Hewlett Packard
Enterprise

HPE Reference Architecture for Citrix XenDesktop 7.13 on HPE SimpliVity 380

Technical white paper

Contents

Executive summary

Client virtualization is a top initiative for many IT organizations; driven in part by the promise of a flexible, mobile computing experience for end users, and consolidated management for IT. Organizations are looking to client virtualization solutions, like Citrix® XenDesktop®, to reduce distribution and administration expenses, minimize operating expenses of their desktop environment, and to improve security and compliance.

Too often, client virtualization deployments are plagued by sluggish and unpredictable desktop performance and higher than expected up-front capital expenses. As a result, adopting organizations need to compromise amongst the competing needs of strong solution performance, resiliency and cost reduction.

The HPE SimpliVity 380 is a market-leading hyperconverged infrastructure platform, ideally suited for addressing the challenges of client virtualization. It provides the end-user experience organizations require, without sacrificing economics or resilience. The HPE SimpliVity 380 provides:

- Simplified deployment with hyperconverged building blocks
- Ability to start small and scale out in affordable increments—from pilot to production
- Independently validated client virtualization performance
- Deployment of full-clone desktops with the same data efficiency as linked clones
- Enterprise-class data protection and resiliency

This Reference Architecture provides a roadmap for architecting these capabilities and showcases third-party validated Login VSI performance testing. It provides an enterprise-scale architecture for implementing Citrix XenDesktop 7.13, hosted and hosted shared desktops, on HPE SimpliVity 380 hyperconverged infrastructure and describes the tests performed by Hewlett Packard Enterprise to validate the efficiency of the recommended solution.

The performance testing illustrates the ability of the HPE SimpliVity 380 to deliver an excellent end-user experience in client virtualization deployments as the environment scales. Highlights include:

- Performance at scale: In Login VSI testing, consistent low-latency was observed for both hosted and hosted shared desktop implementations, even as additional nodes were added to the solution.
- Best in class user density: 3000 user sessions (1400 hosted desktops and 1600 hosted shared desktop sessions) hosted on only 8 HPE SimpliVity 380 nodes with 8 HPE ProLiant DL380 compute nodes, including resilient N+1 design.

Target audience: This document is intended for customer IT architects, managers and administrators; channel partner engineers, professional services personnel and other IT professionals who plan to deploy the HPE SimpliVity 380 hyperconverged solution to support Citrix XenDesktop 7.13.

Document purpose: The purpose of this document is to describe an enterprise-scale Reference Architecture, highlighting recognizable benefits to technical audiences.

Introduction

Simplifying client virtualization

Many businesses are constrained by legacy IT infrastructure that isn't well suited for client virtualization initiatives. Siloed data centers, composed of independent compute, storage, network and data protection platforms with distinct administrative interfaces are inherently inefficient, cumbersome and costly. Each platform requires support, maintenance, licensing, power and cooling—not to mention a set of dedicated resources capable of managing and maintaining each component. Rolling out a new application, like client virtualization, becomes a time-consuming effort involving many different technology platforms, management interfaces, and operational teams. Expanding system capacity can take days or even weeks, and require cumbersome process and administration. Troubleshooting problems and performing routine data backup, replication and recovery tasks can be just as inefficient.

While grappling with this complexity, organizations also need to address challenges that are unique to virtualization, including:

- Difficulty sizing client virtualization workloads upfront, due to random and unpredictable user behaviors.
- Periodic spikes in demand, such as "login storms" and "boot storms", that may significantly degrade performance, if not properly handled.
- High cost of downtime in the event of an outage, either unexpected or due to system maintenance.

The HPE SimpliVity 380 addresses each of these challenges by providing a scalable, building block-style approach to deploying infrastructure for virtualization. This solution offers an enterprise predictable cost and delivers a high-performing desktop experience to end users.

Superior user experience through unmatched client virtualization performance
The HPE SimpliVity 380 enables high performance even at high user density. It eliminates the performance impact of client login storms, delivering 1,000 logins in 1,000 seconds – nearly 3x faster than the standard Login VSI benchmark client login speed and unparalleled in the hyperconverged infrastructure solution market.

Linear scalability from pilot to production with cost-effective client virtualization deployments
The scale-out architecture of the HPE SimpliVity 380 minimizes initial capital expense and tightly aligns investments with business requirements. HPE SimpliVity 380 building blocks are added incrementally, providing a massively-scalable pool of shared resources.

Enterprise-grade data protection and resiliency for client virtualization workloads
The HPE SimpliVity 380 provides built-in backup and disaster recovery capabilities for the entire client virtualization infrastructure, as well as for supporting management workloads. The solution ensures resilient, highly available, desktop operations and the ability to withstand node failures with no loss of desktops and minimal increase in latency.

Technology overview

The HPE SimpliVity 380 hyperconverged infrastructure solution is designed from the ground up to meet the increased performance, scalability and agility demands of today's data-intensive, highly virtualized IT environments. The HPE SimpliVity 380 technology transforms IT by virtualizing data and incorporating all IT infrastructure and services below the hypervisor into compact building blocks. The HPE SimpliVity 380 delivers the best of both worlds: the enterprise-class performance, protection and resiliency that today's organizations require, with the cloud economics businesses demand.

The HPE SimpliVity solution provides a single, shared resource pool across the entire IT stack, eliminating point products and inefficient siloed IT architectures. The solution is differentiated from other converged infrastructure solutions by three unique attributes: accelerated data efficiency, built-in data protection functionality and global unified management capabilities.

- **Accelerated Data Efficiency:** HPE SimpliVity performs inline data deduplication, compression and optimization on all data at inception across all phases of the data lifecycle, all handled with fine data granularity of just 4KB-8KB. On average, HPE SimpliVity customers achieve 40:1 data efficiency while simultaneously increasing application performance.
- **Built-In Data Protection:** HPE SimpliVity includes native data protection functionality, enabling business continuity and disaster recovery for critical applications and data, while eliminating the need for special-purpose backup and recovery hardware or software. The inherent data efficiencies of the HPE SimpliVity platform minimize I/O and WAN traffic, reducing backup and restore times from hours to minutes, while obviating the need for special-purpose WAN optimization products.
- **Global Unified Management:** The VM-centric approach of the HPE SimpliVity 380 platform to management eliminates manually intensive, error-prone administrative tasks. System administrators are no longer required to manage LUNs and volumes; instead, they can manage all resources and workloads centrally, using familiar interfaces such as VMware® vCenter Server.

