VMware Horizon® View on SUPERMICRO® Virtual SAN™

Ready Node with SanDisk Flash Storage

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Introduction

The SUPERMICRO TwinPro™ Solution architecture builds on SUPERMICRO's proven Twin technology to provide outstanding throughput storage, networking, I/O, memory, and processing capabilities in a 2U server, allowing customers to further optimize SUPERMICRO solutions to solve their most challenging IT requirements.

Optimized for high-end Enterprise, Data Center, Hyper-Converged and Cloud Computing environments, the SUPERMICRO TwinPro Solutions are designed for ease of installation and maintenance with high quality for continuous operation at maximum capacity. The resulting benefit is compelling Total Cost of Ownership for customers seeking a competitive advantage from their data center resources.

SanDisk SAS-based flash storage has long helped customers realize new levels of technical, operational and financial efficiencies in virtualized environments. This storage has enabled

- Scaling up of Virtual Machine (VM) performance
- Increased VM densities
- Higher productivity and service levels

When a VMware® all-flash Virtual SAN™ is combined with Horizon View software on SUPERMICRO TwinPro[2] servers, customers have one of the most-cost effective, high-performing solutions for client virtualization and virtual desktop infrastructure) needs.

VMware Virtual SAN is software-defined storage for VMware vSphere. The all-flash Virtual SAN solution clusters server-attached, SAS-based, mixed-used-capability SSDs as a flash storage tier for caching, and provides read-intensive-capability SSDs for capacity. The result is a flash-optimized, highly resilient shared datastore designed for virtual environments.

VMware Horizon View enables users to access all their virtual desktops, applications and online services through a single workspace. Horizon View is the virtual desktop host infrastructure for vSphere. This platform enables user desktops as virtual machines on top of ESXi hosts.

This white paper discusses the benefits of the solution described above. A key benefit is the high level of responsiveness of the virtual desktops and applications as measured by response times.

Executive Summary

Virtual desktop infrastructure has been adopted extensively by enterprises who use it in financial, healthcare, engineering, education, and other sectors. As virtual desktop infrastructure is being widely deployed, new challenges are emerging. With workforce globalization and desktop consolidation in data centers, user demands and expectations have changed. The boot storm is no longer simply a 9 a.m. phenomenon for a particular time zone, or accessing desktops for a certain time period. The virtual desktop infrastructure environment now needs to be up and running 24x7, with the promise of consistent, predictable performance under any condition.

With the adoption of cloud deployment, virtual desktop infrastructure needs have become more elastic in nature. The environment grows or shrinks rapidly, and traditional storage approaches are not a good fit for these demands.

All these challenges need elastic, scalable, and predictable performance in a pre-configured environment. This white paper demonstrates and discusses VMware all-flash Virtual SUPERMICRO SAN Ready Node, a hypervisor-converged infrastructure, which perfectly fits these needs. The paper also shares the results of virtual desktop infrastructure full-clone and linked desktop deployments scenarios running on SUPERMICRO TwinPro[2] servers, which are superior deployment models for virtual desktop infrastructure.

The average response times for virtual desktop infrastructure desktops are listed below. This shows how robust the solution is, as the application response time is well below the threshold.

Linked-Clone Desktop Response Time

CPU-sensitive applications: 95th percentile: 0.53 seconds (threshold <1 sec.)

CPU- and disk-sensitive applications: 95th percentile: 3.10 seconds (threshold <6 sec.)

Full-Clone Desktop Response Time:

CPU-sensitive applications: 95th percentile: 0.58 seconds (threshold <1 sec.)

CPU- and disk-sensitive applications: 95th percentile: 3.23 seconds (threshold <6 sec.)

Solution Summary: SUPERMICRO Virtual SAN Ready Node

As VMware defines it, "Virtual SAN Ready Node is a validated server configuration in a tested, certified hardware form factor for Virtual SAN deployment, jointly recommended by the server OEM and VMware. Virtual SAN Ready Nodes are ideal as hyperconverged building blocks for larger data center environments looking for automation and a need to customize hardware and software configurations."

SUPERMICRO and SanDisk jointly tested an all-flash VSAN Ready Node. Below are the configuration details.

Supermicro Computer Inc	2U 4-Node TwinPro2 server w/3008		Ready Node Generation: Gen2 - 12G Profile: AF-6 Series Raw Storage Capacity: 32 TB

Click here for Ready Node Model details : 2U 4-Node TwinPro2 server w/3008

Components	Details	Quantity
SKU	SYS-2028TP-VSNF11/2X	
System	2U 4-Node TwinPro2 server w/3008	1
CPU	E5-2670V3 12C 2.3G 30M 9.6GT/s	8
Memory	16GB 2133MHz ECC DDR4 RDIMM	64
Caching Tier	Sandisk SDLKODDM400G5C00 400GB	4
Capacity Tier	Sandisk SDLLOCDR038T5C00 4TB	8
Controller	SMC3008 12 Gbps SAS3/HBA/2 internal mini ports	4
NIC	Dual port RJ45 or SFP+ 10GbE adaptor LP	1
Boot Device	8GB USB Flash Device	1
Supported Releases	ESXi 6.0 U1, ESXi 6.0	

Figure 1: All-flash VSAN Ready Node using a SUPERMICRO Server and SanDisk SAS SSDs

In this Ready Node, the following tasks were done:

- Installed and configured VMware Horizon View with the virtual desktop infrastructure solution.
- Executed a virtual desktop infrastructure workload using View Planner, VMware's workload generator tool.
- Created two types of desktops: Linked Clone and Full Clone.
- Validated both the deployments, as customers are always interested to know the performance of both for taking deployment decision.
- Used a 60 GB Windows7 desktop image for validating the performance.

Below are the application response times for virtual desktop infrastructure desktops under test.

Full-Clone Desktops (230 users) Response Time

CPU-sensitive applications 95th percentile: 0.58 seconds (threshold target of <= 1 second)

CPU-and disk-sensitive applications 95th percentile: 3.23 seconds (threshold target of <= 6 seconds)

Linked-Clone Desktops (730 users) Response Time

CPU-sensitive applications 95th percentile: 0.53 seconds (threshold target of <= 1 second)

CPU- and disk-sensitive applications 95th percentile: 3.10 seconds (threshold target of <= 6 seconds)

The above application response times were measured using VMware View Planner, which provides 95th-percentile value at the end of the test run and generates a report. Individual application response times are shown in the Test Results section.

Scaling the number of users depends on the storage capacity of the Ready Node: with 14 TB of usable capacity, scale-up can reach 230 Full Clone users. However, Linked Clone has better image management and thus can accommodate more users. Additional storage can be added to increase the density of virtual desktop infrastructure users.

Testing Process

For validation testing in the Virtual SAN environment, the VMware View Planner standard benchmark workload was used. Group A (CPU-sensitive) and Group B (CPU- and I/O-sensitive) scores were used to determine the Virtual SAN environment capability for hosting virtual desktop infrastructure.

The View desktop was created using a Windows 7, 32-bit operating system standard image. Necessary configuration changes were done according to the View Planner Installation and Configuration User Guide. All applications included in the View Planner pre-selected workload requirements were installed inside this image.

The VMware Virtual SAN default storage policy was applied to the desktop VM, which provides high availability in case one of the nodes goes down.

A four-node Virtual SAN cluster was created as defined in the Ready Node.

