are configured in RAID-0 mode, the storage controller cache should be

disabled to avoid the conflict with SSD cache maintained by Virtual SAN. In this mode, hot-plug capabilities are not managed by Virtual SAN as there is a RAID-0 volume associated with the disk. All hot-plug operations are handled by the storage controller firmware.

Multiple controllers on a single server are useful in the following two ways:

- When the supported number of HDDs by a given controller (H310 supports 32disks as passthrough and 16 VDs in RAID-0 mode) are exceeded. A maximum of 40 Disks can be configured on single host for Virtual SAN.
- When performance is a key factor. You can consider splitting the total drives between two storage controllers to gain performance.

The following table lists the Virtual SAN Compatible Dell Storage Controllers:

Table 4. Supported Storage Controllers for Virtual SAN

Controller Name	Type	Pass-through Support	RAID-0 Support	Queue Depth	Maximum disks per VD through RAID-0
PERC H710P	SAS-RAID	No	Yes	975	64 RAID-0 Volumes
PERC H710 Adapter	SAS-RAID	No	Yes	975	64 RAID-0 Volumes
PERC H310 Adapter*	SAS-RAID	Yes	Yes	25	32 Non-RAID or 16 RAID-0 Volumes
LSI SAS 9207-8i	SAS	Yes	No	337	256 Non-RAID Devices
LSI SAS 9265-8i	SAS	No	Yes	975	128 Non-Raid or 64 RAID-0 volumes

NOTE: PERC H310* was supported during VMware's Virtual SAN beta program. During the beta, it was determined that the low queue depth can create performance bottle-necks, so it is no longer recommended for a commercial Virtual SAN environment.

NOTE: SSDs connected to the H710 or H710p controller might not appear as SSDs in ESXi as there is a RAID-0 VD created on top of the SSDs. Refer the VMware Knowledge Base (KB) article 2013188 to set the SSD flag to these devices.

Hard Disk Drives

Hard disk drives contribute to the total capacity of the Virtual SAN data store.

NOTE: 750MB of space per HDD is reserved by Virtual SAN for Disk formatting.

The following is an example of how to determine the storage capacity of a Virtual SAN cluster, starting with *cluster capacity*.

If a cluster is composed of eight R720XD Servers, where each host contains one disk group composed of seven magnetic disks of 2TB in size each, the total cluster capacity of the Virtual SAN shared data store is ~1007.8 TB after subtracting the metadata overhead capacity.

*8 R720XD Servers * 3 disk groups * 7 HDDs * 2TB = 1008 TB Virtual SAN raw capacity*

1008 TB Virtual SAN raw capacity - 124 GB of metadata overhead = 1007.8 TB Virtual SAN Cluster Capacity

Usable capacity is determined by dividing the *cluster capacity* by the Number of Failures to Tolerate (per the Virtual SAN setup, the number of copies created for a given Virtual Machine) plus 1. In the above example, if Number of Failures to Tolerate is 1, the total usable capacity is 1007.8/1+1=~503.9TB

For a list of Virtual SAN Certified Dell SAS and NL-SAS HDDs, refer the VMware Compatibility Guide or see Appendix – Supported HDDs.

NOTE: Currently SATA HDDs from Dell are not supported for Virtual SAN configuration because of the Virtual SAN requirement to disable write cache on SATA disks.

Solid State Drives

Solid State Drives in Virtual SAN environment are used as the read cache and the write buffer for the HDDs in each disk group. 30 percent of each flash-based device is used as a write-back buffer and 70 percent as read cache. It is a requirement to have one SSD per Disk Group.

The specifications of the SSD contribute directly to the performance of the VSAN cluster due to the following reasons:

- All writes are first written to SSD before being written to HDD
- All reads try the cache first. If there is a read cache miss, the read request moves on to disk

For sizing flash capacity for Virtual SAN, VMware recommends using ten percent of the anticipated consumed storage capacity before the number of tolerated failures is considered. VMware has the following calculation for this in their Design and Sizing guide:

Total flash capacity required for the cluster = {(Total estimated virtual machine space usage) x (Total number of expected virtual machines)} x ten percent

If you do not have projections for the total VM usage or want to use hardware calculations, Dell recommends the following:

- For calculating the SSD needed for a single host, treat it like an isolated Virtual SAN cluster and use the *raw capacity* and *cluster capacity* calculations. In the case of the R720XD with 3 disk groups and 7 HDDs of 2TB capacity each, the total SSD capacity needed would be 2.07GB, which is equivalent to 800GB SSDs per disk group.