An individual HPE SimpliVity 380 node includes:

- **OVC – HPE OmniStack Virtual Controller** – A virtual machine is deployed and pinned to the host, used to expose HPE SimpliVity storage as NFS-based vSphere datastores. vSphere DirectPath I/O is used to pass through the local SCSI controller and the HPE OmniStack Accelerator Card to the OVC. Multiple OVCs in a vSphere Cluster present a unified namespace of storage across all HPE SimpliVity nodes within a vSphere Cluster.
- **OAC – OmniStack Accelerator Card** – Acknowledges writes, performs data efficiency operations, manages metadata and works with OVC to store metadata in the SSD pool. DRAM is used for transient data. Super capacitors are used to de-stage DRAM to SSD in the event of a power failure.

- **SSD Pool** – SSD drives (number and sizes vary based on HPE SimpliVity 380 model) protected with RAID5 or RAID6 using a local SCSI controller – provides a single tier of storage for all system and user data requirements.

HPE SimpliVity is a software-defined hyperconverged infrastructure solution. Clustering multiple HPE SimpliVity-powered hyperconverged infrastructure units forms a shared resource pool and delivers mobility, high availability, and efficient scaling of performance and capacity.

Solution overview

The solution outlined in this document provides guidance for implementing HPE SimpliVity 380 to enable a single client virtualization building block, supporting 3000 users of mixed workload types. This architecture can be used to scale to tens of thousands of users, by duplicating the building blocks as outlined below.

This solution leverages HPE SimpliVity 380 hyperconverged infrastructure as the fundamental element of the design. HPE SimpliVity nodes are combined, forming a pool of shared compute (CPU and memory), storage, and storage network resources. VMware vSphere and Citrix XenDesktop provide a high-performance client virtualization environment that is highly available and highly scalable.

The building block includes:

- HPE SimpliVity 380 nodes with Broadwell-based Intel® Xeon® E5-2697 v4 CPUs and 443GB usable memory for desktop workloads
- HPE ProLiant DL380 Gen9 compute nodes with Broadwell-based Intel® Xeon® E5-2697 v4 CPUs and 512GB memory for desktop workloads
- HPE SimpliVity 380 nodes with Broadwell-based Intel Xeon E5-2680 v4 CPUs and 187GB usable memory for management workloads
- 2TB datastore per HPE SimpliVity 380 node – applies to all workloads
- 10GbE networking
- Windows 10 Enterprise LTSB (Long Term Servicing Branch) for hosted desktops
- Windows Server 2016 for hosted shared desktops and management server workloads
- N+1 design for management workloads and infrastructure where possible

The testing performed for this Reference Architecture was designed to validate the functionality of the system as a 4&4 block. This is defined as four HPE SimpliVity 380 nodes tied together with four HPE ProLiant DL380 Gen9 compute nodes in a 1:1 configuration, as shown in Figure 1 below.

Login VSI 4.1.12.8 was used for testing all workloads, including Login VSI Standard Knowledge Worker for hosted desktops and Login VSI Standard Office Worker for hosted shared desktops. Proper sizing methodology is shown below to ensure that the configuration and load described in this document are production-ready for customer environments and resilient to N+1 design requirements.

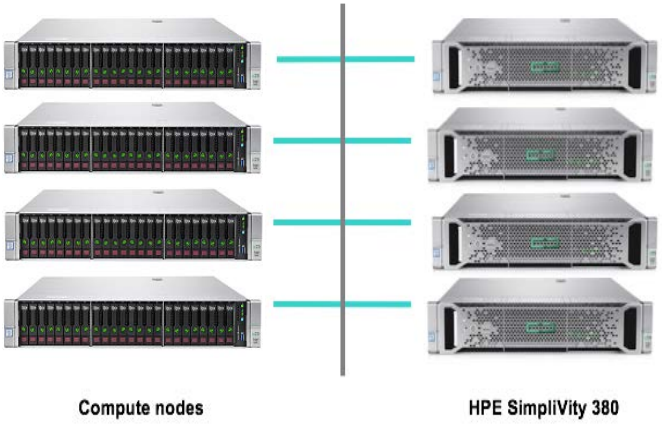

Figure 1. Compute Nodes

Management infrastructure

This section details the HPE SimpliVity environment dedicated to running the management workloads required to support 3000 user sessions. A separate, dedicated, HPE SimpliVity environment is also used for the XenDesktop hosted desktops and hosted shared desktops, further detailed in the Desktop infrastructure section of this document. The management workloads considered in this document are outlined in detail in the Best practices and configuration guidance for the solution section below.

The following infrastructure was used to support the management workload:

- 2x HPE SimpliVity 380 servers
- Intel Xeon E5-2680 v4 (Broadwell 14-core, 2 sockets per server)
- 187GB usable memory each server
- 2x 2TB datastores
- 10GbE interconnect between systems (no 10GbE switch required, but may be used)

Desktop infrastructure

The desktop block for 1400 Knowledge Workers on MCS-deployed hosted desktops is a four-node HPE SimpliVity 380 Cluster with four compute nodes attached, making an eight-node vSphere Cluster. Another instance of the same four HPE SimpliVity 380 nodes with four compute nodes also supports 1600 Office Worker sessions on MCS-deployed hosted shared desktops. This configuration has been tested and validated to support the workload as defined, including N+1 design for compute and storage. Results of these tests are available in the Analysis and recommendations section of this document.

The following infrastructure was used to support these workloads, per cluster:

- 4x HPE SimpliVity 380 Small Enterprise All-Flash servers
- 4x HPE ProLiant DL380 compute nodes
- Intel Xeon E5-2697 v4 (Broadwell 18-core, 2 sockets per server)
- 443GB usable memory per HPE SimpliVity 380 system
- 512GB memory per DL380 compute node
- 4x 2TB datastores
- 10GbE networking

Solution components

The following table provides an overview of the configuration for Citrix XenDesktop 7.13, Login VSI 4.1.12.8, and the tested HPE SimpliVity 380 plus HPE ProLiant DL380 Gen9 compute node building block.

Table 1. Solution Components

Parameter	Setting
Users per host/HPE SimpliVity 380 node	
• Hosted desktops	• 175 per host, 350 per HPE SimpliVity 380 node
• Hosted shared desktops	• 200 per host, 400 per HPE SimpliVity 380 node
Machine Catalogs deployed	
• Hosted desktops	• 1x MCS-deployed catalog w/1400 Windows 10 VMs
• Hosted shared desktops	• 1x MCS-deployed catalog w/72 Windows Server 2016 VMs
Machine Catalog configuration	
• Hosted desktops	• Random, user data not saved, 512MB RAM cache, 10GB disk cache per VM
• Hosted shared desktop	• Random, user data not saved, 4GB RAM cache, 100GB disk cache per VM
Login VSI configuration	
• Benchmark mode	Enabled
• Hosted desktop workload	Knowledge Worker
• HSD workload	Office Worker
• Hosted desktop connection	Direct desktop connection (DDC)
• HSD connection	Citrix Receiver via Storefront
• Number of launchers – hosted	6 launchers
• Number of launchers – HSD	60 launchers

Best practices and configuration guidance for the solution

In this section, configuration guidance and best practices will be shown for deploying Citrix XenDesktop 7.13 on HPE SimpliVity 380 infrastructure. Both management and desktop workload supporting infrastructure guidance are shown here.

