Hewlett Packard Enterprise

HPE Reference Configuration for Citrix XenDesktop 7.8 on HPE Hyper Converged 380

Technical white paper

Contents

Executive summary

The modern workplace is undergoing a digital transformation, driven by users who demand ubiquitous mobile access to their applications and data, and business leaders striving to increase workplace productivity while addressing security and compliance mandates. Faced with limited staff and tight budgets, delivering these new outcomes has often been a challenge for an IT organization already addressing a rapidly changing business environment.

This paper presents a solution with Citrix® XenDesktop® on Hewlett Packard Enterprise's next generation data center platform, the HPE Hyper Converged 380, which dramatically simplifies deploying, managing, and expanding a digital workplace. With the HPE Hyper Converged 380 and Citrix XenDesktop, you can:

- Enable a mobile workforce that can work on any device from any location with a seamless digital experience and instant access to applications, tools, and support

- Support a mixed workload of over 500 task workers and 50 power users on a 4 node configuration maintaining a positive user experience and easily scale by simply adding additional nodes

- Provide more secure access to applications and desktops residing in the data center

- Leverage Citrix PVS with RAM Cache capabilities to greatly reduce IOPs and improve storage utilization

This document focuses on deploying two types of user personas, task/office worker and power user, on a 4-node HPE Hyper Converged 380 with Citrix XenDesktop, and examines growth capabilities both within the 4-node environment as well as by adding additional nodes. The solution supports hosted shared desktop users and dedicated power users, while also providing user data space and maintaining very acceptable performance goals. Citrix's XenDesktop Desktop Studio will be used to manage the hosted shared desktop and dedicated user environments, and all VMs will be running across the 4-node cluster. The power users will each be provided a dedicated virtual machine (VM) for their use. The VM will not be shared with any other users. The hosted shared desktop users will be running in XenApp VMs. This is also referred to as Hosted Shared Desktop (HSD) VMs.

Target audience: This document is targeted for architects, implementers, data center managers and others looking to understand the power and usability of the HPE Hyper Converged 380 with Citrix XenDesktop.

Introduction

Hyperconvergence. What does it mean? In the IT industry it is accepted to mean an infrastructure system that is tightly integrated between the compute, storage, networking, and virtualization layers. In reality it is the next iteration of a converged system. A converged system can be utilized as a single solution or separated into its parts and used in different ways, but a hyperconverged system cannot be separated. The goal of a hyperconverged system is to create a solution that does not have a lot of different parts, is simple to install and configure, and will support today's virtualized world. For Hewlett Packard Enterprise, it started with the HPE Hyper Converged 250, a 2U/4-node form factor with up to 4 systems (16 nodes) in a resource pool. This is an excellent beginning to a new market and now HPE brings to market the HPE Hyper Converged 380. This leverages the compute and storage power of the already enterprise proven HPE ProLiant DL380 Gen9, and adds the HPE StoreVirtual Virtual Storage Array (VSA) software to manage the storage, and for creating a cluster across the nodes. NVIDIA® K1 or K2 graphics cards can be added to improve the virtual user experience from a graphics standpoint. The HPE Hyper Converged 380 comes as a 2-node 4U starter appliance, easily expandable to 16 nodes in a single cluster. A 2-node starter can be up and running in minutes to hours, not days like other systems, with a straight forward easy to use user interface (UI) to install, configure and prepare the HPE Hyper Converged 380 for the production environment. The compute and storage components reside within each node, with the network requirements being pairs of 10Gb and 1Gb switches to connect all the nodes together. The operating system, management software, and solution software all run on the nodes, no external management software is required.

Citrix XenDesktop, with XenApp built in, allows organizations of all types to deliver secure virtual apps and desktops across the spectrum of users from task/office workers to power users. XenDesktop provides a complete virtual app and desktop solution to meet all customer needs from a single, easy-to-deploy platform. Employees gain the freedom to work from anywhere which improves productivity, while streamlining IT operations and securing sensitive. This document will look at utilizing the power of the HPE Hyper Converged 380 to support your Citrix environment, focusing on two of the primary user types in your virtual application and desktop environment:

- **Task/office worker:** A hosted shared desktop user; a task or office level worker focused on specific, mostly generic, tasks and using Citrix XenApp to deliver desktops and applications.

- **Power worker:** A dedicated user; this user is assigned a VM, always gets the same VM, and has the same administrative rights and controls over the VM as they would a physical desktop or laptop. Power users run specific applications, need more power and control on their environment and are expecting a very high user experience.

Solution overview

The following figure is representation of a racked 4-node HPE Hyper Converged 380, front and back.
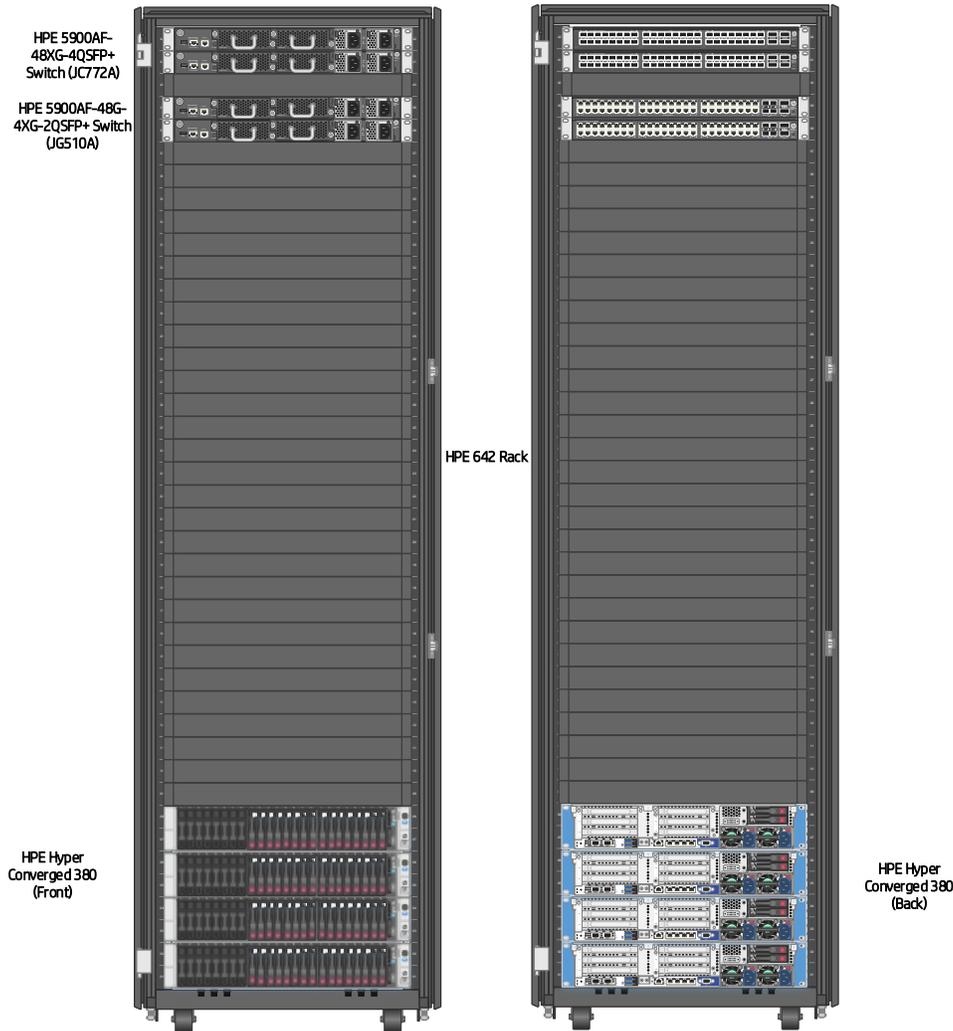