1. A Full Clone desktop pool was created and tested.
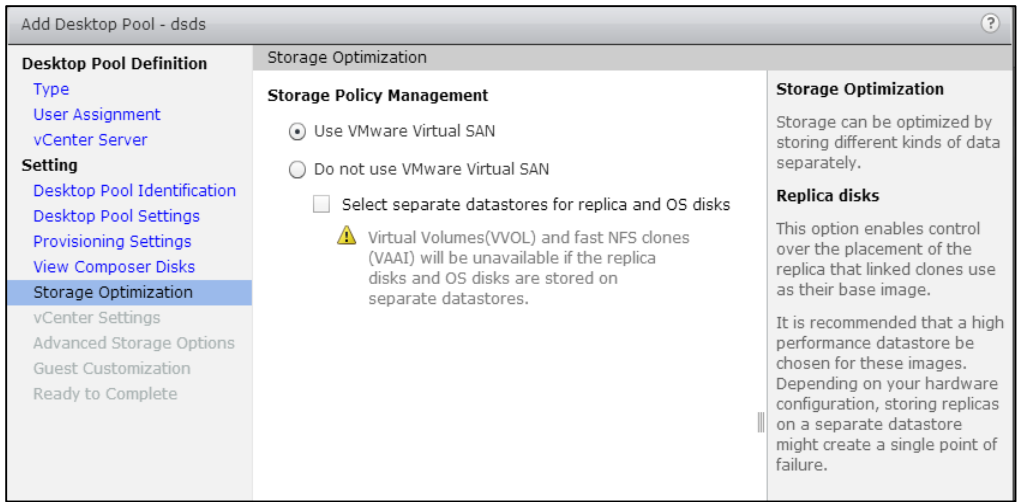2. After testing, the pool was removed, and the Linked Clone pool was built to test.

Figure 2: VMware Horizon View pool creation - datastore selection

All other Horizon View infrastructure VMs, such as View Planner Appliance, vCenter, AD-DNS, DHCP, and VMware Horizon View, were provisioned outside the Virtual SAN cluster.
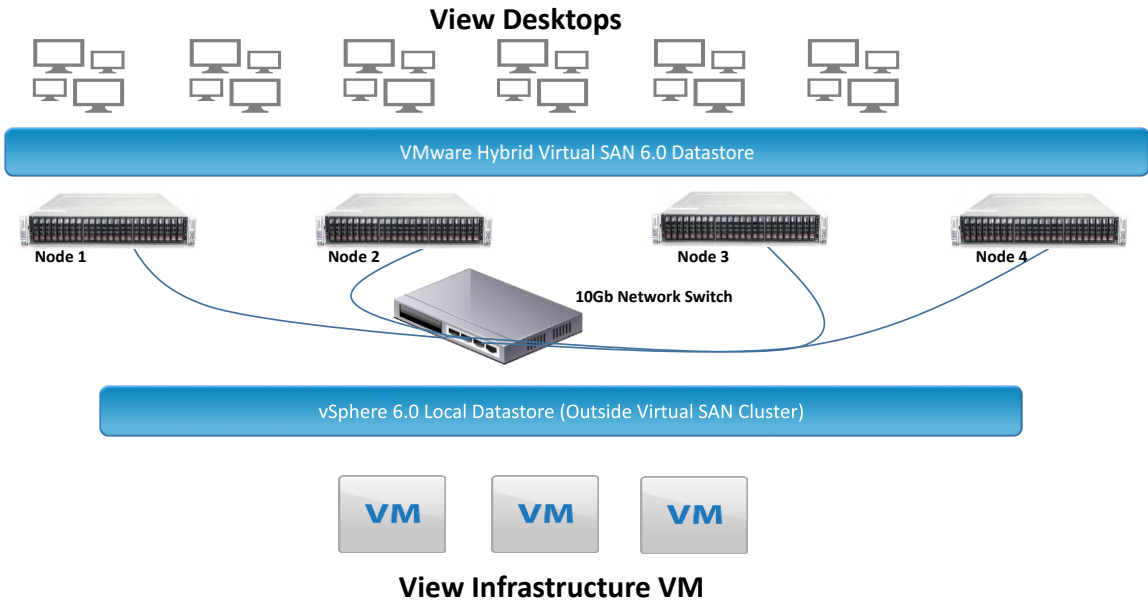

Figure 3: Test bed architecture

The Virtual SAN datastore was configured using a single disk group in each node. Each disk group was configured with one caching tier, using a 400 GB Optimus Ascend™ SAS SSD and two capacity-tier Optimus MAX 4 TB SAS SSDs per server.
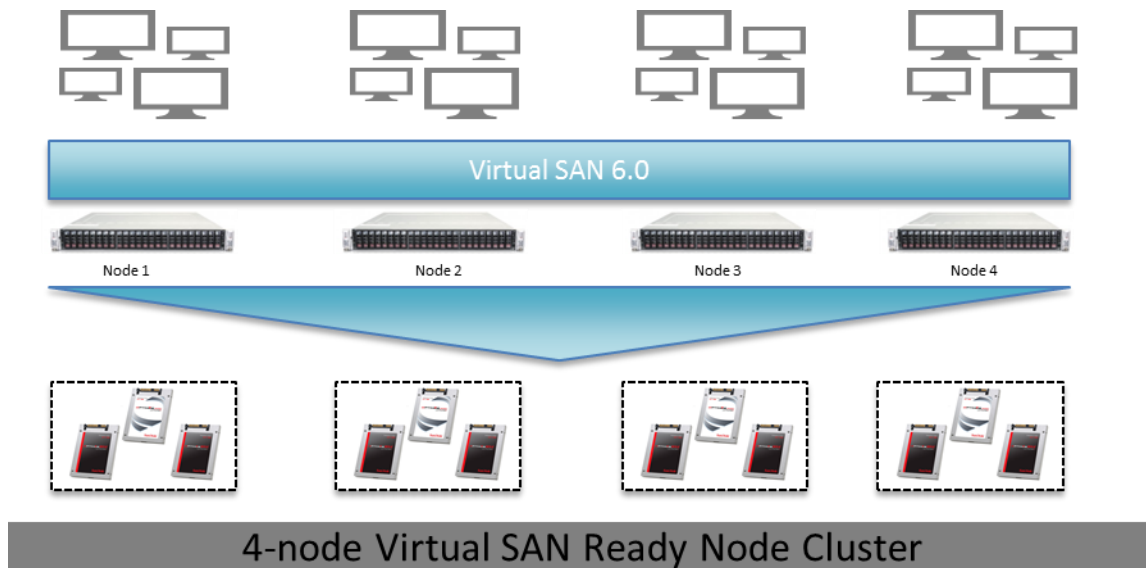

Figure 4: All-flash Virtual SAN disk group configuration

Test Results

The tests were executed in two different phases. First, the Full Clone desktop pool was created, and the desktops were tested for performance and density using View Planner. Later, the Full Clone pool was deleted, and Linked Clones were recreated from the same desktop image.

The following section discusses the test results for both environments.

View Planner: Full Clone

Full clone desktops are generally used for engineering or high-end users. For that reason, we ran View Planner Standard Benchmark, which generally represents the power user profile requirement.

