



Hewlett Packard
Enterprise

Trader Workstation powered by HPE Moonshot System using HPE ProLiant Server Cartridges

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Executive summary

This paper outlines a reference architecture for a high-end financial trader workstation solution using the HPE Moonshot System and Citrix® XenDesktop® software. By moving the user's compute off of large, power-hungry, heat-generating, and noisy desk-side workstations and on to the HPE ProLiant m710p Server Cartridge hosted in a data center, users free up their existing workplace environment. They also gain the ability to access their data and programs from anywhere and on any device while their data stays more secure as it is physically located in the data center.

The HPE ProLiant m710p Server Cartridge provides an excellent end-user experience with Citrix HDX, including rich multimedia content such as streaming videos, because of the Intel® Xeon® E3 processor paired with Intel® Iris Pro graphics. The HPE ProLiant m710p solution also provides high-speed, low-latency 10GbE networking essential for the trade floor. All this comes in a platform which is optimized to reduce costly square meter footprint, power, cooling, and complexity of existing data center-hosted trader workstation solutions.

Target audience: This paper is intended for HPE and Citrix partners and customers who seek a framework for the deployment and delivery of high-end workstations powered by the HPE Moonshot System. It is also intended for HPE technical presales and solution architects. A working knowledge of server architecture, networking architecture, and storage design is recommended.

Document purpose: The purpose of this document is to describe a recommended architecture/solution, highlighting recognizable benefits to technical audiences. This white paper describes testing performed by HPE in July and August 2015.

Overview

Citrix XenDesktop

Citrix XenDesktop is a complete software suite for transforming Windows® desktops and applications into an on-demand service accessible from any device, and for managing those desktops and apps, and the users who access them. With XenDesktop, IT can reduce workload and costs by consolidating control and security for sensitive data and intellectual property in the data center. HDX technologies facilitate XenDesktop to deliver a rich native look-and-feel, dynamically optimized for both the type of device and network conditions. Users interact with the desktop as they would a local desktop by sending keystrokes and mouse movements which are sent to the server. The server then sends screen updates back to the user's device. This paradigm of interaction utilizes server-side processing, which can free IT from the endless cycle of PC hardware refreshes normally necessary to support new applications and application upgrades when using traditional, user-side compute deployment techniques.

Citrix also provides an excellent tool for image management and deployment, called Provisioning Services (PVS). PVS streams a complete operating system image to desktops running on both virtual and physical resources, including Moonshot. PVS can dramatically reduce IT maintenance costs by allowing IT to maintain a single image for all devices. Citrix PVS is not a requirement for this solution, but it is an option that may be implemented as desired.

HPE Moonshot System with HPE ProLiant m710p Server Cartridges

HPE Moonshot System is a huge leap forward in infrastructure design that delivers breakthrough efficiency and scale by aligning the right amount of compute, memory, and storage to get the work done. The Moonshot Chassis includes all of the common resources from a traditional server—power, cooling, management, fabric, switches, and network uplinks—all shared across 45 hot-pluggable server cartridges in a dense 4.3U form factor. It replaces general purpose processors with more energy-efficient Systems-on-Chips (SoCs) containing integrated accelerators, such as a graphics processor, tailored for specific workloads. The HPE ProLiant m710p Server Cartridge was built on the lower-power Intel Broadwell processing architecture, including a powerful, integrated GPU with Iris Pro graphics, specifically for Moonshot, and has been optimized for the best possible performance with Citrix XenDesktop. Together, the HPE Moonshot System and the HPE ProLiant m710p Server Cartridge provide an architecture well-suited to support high-end desktops hosted in the data center, delivering excellent processing and graphical capabilities to the end user over Citrix XenDesktop.