Figure 1. Racked 4-node HPE Hyper Converged 380

The networking with the HPE Hyper Converged 380 utilizes both 1Gb and 10Gb networks, there is a pair of each at the top of rack to provide redundancy, the physical wiring is highlighted in Figure 4.

The following figure gives a high-level real world view of an HPE Reference Configuration for Citrix XenDesktop 7.8 on HPE Hyper Converged 380 configuration. In the test environment used for this paper, the users are considered internal and connect directly to the StoreFronts.
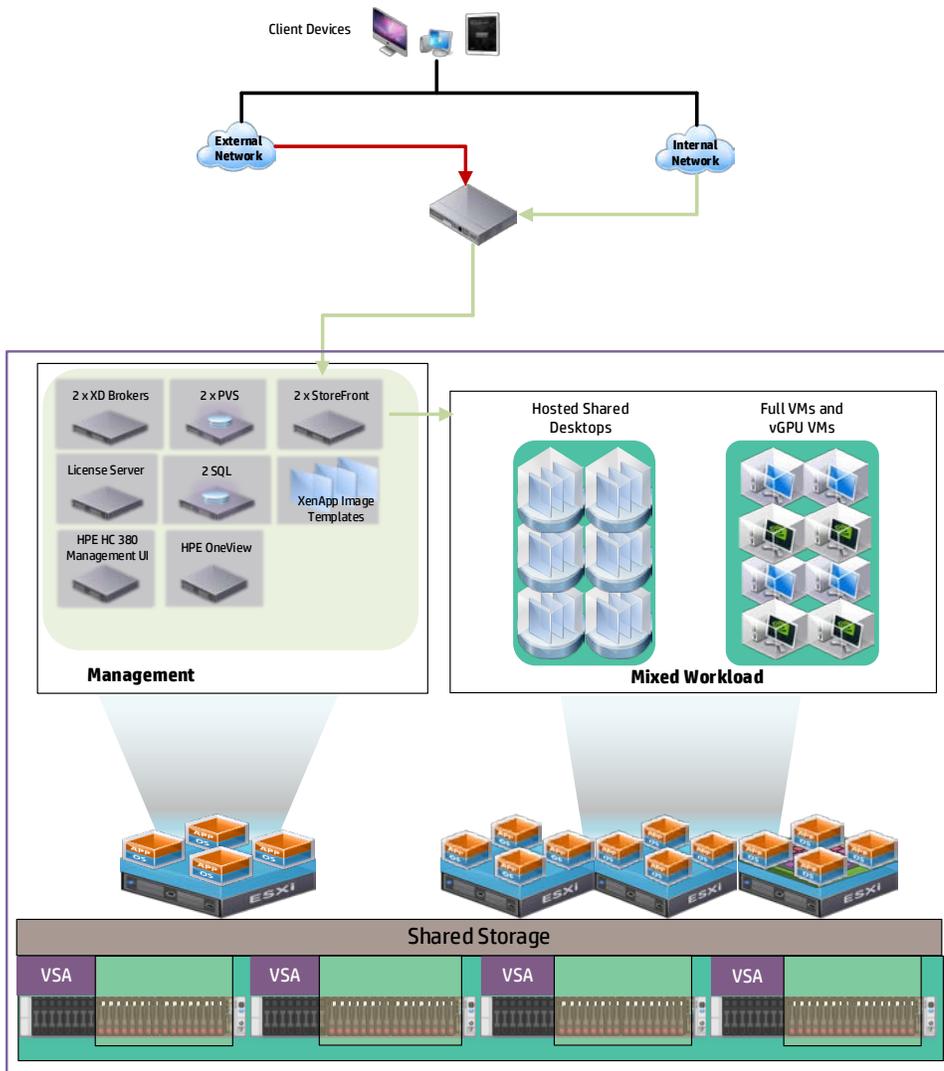

Figure 2. Solution Overview

VMware® vSphere 6.0 will be running at the hypervisor, with Citrix XenDesktop 7.8 to manage the user desktop environment. In following Citrix best practices[1], redundant infrastructure servers will be built for Citrix Provisioning Services (PVS), the broker, and the StoreFronts even though a single instance of each could easily support the workload of users. Citrix tests have shown that once the system is up and steady the Citrix resources pull less than 5% of the overall CPU capacity and generate very few IOPs for the VMs. The solution will also be built using the PVS Ram Cache with disk overflow for the XenApp VMs. This leverages memory rather than disk for PVS caching, and since we are not memory bound on these systems this will be not an issue. This will also greatly reduce the IOPs required by the XenApp VMs.

[1] Documentation around Citrix Best Practices can be found in Appendix C.