Response Time

The following figures shows the response time for CPU-sensitive and disk-sensitive application operations of the View Planner workload.
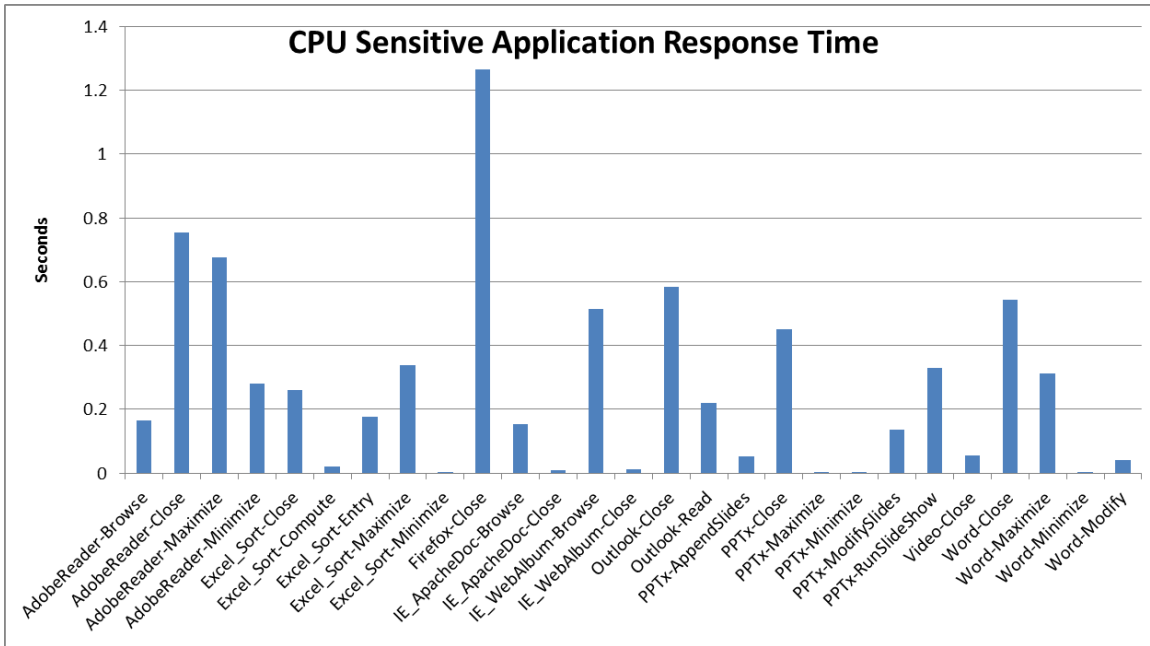
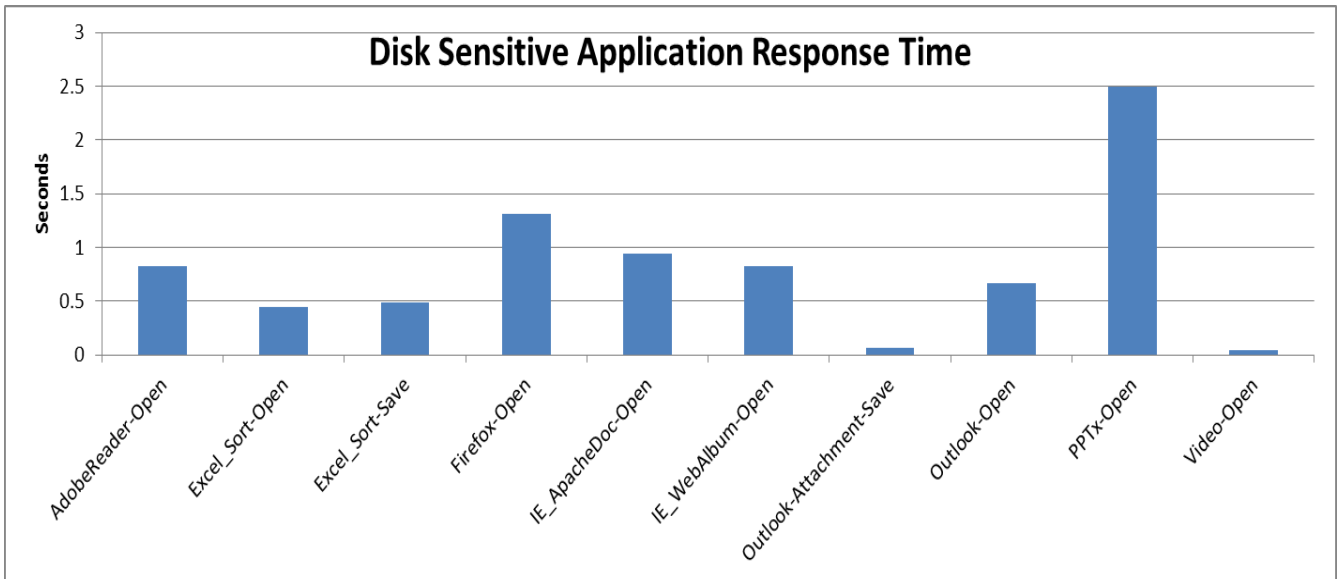Figure 5: Response time – CPU-sensitive applications operation

Figure 6: Response time – disk-sensitive applications operation

CPU Utilization Data for VSAN

The following graph captures the CPU core utilization across all the nodes and combined. The CPU utilization at the host was well below the availability of CPU cycles.
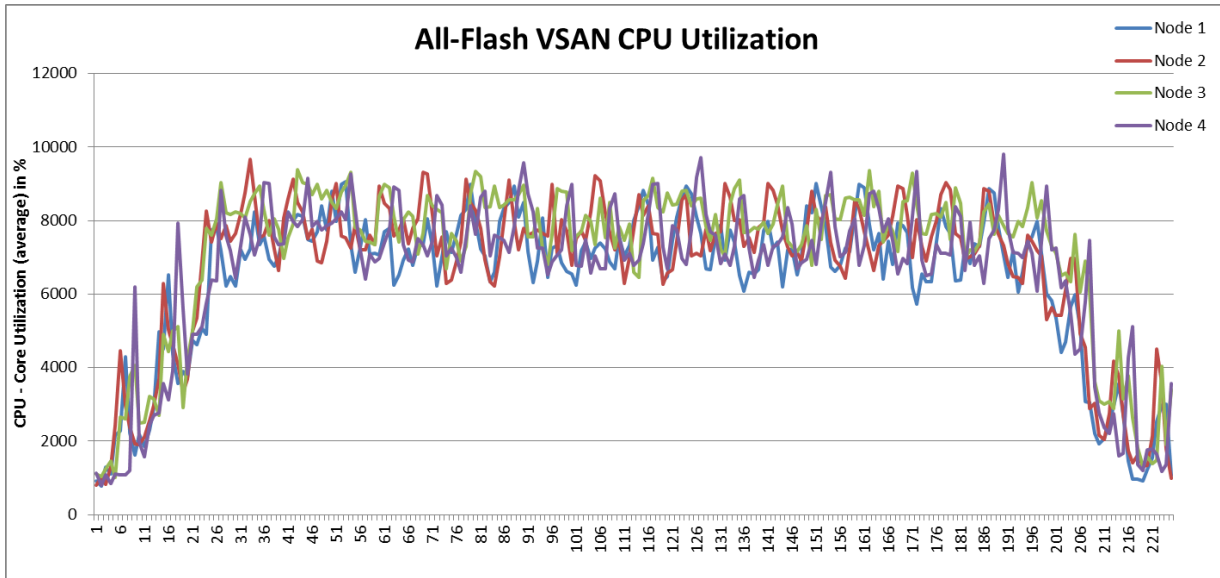