Management infrastructure

The following infrastructure was deployed to support the Citrix XenDesktop 7.13 workloads that were tested to produce this Reference Architecture.

Table 2. Management Infrastructure Workloads

Workload	Version	vCPUs	RAM	Disk	OS
vCenter Server Appliance – Desktop (Large)	6.5	16	32GB	640GB	VMware Virtual Appliance
vCenter Server Appliance – Mgmt (Small)	6.5	4	16GB	290GB	VMware Virtual Appliance
Arbiter – Desktop	3.6.2	2	4GB	40GB	Windows Server 2016
Arbiter – Mgmt (lives outside of cluster)	3.6.2	2	4GB	40GB	Windows Server 2016
Microsoft SQL Server x 2 (Always On Availability Group)	2014 U1	4	8GB	100GB	Windows Server 2016
File Share Witness (Always On Availability Group)	N/A	2	4GB	40GB	Windows Server 2016
AD DC/DHCP/DNS x 2	N/A	2	4GB	40GB	Windows Server 2016
Citrix XenDesktop Controller Server x 2	7.13	4	8GB	40GB	Windows Server 2016
Citrix XenDesktop StoreFront Server x 2	7.13	4	4GB	40GB	Windows Server 2016
Citrix XenDesktop Licensing Server	7.13	4	4GB	40GB	Windows Server 2016

Table 3. Management Infrastructure vSphere Design

Attribute	Value	Rationale
Number of vCenter Servers	1	Only a single vCenter Server is required to support this workload. The desktop-supporting vCenter Server Appliance was deployed as an HPE SimpliVity 380 Small Enterprise All-Flash
Number of vSphere Clusters	1	Given the number of HPE SimpliVity systems required to support the given workload, there is no need to split out hosts into separate vSphere Clusters.
Number of vSphere Datacenters	1	A single vSphere Cluster is present and no Datacenter-level separation is necessary.
vSphere HA Configuration	HA enabled Admission Control enabled % of cluster resources reserved – 50% Isolation Response – Leave Powered On	Enabled to restart VMs in the event of an ESXi host failure Ensure VM resources will not become exhausted in the case of a host failure. Set to the percentage of the cluster a single host represents. Ensure a host isolation event does not needlessly power off desktops.
vSphere HA – Advanced Settings	das.vmmemoryminmb – 8507MB das.vmcpuminmhz – 1000MHz	Both are set to averages of the workloads in the cluster. This serves to set the percentage of cluster resources in HA calculation to that of an average VM.
vSphere Version	6.5.0	Latest supported release

HPE SimpliVity Servers – To support the management workloads outlined in this document, a two-host vSphere Cluster, comprised of a pair of HPE SimpliVity 380 nodes, is recommended. Unlike other hyperconverged infrastructure solutions, HPE SimpliVity fully supports a two-host cluster in its minimum configuration. Using HPE SimpliVity allows you to start small, with only the infrastructure you need, and scale out as your VDI environment grows.

vCenter Servers – All roles were deployed on to a single vCenter Server Appliance (VCSA) instance. No CPU or memory pressure were observed during testing, so dedicating servers for each service was unnecessary. Integrated vPostgres databases were used for each VCSA deployed.

XenDesktop Delivery Controllers – A single Delivery Controller supports up to 5000 users. Two Delivery Controllers were deployed in an N+1 configuration for high availability.

XenDesktop StoreFront Servers – A single StoreFront Server supports up to 10000 users. Two StoreFront Servers were deployed in an N+1 configuration for high availability.

XenDesktop License Server – Only a single License Server is required.

Infrastructure Services (Domain Controllers/DNS/DHCP) – These services were all co-located on the same virtual machines. No CPU or memory pressure was observed during testing. In-depth Active Directory design and recommendations are outside the scope of this document. Please see https://msdn.microsoft.com/en-us/library/bb727085.aspx for more information and best practices.

Microsoft SQL Server – All supporting databases for this reference design, were run on a pair of virtual machines running Microsoft SQL Server 2014 Update 1 with Always On Availability Groups. A small file server virtual machine was used as cluster witness. These databases are referenced in the table below.

Table 4. Required Microsoft SQL Databases

Database	Authentication	Size	Recovery Mode
XenDesktop Delivery Controller DBs	Windows Authentication	Default	Full

Sizing – Compute, storage, and network resources for each infrastructure VM were selected using Citrix best practices as a baseline and modified based on their observed performance on the HPE SimpliVity 380 systems.

HPE SimpliVity Arbiter Placement – The HPE SimpliVity arbiter should always be deployed outside of the HPE SimpliVity infrastructure it manages. The arbiter instance supporting the desktop VCSA is deployed as a virtual machine in the management cluster. The arbiter instance supporting the management VCSA should be deployed outside of the management cluster. In this instance, it is deployed as a small virtual machine outside of this configuration.

vStorage API for Array Integration (VAAI) – VAAI is a vSphere API that allows storage vendors to offload some common storage tasks from ESXi to the storage itself. The VAAI plugin for HPE SimpliVity is installed during deployment, so no manual intervention is required.

Datastores – A single datastore per HPE SimpliVity 380 server is required to ensure even storage distribution across cluster members. This is less important in a two-node HPE SimpliVity server configuration; however, following this best practice guideline will ensure a smooth transition to a three-node HPE SimpliVity environment, should the environment grow over time. This best practice has been shown to deliver better storage performance and is highly encouraged for management workloads. It should be noted that this is a requirement for desktop-supporting infrastructure.