*Host raw capacity: 1 R720XD server * 3 Disk Groups * 7 HDDs * 2TB capacity = 42TB raw capacity*

*Host cluster capacity: 42TB raw capacity - (3 disk groups * 7 HDDs *750MB metadata overhead = 15.38GB) metadata overhead = 41.4TB cluster capacity*

Host usable capacity: 41.47TB cluster capacity / Failure tolerance (1+1) = 20.73TB usable capacity

*Total flash capacity required: 10 percent of usable capacity = .1 * 20.73TB = 2.07TB*

SSD per disk group: 2.07TB / 3 disk groups = 706GB per disk group = 800GB SSD recommended per disk group

NOTE: In the event of an SSD failure, the entire disk group associated with it is lost to the Virtual SAN cluster. It is generally recommended that you have multiple disk groups per server when possible due to this.

Flash devices in the VMware Compatibility Guide for Virtual SAN are categorized into classes, based on write performance. All flash devices are not created equal, and the class of the flash device can greatly affect the performance of a Virtual SAN cluster. The VMware Compatibility Guide specifies the following designated flash device classes, where performance starts at Class A and increases up to Class E:

- **Class A:** 2,500–5,000 writes per second
- **Class B:** 5,000–10,000 writes per second
- **Class C:** 10,000–20,000 writes per second
- **Class D:** 20,000–30,000 writes per second
- **Class E:** 30,000+ writes per second

For a list of Virtual SAN Certified Dell SAS, SATA, and PCIe SSDs size range of 100GB to 800GB, refer the VMware Compatibility Guide.

Networking

Virtual SAN provides support for both vSphere standard switch and VMware vSphere Distributed Switch™, with either 1GbE or 10GbE network uplinks. Although both vSphere switch types and network speeds work with Virtual SAN, VMware recommends the use of the vSphere Distributed Switch with 10GbE network uplinks (vSphere Enterprise Plus licensing is required to use vSphere Distributed Switch).

These recommendations are made because of the possible replication and synchronization activities that Virtual SAN might impose on the network based on the number of virtual machines hosted in the system and the number of active operations.

VMware recommends the use of multiple network adapters in active–passive mode with explicit failover order, whenever using a route based on the originating virtual port ID load-balancing mechanism.

Virtual SAN does not support IPv6.

VMware recommends isolating Virtual SAN traffic to its own VLAN. Any Quality of Service (QoS) mechanisms available are also recommended, such as the Network input or output Controller available in vSphere Enterprise Plus licensing.

For performance and security, it is also recommended isolating Virtual SAN traffic to its own physical layer 2 network. Virtual SAN requires that IP multicast be enabled on the layer 2 physical network segment utilized for Virtual SAN intra-cluster communication. Layer 2 multicast traffic can be limited to specific port groups by using Internet Group Management Protocol (IGMP) snooping. VMware does not recommend implementing multicast flooding across all ports as a best practice. Virtual SAN does not require layer 3 multicast for any of its network communication requirements. For more information on network recommendations, refer to the VMware Virtual SAN Design and Sizing Guide.

ESXi Installation Media

ESXi installation on a node can be done in two ways, either via local storage or via flash on the server.

