Reference Architecture for Citrix WorkspacePod™ Powered by HP Moonshot

An ultra-converged infrastructure solution

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Abstract

This technical article outlines a reference architecture for a heterogeneous, two-level (L1-compute, L2-compute), server and storage infrastructure based on WorkspacePod Powered by HP. WorkspacePod Powered by HP combines HP’s Moonshot System and ProLiant SL4540 server as a fully integrated delivery solution for modern workspaces. With an integrated compute, storage, on-die GPU, and networking solution, this ultra-converged solution provides a framework for companies to remain competitive by accelerating the productivity of their workforce on the device of their choice, at any time, and from any place.

Delivering rich apps and desktops with the best price, performance, and flexibility, WorkspacePod Powered by HP provides hardware savings up to 40 percent compared to traditional SAN-based architectures; three times the user density per rack at less than one watt per user; high-performance, integrated 40 GbE switching between compute and storage; superior graphics performance with integrated CPU/GPU to support rich applications and desktops with motion graphics and server-rendered video; and a fully redundant and highly available system for infrastructure, storage, and workloads.

Target audience: This article is intended for HP and Citrix partners and customers who seek a simplified framework for the deployment and delivery of WorkspacePod Powered by HP.

Introduction

In collaboration with its partners, Citrix has announced WorkspacePod. As a leading-edge, converged infrastructure solution and in conjunction with Citrix Workspace infrastructure software, WorkspacePod reduces the cost and complexity for delivering Windows, Mobile, Web and Linux apps. These pre-engineered, Citrix-Ready partner infrastructure offerings include integrated compute, storage, and networking and can linearly scale out from less than 100 to 1000’s of users.

With highly complementary technology at the hardware and software levels, HP’s existing Moonshot for Citrix XenApp and XenDesktop solution enables customers to boost worker productivity by consolidating and simplifying their infrastructure and applications through greater space and power efficiency. At Discover Barcelona in December 2014, HP demonstrated an integrated Citrix Workspace Suite Solution in a single Moonshot chassis for density-optimized small deployments.

Integrating ProLiant SL4540 Scalable System, we are expanding these plans with an architecture to enable new storage features and compute capabilities for large enterprises while reducing complexity. With three dual-socket Xeon-E5 nodes, up to 45 LFF and 6 SFF HDDs, SL4540 3x15 solution provides more flexibility and greater storage capacity, availability, and scalability with less complexity. Complementary WorkspacePod services hosted on a hyper-converged, distributed storage stack allow fault-tolerant services to run on the three dual-socket Xeon-E5 server nodes; while the 6x40GbE-interconnected Moonshot Chassis runs user applications on ProLiant m710 Xeon-E3 nodes with on-die, integrated GPUs.

Without adding datacenter complexity and without the need for an intermediary 40GbE top-of-rack (TOR) or Core Switch, this tightly-coupled fabric between the local cluster of L1-compute and L2-compute nodes affords the end-users the benefits of a local, high-bandwidth, low-latency 40GbE network; while, the rest of their datacenter may remain 10GbE, and their external network may remain at 1GbE.

With HP’s "white glove" support, PoC customers can quickly benefit from this new architecture and demonstrate the value of this integrated modular cluster solution.

Advantages of New Architecture

- CorePod services run on the HP SL4540 dual-socket Xeon-E5 servers (e.g., core services Citrix NetScaler Gateway, XenDesktop Delivery Controller, Citrix/RDS licensing, XenApp Management, Citrix StoreFront, Vyatta Router, Active Directory, File Services, Zenoss, ShareFile Storage Zones, Microsoft SCCM, Microsoft App-V 5.0, Microsoft Windows 2012 R2 Templates, and Microsoft SQL Server)
- Additional compute and storage capacity in each SL4540 (six Xeon-E5 and 45 LFF SSDs or HDDs up to 6TB each)
- Flexibility, High Availability, and Scalability with a distributed storage software on SL4540
- All-in-one, ultra-converged, heterogeneous solution integrating Xeon-E5 and Xeon-E3 CPUs, GPUs, Distributed Storage, and Networking (Moonshot’s cartridge-based, modular architecture allows for other workload-optimized CPU architectures and compute engines.)
- SL4540 provides the gateway to the outside world; the high bandwidth, low latency 40GbE network remains local within this architecture as the interconnect between HP Moonshot and HP ProLiant SL4540 without the need for a separate TOR or Core network Switch
- Ability to scale up to three HP Moonshot chassis with a single HP SL4540 3x15 system and the ability to scale to three ProLiant SL4540 1x60 chassis or three SL4540 3x15 with a single Moonshot 1500 chassis
• Measured lab data for this reference architecture has shown 2250 concurrent sessions for XenApp and 675 concurrent sessions for XenDesktop. This demonstrates great TCO as compared to alternative solutions.