Networking – The following best practices are utilized in the vSphere networking design:

- Segregate OVC networking from ESXi host and virtual machine network traffic
- Leverage 10GbE where possible for OVC and virtual machine network traffic

These best practices offer the highest network performance to VMs running on HPE SimpliVity. Taking this into consideration, a single vSphere Standard Switch is deployed for management traffic, and a single vSphere Distributed Switch is deployed for the remaining traffic, including:

- Virtual Machines
- HPE SimpliVity Federation
- HPE SimpliVity Storage
- vMotion

Table 5. Management Infrastructure vSphere Standard Switch Configuration

Parameter	Setting
Load balancing	Route based on Port ID
Failover detection	Link status only
Notify switches	Enabled
Failback	No
Failover order	Active/Active
Security	Promiscuous Mode – Reject MAC Address Changes – Reject Forged Transmits – Reject
Traffic Shaping	Disabled
Maximum MTU	1500
Number of Ports	128
Number of Uplinks	2
Network Adapters	1GbE NICs on each host
VMkernel Adapters/VM Networks	vmk0 – ESXi Management – Active/Active – MTU 1500 VM – vCenter Server – Active/Active – MTU 1500

Table 6. Management Infrastructure vSphere Distributed Switch Configuration

Parameter	Setting
Load balancing	Route based on physical NIC load
Failover detection	Link status only
Notify switches	Enabled
Failback	No
Failover order	Active/Active
Security	Promiscuous Mode – Reject MAC Address Changes – Reject Forged Transmits – Reject
Traffic Shaping	Disabled
Maximum MTU	9000
Number of Ports	4096
Number of Uplinks	2
Network Adapters	10GbE NICs on each host
Network I/O Control	Disabled
VMkernel ports/VM Networks	vmk1 – vMotion vmk2 – Storage vMotion – Active/Standby – MTU 9000 Federation – Standby/Active – MTU 9000 Storage – Standby/Active – MTU 9000 Management VMs – Active/Active – MTU 9000
Port Binding	Static

Desktop infrastructure

The following configurations were performed during our testing for this document.

Table 7. Knowledge Worker Virtual Machine Configuration – Hosted Desktops

Attribute	Specification
Operating System	Windows 10 LTSB 64-bit
Virtual Hardware	VM virtual hardware version 13
VMware Tools	10.1.5
Number of vCPUs	2
Memory – including MCS RAM cache	2304MB
MCS RAM cache size	512MB
Virtual Disk – VMDK	40GB
NTFS Cluster Alignment	8KB
SCSI Controller	VMware Paravirtual
Virtual Floppy Drive	Removed
Virtual CD/DVD Drive	Removed
NIC vendor and model Number of ports/NIC x speed	VMXNET3 1x 10 Gigabit Ethernet
OS Page file	1.5GB starting and max
Number deployed	1400

Table 8. Office Worker Virtual Machine Configuration - Hosted Shared Desktops

Attribute	Specification
Operating System	Windows Server 2016
Virtual Hardware	VM virtual hardware version 13
VMware Tools	10.1.5
Number of vCPUs	4
Memory – including MCS RAM cache	32768MB
MCS RAM cache size	4096MB
Virtual Disk – VMDK	60GB
NTFS Cluster Alignment	8KB
SCSI Controller	VMware Paravirtual
Virtual Floppy Drive	Removed
Virtual CD/DVD Drive	Removed
NIC vendor and model Number of ports/NIC x speed	VMXNET3 1x 10 Gigabit Ethernet
OS Page file	24GB starting and max
Number deployed	72
Users per server	22

vStorage API for Array Integration (VAAI) – VAAI is a vSphere API that allows storage vendors to offload some common storage tasks from ESXi to the storage itself. The VAAI plugin for HPE SimpliVity is installed during deployment, so no manual intervention is required.

Datastores – An equal number of datastores to the number of HPE SimpliVity 380 systems in each vSphere Cluster must be deployed. In this configuration, four datastores were created for each vSphere Cluster. This is done to more evenly distribute storage load across the HPE SimpliVity systems in the vSphere Cluster, as well as increase the likelihood any given desktop has locality with its VMDK disk.

Each datastore contains a virtual machine template and write cache files for every virtual machine. The write cache file contains all disk writes of a target device when using a write-protected vDisk (Standard Image).

OVC Configuration – For the desktop-supporting HPE SimpliVity 380 nodes, the OVC should be tuned to use six virtual CPUs versus the stock configuration of four virtual CPUs for the HPE SimpliVity 380 Small Enterprise All-Flash model. This is done to allow for increased numbers of VMs to be supported per HPE SimpliVity 380 node, which is required to support the number of compute nodes required.

Compute Nodes – This design calls for the use of compute nodes, which are vSphere servers with no local HPE SimpliVity 380 components. The compute nodes, in this design, are attached 1:1 with HPE SimpliVity nodes within the vSphere Cluster. That is to say, each HPE SimpliVity node in the vSphere Cluster will have a single HPE ProLiant DL380 compute node attached via NFS mount. This requires the mapping of a VMkernel port per compute node to an individual OVC to mount its storage. No single OVC should have more than one compute node mapped. In the tested configuration, the compute node to OVC mapping was done as follows:

Table 9. vSphere VMkernel port to OVC Storage IP Mapping

Compute Node (VMkernel IP)	HPE SimpliVity 380 (VMkernel IP)	OVC Mapped (Storage IP)
HPE DL380 Gen9 #1 (10.111.33.121/22)	HPE SimpliVity 380 #1 (10.111.33.111/22)	OVC #1 (10.111.32.111/22)
HPE DL380 Gen9 #2 (10.111.33.122/22)	HPE SimpliVity 380 #2 (10.111.33.112/22)	OVC #2 (10.111.32.112/22)
HPE DL380 Gen9 #3 (10.111.33.123/22)	HPE SimpliVity 380 #3 (10.111.33.113/22)	OVC #3 (10.111.32.113/22)
HPE DL380 Gen9 #4 (10.111.33.124/22)	HPE SimpliVity 380 #4 (10.111.33.114/22)	OVC #4 (10.111.32.114/22)

Networking – The following design patterns were observed in the design of the vSphere networking for the solution:

- Segregate OVC networking from ESXi host and virtual machine network traffic
- Leverage 10GbE where possible for OVC and virtual machine network traffic

A single vSphere Standard Switch is deployed for management traffic, and a single vSphere Distributed Switch is deployed for the remaining traffic, including:

- Virtual Machines
- HPE SimpliVity Federation
- HPE SimpliVity Storage
- vMotion

Table 10. Desktop Infrastructure vSphere Standard Switch Configuration

Parameter	Setting
Load balancing	Route based on Port ID
Failover detection	Link status only
Notify switches	Enabled
Failback	No
Failover order	Active/Active
Security	Promiscuous Mode – Reject MAC Address Changes – Reject Forged Transmits – Reject
Traffic Shaping	Disabled
Maximum MTU	1500
Number of Ports	128
Number of Uplinks	2
Network Adapters	1GbE NICs on each host
VMkernel Adapters/VM Networks	vmk0 – ESXi Management – Active/Active – MTU 1500

Table 11. Desktop Infrastructure vSphere Distributed Switch Configuration

Parameter	Setting
Load balancing	Route based on physical NIC load
Failover detection	Link status only
Notify switches	Enabled
Failback	No
Failover order	Active/Active
Security	Promiscuous Mode – Reject MAC Address Changes – Reject Forged Transmits – Reject
Traffic Shaping	Disabled
Maximum MTU	9000
Number of Ports	4096
Number of Uplinks	2
Network Adapters	10GbE NICs on each host
Network I/O Control	Disabled
VMkernel ports/VM Networks	vmk1 – vMotion vmk2 – Storage vMotion – Active/Standby – MTU 9000 Federation – Standby/Active – MTU 9000 Storage – Standby/Active – MTU 9000 Desktop VMs – Active/Active – MTU 9000
Port Binding	Static

Desktop infrastructure capacity and sizing

HPE SimpliVity Federation and vSphere Cluster Sizing –The solution is architected such that workloads are split into multiple vSphere Clusters, with the 1400 Hosted Desktop workloads in one vSphere Cluster and the 1600 Hosted Shared Desktop workloads in the other.