Client hardware

While one of the advantages of deploying server-side processing in the data center and delivering desktops via Citrix XenDesktop is that users can access their desktops from any end-point device, special considerations must be taken for support of a typical financial use case that includes four or more Full HD monitors at the user's desk. Four to six high-resolution monitors afford the end-user plenty of screen real estate to increase their productivity and efficiency, even with multiple simultaneous workflows. Driving four to six Full HD monitors requires as many display ports on the end-point device, along with an end-point CPU that is powerful enough to handle delivering that many monitors of rich XenDesktop content, including multimedia, simultaneously. The HP t730 Thin Client fits this requirement as a small and quiet client device with expandable graphics ports. Configured with an AMD R-Series processor with AMD Radeon HD 9000 graphics and optional AMD FirePro W2100 graphics adapter, the t730 thin client supports up to six monitors while providing a responsive end-user experience with Citrix XenDesktop.

Putting it all together

All of these components together present a solution that is different from typical high-end desktop deployments in use today, which tend to fall into one of two categories. First, there are tower PCs located at the user's desk. These can be bulky, loud, and generate extra heat near the user. They also tend to be less secure than resources hosted in a data center with stricter access control and less physical traffic. Second, there are workstation blades, which have oversized processors and GPUs for most financial workloads, and are often expensive.

The issues with today's typical deployments are addressed by combining the HPE Moonshot System and HPE ProLiant m710p servers with Citrix XenDesktop and a smart choice of end-point device. Moonshot compute in the data center moves the user compute off the desk and more securely into the data center. The HPE ProLiant m710p Server Cartridge is an ideal combination of size and compute/graphics capability for high-end desktop users, providing excellent processing power, fast graphics, and a great end-user experience without wasted CPU cycles.

Figure 1 shows a diagram of the solution layout, including the Moonshot compute and Citrix XenDesktop infrastructure in the data center and the client hardware at the user's desk.

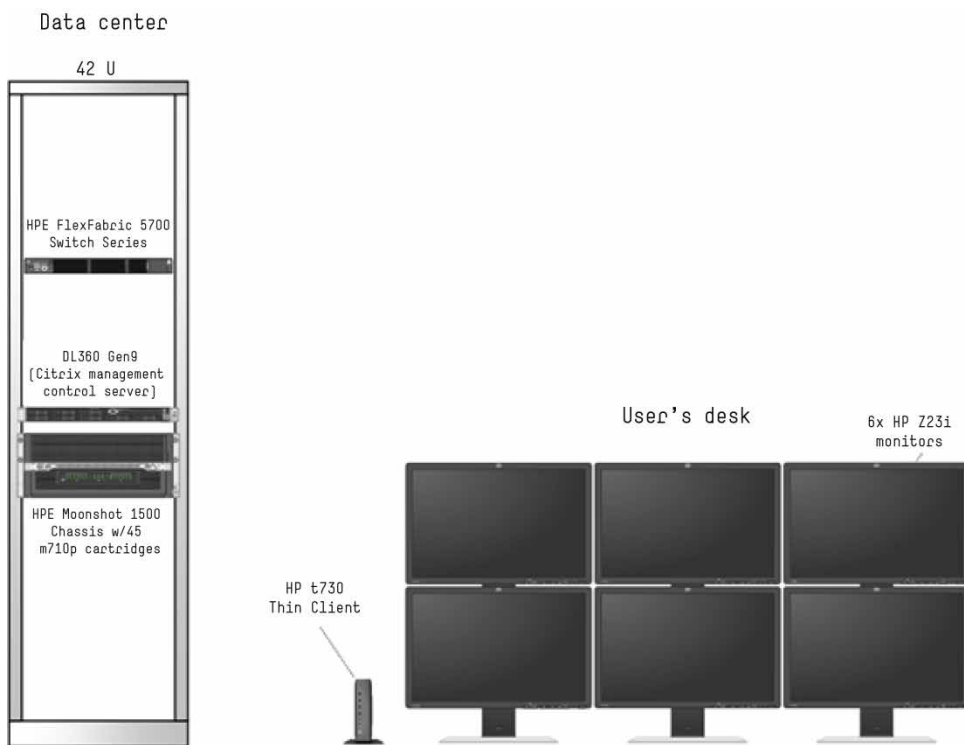


Figure 1. Solution diagram

Solution components

The following sections describe the hardware and software used together in this configuration for the testing reported here. These components create a building block that can be scaled simply with minimal alterations to the overall infrastructure. This solution assumes that Active Directory, DNS, Citrix Delivery Controller, and other supporting infrastructure for Citrix XenDesktop already exist.