- **Local Storage:** For local storage, Dell requires a minimum of two drives in a RAID 1 configuration, for a supported configuration. This is to provide redundancy for the hypervisor; otherwise, a failure of the local storage crashes the system. A RAID controller is required as the storage controller and the drives dedicated to the ESXi install cannot be used as part of the Virtual SAN storage.
- **Internal Flash:** The Dell recommended PowerEdge server configurations allow for embedded dual SD deployments of ESXi on the server (with the exception of the C6220 II), which allows dedicating any local drives to the Virtual SAN capacity. With internal flash, an ESXi install by default will not keep persistent logs locally if the SD card is less than 4GB, instead creating a ramdisk to store the log files. Dell recommends configuring a Dump Collector and a Syslog Collector to direct ESXi memory dumps and system logs to a server on the network, rather than to a local disk. After the installation, the ESXi installation can be reconfigured to use a persistent datastore for scratch and core dumps. For more information, see the About the Scratch Partition section in the vSphere Installation and Setup documentation.

For information on the supported SD/USB cards on Dell PowerEdge servers, refer to the Dell Storage Matrix for ESXi under VMware ESXi v5.x at the Dell document site.

Software Requirements

The software requirements for Virtual SAN cluster implementation are listed below:

- Either vSphere 5.5 U1 (VMware vSphere® Standard, Enterprise, or Enterprise Plus), VMware vSphere® with Operations Management™ 5.5 U1 (any edition) or VMware vCloud® Suite 5.5U1 (any edition) per socket of the hosts to serve in the cluster. (even if the host is compute only and does not provide storage)
- VMware® vCenter Server™ 5.5 U1
- Virtual SAN licensing per socket of the hosts to serve in the cluster

  NOTE: Different versions of vSphere and vSphere with Operations Management are allowed if the versions have the appropriate Virtual SAN licensing. All versions of vCloud include vSphere Enterprise Plus.

Best Practices

- For optimal performance, when a storage controller (ex: H710) is configured in RAID-0 mode, it is recommended to disable the write cache and disable read-ahead option.
- When using storage controller in RAID-0 mode, hot-add and hot-remove operations of HDD or SSD are recognized by Virtual SAN. Auto Configuration Mode in Virtual SAN does not work when disks are configured in RAID-0 mode.
- When sizing Virtual SAN environment, you must not include SSD capacity in the total datastore capacity. SSDs do not contribute any space to actual datastore size.
- It is recommended to dedicate a 10GbE NIC port for Virtual SAN traffic. Although 1GbE is fully supported, it could be a limiting factor in intensive input output environments.

- When Jumbo Frames are enabled, ensure that they are enabled end-to-end.
- Non-uniform cluster configuration could lead to variations in performance and could make it more complex to stay compliant to defined policies after a failure. It is a recommended practice to keep the hosts and disk configuration for a Virtual SAN cluster similar.
- When adding new SSDs or HDDs ensure that the disks are not pre-formatted.

  NOTE: When Virtual SAN is configured to automatic mode disks are added to existing disk groups or new disk groups are created automatically.
- Team two NICs for Virtual SAN network traffic per host with explicit failover order. If one should fail, that ESXi host can continue to participate in the Virtual SAN cluster. NIC teaming does not give additional bandwidth sharing to the VSAN network. It simply provides a highly available network.

Dell PowerEdge Ready Node References

A Virtual SAN Ready Node is a preconfigured single-node or multi-node server hardware configuration that fits a general server or VDI profile. A Ready Node configuration includes recommendations on the CPU, Memory, Flash, HDD, IO Controller , and NICS within each server.

With VMware's guidance, there are two types of profiles, the VDI or general server profiles.

Server Profiles

The server profiles are guidance on a place to start for building a Virtual SAN configuration, primarily aimed at proof of concept.

The guidance from VMware is based on targets of performance and capacity, making for three server profiles:

- High
- Medium
- Low

Depending on the actual usage for your environment, different configurations may make for better performance, built from different certified components listed in theVMware Compatibility Guide.