To support multiple vSphere Clusters in a single vCenter Server, both Clusters must belong to a single HPE SimpliVity Federation. A vCenter Server supports a single HPE SimpliVity Federation. For Citrix desktop workload-supporting vSphere infrastructure, vCenter Server Linked Mode is not supported by Citrix.

Note

This solution architecture was designed based on the Login VSI workload size standards. When sizing a production environment, proper assessment and use case definition should be done to accurately size the environment.

Table 12. Desktop Infrastructure vSphere Design

Attribute	Value	Rationale
Number of vCenter Servers	1	Only a single vCenter Server is required to support this workload. The desktop-supporting vCenter Server Appliance was deployed as an HPE SimpliVity 380 Large Enterprise All-Flash.
Number of vSphere Clusters	2	The hosted desktop and hosted shared desktop workloads are split into separate vSphere Clusters.
Number of vSphere Datacenters	1	With HPE OmniStack 3.6.2, the fault domain for an HPE SimpliVity Cluster has been moved to the vSphere Cluster level and multiple vSphere Clusters per Datacenter are supported.
vSphere HA Configuration	HA enabled Admission Control enabled % of cluster resources reserved – 12% Isolation Response – Leave Powered On	Enabled to restart VMs in the event of an ESXi host failure Ensure VM resources will not become exhausted in the case of a host failure. Set to the percentage of the cluster a single host represents. Ensure a host isolation event does not needlessly power off desktops.
vSphere HA – Advanced Settings (Hosted Desktop Cluster)	das.vmmemoryminmb – 2304MB das.vmcpuminmhz – 187MHz	Both are set to averages of the workloads in the cluster. This serves to set the percentage of cluster resources in HA calculation to that of an average VM.
vSphere HA – Advanced Settings (Hosted Shared Desktop Cluster)	das.vmmemoryminmb – 32768MB das.vmcpuminmhz – 1820MHz	Both are set to averages of the workloads in the cluster. This serves to set the percentage of cluster resources in HA calculation to that of an average VM.
Reservations and Limits	Full memory reservation for all desktop workloads	Ensures all desktop workloads have access to memory resources. Also avoids creation of VMkernel swap files on storage.
vSphere Version	6.5.0	Latest supported release

HPE SimpliVity Servers – Two eight-node vSphere Clusters comprised of four HPE SimpliVity 380 systems plus four HPE ProLiant DL380 compute nodes each to support the Knowledge Worker hosted desktop and Office Worker hosted shared desktop workloads. The following design patterns were observed:

- **Limit physical CPU to virtual CPU oversubscription –** In this configuration, each HPE SimpliVity 380 system has 36 physical cores. The OVC takes six physical cores, leaving 30 per system for desktop workloads to use. The HPE ProLiant DL380 compute nodes have 36 usable physical cores each. Each hosted desktop VM has two vCPUs, and each hosted shared desktop VM has four vCPUs.
- **Do not overcommit memory –** In this configuration, each HPE SimpliVity 380 system has 512GB of available physical memory. 69GB of memory is reserved for the OVC on each system. That leaves 443GB available per HPE SimpliVity 380 system for desktop workloads. The HPE ProLiant DL380 compute nodes have 512GB of usable memory each. Each hosted desktop VM has 2.25GB of memory, and each hosted shared Desktop VM has 32GB of memory.

Table 13. Desktop Infrastructure Resource Requirements

	HPE SimpliVity 380	HPE DL380 Compute Node	Total Usable	Req'd	Ratio/Overage
Hosted Desktop CPU	30 x 4 = 120 pCPUs	36 x 3 = 108 pCPUs	228 pCPUs	2800 vCPUs	12.28:1
Hosted Shared CPU	30 x 4 = 120 pCPUs	36 x 3 = 108 pCPUs	228 pCPUs	288 vCPUs	1.26:1
Hosted Desktop RAM	443GB x 4 = 1772GB	512GB x 3 = 1536GB	3308GB	3150GB	158GB spare
Hosted Shared RAM	443GB x 4 = 1772GB	512GB x 3 = 1536GB	3308GB	2304GB	1004GB spare

Note

The same configuration was used for both hosted and hosted shared desktop configurations in lab testing, and that is reflected here. However, given the lower relative memory requirement per user with the Office Worker hosted shared desktop configuration, 384GB per host will fulfill the memory requirement including N+1.

Workload description

Login VSI has standard workloads for use in benchmark testing, including the two which were used here, Office Worker and Knowledge Worker. The percentage values for CPU usage, disk reads, and disk writes are relative to the Knowledge Worker workload. These standard workloads are defined as follows by Login VSI, per user.

Table 14. Office and Knowledge Worker

Parameter	Office Worker Setting	Knowledge Worker Setting
Apps Open	5 – 8	5 – 9
CPU Usage	82%	100%
Disk Reads	90%	100%
Disk Writes	101%	100%
IOPS	8.1	8.5
Memory	1.5GB	1.5GB
CPU	1 vCPU	2 vCPU

Table 15. Applications

Setting
Microsoft Word 2010
Microsoft Excel 2010
Microsoft Outlook 2010
Microsoft PowerPoint 2010
Internet Explorer 11
MindMap
Adobe® Flash Player
DoroPDF Printer
Photo Viewer

All performance testing documented utilized the Login VSI (loginvsi.com) benchmarking tool. Login VSI is the industry-standard load testing solution for centralized virtualized desktop environments. When used for benchmarking, the software measures the total response time of several specific user operations being performed within a desktop workload in a scripted loop. The baseline is the measurement of the response time of specific operations performed in the desktop workload, which is measured in milliseconds (ms).

All performance results published in this document have been independently validated by Login VSI. These results have been reviewed for accuracy and to ensure they meet the strict performance requirements that Login VSI has set to qualify for the Validated by Login VSI program.

There are two values in particular that are important to note: **VSIbase** and **VSImax**.

- **VSIbase:** A score reflecting the response time of specific operations performed in the desktop workload when there is little or no stress on the system. A low baseline indicates a better user experience, resulting in applications responding faster in the environment.
- **VSImax:** The maximum number of desktop sessions attainable on the host before experiencing degradation in host and desktop performance.