Citrix XenDesktop

Citrix XenDesktop version 7.6 was used for the duration of the testing. XenDesktop 7.6 has a number of feature additions and enhancements over previous XenDesktop versions, including the ability for generic USB redirection, and is recommended as the latest Citrix XenDesktop release. Table 1 describes the software versions of each Citrix XenDesktop component.

Table 1. Citrix XenDesktop software versions

SOFTWARE	VERSION
XenDesktop Controller	7.6.0.5026
Virtual Desktop Agent	7.6.0.5026
StoreFront	2.6.0.5031
Citrix Receiver	14.2.0.10
HDX Protocol	HDX Standard, Desktop Composition Redirection

HPE Moonshot System

In the HPE Moonshot 1500 System, a 4.3U chassis houses dual fully redundant 45-port 1GbE or 10GbE switches, two uplink modules (16 x 10GbE or 4 x 40GbE connectors each), fans, power supplies, HPE Moonshot 1500 Chassis Management Module, and up to 45 server cartridges.

HPE ProLiant m710p Server Cartridges

Table 2 describes the specifications of the HPE ProLiant m710p Server Cartridge.

Table 2. HPE ProLiant m710p Server Cartridge technical specifications

COMPONENT	DESCRIPTION
CPU	Intel Xeon E3-1284L v4, 2.9 GHz (3.8 GHz Turbo), 4-core
Memory	32 GB of DDR3 PC3L-12800 (1600 MHz) SODIMM Low Voltage Memory
Network	Mellanox Connect-X3 Dual 10GbE NIC
Storage	120 GB, 240 GB, 480 GB, or 960 GB of M.2 solid state storage
Graphics	Intel Iris Pro Graphics P6300
Operating system	Windows 7 Enterprise 64-bit or Windows 8.1 Pro 64-bit

Networking

To connect the HPE Moonshot 1500 Chassis to the main network, an HPE 5700-series switch is recommended. For this testing, one 10GbE SFP port was connected from the Moonshot uplink module to the HPE 5700 switch.

Client hardware

The client side hardware consists of:

- A client machine to connect to the XenDesktop session,
- Monitors to display the session, and
- Any additional peripherals needed by the user.

For this testing, six Full HD monitors were selected to provide an excellent end-user experience with ample screen real estate, a total resolution of 5760 by 2160 when placed in a 3 x 2 grid. Specifically, HP Z23i monitors were used, an LED backlit IPS display with faithful color reproduction, brightness, and reliability. Six HP Z23i monitors were mounted in a 3 x 2 grid on an Ergotron DS100 quad monitor stand and an Ergotron DS100 dual monitor stand.

While there are a variety of end-point device choices, including a wide range of thin clients, mobile clients, and small form factor PCs, the best performance and end-user experience was achieved with an HP t730 Thin Client as the client device. The t730 features an AMD R-Series processor with AMD Radeon HD 9000 graphics, 8 GB of RAM, and an additional AMD FirePro W2100 graphics card to support six Full HD monitors. Table 3 describes the client hardware used for this testing.

Table 3. Client hardware technical specifications

COMPONENT	DESCRIPTION
Displays	(6) HP Z Display Z23i 23-inch IPS LED backlit monitor, 1920x1080
Display mount	Ergotron DS100 quad monitor mount, Ergotron DS100 dual monitor mount
Client device	HP t730 Thin Client AMD RX-427BB with AMD Radeon HD 9000 graphics, 8GB RAM, AMD FirePro W2100 Windows Embedded Standard 7P, 64-bit

Additional peripherals may include specialized hardware to interface with specific software suites, such as a Bloomberg keyboard to use with Bloomberg Terminal software. Common USB devices such as flash drives, webcams, and microphones are supported with Citrix XenDesktop.