**The Reference Architecture**

To demonstrate the capabilities of this ultra-converged architecture with lower deployment risk, a team of Citrix and HP engineers architected a framework for an interconnected pair of HP Moonshot 1500 and ProLiant SL4540 chassis. This reference architecture employs a network-connected collection of specialized compute, storage, and infrastructure software based on Citrix software suite and Microsoft Windows 2012-R2 and Hyper-V.

In this architecture, Moonshot 1500 System provides a framework for 45 network-connected, hot-pluggable Cartridges as specialized execution nodes with their local 480GB SATA 6Gbps M.2 Internal SSD for XenApp and XenDesktop workloads. (L1-compute nodes)

The SL4540 chassis is a gateway to the outside world and provides a framework for the core services: storage, provisioning (PVS and MCS), control, management, and monitoring. Built on the three SL4540 E5 nodes, a hyper-converged cluster provides the storage for the core services and for the workloads running on the Moonshot m710s. (L2: core services)

Moonshot’s integrated, redundant 10GbE Ethernet Switches provide for a RoCE-capable, closely-coupled inter-chassis and intra-chassis compute and storage cluster.

As Figure 1 depicts, the goal of this reference architecture is to enhance user experience while keeping IT manager’s experience simple.

![Figure 1. WorkspacePod Powered by HP: An architecture for optimized user experience and simplified IT](image)

**Software Infrastructure**

While it is modular for scale-out applications, this chassis-pair forms the nucleus for an engineered solution around Citrix Workspace Suite for delivering a secure, state-of-the-art workspace. This accelerates workforce productivity on the device of their choice, at any time, and from any place. As a result, customers can manage apps and devices, collaborate from anywhere with secure apps and data, virtualize Windows desktops and apps, optimize their network, and leverage the cloud.
**Citrix Workspace Suite**

Citrix Workspace Suite is the software infrastructure for this reference architecture. It consists of a number of essential components for secure application delivery.

For example, Citrix XenApp delivers Microsoft® Windows® apps as secure mobile services. With XenApp, IT can mobilize the business, while reducing costs by centralizing control and security for sensitive data and intellectual property. Users can self-select applications from an easy-to-use app store that is accessible from tablets, smartphones, PCs, Macs, and thin clients. HDX technologies enable XenApp to deliver a native touch-enabled look-and-feel that is optimized for the type of device, as well as network conditions. XenApp is built on the same FlexCast management architecture as XenDesktop®. It offers simple, powerful configuration and operations management and cloud-style automation and scalability. XenApp leverages session virtualization which enables delivery of applications from servers in the datacenter. XenApp connects the user to the server which hosts the application. Such application executes entirely on the server. The user interacts with the application remotely by sending mouse-clicks and keystrokes to the server. The server responds by sending screen updates back to the user’s device. XenApp enables Windows, Mac, Linux®, iOS, and Android devices to run any application using session virtualization through Citrix receiver. Furthermore, session virtualization leverages server-side processing power. This liberates IT from the endless cycle of PC hardware refreshes, which are typically needed to support application upgrades when using traditional application deployment methods.

In session virtualization, user interaction with the application is seamless. Printers, drives, peripherals, and even the clipboard work in the same manner as if the application were installed on the endpoint device. As a result, XenApp reduces the cost of application management and related costs by up to 50 percent and enables a better-than-installed experience for users when compared to traditional application deployment models.

**Storage Stack**

One major contributor to the success of this reference architecture is the distributed, clustered storage stack. This storage platform provides a unified management stack over all compute nodes in both chassis and eliminates the siloed storage/server paradigm. It allows running applications simultaneously on multiple compute nodes for higher resource utilization and increased capacity. It also provides fault-tolerance and disaster-recovery by spanning application availability across geo-dispersed, physical, virtual, and cloud environments.

Taking advantage of the high-bandwidth, low-latency 40GbE inter-chassis network of this reference architecture, the distributed storage optimizes application performance across all compute nodes and reduces response time. Coupled with Citrix Provisioning Server, this storage stack offers enhanced performance, increased availability, and reduced per-seat storage cost.

**Hardware Infrastructure**

The approach of this reference architecture is to preserve the choice of direct-attached storage and to enhance it with a fault-tolerant, high-performing, distributed storage layer which spans multiple application and storage nodes.