Storage

The HPE Hyper Converged 380 nodes not only provide compute and memory but also create a clustered storage environment using HPE StoreVirtual VSAs. Multiple datastores were configured to reduce I/O contention at the hypervisor level. The following figure shows a high-level breakdown of the datastores.
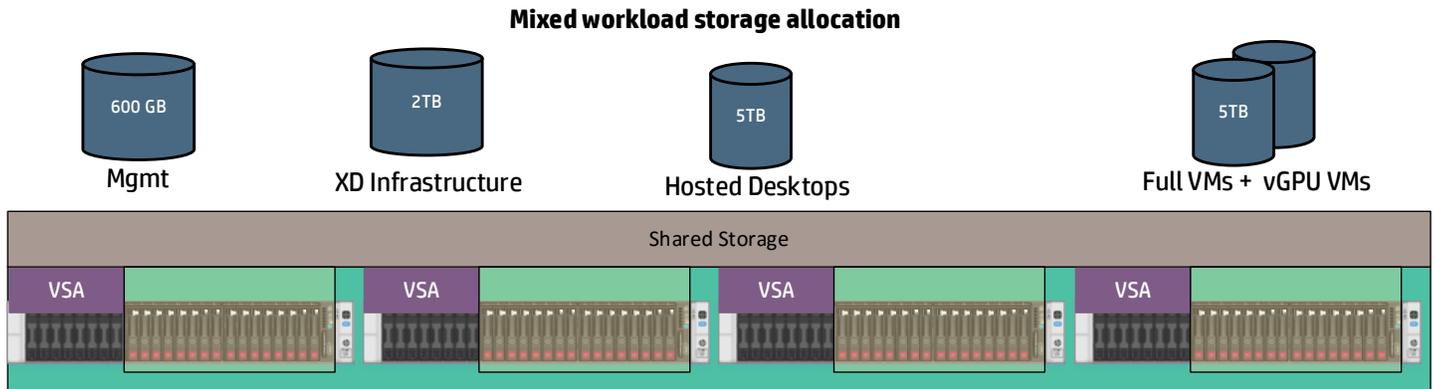

Figure 3. High level layout of datastores

This is listed as a mixed workload because we will be supporting task workers and power users in the same environment. The task workers will be supported by the hosted desktops, the power users are using dedicated VMs and are separated into two datastores holding 25 users each, and this will be the highest IOP usage. A small datastore was created to support PVS, and the remaining space was allocated to a Profiles datastore, and can be utilized for user data storage if desired. When creating the datastores Network RAID 10 was implemented, preserving a chunk of storage on each node to be able to handle failure of any node without the loss of data. The following table defines all of the datastores created.

Table 1. Datastores

DATASTORE	SIZE	PURPOSE
MGMT	600GB	Created by HPE HC 380 during installation to host the mgmt VMs required to support the HPE HC 380
Infrastructure	2TB	Contains all XenDesktop infrastructure VMs
Dedicated1 datastore	5TB	Contains 25 dedicated power users VMs
Dedicated2 datastore	5TB	Contains 25 dedicated power users VMs
PVS	1TB	Contains PVS master image vhds
Profiles	5TB	Contains user profiles and user data
HSD Datastore	5TB	Contains the hosted shared desktops and overflow cache files
SQL Volume	500GB	To hold necessary SQL Databases

There are several datastores created during the HPE Hyper Converged 380 initial setup of the cluster; these are labeled starting with datastore1 and should not be used.

Networking

The following diagram highlights the physical networking required for a 4-node configuration of an HPE Hyper Converged 380. The HPE Hyper Converged 380 utilizes 10Gb and 1Gb physical networks for all traffic, a redundant pair of switches is configured for failover. The following diagram shows the physical network wiring required to configure the 4-node HPE Hyper Converged 380 used in testing.
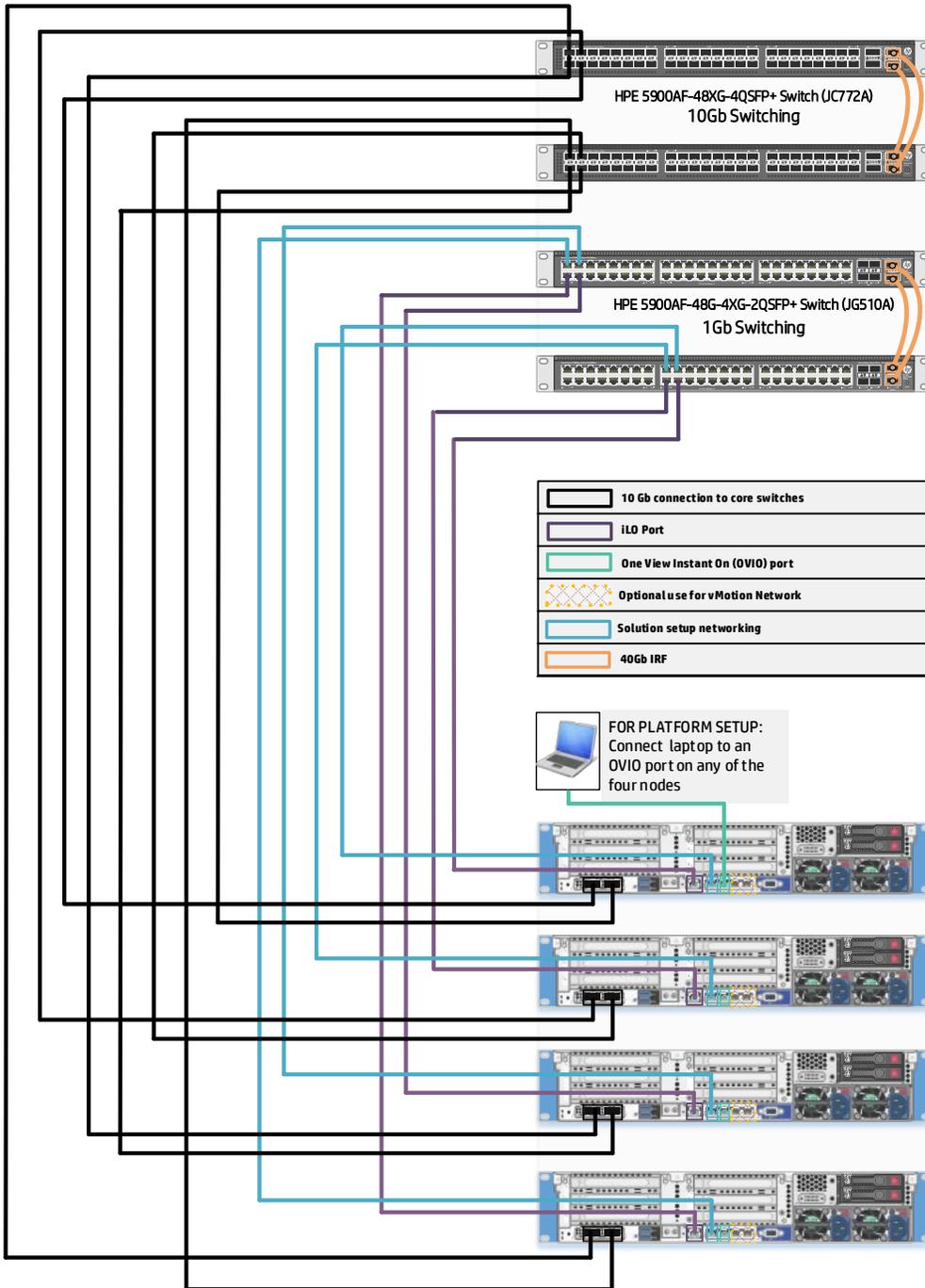

Figure 4. Physical network cabling

All nodes of the HPE Hyper Converged 380 used in testing had two 10Gb Ethernet ports and four 1Gb ports.