Table 5. Server profile guidelines

	High	Medium	Low
IOPs per node (70% Read 30% Write)	Up to 20 K	Up to 12 K	Up to 2 K
Raw storage capacity per node	14.4 TB	8TB	4TB
Usable Storage / Flash requirement*	7.15 TB / 740 GB	3.95 TB / 405 GB	1.95 TB / 700 GB SSD

	High	Medium	Low
CPU / Core Count**	2 / 10 core	2 / 8 core	1 / 6 core
Memory	384 GB	256 GB	64 GB
Disk Group Minimum	2	2	2
HDD configuration per Disk Group	6 x 1.2 TB SAS 10 K RPM	4 x 1 TB NL-SAS 7.2 K RPM	2 x 1 TB NL-SAS 7.2 K RPM
SSD configuration per Disk Group	700 GB SSD (Class E)	200 GB SSD (Class D or E)	200 GB SSD (Class B or C)
IO Controller Queue Depth	>= 512	>= 256	>= 256
NIC	2 x 10GbE	2 x 10GbE	2 x 1GbE

* Where Number of Failures to Tolerate, the policy determining how many copies of a VM created, is 1. If the number is changed, it impacts the amount of recommended flash.

** Assumes current generation chipsets, and core count listing is minimum recommendation

Recommended server profiles

The following are the Dell Server Profile recommendations:

Components	R820 (Server Profile – High)	R720xd (Server Profile – Medium)	R620 (Server Profile – Low)
SYSTEM	Intel Xeon E5-46XX v2 Processors	Intel XeonE-26XX Processors	Intel Xeon E-26XX v2 Processors
CPU	Intel Xeon E5-4650 v2 2.4 GHz, 25 M Cache, 8.0 GT/s QPI, Turbo, 10 C, 95 W, Max Mem 1866 MHz	Intel Xeon E5-2660 v2 2.2 GHz,25 M Cache, 8.0 GT/s QPI, Turbo, HT, 10 C, 95 W, Max Mem 1866 MHz	Intel Xeon E5-2630 v2 2.6 GHz,15 M Cache, 7.2 GT/s QPI, Turbo, HT, 6 C, 80 W, Max Mem 1600 MHz
Memory	72 X 16 GB RDIMM, 1866 MT/s, Standard Volt, Dual Rank, x4 Data Width	24 X 32 GB LRDIMM, 1866 MT/s, Standard Volt, Quad Rank, x4 Data Width	24 X 8 GB RDIMM, 1600 MT/s, Low Volt, Single Rank, x4 Data Width
SSD Count	6 X 700 GB P420 M MLC PCIe Solid State Storage Card-Assumes System Warranty up to 5 Years; Not Extendable Past 5 years	6 x 200 GB Solid State Drive SAS Write Intensive SLC 6 Gpbs 2.5 in Hot-plug Drive	6 X 200 GB Solid State Drive SAS Value SLC 6 Gbps 2.5 in Hot-plug Drive

Components	R820 (Server Profile – High)	R720xd (Server Profile – Medium)	R620 (Server Profile – Low)
HDD Count	36 X 1.2 TB 10 K RPM SAS 6 Gbps 2.5 in Hot-plug Hard Drive	24 X 1 TB 7.2 K RPM Near-Line SAS 6 Gbps 2.5 in Hot-plug Hard Drive	12 X 1 TB 7.2 K RPM Near-Line SAS 6 Gbps 2.5 in Hot-plug Hard Drive
Controller	PERC H710P Integrated RAID Controller, 1 GB NV Cache	PERC H710P Integrated RAID Controller, 1 GB NV Cache	PERC H710 Integrated RAID Controller, 512 MB NV Cache
NIC	Intel X520 DP 10 Gb DA/SFP+, + I350 DP 1 Gb Ethernet, Network Daughter Card	Intel X520 DP 10 Gb DA/SFP+, + I350 DP 1 Gb Ethernet, Network Daughter Card	Broadcom 5720 QP 1 Gb NetworkDaughter Card
Virtual Machine Profile	2 vCPU, 6 GB Memory, 2 x 60 GB virtual disks	2 vCPU, 6 GB Memory, 2 x 60 GB virtual disks	2 vCPU, 6 GB Memory, 2 x 60 GB virtual disks

NOTE: A vCenter Server is mandatory with any of the above configurations and is not listed in the node configurations and needs to be procured. If you already have a vCenter Server, it can be used to administrate the environment.