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**Figure 2.** L1-Compute (user applications) & L2-Compute (core services)

Citrix software suite and storage management stack assign jobs to specific workload-optimized resources within Moonshot’s workload-optimized servers.
**Hierarchy Overview**

The framework of this reference architecture implements a heterogeneous, two-level cluster hierarchy:

- **L1-Compute: Compute nodes** – Providing a framework for workload-optimization, HP Moonshot cartridges deliver the first level (L1) of a scalable, high-density layer for compute tasks of various applications. This reference architecture deploys ProLiant m710 cartridge with E3 Xeon processors with an on-die GPU, 32GiB of DRAM, and 480 GB of SSD.

- **L2-Compute: Storage and Control nodes** – HP ProLiant SL4540 Gen8 3-node servers provide the second level (L2) of compute based on dual-socket Xeon-E5 server nodes for management and control and storage layers as well as for larger applications such as Microsoft SQL database.

- **Interconnect**: a high-speed, low-latency 40GbE network interconnects the two compute levels. Using one 40GbE cable, in this reference architecture, the two integrated switches within Moonshot chassis form one switch stack. This stacked switch support all L1 nodes internally and support the three L2 nodes of SL4540 via 6 x 40GbE cables.

- **Management and Software**: Citrix software layers provide a harmonious environment for a hyper-converged architecture to manage compute and storage nodes in both L1 and L2 compute levels.

Once interconnected, L1 and L2 compute nodes may efficiently communicate via an RDMA-capable transport over Converged Ethernet (RoCE). This provides for much bandwidth at low latency for peer-to-peer traffic within the local fabric.
HP Moonshot System
For this reference architecture, the user applications run on 45 ProLiant m710 Server Cartridges within one HP Moonshot 1500 Chassis.

The Moonshot 1500 Chassis is a 4.3U rack-mount unit containing up to 45 hot-pluggable server cartridges, two redundant network switches, and two redundant external 10GbE or 40GbE uplink modules along with redundant power, cooling, and management components.

This shared, federated system integration saves energy, space, and cost. It also enables extreme scale-out capacity without increasing physical and management complexities.

**HP ProLiant m710 Server Cartridge**
The ProLiant m710 Server Cartridge in Figure 6 has a 4-core Intel® Xeon® Processor E3 family with 32 GiB of RAM and up to 480 GB of solid-state storage (M.2 SSD). Each cartridge has two internal 10 GbE network interfaces with RoCE capability (RDMA over Converged Ethernet).

The ProLiant m710 Server Cartridge supports the following operating systems:

- Windows Server 2012 and 2012 R2
- Red Hat Enterprise Linux 6.5 and 7.0
- Canonical Ubuntu 14.04
- SUSE Linux Enterprise 11 Service Pack 3
**Moonshot Local Chassis Fabric (LCF)**

Moonshot interconnect framework is based on 4 chassis-local fabrics. Using one data fabric, Figure 7 illustrates how Moonshot Cartridges interconnect to each other and to the outside world through two redundant Switches and two Uplink Modules.

For clarity, the Figure 7 shows 10GbE connectivity to one of the integrated switches.

![Figure 7. Moonshot Chassis Backplane offers 4 independent fabrics. One is shown here.](image)

**Network Switches and Uplinks**

Moonshot 1500 Chassis integrates two redundant switches. Each Switch supports Layer 2, Layer 3, Routing, QoS, IPv6, OpenFlow 1.3, Precision Time Protocol, IRF stacking, and Management (CLI, SNMP, sFlow).

For this reference architecture, a Moonshot chassis externally connects with four 40 GbE QSFP+ uplinks.

Table 2 includes the switch and uplink modules used in this reference architecture.

<table>
<thead>
<tr>
<th>Table 2. Switch and Uplink Modules RA platform</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>45 Port Switch, 10GbE</strong></td>
</tr>
<tr>
<td><strong>Moonshot-45XGc</strong></td>
</tr>
<tr>
<td>Switch P/N 704644-B21</td>
</tr>
<tr>
<td>SPS-ASSY 712675-001</td>
</tr>
<tr>
<td><strong>4x40Gb QSFP+</strong></td>
</tr>
<tr>
<td><strong>Moonshot-4QSFP+</strong></td>
</tr>
<tr>
<td>Uplink P/N 704652-B21</td>
</tr>
<tr>
<td>SPS-ASSY 712694-001</td>
</tr>
<tr>
<td><strong>Direct Attach Copper Cable</strong></td>
</tr>
<tr>
<td>40GbE QSFP+ to QSFP+</td>
</tr>
</tbody>
</table>
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**HP ProLiant SL4500 Server Series**

The family of ProLiant HP SL4500 storage servers is a suitable companion to expand storage capacity of Moonshot System. With three dual-socket Xeon-E5 server nodes with 192GiB of memory each, one SL4540 chassis provides up to 45 LFF and 6 SFF drives for storage.