Capacity and sizing

Test hardware setup

HPE ProLiant m710p Server Cartridges inside an HPE Moonshot 1500 Chassis function as the server compute. A variety of end-point devices were initially tested for suitability. Full tests were conducted on an HP t730 Thin Client with up to six HP Z23i monitors.

Workload description

The workload used for desktop performance and end-user experience characterization is based on real-world usage of high-end desktops in the financial industry. It includes the following applications all running simultaneously:

- Internet Explorer—streaming live Adobe® Flash-based video
- Microsoft® Excel—running macros to continuously randomize and calculate tens of thousands of values
- CoolTick—a live updating stock ticker application
- Lync®—making an audio call

In addition to the workload applications, the m710p server is also running performance collection tools, including Citrix HDX monitor, Windows Performance Monitor, and TechPowerUp GPU-Z. The client machine also runs Windows Performance Monitor and GPU-Z. The given workload is tested across a wide variety of end-point devices and monitor configurations, from one to four Full HD monitors.

Each high-end desktop user maps to a separate cartridge with independent compute, GPU, memory, and disk, and therefore solution sizing is pre-determined at one user per cartridge. The purpose of this workload testing is to determine end-user experience. End-user experience is measured objectively through frames per second delivered, and round-trip latency metrics and system performance metrics are captured to characterize any degradation in end-user experience. For example, if the frame rate drops below 24 frames per second (the standard used for films in movie theaters), there must be some limiting factor in the environment: CPU on the client or server, GPU on either device, network, etc.

Results

The results show that the HPE ProLiant m710p is not a limiting factor for the tested workload. It maintains a relatively low CPU, GPU, and memory utilization throughout the tests, despite multiple simultaneous applications running varying workloads. Differences in performance instead come from different end-point device choices and different monitor configurations. The t730 thin client is powerful enough to maintain an excellent end-user experience, even with a six-monitor configuration. Table 4 shows the frame rate and round-trip latency (ICA RTT, or Independent Computing Architecture round trip time) for the desktop delivered to a t730 thin client full screen across one, two, four, and six Full HD monitors. Notice that ICA RTT stays extremely low throughout the tests, right on the line of human perception. Also, the frame rate stays above 24 frames per second across all tests.

Table 4. End-user experience data for high-end desktop, HPE ProLiant m710p (Windows 7) and HP t730

	1 MONITOR	2 MONITORS	4 MONITORS	6 MONITORS
Average ICA RTT (ms)	12.5	14.6	21.1	22.1
Average FPS	29.9	28.3	25.6	25.9

Average CPU utilization on the HPE ProLiant m710p does not change significantly from test to test, as its workload remains constant. The average m710p Server Cartridge CPU utilization during the six monitor test is 29.5 percent. The m710p more than comfortably accommodates the tested workload with additional CPU capacity to tackle even more demanding workloads.

Analysis and recommendations

Based on the desktop performance and end-user experience characterization workload, the recommended configuration for a financial use case high-end desktop setup includes one m710p Server Cartridge in the data center, and up to six Full HD monitors and one t730 at the user's desk. As noted, different monitor configurations up to six Full HD monitors are also options, depending on end-user requirements. The t730 supports four monitors out of the box, and requires the addition of an AMD FirePro W2100 graphics card to enable six-monitor support. This configuration provides excellent end-user experience even for media and heavy processing workloads. This configuration is also easily scalable, as each user has a dedicated Moonshot cartridge for compute. To add a new user is as simple as adding another HPE ProLiant m710p cartridge, along with the thin client and monitors. As previously mentioned, a single Moonshot chassis can hold up to 45 cartridges, or 45 high-end desktop users. At 4.3U for a Moonshot chassis, this is a density of over 10 users per rack unit. Multiple Moonshot chassis can communicate with the same domain and Citrix XenDesktop infrastructure, so scaling is very straightforward.