Note

The HPE Hyper Converged 380 has three different models, each with a specific focus and different NIC/memory/storage configurations, depending on the model. The models are General Virtualization, Virtual Desktop Infrastructure (VDI), and CloudSystem. Information about the model configurations can be found at http://h20195.www2.hpe.com/v2/Getdocument.aspx?docname=c04790439.

Port 2 of the 1Gb NIC adapter on each node is reserved for initial installation and configuration, only one port on any one of the nodes is utilized, and it is a direct connect network in vCenter called mgmtVMPrivate. Do not use this port or network. See the installation guide for the HPE Hyper Converged 380 on how to connect and install the HPE Hyper Converged 380.

Port 1 for the 1Gb NIC is for solution software setup between the nodes and in vCenter, and is called mgmtVMNetwork. Do not use this network. The remaining two 1Gb ports on the NIC can be utilized for operations like PXE booting or live migration, as desired. This solution did not leverage the remaining two ports.

The 10Gb ports are configured in a fail-over configuration with a standard vSwitch created and multiple VLANs are created on this network. The following table defines the networks created on the 10Gb network during setup of the HPE Hyper Converged 380 and the networks that need to be created to support the XenDesktop environment.

Table 2. Networks

NETWORK NAME	PURPOSE
VSAeth0	Created during HPE HC 380 setup; Connectivity to datastores
Production	User connectivity to XenDesktop environment
PXE	PXE boot network controlled by PVS

Solution components

As previously stated this is a 4-node HPE Hyper Converged 380 configuration, running Citrix XenDesktop 7.8 on top of vSphere 6.0.
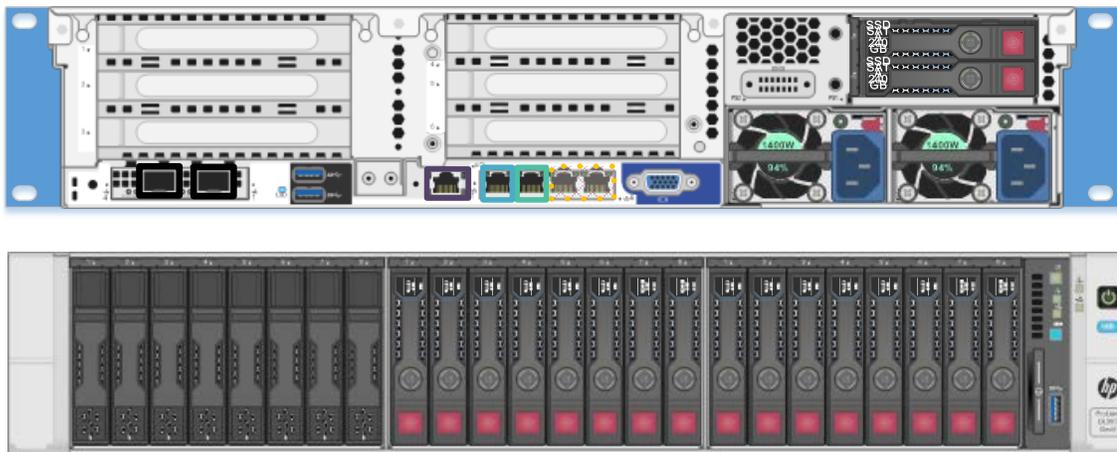
Hardware

Figure 5. Single HPE Hyper Converged 380 node, front and back

Figure 5 shows a single HPE Hyper Converged 380 node configured for VDI. For this solution an HPE Hyper Converged 380 VDI model with 16 disk hybrid storage and optional host cache SSDs was configured.

Table 3. Hardware specifications per node

COMPONENT	DESCRIPTION
CPU	2 - Intel® Xeon® E5-2690v3 (2.6GHz/12-core) processors
Memory	8 - HPE 32GB Dual Rank x4DDR DIMMS, 256GB total
1Gb-networking	2 - HPE Ethernet 7ft CAT5e RJ45 M/M Cables
10Gb Networking	2 - X240 10G SFP+ SFP+ 3m DAC Cables
1.2TB HDD Storage	12 -1.2TB 12G SAS 10K rpm SFF (2.5-inch) Hard Drive disk packs
800GB Write Intensive SSD Storage	2 - 800GB 6G SATA Write Intensive-2 SFF 2.5-in SC 3yr Wty Solid State Drive
240GB Rear Cache Storage	2 - 240GB 6G SATA Read Intensive-2 SFF 2.5 Solid State Drive

Graphics hardware was not utilized in this testing.

Software

In Tables 4 and 5, the software is displayed in two categories, the HPE Hyper Converged 380 management software and the application software. Table 4 lists the HPE Hyper Converged 380 software.

Table 4. HPE Hyper Converged 380 software

SOFTWARE	VERSION
HPE OneView InstantOn	1.3.1
HPE StoreVirtual Centralized Management Console (CMC)	12.5
HPE StoreVirtual Virtual SAN Appliance	12.5
HPE OneView Plugin for vCenter	7.8.1
HPE OneView User Experience (UX)	1.0
HPE OneView	2.0

Application software

The following table lists the hypervisor and Citrix XenDesktop software.

Table 5. Application Software

SOFTWARE	VERSION
Citrix XenDesktop	7.8
PVS	7.8
VMware vSphere 6.0	6.0 U1
VMware vCenter Server 6.0	6.0 U1
SQL Server	2014
Microsoft® Windows Server®	2012R2

Best practices and configuration guidance for the solution

When deploying the Citrix XenDesktop environment to support hosted shared desktop (HSD) users, the Citrix best practice of redundancy was followed, as were recommendations for the sizing of the infrastructure VMs. Although a single instance of the XD broker, StoreFront, or PVS server could easily support the workload, a pair of each was installed, to provide high availability and prevent downtime. The following table defines the VM specifications.