To run Workspace Pod suite of services along with the storage stack, this reference architecture employs a 3-node SL4540 Server. For this setup, each SL4540 server node provides 192GiB of memory, two 160GB SSDs, one dual-port 40GbE Mellanox NIC, one SmartArray controller, four 400GB SSDs, and six 2TB HDDs.

![Figure 8. ProLiant SL4540 Server and its 3-node configuration with 45 LFF drives](image)

**BOM**

The following is a list of material for this reference architecture to configure the two chassis and demonstrate the feasibility and the performance.

**Table 2. List of materials for the chassis pair of reference architecture for WorkspacePod Powered by HP**

<table>
<thead>
<tr>
<th>HP 3xSL4500 Chassis</th>
<th>HP Moonshot 1500 Chassis</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 HP 1500W Ht Plg Pwr Supply Kit *</td>
<td>4 HP 1500W Ht Plg Pwr Supply Kit</td>
</tr>
<tr>
<td>3 HP 3xSL4540 Gen8 Tray Node Svr</td>
<td>2 HP Moonshot-4QSFP+ Uplink Module Kit</td>
</tr>
<tr>
<td>3 HP SL4540 Gen8 E5 2450v2 FIO Kit</td>
<td>2 HP Moonshot-45XGc Switch Kit</td>
</tr>
<tr>
<td>3 HP SL4540 Gen8 E5 2450v2 Kit</td>
<td>45 HP ProLiant m710 Server Cartridge</td>
</tr>
<tr>
<td>36 HP 16GB 2Rx4 PC3L-12800R-11 Kit</td>
<td>45 HP Moonshot 480G SATA VE M.2 2280FI0 Kit</td>
</tr>
<tr>
<td>3 HP IB FDR/EN 10/40Gb 2P 544QSFP Adptr</td>
<td>1 HP Moonshot Installation and Startup SVC</td>
</tr>
<tr>
<td>3 HP 1GB FBWC for P-Series Smart Array</td>
<td>1 HP 3y Nbd Moonshot 1500 FC SVC</td>
</tr>
<tr>
<td>18 HP 2TB 6G SAS 7.2K 3.5in SC MDL HDD</td>
<td>1 HP Insight CMU Moonshot 3yr24x7 Flex Lic</td>
</tr>
<tr>
<td>12 HP 400GB 6G SATA ME 3.5in SCC EM SSD</td>
<td>6 HP X240 40G QSFP+ QSFP+ 1m DAC Cable</td>
</tr>
<tr>
<td>6 HP 120GB 6G SATA VE 2.5in SC EB SSD</td>
<td>1 HP X240 40G QSFP+ QSFP+ 3m DAC Cable</td>
</tr>
<tr>
<td>3 HP Raid 1 Drive 1 FIO Setting</td>
<td>3 HP Smart Array P420i Mezz Ctrlr FIO Kit</td>
</tr>
<tr>
<td>3 HP SL4500 1G FIO IO Module Kit</td>
<td>3 HP SL4500 Storage Mezz to PCIe Opt Kit</td>
</tr>
<tr>
<td>3 HP 12in Super Cap for Smart Array</td>
<td>3 HP iLO Adv E-LTU inc 1yr TS&amp;U SW</td>
</tr>
</tbody>
</table>
Benefits and Proof points

Moonshot System architecture principles provide a basis for high resource utilization to achieve high efficiency; deliver high performance at low energy consumption; achieve high compute density by using less space; integrate power, cooling, storage, networking, and management infrastructure; simplify cabling; provide a streamlined framework to introduce and validate new technologies; and achieve higher availability through an architecture for simple-to-repair in-place.

The demonstrated benefits of this reference architecture for WorkspacePod centers around its pre-engineered, scalable, low-cost, and flexible-to-deploy design for Citrix Workspace Suite and a hyper-converged storage stack.

Deploying such an integrated system increases employee productivity and efficiency; allows centralization of data and assets to protect sensitive information; and reduces cost and complexity of IT management.

Specifically, with built-in, on-die GPU, it supports graphics-intensive applications without expensive graphics cards; it reduces risk and failover/recovery time with its smaller failure domain to right-sized processors; and it scales readily with hot-plug cartridges without extensive cabling and racking complexities.