Configuration guidance

For information on setting up the HPE Moonshot System and provisioning the HPE ProLiant m710p Server Cartridge, refer to the [HPE Moonshot for Citrix Integration Guide](#). Specific network implementations and considerations are addressed in the [HPE Moonshot Networking Cookbook](#). For more information regarding OS deployment, including special cases and alternative methods, such as Windows System Center Configuration Manager, refer to [Operating System Deployment on HPE ProLiant Moonshot Server Cartridges](#) and [HPE Moonshot Integration with Microsoft System Center](#).

Best practices and tuning parameters

This section will cover best practices and tuning parameters that are specific to this high-end desktop implementation.

General

It is important to ensure that Windows is up to date through Windows Update, though it is especially important when running Windows 7 to ensure that the operating system is up to date, as there have been significant performance improvement in Windows 7 since its release. However, be sure that the Windows-suggested Intel graphics and Mellanox network drivers are not installed through Windows Update. Instead, get the latest graphics and network drivers from hpe.com. It is also important to make sure that Windows is running in "High performance" mode under Power Options, as seen in figure 2, to avoid unnecessary throttling of the CPU. When confronted with the 32 GB of RAM on the HPE ProLiant m710p Server Cartridge, Windows 7 will, by default, create a page file of 32 GB. Because a page file this large is not necessary, it is recommended to decrease the page file size to 1 GB. Windows 8.1 creates a more reasonable page file size by default, but it can also be reduced to 1 GB. Figure 3 shows the relevant setting under System Properties > Performance Options > Virtual Memory.

By default, the m710p Server Cartridge with Windows 7 or Windows 8.1 and Citrix XenDesktop 7.6 has a set system video memory of 64 MB. This value is large enough to support four Full HD monitors for a single Citrix session, but no more. To enable support of additional monitor configurations, such as six Full HD monitors, this value has to be increased. The following registry key should be change:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\vbdenum\MaxVideoMemoryBytes.

Increase the decimal value from 67,108,864 to 134,217,728 and restart the machine.