Table 6. Infrastructure VM specifications

VM	VCPU	MEMORY (GB)	HDD (GB)	NETWORKS	NUMBER OF VMS	OS
Broker/Controller	2	8	40	Production mgmtVMNetwork VSAeth0	2	Windows Server 2012R2
License Server	2	4	40	Production	1	Windows Server 2012R2
Provisioning Server (PVS)	2	16	40	Production mgmtVMNetwork VSAeth0 PXE	2	Windows Server 2012R2
StoreFront	2	4	40	Production	2	Windows Server 2012R2
SQL Server	2	4	40	Production VASeth0	2	Windows Server 2012R2
HPE HC 380 Management VM	4	16	70	mgmtVMprivate mgmtVMNetwork VSAeth0 VM Network	1	Windows Server 2012 (provided as part of the solution)
XenApp template	6	24	60	Production PXE	1	Windows Server 2012R2
Dedicated VM	2	4	100	Production	50	Windows Server 2012R2
File Server	2	4	40	Production VSAeth0	2	Windows Server 2012R2

Two machine catalogs with associated delivery groups were created within Desktop Studio. The first machine catalog contained the 32 HSD user VMs and the second catalog contained the 50 dedicated user VMs. These VMs were individual VMs, not provisioned by PVS or Machine Create services, and the use of Desktop Studio was to maintain power control and maintenance mode for the VMs. Access to the desktops was through the StoreFront URL for the site.

The File Server VMs served up the profile share for storage of user profiles and possible user data access.

Installation of the software was done following Citrix and Microsoft documentation and best practices. No tuning was done to the environment, but the defined Citrix Group Policies were applied for User Experience.

Capacity and sizing

The goal of this paper was not to determine the maximums for different user types but to look at a mixed workload of the type of users most seen in the VDI/HSD space. The decisions on number of users was made from looking at other testing done using the HPE Hyper Converged 380 as well as testing focused on virtualized XenApp VMs. Once this data had been gathered a single VM test was initiated to verify the findings.

The original goal of 500 HSD users led to the decision of 15-16 users per HSD VM, with the VMs configured with 8 vCPUs, 24GB of memory and utilizing PVS RAM Cache. All users were tested with the Citrix User Experience setting, looking to provide the best possible user experience. With eight VMs per node, this gives us approximately 128 users per node, and just over 500 users across the entire platform. Once we had determined the proper configuration for the HSD user VMs, the dedicated power user VMs were brought on line. The power user VMs were running Windows Server 2012R2 as well, this was considered to be the worst case scenario for a power user requiring a server OS to support their work.

Analysis and recommendations

The following graph shows the 4-node HPE Hyper Converged 380 under load supporting 510 HSD users and 50 power users.
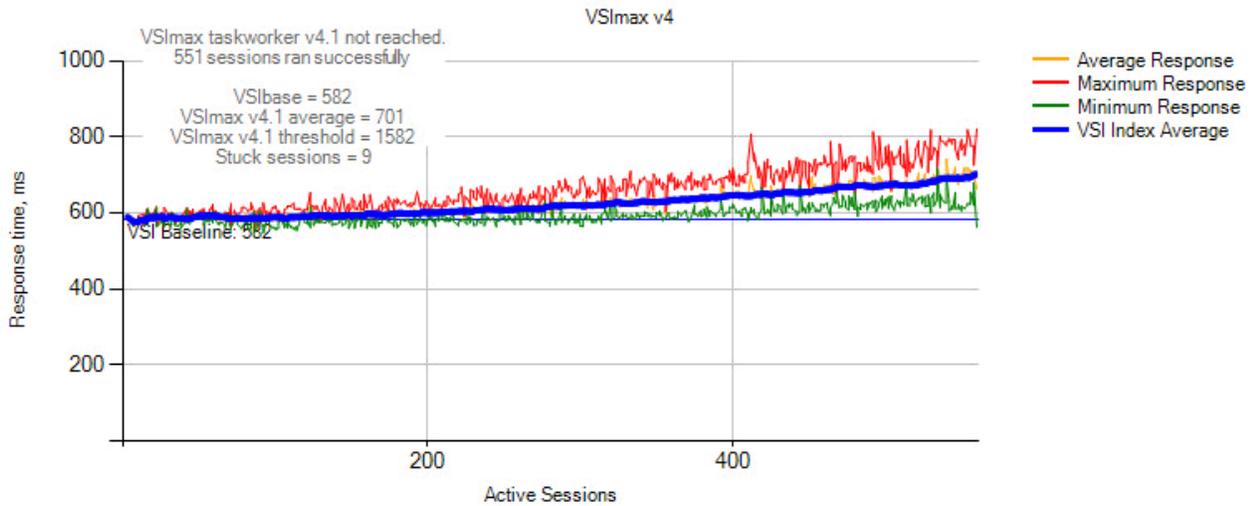

Figure 6. VSImax graph

This run finished with a Login VSI baseline performance score of 582, this is the average of the 15 lowest samples with the lowest two removed. The threshold is the baseline + 1000ms, VSImax is determined when the average response times exceed this number. The average response time is calculated using the amount of active sessions at that moment. Under full load of our 550 desired users the average was 701ms, or under half of the defined threshold.

Taking a look at the ESX performance the following graph highlights percentage of total physical CPU utilization for a single node in the cluster.
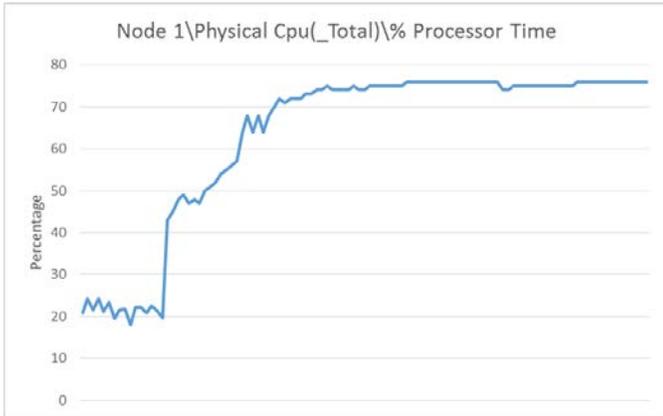