The resulting solution is one part-number/system to manage; reduced cost and increased performance; pre-tested, expanded storage (SL4540); and the support for extremely high number of users in a small space.

The final outcome extends higher-end graphic applications to more users and boosts their productivity; provides workers with immediate access to the graphics-intensive information they need for better real-time decision-making; and reduces IT complexity to dynamically support a continuum of applications throughout the day and night with a single system.

Delivering a broad spectrum of applications from low-end to rich, with graphics and video capability and desktops with the best price, performance, and flexibility, WorkspacePod Powered by HP provides:

- Hardware savings up to 40 percent compared to traditional SAN-based architectures
- Up to three times the user density per rack at less than one watt per user
- High-performance, integrated 40 GbE switching between compute and storage
- Superior graphics performance with integrated CPU/GPU to support rich applications and desktops with motion graphics and server-rendered video
- Fully redundant and highly available system for infrastructure, storage, and workloads

Flexibility and Scale

Since a high-speed network interconnects the leaf nodes of L1 layer as well as L2 nodes, this hierarchical approach provides flexibility of scale for storage and compute elements independent of each other. Adding compute nodes or storage nodes, for example, can scale compute and storage independently. Citrix and HP performance analysis has shown that most workloads respond almost linearly to additional compute resources.

While this reference architecture implemented a 1:1 chassis pair, the integrated Moonshot Switches are flexible enough to allow forming a larger cluster of several Moonshot Chassis or several ProLiant SL4540 Chassis. A range of ratios from 1:3 to 3:1 are quite feasible.

Performance

As Table 3 shows, lab measurements from the chassis pair in this reference architecture demonstrate great response times for high levels of concurrent sessions.

<table>
<thead>
<tr>
<th></th>
<th>XenApp User Concurrent Sessions</th>
<th>2250</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>XenDesktop Concurrent Sessions</td>
<td>675</td>
</tr>
</tbody>
</table>

For a comprehensive performance analysis of a medium and a rich application workload profile, refer to:


In addition to the number of users, it explores, response time, processor utilization, power consumption, memory utilization, network utilization, disk throughput, and GPU utilization for rich application delivery.
Summary

WorkspacePod Powered by HP uniquely integrates the HP Moonshot platform with the HP ProLiant SL4540 server to provide an integrated compute, storage, GPU, and networking solution that can deliver rich apps and desktops with the best price, performance, and flexibility.

To deliver a wide range of applications, the combination of HP Moonshot System, ProLiant SL4540, Citrix Workspace Suite, and a hyper-converged storage form an efficient solution for WorkspacePod. It satisfies today’s “zero-patience” end-users who expect consistently high application performance across all of their devices.

This reference architecture for WorkspacePod Powered by HP provides a framework for companies to remain competitive by accelerating the productivity of their workforce. This framework provides diverse and rich content to the workforce who increasingly wants to access data anywhere, anytime, and on any device. Providing access to personal and professional types of data from the same device, WorkspacePod Powered by HP accommodates “converged” work styles which have blurred the boundaries between professional and personal lives. This architecture is a proven method to accomplish this goal by enabling employees to use whatever device they prefer to access corporate applications from any location at any time. Such devices may include BYOD programs or a company-issued laptop, desktop, smartphone, or tablet.

Using WorkspacePod, HP and Citrix are delivering a solution specifically designed for the evolving ways people consume applications. This solution leverages the simplicity, cost-efficiency, and flexibility of HP Moonshot for Citrix Workspace Suite. Using these highly complementary technologies, IT managers can extend the value of virtual application delivery to a broader set of users and to a wider array of applications.

In summary, HP ProLiant m710 Server Cartridges, HP Moonshot 1500, and ProLiant SL4540 form the nucleus for a highly secure and scalable hyper-converged server and storage infrastructure to deliver Citrix Workspace Suite for low-end, middle, and rich applications to any user, on any device, at any time.

As a best practice for all deployments, HP recommends implementing a proof-of-concept (PoC) using an environment that closely matches your planned production environment. To obtain the appropriate performance and scalability characterizations, contact your HP Services representative (www.hp.com/large/contact/enterprise) or your HP partner.
For more information

HP Moonshot System: [hp.com/go/moonshot](http://hp.com/go/moonshot)
HP ProLiant servers: [hp.com/go/ProLiant](http://hp.com/go/ProLiant)
HP Networking: [hp.com/go/networking](http://hp.com/go/networking)
20th Century Fox & Moonshot: [https://www.youtube.com/watch?v=2AEkVHylrK0&app=desktop](https://www.youtube.com/watch?v=2AEkVHylrK0&app=desktop)

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