Virtual Desktop Infrastructure (VDI) Profiles

The Dell Ready Node configurations are generic places to start for proof of concept, but your environment might generally require customization. For VDI Nodes, it is important to understand the details of your usage profile like user activity, capacity, input output requirements, and use types to be able to get a true performance configuration. If you would like help in getting a custom VDI configuration, you can contact your Dell sales team to engage additional resources for assistance.

Appendix – Tables

VMware HCL Listed Dell Ready-Nodes

Server	IO Controller	HDD	SSD
PowerEdge T620	LSI SAS 9207-8i	900GB 10K RPM SAS 6Gbps 2.5in Flex Bay Hard Drive	400GB SSD SAS Value SLC 6Gbps 2.5in
PowerEdge T620	PERC H310 Adapter	1TB 7.2K RPM Near-Line SAS 6Gbps 2.5in Hot-plug Hard Drive	400GB SSD SATA Value MLC 3Gbps 2.5in
PowerEdge T620	PERC H310 Adapter	300GB 15K RPM SAS 6Gbps 2.5in	400GB SSD SATA Value MLC 3Gbps 2.5in
PowerEdge C6220 II	LSI 9265-8i	900GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	200GB SSD SATA Value MLC 3Gbps 2.5in
PowerEdge R720	LSI SAS 9207-8i	300GB 15K RPM SAS 6Gbps 2.5in	100GB SSD SATA Value MLC 3Gbps 2.5in

Server	IO Controller	HDD	SSD
PowerEdge R720	PERC H310 Adapter	1TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive	200GB SSD SAS Mixed Used/ Value 6Gbps 2.5in
PowerEdge R720-XD	PERC H310 Adapter	1TB 7.2K RPM Near-Line SAS 6Gbps 2.5in Hot-plug Hard Drive	200GB SSD SAS Write Intensive (WI) 6Gbps 2.5in
PowerEdge R820	PERC H710 Adapter	1.2TB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	400GB SSD SAS Value SLC 6Gbps 2.5in

Appendix – Supported SSDs

The following table lists the SSDs supported for VMware Virtual SAN

Model	Device Type	FormFactor	Grade	Grade	Capacity GB
Dell PowerEdge Express Flash PCIe SSD 350GB	PCI-E	2.5"	Class E: 30,000+ writes per second	SLC	350
Dell PowerEdge Express Flash PCIe SSD 175GB	PCI-E	2.5"	Class E: 30,000+ writes per second	SLC	175
400GB SSD SAS Write Intensive (WI) 6Gbps 2.5in	SAS	2.5"	Class D: 20,000-30,000 writes per second	SLC	400
400GB SSD SAS Value SLC 6Gbps 2.5in	SAS	2.5"	Class D: 20,000-30,000 writes per second	SLC	400
200GB SSD SAS Write Intensive (WI) 6Gbps 2.5in	SAS	2.5"	Class D: 20,000-30,000 writes per second	SLC	200
800GB SSD SAS Mixed Used/ Value 6Gbps 2.5in	SAS	2.5"	Class C: 10,000-20,000 writes per second	SLC	800
200GB SSD SAS Mixed Used/ Value 6Gbps 2.5in	SAS	2.5"	Class C: 10,000-20,000 writes per second	SLC	200
800GB SSD SATA Value	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	800

Model	Device Type	FormFactor	Grade	Grade	Capacity GB
MLC 6Gbps 2.5in					
800GB SSD SATA Value MLC 3Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	800
400GB SSD SATA Value MLC 6Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	400
400GB SSD SATA Value MLC 3Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	400
200GB SSD SATA Value MLC 6Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	200
200GB SSD SATA Value MLC 3Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	200
100GB SSD SATA Value MLC 6Gbps 2.5in	SATA	2.5"	Class C: 10,000-20,000 writes per second	eMLC	100
100GB SSD SATA Value MLC 3Gbps 2.5in	SATA	2.5"	Class B: 5,000-10,000 writes per second	eMLC	100

Appendix – Supported HDDs

The following table lists the HDDs supported by VMware Virtual SAN:

Model	Form Factor	RPM	Capacity GB
600GB 15K RPM SAS 6Gbps 3.5in Hot-plug Hard Drive	2.5"	15000	600
300GB 15K RPM SAS 6Gbps 3.5in Hot-plug Hard Drive	2.5"	15000	300
300GB 15K RPM SAS 6Gbps 2.5in	2.5"	15000	300

Model	Form Factor	RPM	Capacity GB
900GB 10K RPM Self-Encrypting SAS 6Gbps 2.5in Hot-plug Hard Drive,FIPS140-2	2.5"	10000	900
900GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	10000	900
900GB 10K RPM SAS 6Gbps 2.5in Flex Bay Hard Drive	2.5"	10000	900
600GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	10000	600
600GB 10K RPM SAS 6Gbps 2.5in Flex Bay Hard Drive	2.5"	10000	600
300GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	10000	300
300GB 10K RPM SAS 6Gbps 2.5in Flex Bay Hard Drive	2.5"	10000	300
1.2TB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	10000	1200
1.2TB 10K RPM SAS 6Gbps 2.5in Flex Bay Hard Drive	2.5"	10000	1200
500GB 7.2K RPM Near-Line SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	7200	500
1TB 7.2K RPM Self-Encrypting Near-Line SAS 6Gbps 2.5in Hot-plug Hard Drive,FIPS140-2	2.5"	7200	1000
1TB 7.2K RPM Near-Line SAS 6Gbps 2.5in Hot-plug Hard Drive	2.5"	7200	500
4TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive	3.5"	7200	4000
3TB 7.2K RPM Self-Encrypting Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive, FIPS140-2	3.5"	7200	3000
3TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive	3.5"	7200	3000
2TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive	3.5"	7200	2000

Model	Form Factor	RPM	Capacity GB
1TB 7.2K RPM Near-Line SAS 6Gbps 3.5in Hot-plug Hard Drive	3.5"	7200	1000

Appendix – Formulas

Host failures to tolerate in a Virtual SAN cluster

Minimum servers needed = 2 (Number of Host failures to tolerate) + 1

Calculating Virtual SAN Storage Capacity

- **Virtual SAN raw capacity** = Number of Servers * Number of disk groups * Number of HDDs per disk group * HDD size
- **Virtual SAN cluster capacity** = *Virtual SAN raw capacity* – (750 MB * Number of disk groups * Number of HDDs per disk group)
- **Usable capacity** = *Virtual SAN Cluster capacity* / (Number of Failures to Tolerate + 1)

  Here *Number of Failures to Tolerate* refers to the Virtual SAN setting determining the number of copies of the Virtual Machines to be created across the Virtual SAN cluster.
- **Total flash capacity required for the cluster** = {(Total estimated virtual machine space usage) x (Total number of expected virtual machines)} x 0.1

Calculating Virtual SAN Storage for a single host

- **Host raw capacity** = Number of disk groups * Number of HDDs per disk group * HDD size
- **Host Virtual SAN capacity** = *Host raw capacity* – (750 MB * Number of disk groups * Number of HDDs per disk group)
- **Host usable capacity** = Host *Virtual SAN capacity* / (Number of Failures to Tolerate + 1)

  Here *Number of Failures to Tolerate* refers to the Virtual SAN setting determining the number of copies of the Virtual Machines to be created across the Virtual SAN cluster.
- **Needed host flash capacity** = *Host usable capacity* x 0.1
- **SSD per host disk group =** *Needed host flash capacity* / Number of disk groups

References

- What's New in VMware® Virtual SAN™ - TECHNICAL WHITE PAPER http://www.vmware.com/files/pdf/products/vsan/VMware_Virtual_SAN_Whats_New.pdf
- VMware® Virtual SAN™ Design and Sizing Guide -TECHNICAL MARKETING DOCUMENTATION https://www.vmware.com/files/pdf/products/vsan/VSAN_Design_and_Sizing_Guide.pdf
- Additional Technical References:

- http://www.vmware.com/products/virtual-san/resources.html
- http://pubs.vmware.com/vsphere-55/topic/com.vmware.vsphere.storage.doc/GUID-18F531E9-FF08-49F5-9879-8E46583D4C70.html