Figure 7. ESX CPU utilization data

The following set of charts show the total IO/s for each Virtual Storage Array (VSA) in the cluster.
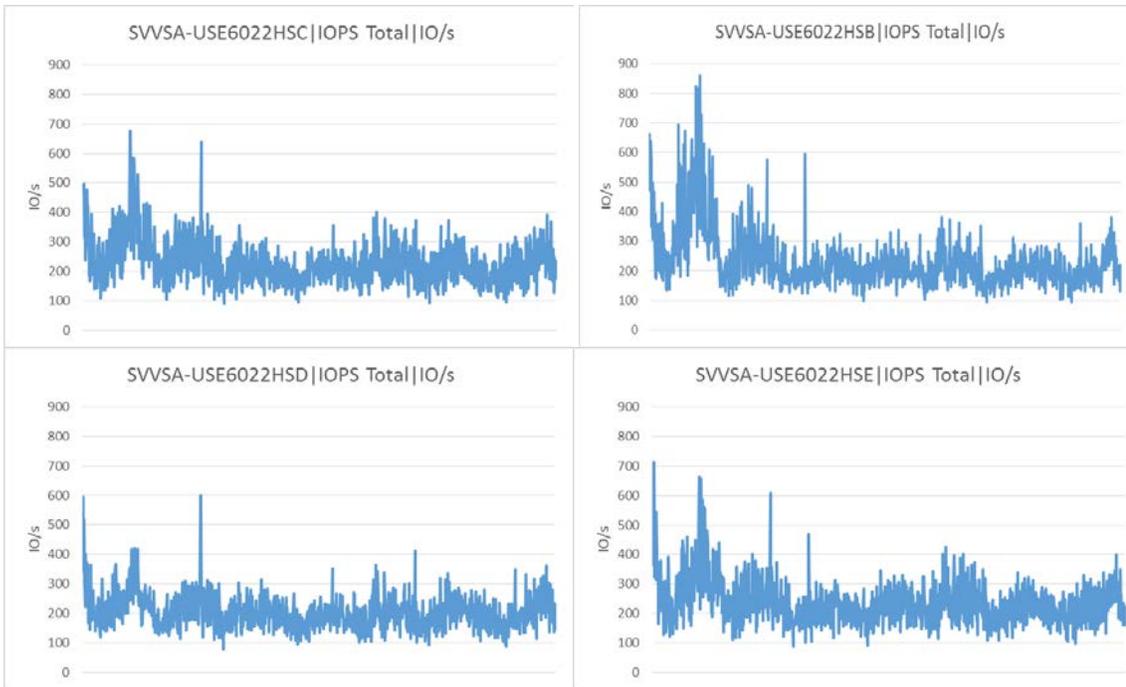

Figure 8. Input/Output Operations per second (IOPs)Totals

The beginning spike across the VSAs relates to startup of the VMs, once everything is up and running the IO/s settle out to under 400 per VSA, and are fairly evenly distributed across the four VSAs. The majority of these IO/s are being generated by the dedicated user VMs. This can be proven by looking at the 800 task worker test defined in Appendix B.
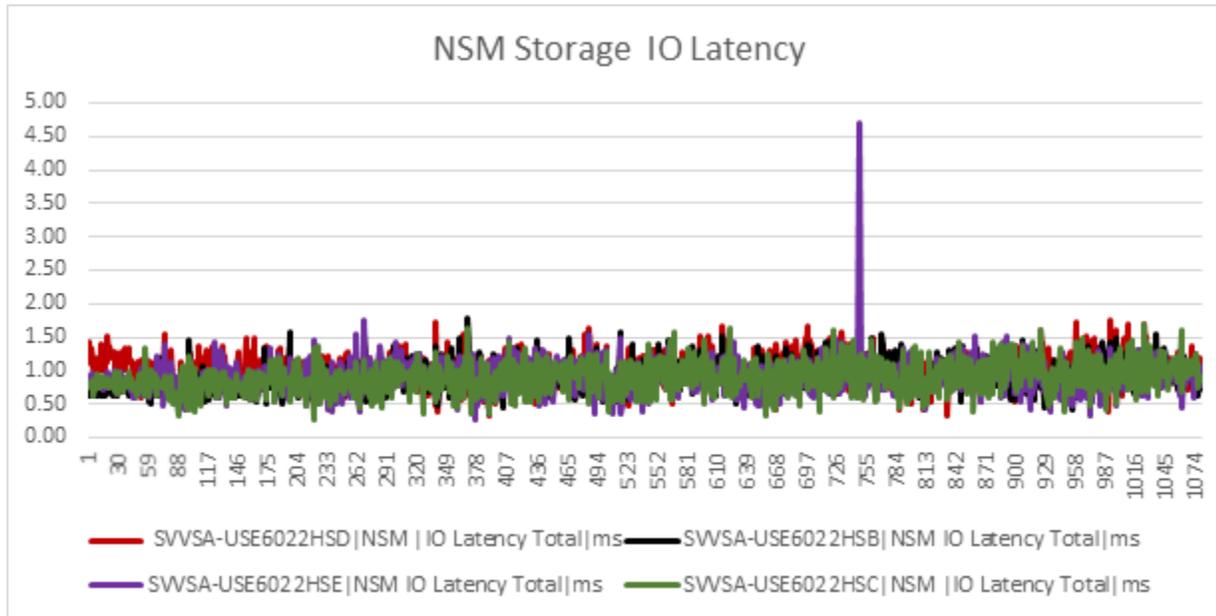
The final graph shows the latencies across all four nodes.

Figure 9. IO latencies

For the 550 user run that is the focus, the latencies across the VSAs is averaging about 1ms each.

Summary

The goal of this test was not to press and see how much the HPE Hyper Converged 380 could do with Citrix XenDesktop, but to focus on two major user groups who make up the majority of virtual desktop users, this being the HSD task level worker and the dedicated VM power user, while keeping the TCO for hardware, software and licensing in the low. As the results showed, the desired number of users was easily obtained, with headroom left for some additional users or for failure of a node without affecting the user experience, and we could have easily support 20-25 users per HSD VM. Appendix B shows testing around an 800 task worker test run, the results and conclusions on potential performance limits.

The other part of this solution is its ability to grow by simply adding more HPE Hyper Converged 380 nodes. No additional network switches or other hardware is required, up to 16 nodes will fit into the rack with the networking switches. In addition, the Citrix environment is configured in a fail-over solution that will support thousands of users so no changes are required in the Citrix XenDesktop environment to add more users. Each new node will support roughly 100-120 HSD users or 25 dedicated power users. Add a node to the cluster, let the HPE StoreVirtual VSA integrate the new storage, deploy the additional HSD VMs to support the users, or the dedicated power user VMs, from the Desktop Studio and expand your system. This is what a hyperconverged system should do for you. Easy to configure, easy to maintain, and easy to expand. At some point you will want to create an additional datastore for the HSD VMs, but each node also brings with it additional possible user data storage space. In this solution the graphics capabilities of the HPE Hyper Converged 380 with NVIDIA cards was not implemented or utilized.