HPE used Login VSI 4.1.12.8 to perform the tests. The VMs were balanced across each of the servers, maintaining a consistent number of VMs on each node. All Hosted and Hosted Shared Desktops were powered on, registered, and idle prior to starting the actual test sessions.

Analysis and recommendations

The following are a summarization of the results from the tests described below.

Table 16. Summary of Login VSI Test Results

Test Case	VSIbase	VSImax Average	VSImax reached?
750 Knowledge Workers – Hosted	754ms	1001ms	No
1400 Knowledge Workers – Hosted	723ms	910ms	No
800 Office Workers – Hosted Shared	705ms	1323ms	No
1600 Office Workers – Hosted Shared	666ms	1140ms	No

Hosted Desktops – 750 Knowledge Worker Users – Without Compute Nodes

VSIbase for the environment was 754ms, and VSImax was not reached in any run. VSImax average was 1001ms, and VSImax threshold was 1754ms. Latency was consistently low, showing how the HPE SimpliVity infrastructure could easily handle the 750 Knowledge Worker users.

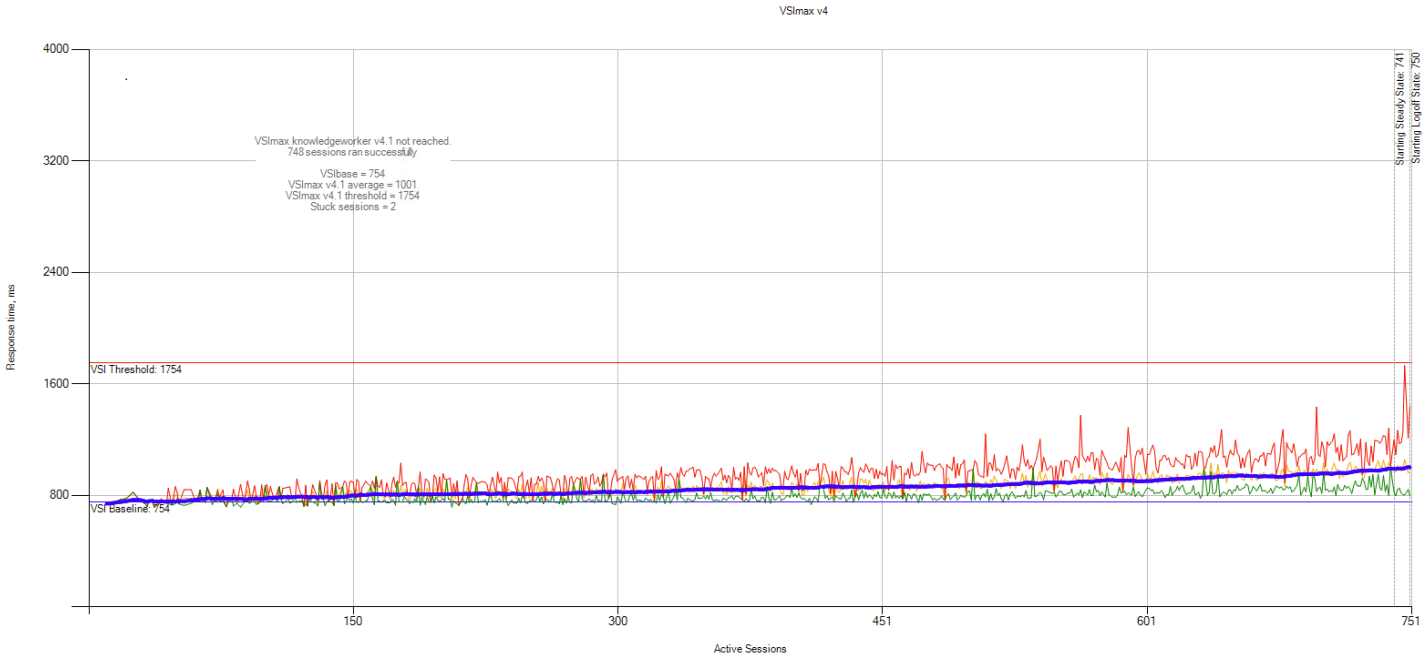

Figure 2. 750 Knowledge Worker Results

Hosted Desktops –1400 Knowledge Worker Users – With Compute Nodes

VSIbase for the environment was 723ms, and VSImax was not reached in any run. VSImax average was 910ms, and VSImax threshold was 1724ms. Latency was consistently low, showing how the HPE SimpliVity 380 infrastructure could easily handle the 1400 Knowledge Worker users in a hosted desktop configuration with Windows 10. Most importantly, this test was done using only four nodes of storage resources.