Figure 7: CPU utilization – all nodes shown as combined

Disk IOPS

The next graph collects the IOPS at the storage controller level to aggregate the total IOPS at steady state. Each disk group in the VSAN node is configured with a single storage controller.
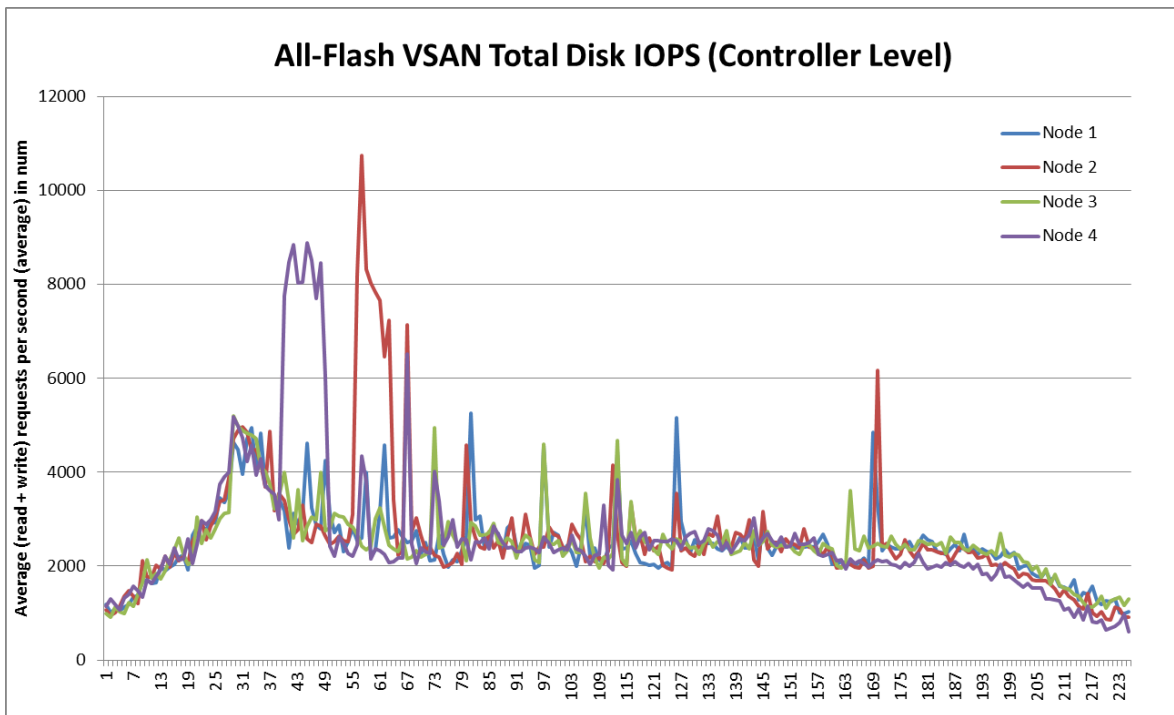

Figure 8: Disk IOPS (read and write) – combined storage IOPS (controller level)

Disk Throughput

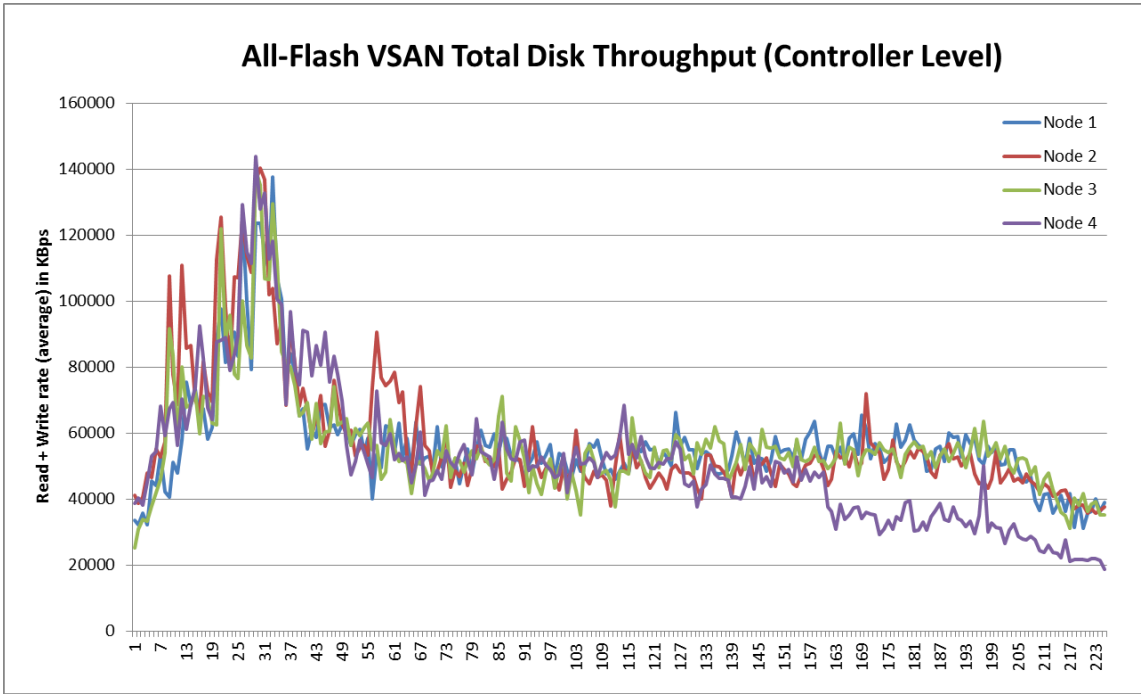Similar to the IOPS collection, the throughput of all disks is gathered at the storage controller level.

Figure 9: Disk throughput (read and write) – combined storage IOPS (Controller Level)

Disk Latency

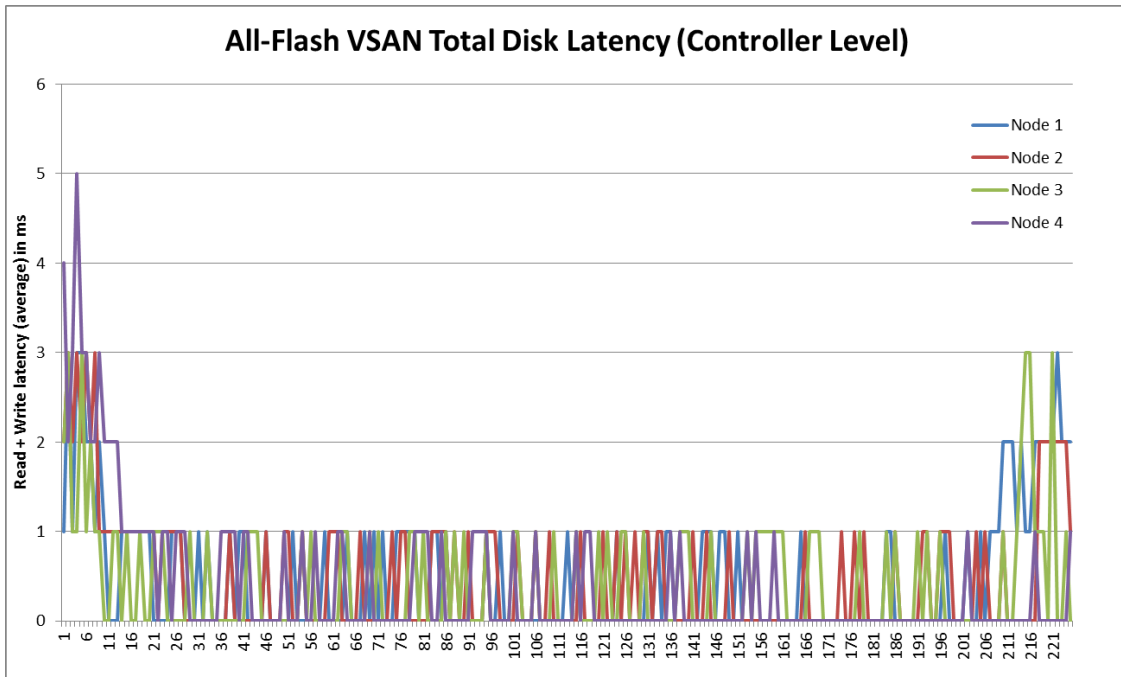The disk latency is well below one millisecond, except for some occasional spikes during steady state.

Figure 10: Disk latency (read and write) – combined latency (controller level)

This shows the excellent performance of the all-flash VSAN in keeping latency low.

View Planner Linked Clone

Linked clone pools are widely deployed, mostly being used for knowledge user profiles. For that reason, we ran a modified standard benchmark by increasing the think time from 5 sec. (for power user profile) to 10 sec. for a knowledge user profile. There is no standard definition of power or knowledge user think time, but as think time is increased, the resource consumption reduces for each desktop.