This Reference Configuration describes solution testing performed in May of 2016.

Implementing a proof-of-concept

As a matter of best practice for all deployments, HPE recommends implementing a proof-of-concept using a test environment that matches as closely as possible the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact an HPE Services representative (hpe.com/us/en/services/consulting.html) or your HPE partner.

Appendix A: Bill of materials

The following bill of materials (BOM) contains electronic license to use (E-LTU) parts. Electronic software license delivery is now available in most countries. HPE recommends purchasing electronic products over physical products (when available) for faster delivery and for the convenience of not tracking and managing confidential paper licenses. For more information, please contact your reseller or an HPE representative.

Note

Part numbers are current as of time of testing and subject to change. The bill of materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your HPE Reseller or HPE Sales Representative for more details. hpe.com/us/en/services/consulting.html.

Table 7. Bill of materials - 4-node cluster configuration

QTY	PART NUMBER	DESCRIPTION
1	BW908A	HPE 42U 600x1200mm Enterprise Shock Rack
4	P9D74A	HPE Hyper Converged 380 Cluster Appliance (node)
4	719044-L21	HPE DL380 Gen9 Intel Xeon E5-2690v3 (2.6GHz/12-core/30MB/135W) FIO Processor Kit
4	719044-B21	HPE DL380 Gen9 Intel Xeon E5-2690v3 (2.6GHz/12-core/30MB/135W) Processor Kit
32	728629-B21	HPE 32GB (1x32GB) Dual Rank x4 DDR4-2133 CAS-15-15-15 Registered Memory Kit
4	724864-B21	HPE DL380 Gen9 2SFF Front/Rear SAS/SATA Kit
8	804587-B21	HPE 240GB 6G SATA Read Intensive-2 SFF 2.5-in SC 3yr Wty Solid State Drive
8	804671-B21	HPE 800GB 6G SATA Write Intensive-2 SFF 2.5-in SC 3yr Wty Solid State Drive
48	781518-B21	HPE 1.2TB 12G SAS 10K rpm SFF (2.5-inch) SC Enterprise 3yr Warranty Hard Drive
4	719073-B21	HPE DL380 Gen9 Secondary 3 Slot GPU Ready Riser Kit
4	719076-B21	HPE DL380 Gen9 Primary 2 Slot GPU Ready Riser Kit
4	665243-B21	HPE Ethernet 10Gb 2-port 560FLR-SFP+ Adapter
4	749974-B21	HPE Smart Array P440ar/2GB FBWC 12Gb 2-ports Int FIO SAS Controller
4	726821-B21	HPE Smart Array P440/4GB FBWC 12Gb 1-port Int SAS Controller
4	726897-B21	HPE Smart Array P840/4GB FBWC 12Gb 2-ports Int SAS Controller
12	783009-B21	HPE DL380 Gen9 8SFF SAS Cable Kit
4	785991-B21	HPE DL380 Gen9 12LFF SAS Cable Kit
4	786092-B21	HPE DL380 Gen9 8SFF H240 Cable Kit
4	733660-B21	HPE 2U Small Form Factor Easy Install Rail Kit
8	720620-B21	HPE 1400W Flex Slot Platinum Plus Hot Plug Power Supply Kit
4	JG505A	HPE 59xx CTO Switch Solution
2	JG510A	HPE 5900AF-48G-4XG-2QSFP+ Switch
2	JC772A	HPE 5900AF-48XG-4QSFP+ Switch
12	JD096C	HPE X240 10G SFP+ SFP+ 1.2m DAC Cable
8	JD097C	HPE X240 10G SFP+ SFP+ 3m DAC Cable
2	JG326A	HPE X240 40G QSFP+ QSFP+ 1m DAC Cable
9	C7535A	HPE Ethernet 7ft CAT5e RJ45 M/M Cable

QTY	PART NUMBER	DESCRIPTION
8	JC680A	HPE A58x0AF 650W AC Power Supply
1	H8B55A	HPE 14.4kVA 208V 50A 3Ph NA/JP ma PDU
8	JC682A	HPE 58x0AF Bck(pwr)-Frt(ports) Fan Tray
4	P9D85A	HPE ConvergedSystem 380-HC StoreVirtual Software LTU
1	HA124A1 XW4	HPE 3Y 4 hour 24x7 Proactive Care SVC
1	H1K92A3 YMW	HPE Hyper Converged 380 System Support
4	H1K92A3 YMX	HPE Hyper Converged 380 Node Support
4	H1K92A3 YMY	HPE Hyper Converged 380 SW LTU Support
1	HA124A1	HPE Installation and Startup Service
1	HA124A1 5ZO	HPE 300 Series HC StoreVirtual Startup Svc
1	HA114A1 5WG	HPE 300 Series HC StoreVirtual Strtup Svc
43-84	M7K12AAE	VMware Horizon Enterprise 10 Pack 1yr Concurrent Users E-LTU

Appendix B: 800 task worker XenApp (HSD) test

During testing to determine the right configuration for the 550 user testing, a run of 800 task workers was executed against the 32 HSD VMs configured as define in the document. This was done simply to verify overall performance. The following chart shows the LoginVSI VSImax results. To highlight the available headroom, the following chart shows an 800 task-worker run with no dedicated users.
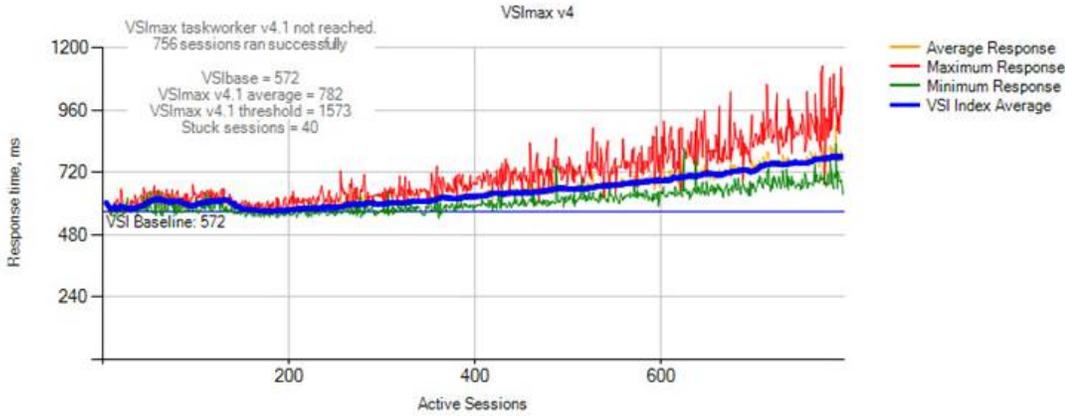

Figure 10. 800 task worker

The baseline is very similar to the one shown earlier in Figure 10 for the 550 user run. In this run 756 users ran successfully with no VSImax reached, and at full load with less than 1% failure the average response time is still well below the threshold. We are moving toward the limit as represented by the maximum response times starting to increase significantly.