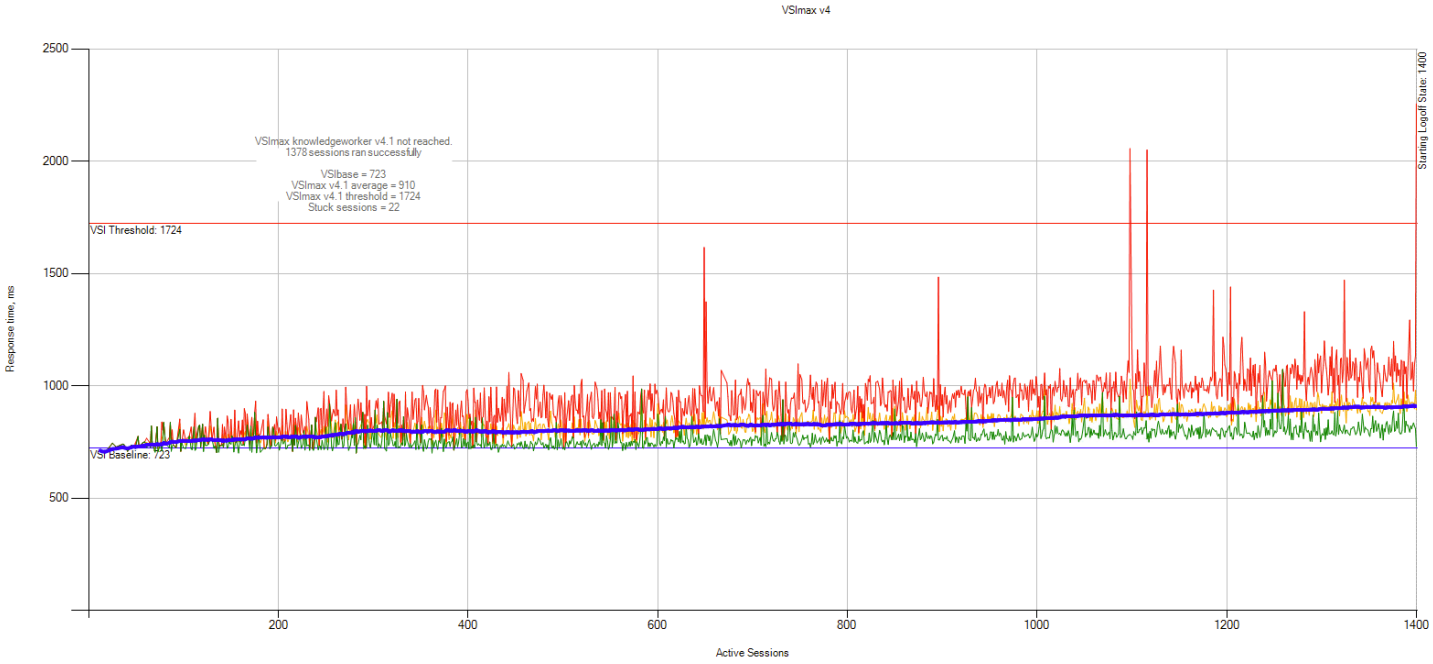

Figure 3. 1400 Knowledge Worker Results

Hosted Shared Desktops – 800 Office Worker Users – Without Compute Nodes

VSIbase for the environment was 705ms, and VSImax was not reached in any run. VSImax average was 1323ms, and VSImax threshold was 1705ms. Latency was consistently low, showing how the HPE SimpliVity 380 infrastructure could easily handle the 800 Office Worker users in a hosted shared configuration with Windows Server 2016.

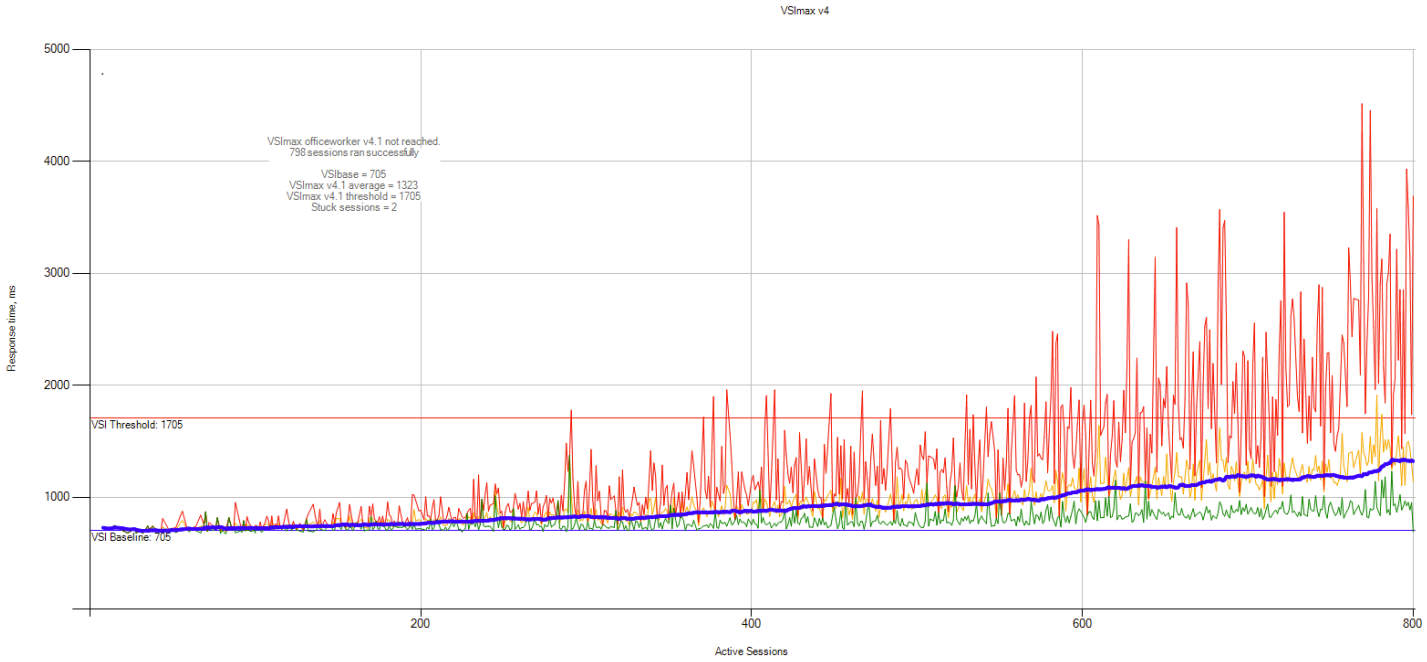

Figure 4. 800 Office Worker Results

Hosted Shared Desktops – 1600 Office Worker Users – With Compute Nodes

VSIbase for the environment was 666ms, and VSImax was not reached in any run. VSImax average was 1140ms, and VSImax threshold was 1666ms. Latency was consistently low, showing how the HPE SimpliVity infrastructure could easily handle the 1600 Office Worker users in a hosted shared desktop configuration with Windows Server 2016. Most importantly, this was done using only four nodes of storage resources.