Response Time

The following figure shows the response time for CPU-sensitive and disk-sensitive application operations of the View Planner workload.
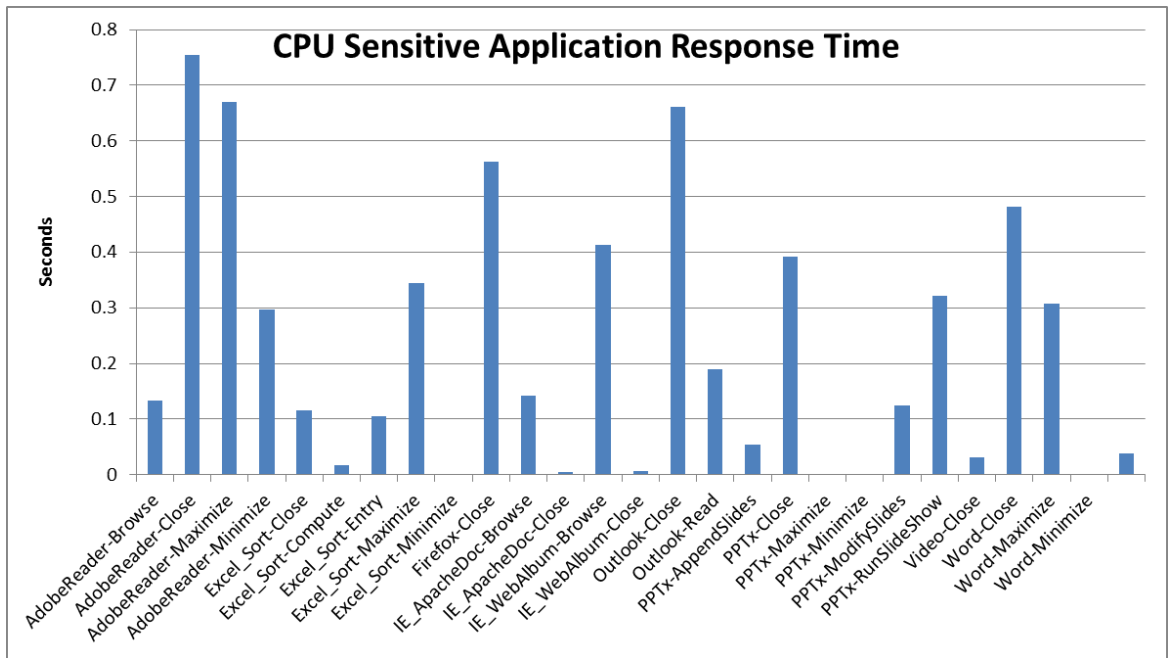

Fig 11: Response time – CPU-sensitive applications operation

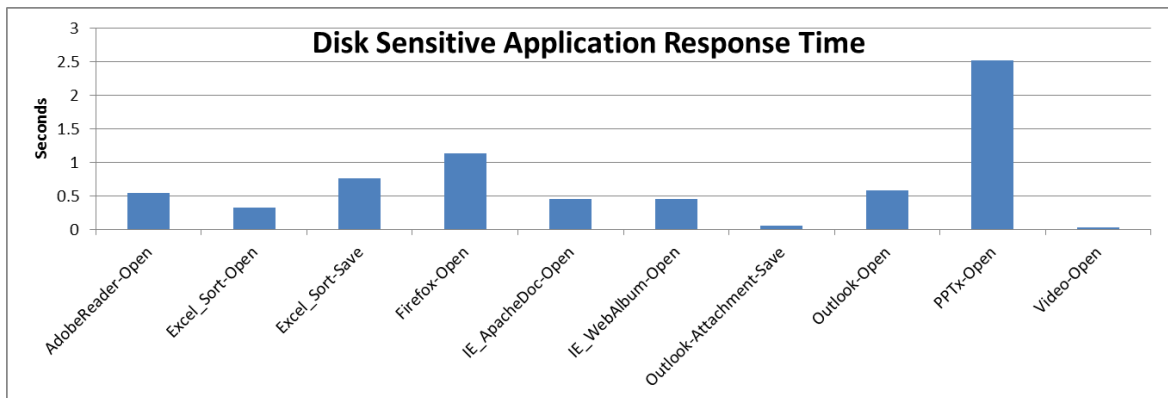

Figure 12: Response time – disk-sensitive applications operation

CPU Utilization Data for VSAN
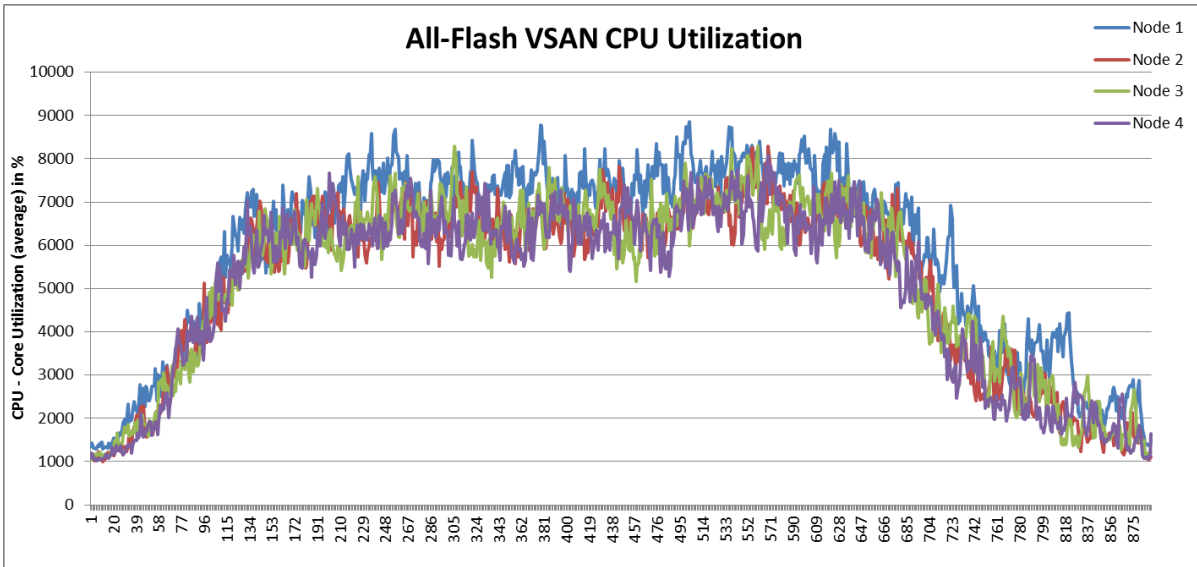

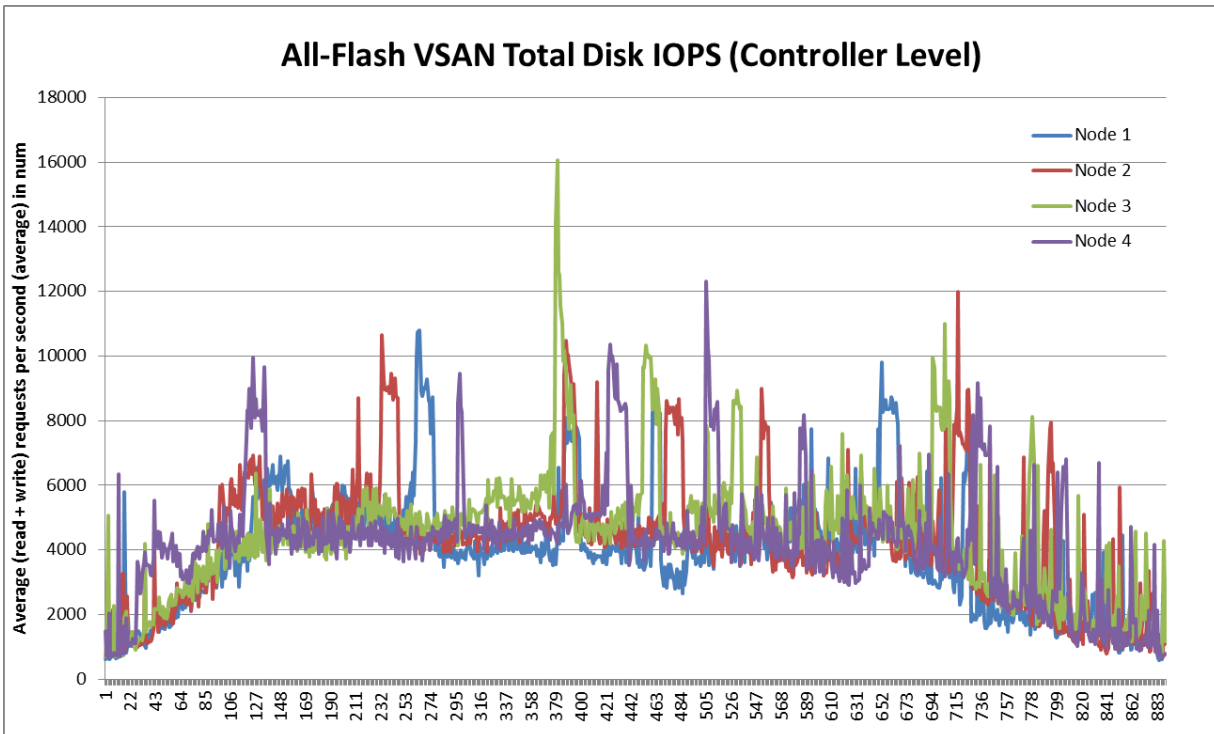Figure 13: CPU utilization – combined nodes