From an IO/s view, this test leveraged the Ram Cache capabilities of PVS. Without the dedicate VMs generating IOPs, even with an increase in users the IO/s dropped significantly for all of the VSAs. As seen in the next set of graphs, the peak IO/s were under 150, and the average less than 40 IO/s with 756 sessions running across 32 Citrix HSD VMs.
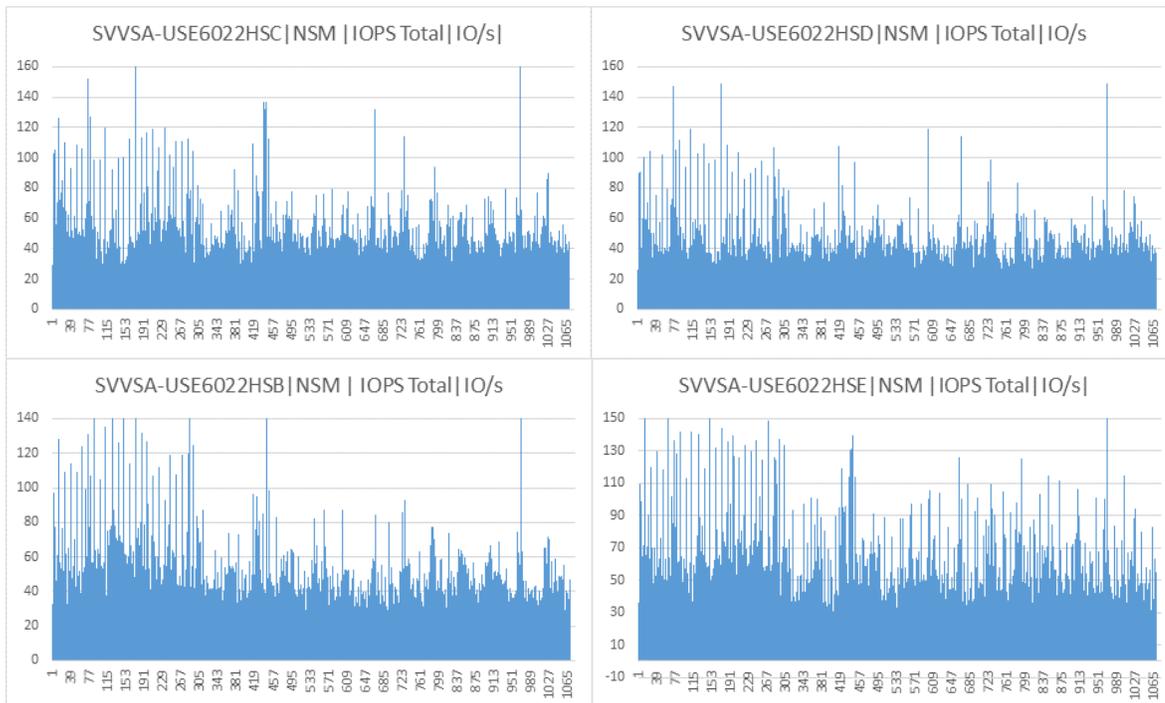
Figure 11. IO/s for 800 task worker test

This highlights the advantage of RAM Cache and the impact of dedicated VMs for users. The final graphs shows the latencies across the VSAs.
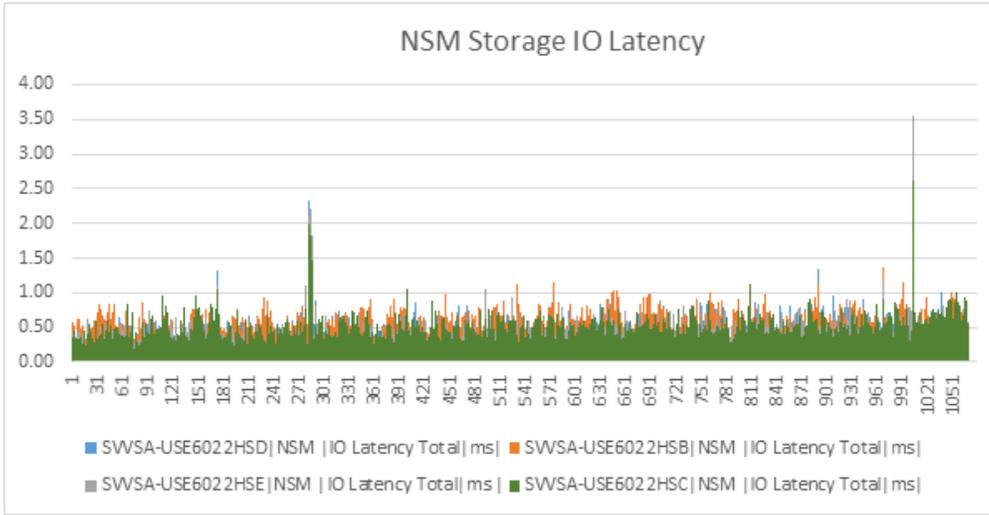

Figure 12. Latencies of VSAs in 800 user test

Appendix C: Resources and additional links

HPE Hyper Converged 380, http://www8.hp.com/us/en/products/cs-solutions/product-detail.html?oid=1008591219

HPE Reference Architectures, hpe.com/info/ra

HPE Converged Infrastructure Management (OneView), hpe.com/info/HPEOV

HPE ConvergedSystem, hpe.com/info/convergedsystem

HPE Servers, hpe.com/servers

HPE Storage, hpe.com/storage

HPE Networking, hpe.com/networking

HPE Technology Consulting Services, hpe.com/us/en/services/consulting.html

Citrix XenDesktop, Citrix.com/XenDesktop

Citrix Best Practices

XenDesktop and XenApp Best Practices, http://support.citrix.com/article/CTX132799

Citrix Blog (search on Citrix Best Practices), citrix.com/blogs

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