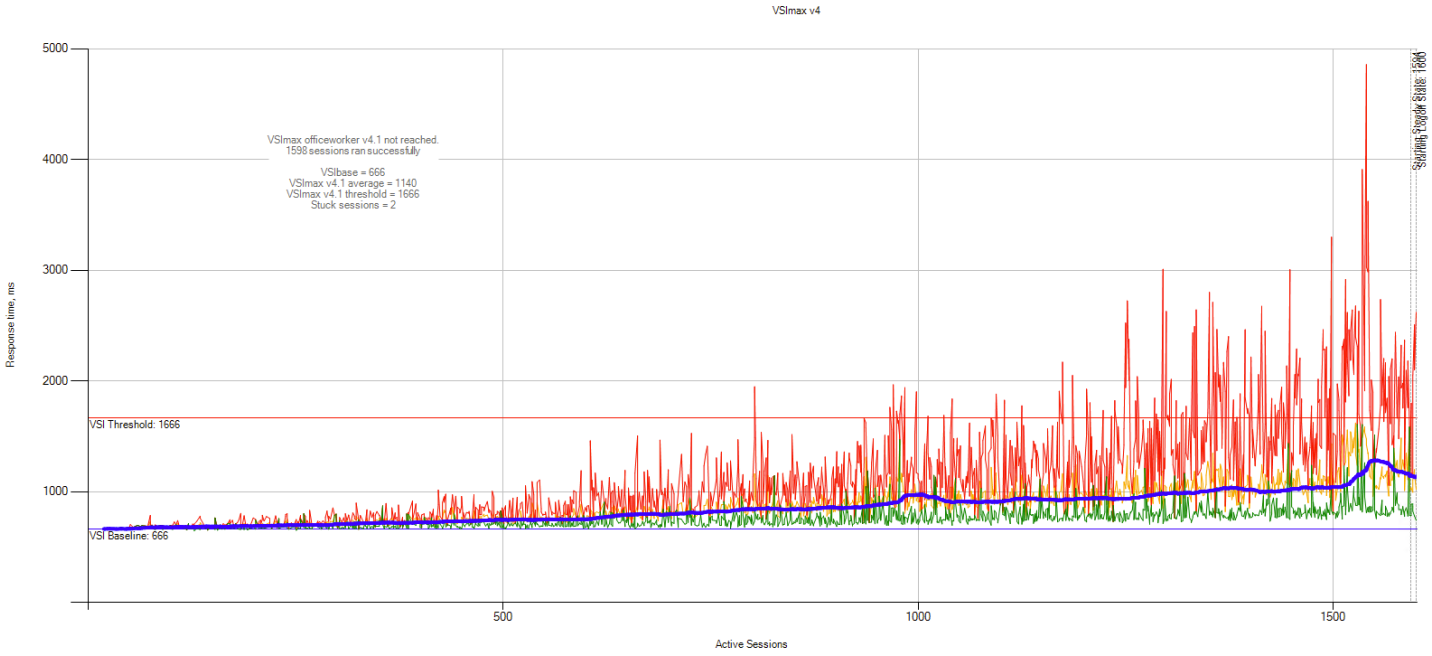

Figure 5. 1600 Office Worker Results

Summary

This Reference Architecture provides guidance to organizations implementing Citrix XenDesktop 7.13 on HPE SimpliVity 380 hyperconverged infrastructure, and describes tests performed by HPE to validate and measure the operation and performance of the recommended solution. This includes third-party validated performance testing from Login VSI, the industry standard benchmarking tool for virtualized workloads.

Organizations are looking to client virtualization solutions like Citrix XenDesktop to reduce software licensing, distribution and administration expenses, and to improve security and compliance. The HPE SimpliVity 380 is a market-leading hyperconverged infrastructure platform which helps to deliver the promised benefits of client virtualization, while overcoming many common challenges.

HPE SimpliVity 380 for client virtualization provides:

- Simplified deployment with hyperconverged, building blocks
- Ability to start small and scale out in affordable increments—from pilot to production
- Independently validated client virtualization performance
- Deployment of full-clone desktops with the same data efficiency as linked clones
- Enterprise-class data protection and resiliency

This Reference Architecture describes solution testing performed in May 2017.

Appendix A: Bill of materials

The following BOMs contain 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 at 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 17. Bill of Materials (per HPE SimpliVity 380 host)

Qty	Part Number	Description
1	767032-B21	HPE PROLIANT DL380 GEN9 24SFF CONFIGURE-TO-ORDER SERVER
1	817963-L21	HPE DL380 GEN9 E5-2697V4 FIO KIT
1	817963-B21	HPE DL380 GEN9 E5-2697V4 KIT
16	805351-B21	HPE 32GB 2RX4 PC4-2400T-R KIT
1	724864-B21	HPE DL380 GEN9 2SFF FRONT/REAR SAS/SATA KIT
2	832414-B21	HPE 480GB 6G SATA MIXED USE-2 SFF 2.5-IN SC 3YR WTY SOLID STATE DRIVE
5	872352-B21	HPE 1.92TB SATA 6G MU SFF SC DS SSD
1	719073-B21	HPE DL380 GEN9 SECONDARY 3 SLOT GPU READY RISER KIT
2	AF556A	HPE C13 - NEMA 5-15P US/CA 110V 10AMP 1.83M POWER CORD
1	665243-B21	HPE ETHERNET 10GB 2-PORT 560FLR-SFP+ ADAPTER
1	749976-B21	HPE H240AR 12GB 2-PORTS INT FIO SMART HOST BUS ADAPTER
1	727250-B21	HPE 12GB SAS EXPANDER CARD WITH CABLES FOR DL380 GEN9
1	783008-B21	HPE DL380 GEN9 2SFF FRONT SAS X4 CABLE KIT
1	758959-B22	HPE LEGACY FIO MODE SETTING
1	488069-B21	HPE TRUSTED PLATFORM MODULE OPTION
1	666988-B21	HPE 2U SECURITY BEZEL KIT
1	733660-B21	HPE 2U SMALL FORM FACTOR EASY INSTALL RAIL KIT
1	700139-B21	HPE 32GB MICROSD ENTERPRISE MAINSTREAM FLASH MEDIA KIT
2	720479-B21	HPE 800W FLEX SLOT PLATINUM HOT PLUG POWER SUPPLY KIT
1	768900-B21	HPE DL380 GEN9 SYSTEMS INSIGHT DISPLAY KIT
1	733664-B21	HPE 2U CABLE MANAGEMENT ARM FOR EASY INSTALL RAIL KIT
1	E6U64ABE	HPE ILO ADV INCL 3YR TSU E-LTU
1	OS-H-DL380G9-LF2-18C	OMNISTACK FOR HPE DL380 GEN9 5X1.92TB SSD, 2X18 CORE CPU

Table 18. Bill of Materials (per HPE DL380 Gen9 compute node)

Qty	Part Number	Description
1	767032-B21	HPE PROLIANT DL380 GEN9 24SFF CONFIGURE-TO-ORDER SERVER
1	817963-L21	HPE DL380 GEN9 E5-2697V4 FIO KIT
1	817963-B21	HPE DL380 GEN9 E5-2697V4 KIT
16	805351-B21	HPE 32GB 2RX4 PC4-2400T-R KIT
2	AF556A	HPE C13 - NEMA 5-15P US/CA 110V 10AMP 1.83M POWER CORD
1	665243-B21	HPE ETHERNET 10GB 2-PORT 560FLR-SFP+ ADAPTER
1	758959-B22	HPE LEGACY FIO MODE SETTING
1	488069-B21	HPE TRUSTED PLATFORM MODULE OPTION
1	666988-B21	HPE 2U SECURITY BEZEL KIT
1	733660-B21	HPE 2U SMALL FORM FACTOR EASY INSTALL RAIL KIT
1	700139-B21	HPE 32GB MICROSD ENTERPRISE MAINSTREAM FLASH MEDIA KIT
2	720479-B21	HPE 800W FLEX SLOT PLATINUM HOT PLUG POWER SUPPLY KIT
1	768900-B21	HPE DL380 GEN9 SYSTEMS INSIGHT DISPLAY KIT
1	733664-B21	HPE 2U CABLE MANAGEMENT ARM FOR EASY INSTALL RAIL KIT
1	E6U64ABE	HPE ILO ADV INCL 3YR TSU E-LTU

Resources and additional links

HPE Reference Architectures
hpe.com/info/ra

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