Disk IOPS

Figure 14: Disk IOPS (read and write) – combined storage IOPS (controller level)
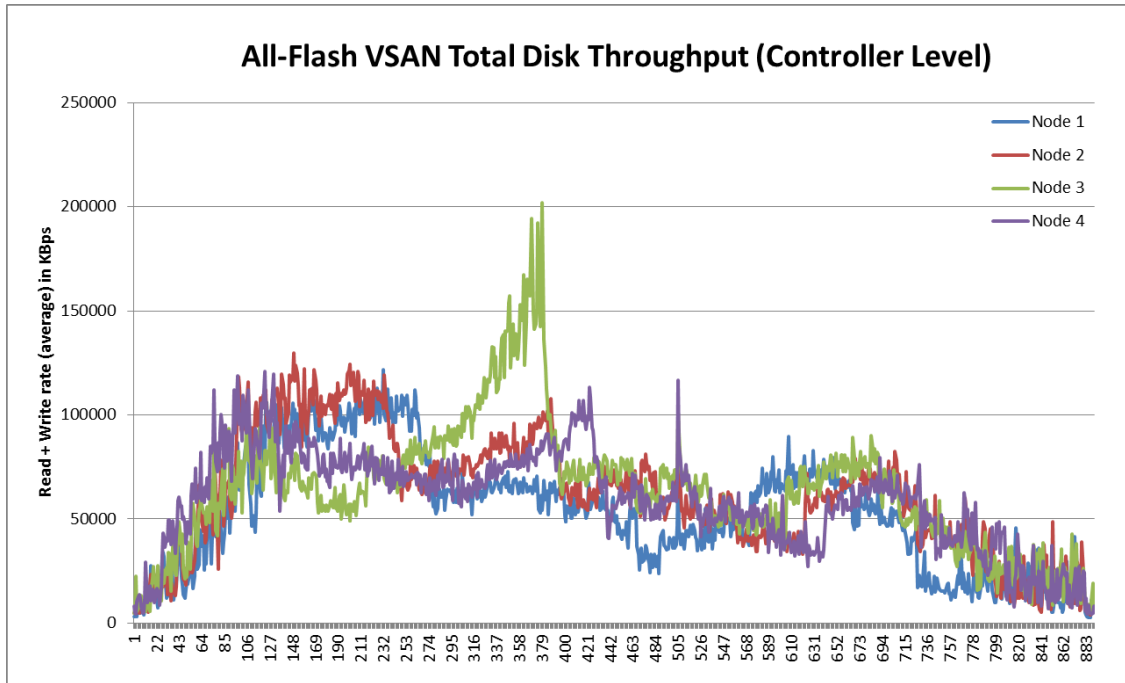
Disk Throughput

Figure 15: Disk throughput (read and write) – combined node storage throughput (controller level)
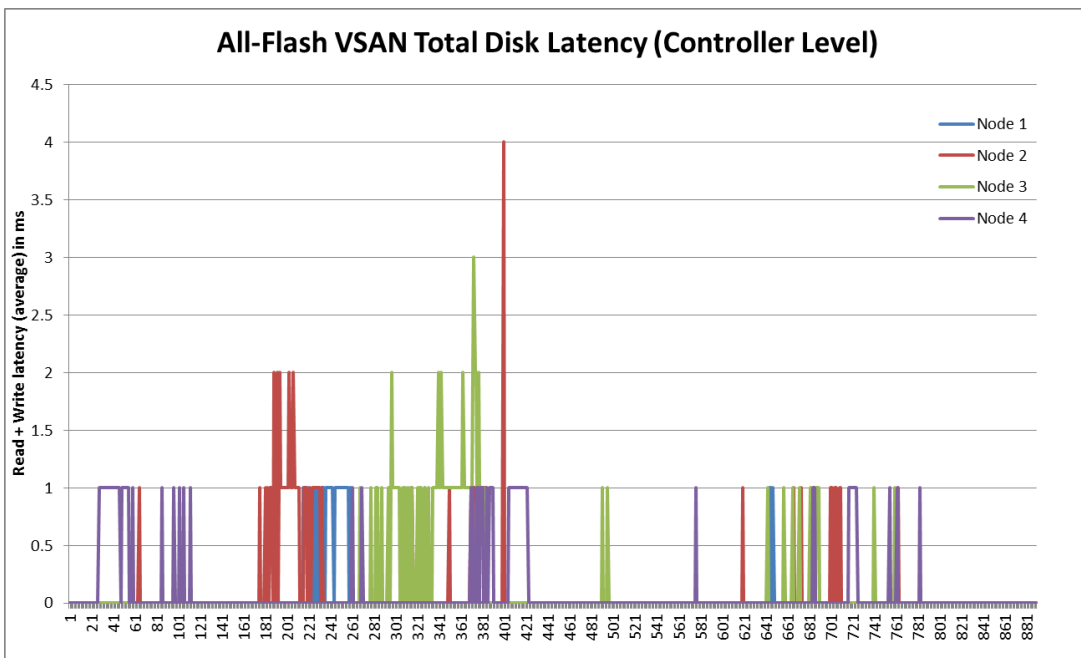
Disk Latency

Figure 16: Disk latency (read and write) – combined node storage latency (controller level)

The disk latency is 0ms for most of the time in steady state. Because of low latency, the application response time is well below the threshold limit.

Test Results Observation

For full-clone desktops, the system was scaled up to 230 users with a power user profile. This is a very high density, considering the resource consumption of the desktops. With the given usable capacity, no additional full-clone desktops could be deployed. If additional storage is added in the four node all-flash Virtual SAN, further scaling is possible, as the resource utilization is well within the limits.

For linked clones, the system was scaled up to 730 users with a knowledge user profile. These are commonly used desktops in any mid- to large-size enterprise. The desktop density was kept at a level where application response times were very fast and user experience needs were met.

In both cases, the disk latencies were sub-millisecond, with very few spikes. This enables faster application response, thus improving user experience.

Virtual SAN Solution Test Bed

The following tables describe the test bed.