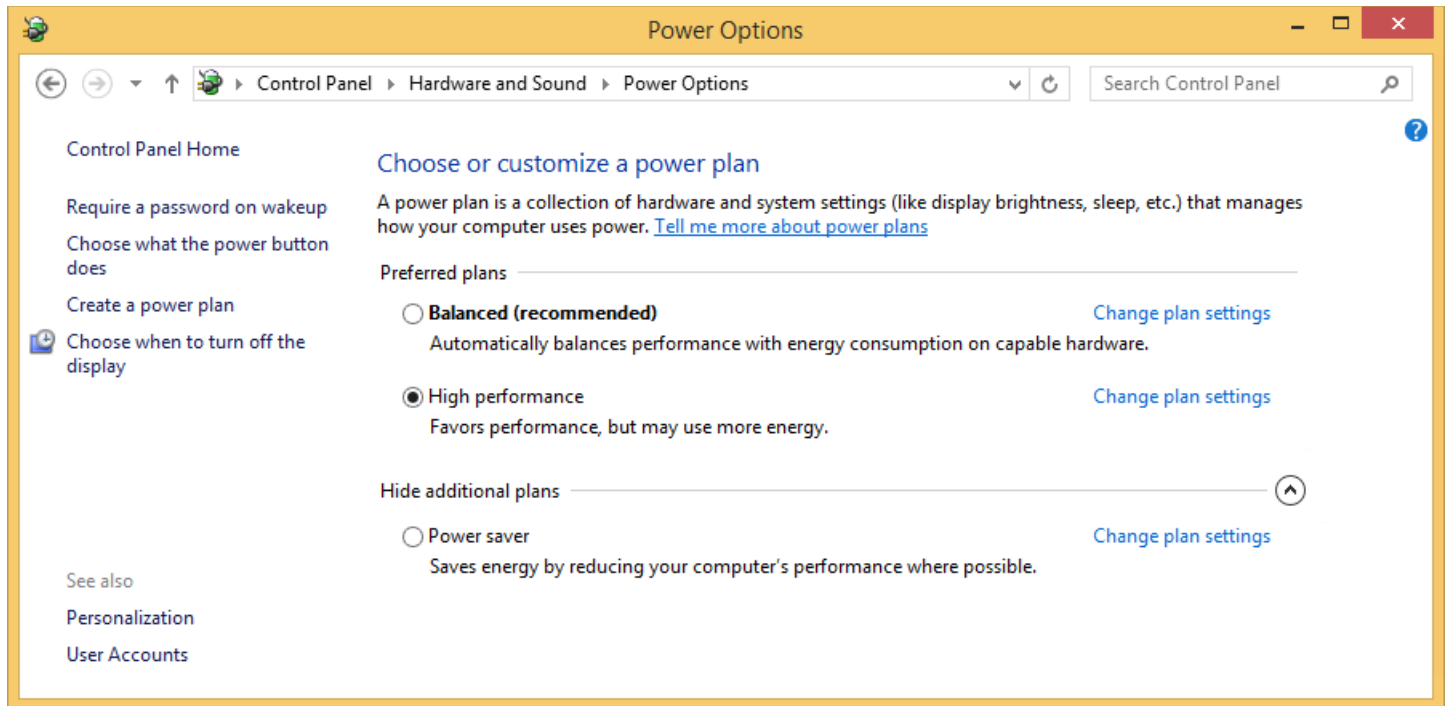


Figure 2. Windows power options

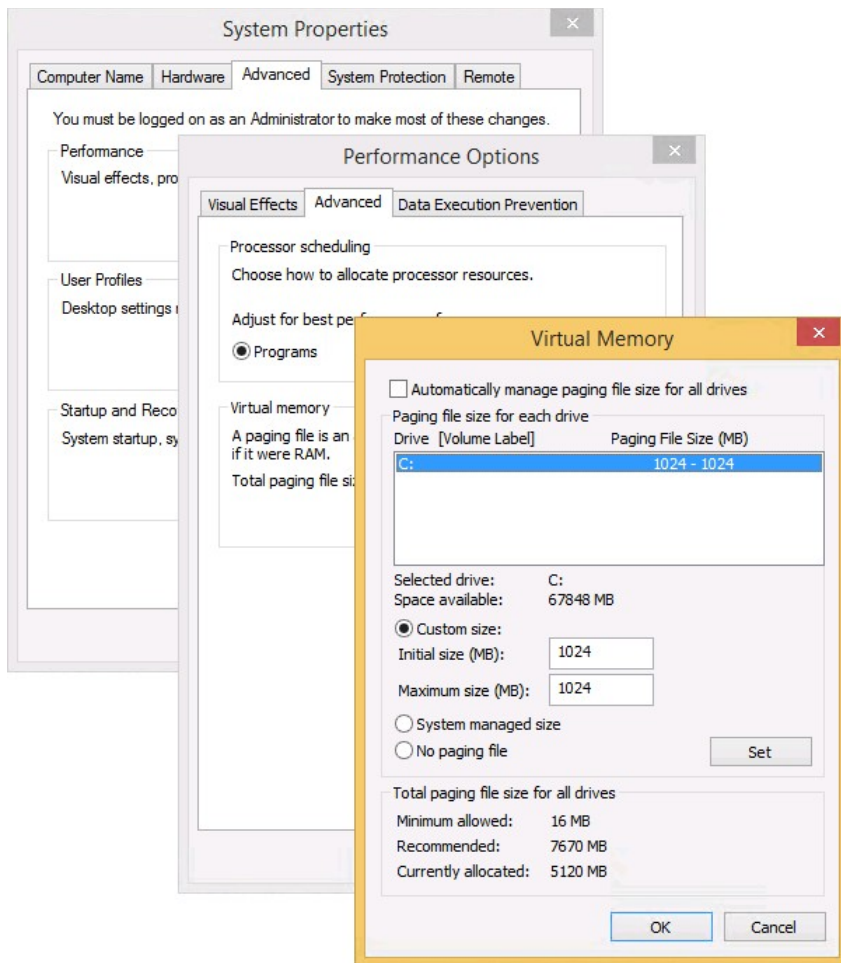


Figure 3. Windows Virtual Memory

Citrix policies

Within Citrix Studio, there are policies that can be set to optimize performance, security, and to tune the system for the specifics of any given environment.

The settings in table 5 reflect the test configuration and allow multiple devices to be redirected. For increased security, USB device redirection should only be enabled when it is necessary to fulfill a user requirement, as Citrix has optimized channels for most USB devices that don't require generic USB redirection. For improved security, disabling Flash acceleration (Flash redirection) and Windows Media redirection is recommended, as the HPE ProLiant m710p Server Cartridge is capable of rendering streamed video content server-side. To avoid delays in session brokering time, it is recommended to only auto-create the client's default printer.

Citrix HDX is a broad umbrella that contains a number of different protocols that will be used to actually deliver the user session depending on operating system, user preferences and other factors. The default setting for Windows with Citrix XenDesktop 7.6 is Desktop Composition Redirection (DCR), which is recommended for smooth performance. For lower powered end-point devices, disabling DCR and forcing HDX to use H.264 compression may help to slightly reduce the processor load on the end-point device.

There are also some end-user experience settings that can be tweaked for the desired balance of performance and appearance. However, with the HPE ProLiant m710p Server Cartridge and its powerful Intel Iris Pro graphics, all of these settings can be left enabled and the system will still deliver excellent responsiveness. Table 5 addresses all of the policies that were set in the test environment.