ESXi Host Configuration

HARDWARE	SPECIFICATION
Servers	• 2U-4Node TwinPro² server w/3008 E5-2670v3 12C 2.3G 30M 9.6 GT/s - Hyper Threading Enabled) • 4 X 512 GB RAM
Storage Per Node	• 1 x 400 GB Optimus Ascend SSD • 2 x 4 TB Optimus MAX SSDs • 1 x SMC3008 12Gbps SAS3/HBA/2 internal mini ports
Network Per Node	• 2 x 10 Gb NIC in each server • 2 x 1 Gb NIC in each server

Virtual SAN Configuration

HARDWARE	SPECIFICATION
Each disk group configuration	• 1 x 400 GB Optimus Ascend SSD – Caching Tier • 2 x 4 TB Optimus MAX SSDs – Capacity Tier
Disk group in each node	• 1
Total Virtual SAN node	• 4

Virtual Machine Configuration

HARDWARE	SPECIFICATION

Desktop	• Win7 Enterprise 32-bit Edition
	• 1 vCPU, 3 GB RAM
	• VM Virtual SAN storage policy
	   ○ Failure to Tolerate (FTT) = 1
	   ○ Stripe Width (SW) = 1

VMware Horizon View Manager	• Win 2012 R2 64-bit Edition • 4 vCPU, 10 GB RAM
VMware Horizon View Composer	• Win 2012 R2 64-bit Edition • 1 vCPU, 4 GB RAM
VMware vCenter	• Win 2012 R2 64-bit Edition • 4 vCPU, 16 GB RAM

Installed Desktop Application

MASTER IMAGE	APPLICATIONS
Golden Desktop	• MS Office 2010 Professional 32 bit with no SP • Internet Explorer 8.0 • Mozilla Firefox 7.0 • Adobe Reader 10.1.4 • Windows Media Player • 7-Zip

Infrastructure Software Configuration

SOFTWARE INSTALLED
VMware vSphere 6.0
VMware Horizon View 6.1.1
VMware View Planner 3.5
SQL Server (Embedded with vCenter)

Bill of Materials

The following table summarizes the bill of materials for this solution:

HARDWARE	COMPONENT	QTY
Servers	2U-4Node TwinPro² server w/3008 E5-2670v3 12C 2.3G 30M 9.6 GT/s 512 GB RAM	4
Storage	400 GB Optimus Ascend SSD (1 per server)	4
	4 TB Optimus MAX SSDs (2 per server)	8
	SMC3008 12Gbps SAS3/HBA/2 internal mini ports (1 per server)	4
Network	2 X10 Gb NIC and 2 X 1 Gb in each node	4
	10G Ethernet Switch SSE-X3348T / SSE-X3348TR	1

Conclusion

This solution from SUPERMICRO and SanDisk, based on VMware's Virtual SAN Ready Node, meets the stringent requirements of today's applications without the complexity but with a scalable technology that is rapidly deployable, cost-effective, easy to manage and can be fully integrated into existing datacenters.

This paper illustrates with relevant benchmark performance case studies how the challenging Service Level Agreement (SLA) requirements for virtual desktop infrastructure can be met with sub millisecond latencies by using SUPERMICRO's Hyper Converged Infrastructure (HCI, here implemented on 2U TwinPro²) with SanDisk storage technologies and VMware's VSAN & Horizon View. In summary, this joint SUPERMICRO/SanDisk/VMware Virtual SAN Ready Node solution delivers lower TCO, with increased scale and operational efficiency over the traditional alternatives.

Acknowledgements

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- Biswapati Bhattacharjee, Technical Marketing Manager, SanDisk.
- Patric Chang, Sr. Director, SanDisk.
- Lena Shuhart, Director, SanDisk.
- Maryam Sepahmansour, Sales Manager, SanDisk.
- Nihir Parikh, Product Director, Super Micro Computer, Inc.
- Sim Upadhyayula, Director of Enterprise Solution Enablement, Super Micro Computer, Inc.
- Calbert Lo, Product Manager, Super Micro Computer, Inc.

Resources

Customers can find more information about SanDisk, VMware, and SUPERMICRO via the links listed below:

SanDisk Resources

- SanDisk website:
  http://www.sandisk.com/
- SanDisk Data Center Products:
  http://www.sandisk.com/enterprise/
- Optimus SAS SSD Products:
- https://www.sandisk.com/business/datacenter/products/flash-devices/ssds/sas-ssd/optimus

VMware Resources

- VMware website:
  http://www.vmware.com/
- VMware Horizon View:
  https://www.vmware.com/products/horizon-view
- VMware Virtual SAN:
  https://www.vmware.com/products/virtual-san/
- VMware Virtual SAN Ready Node:
  http://www.vmware.com/resources/compatibility/search.php?deviceCategory=vsan

SUPERMICRO Resources

- SUPERMICRO website:
  www.supermicro.com/index_home.cfm
- SUPERMICRO TwinPro^2 Server:
  http://www.supermicro.com/products/nfo/2UTwinPro.cfm
- SUPERMICRO Solutions integrated with VMware Virtual SAN
  http://www.supermicro.com/solutions/VMware_VSAN.cfm
- SUPERMICRO Network Switch
  http://www.supermicro.com/products/accessories/Networking/SSE-X3348T.cfm

Appendix A – SanDisk SAS SSDs

Optimus MAX

The Optimus MAX 4 TB SAS SSD is the first SSD of its kind to deliver SAS performance and features at the cost of SATA SSD-like prices for enterprise, cloud and virtualized data centers. This 4 TB SSD enables organization to transition to a leaner infrastructure model, for maximum total cost of ownership (TCO) savings and surpasses the current high capacity 2.5" SAS SSDs and 2.5" SAS HDDs on the market today. The Optimus MAX SSD is optimized for read-intensive application workloads such as data warehousing, media streaming, web servers, Video on Demand (VOD), and web-based applications. This 4TB SAS SSD alleviates I/O bottlenecks by providing high-density storage for efficient data throughput to deliver, high performance, superior reliability, and enhanced endurance for maximum application scalability.

The Optimus MAX 4 TB SAS SSD features industry-leading 19nm eMLC flash with a native 6 Gb/s SAS interface. It provides data transfer rates of up to 500/500 MB/s sequential read/write and performance of up to 85 K/11 K IOPS random read/write. This SSD offers 0.5 full-drive writes per day (DWPD) with a limited 5-year warranty. The Optimus MAX 4 TB SAS SSD removes the flash capacity barrier for replacing 10K and 15 K RPM SAS HDDs and provides an ideal solution for true storage stack applications.

Figure 17: Optimus MAX SSD

For more details refer to product data sheet here.

Optimus Ascend

OEMs and IT managers no longer have to compromise on performance, endurance and reliability to obtain affordability. Optimus Ascend SSDs offer all four in a single package through a combination of unique and innovative IP, and the use of enterprise Multi-Level Cell (eMLC) flash storage. SanDisk's newest generation of 19nm eMLC SSDs feature a native SAS 6 Gb/s interface, outstanding performance metrics, and a comprehensive set of high-end features. This makes them ideal to integrate with existing infrastructure for mixed-use applications, with an I/O pattern designed predominantly for workloads such as On-Line Transaction Processing (OLTP) Databases, E-mail/Messaging, Virtual Desktop, and Collaboration, where performance and high availability are required.

Figure 17: Optimus Ascend SSD

Available in capacities of 200 GB - 1.6 TB, Optimus Ascend SSDs provide random read/write performance of up to 95K/40K IOPS and sequential read/write data transfer rates of up to 550/540 MB/s. Optimus Ascend SSDs provide dual port support with 1 GB/s read, 800 MB/s write in active/active operation for sequential

read/write performance. Optimus Ascend SSDs provide 10 random DWPD. Optimus Ascend SSDs have a 5-year warranty.

For more details refer to product datasheet here.

Appendix B – Overview of VMware View Planner

VMware View Planner is a virtual desktop infrastructure workload generator that automates and measures a typical user's desktop activity. The automated applications are Microsoft Office, PDF browse, watching a video, etc., and the operations on these applications are opening a file, browsing the Web, modifying, saving and closing files, etc.

The central piece in the View Planner architecture is the Harness, the automated controller. It controls everything from managing the participating desktop and client virtual machines, to starting the workload and collecting results, to providing a monitoring interface through a web user interface.

The harness is a CentOS Linux-based appliance virtual machine (VM) that interacts with Horizon View Manager components. It also runs a web server to present a user-friendly interface.

As shown in the diagram, the appliance interacts with a VMware vCenter and Horizon View Manager, and with Active Directory/DNS to control desktop virtual machines and clients/users. It also communicates with client virtual machines to initiate remote protocol connections such as PCoIP, RDP, etc.

The appliance is responsible for starting the workload simulation in desktop virtual machines.

Upon simulation completion, results are uploaded and stored in a database on the appliance. Results can be viewed using the web interface or extracted from the database at any time.
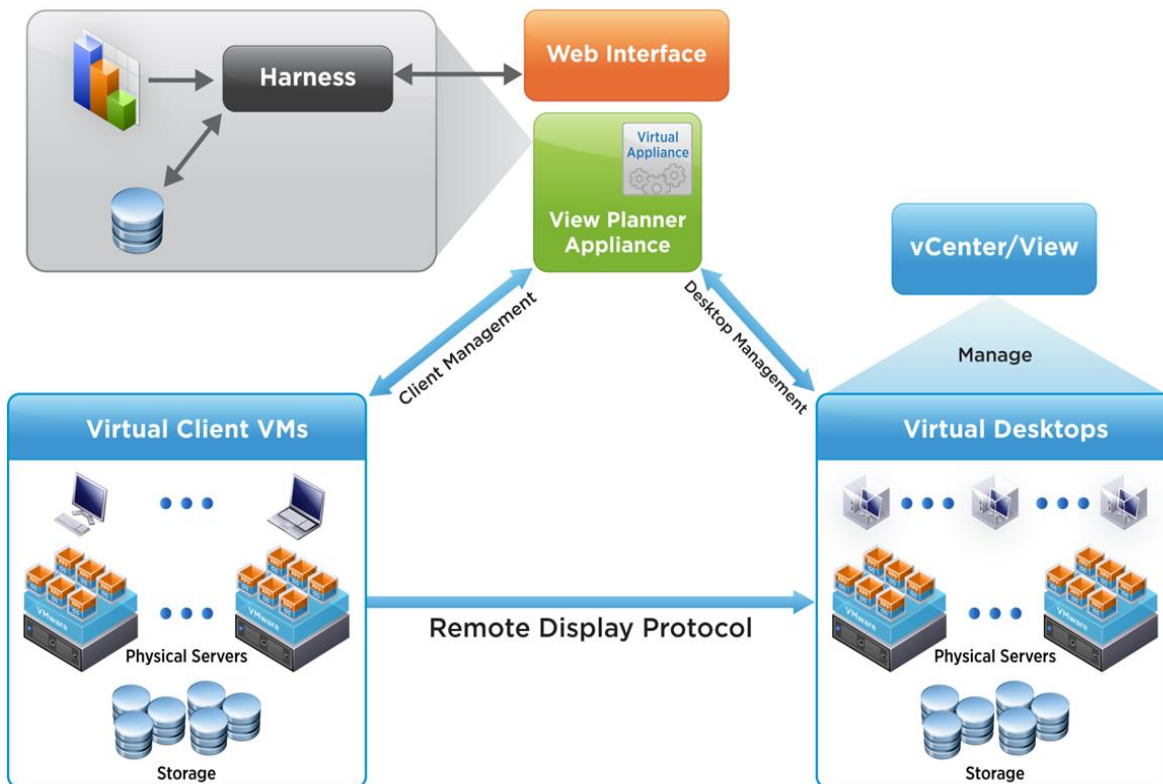

Figure 18: VMware View Planner Architecture

Appendix C – Overview of SUPERMICRO TwinPro² Server

The SUPERMICRO TwinPro Solution architecture builds on SUPERMICRO's proven Twin technology to provide the optimal throughput storage, networking, I/O, memory, and processing capabilities in 2U, allowing customers to further optimize SUPERMICRO solutions to solve their most challenging IT requirements.

The SUPERMICRO 2U TwinPro and 2U TwinPro² provide the following capabilities:

- Up to 1TB of DDR4 up to 2133MHz LRDIMM memory in 16 DIMM slots
- PCIe 3.0 x16, PCIe 3.0 x8 LP (2U TwinPro™), and "0 slot" flexible rear expansion for add-on card solutions such as PCIe SSD, dual 10GbE with SFP+, or GPU/Xeon Phi
- 10GBase-T, InfiniBand, or Gigabit Ethernet networking options
- Up to 4 NVMe and 8 SAS3 (12Gbps) 2.5" hot-swap HDDs per node
- Co-processor support (2U TwinPro)
- IPMI 2.0 + KVM with dedicated LAN
- SATA DOM power connector
- TPM 1.2 header
- Redundant Titanium Level power supplies

Optimized for high-end Enterprise, HPC cluster, Data Center, and Cloud Computing environments, the SUPERMICRO TwinPro Solutions are designed for ease of installation and maintenance with highest quality for continuous operation at maximum capacity. The resulting benefit is best TCO for customers seeking the greatest competitive advantage from their data center resources.

Figure 19: SUPERMICRO TwinPro² Server

Appendix D – Overview of VMware Virtual SAN

Virtual SAN is a new storage solution from VMware that is fully integrated with vSphere. It automatically aggregates server disks in a cluster to create shared storage that can be rapidly provisioned from VMware vCenter during VM creation. It is a platform for VM Storage Policies designed to simplify virtual machine storage placement decisions for vSphere administrators. It is integrated with core vSphere features such as vSphere HA, vSphere DRS, and vMotion. It can also be used to address quality of service (QoS) requirements by creating VM Storage Policies that define the level of performance and availability required on a per–virtual machine basis.
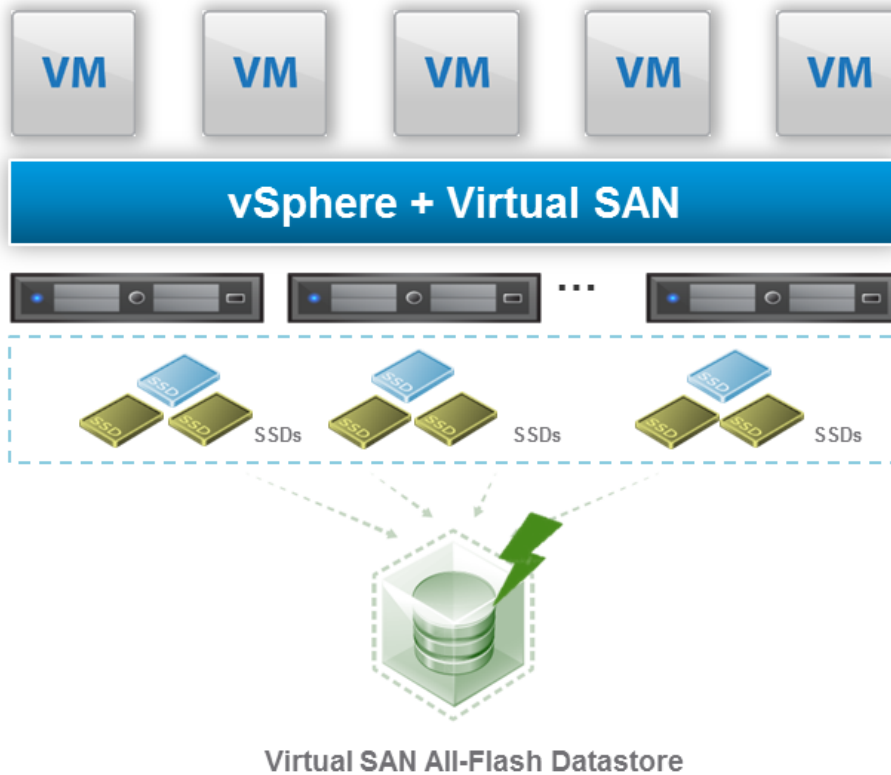

Figure 20: VMware all-flash Virtual SAN high-level architecture

In all-flash Virtual SAN, caching tier SSDs are high-endurance, as they are meant for write buffer use. Capacity tier SSDs are low endurance, as they are meant for storage capacity only.