Table 5. Citrix policies

POLICY	SETTING
Client audio redirection	Allowed
Client microphone redirection	Allowed
Multimedia conferencing	Allowed
Client drive redirection	Allowed
Client USB device redirection	Allowed
Flash acceleration	Disabled
Windows Media redirection	Prohibited
Auto-create client printers	Auto-create the client's default printer only
Desktop Composition Redirection	Enabled
Target frame rate	60 fps
Desktop wallpaper	Allowed
Menu animation	Allowed
View window contents while dragging	Allowed
Client audio redirection	Allowed

Bill of materials

The bill of materials (BOMs) presented here are sized for 45 high-end desktop users, or one Moonshot chassis. This can easily be scaled either up or down by taking away some Moonshot server cartridges, or by adding additional chassis, with switches and power, and additional Moonshot server cartridges. The solution is also configurable in terms of the number of desired displays for each user and the size of the M.2 SSD (up to 960 GB) on each cartridge.

Table 6 and 7 contain the Moonshot server compute and end-user client hardware that comprise this solution, respectively. Table 8 and 9 contain a Citrix Management Control Server and top-of-rack (ToR) switching and cabling, respectively.

Depending on the level of high-availability and redundancy required, consider doubling the infrastructure and compute components as necessary.

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, contact your reseller or an HPE representative.

Note

Part numbers are at the time of publication 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, consult with your HPE Reseller or HPE Sales Representative for more details. hp.com/large/contact/enterprise/index.html

Table 6. Bill of materials [data center]

QUANTITY	PART NUMBER	DESCRIPTION
1	755371-B21	HPE Moonshot 1500 Chassis
45	808915-B21	HPE Moonshot m710p Server Cartridge (Intel Xeon Processor E3-1284L v4, 2.9 GHz)
45	765479-B21	HPE Moonshot 120G SATA VE M.2 2280 FIO Kit
4	684532-B21	HPE 1500W Hot Plug Power Supply Kit
4	AF556A	HPE 1.83m 10A C13-UL US Power Cord
1*	704654-B21	HPE Moonshot-45XGc Switch Kit
1*	704652-B21	HPE Moonshot-4QSFP+ Uplink Module Kit
1	681254-B21	HPE 4.3U Rail Kit
1	681677-B21	HPE 13U FIO Rack Adapter Kit for 3X4.3U Chassis (optional)
1	755371-B21	HPE Moonshot 1500 Chassis

* If switch redundancy is desired, add one more of both 704654-B21 and 704652-B21

Table 7. Bill of materials [client]

QUANTITY	PART NUMBER	DESCRIPTION
45	P3S25AA#ABA	HP t730 Thin Client
45	J3G91AA	AMD FirePro W2100 Graphics Card
270*	D7Q13AB	HP Z Display Z23i 23-inch IPS LED Backlit Monitor (ENERGY STAR®)
45		Ergotron DS100 Quad Monitor Mount
45*		Ergotron DS100 Dual Monitor Mount

* If four monitors per workstation are desired, quantity 180 for Z23i. Ergotron DS100 Dual Monitor Mount is only required for six monitors.

Table 8. Bill of materials [Citrix management control servers]

QUANTITY	PART NUMBER	DESCRIPTION
1	755258-B21	HPE DL360 Gen9 8SFF CTO Server
1	755394-L21	HPE DL360 Gen9 E5-2680v3 FIO Kit
1	755394-B21	HPE DL360 Gen9 E5-2680v3 Kit
8	726719-B21	HPE 16GB 2Rx4 PC4-2133P-R Kit
4	691866-B21	HPE 400GB 6G SATA ME 2.5in SC EM SSD
1	665243-B21	HPE Ethernet 10Gb 2P 560FLR-SFP+ Adapter
1	749974-B21	HPE Smart Array P440ar/2G FIO Controller
4	734807-B21	HPE 1U SFF Easy Install Rail Kit
2	720620-B21	HPE 1400W FS Plat Pl Ht Plg Pwr Supply Kit
1	339777-B21	HPE RAID 0 Drive 1 FIO Setting

Table 9. Bill of materials (switching and cabling)

QUANTITY	PART NUMBER	DESCRIPTION
1	JG896A	HPE FF 5700-40XG-2QSFP+ Switch
2	JC680A	HPE A58x0AF 650W AC Power Supply
2	JC682A	HPE 58x0AF Bck(pwr)-Frt(ports) Fan Tray
2	JG330A	HPE X240 QSFP+ 4x10G SFP+ 3m DAC Cable
2	JD097C	HPE X240 10G SFP+ SFP+ 3m DAC Cable

Summary

Many enterprise users require high end desktops with fast processors and powerful available graphics to cover a broad spectrum of use cases. Financial traders in particular require top-notch performance, all the time, in addition to increased security due to the sensitive nature of the data they work with. In addition, their IT departments want a simplified way to manage all these high-end desktops, without having to fight the constant battle of never-ending hardware refreshes.

HPE Moonshot System and the HPE ProLiant m710p Server Cartridge can address these requirements, providing a high-end compute node with graphics, hosted securely in the data center. The end user enjoys an excellent user experience and a desktop that they can access from anywhere their IT policies allow them to, thanks to Citrix XenDesktop’s powerful HDX protocol. Furthermore, the HPE Moonshot system increases density and efficiency when compared to more traditional solutions, lowering operating costs such as data center space, cabling, and cooling.

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 with 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.

For more information

[HPE Moonshot for Citrix Integration Guide](#)

[HPE Moonshot Networking Cookbook](#)

[Operating System Deployment on HPE ProLiant Moonshot Server Cartridges](#)

[HPE Moonshot Integration with Microsoft System Center](#)

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