



Lab Insight
**4th Gen Intel Xeon
Scalable Processors:
Powering VDI Performance**

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Overview

Hyperconverged Infrastructure (HCI) continues to be a popular way for companies to utilize the compute, memory and storage resources needed for hosting large numbers of Virtual Machines (VMs) for their employees. Due to its relative ease of use and management, whether on-premise or in the cloud, HCI is an excellent choice for companies looking to manage virtual infrastructure.

As companies grow the needs of Virtual Desktop Infrastructure (VDI) users evolve, choosing the best performing CPU to match VDI requirements at the lowest cost possible is a challenge that companies will continue to face. With this in mind, it would be of benefit to select a CPU that will best accommodate VDI needs for at least several years.

The Futurum Group Labs was contracted by Intel to analyze the performance and price-to-performance of HCI using VMware's vSAN with Horizon VDI deployments running on Intel® Xeon 8462Y+, 6442Y+, and 8358 CPUs. We used the standard Login Enterprise Knowledge Worker (KW) profile as the VDI workload, with several types of Virtual Machine configurations to represent various real-world scenarios.

Using 4th generation Intel Xeon Platinum CPUs showed significant increases in capacity and performance for VDI environments over 3rd generation CPUs. For companies needing to support less VDI users, 4th generation Xeon Gold CPU's can still deliver performance suitable for their smaller environments.

Key findings from our testing include:

- The 8462Y+ CPU showed significant improvement in VDI performance over the 8358 at a lower cost per user in every case but one where system memory resources were limited
- 6442Y+ CPU supported almost the same number of users vs the 8358 at a lower cost per user
- 6442Y+ showed significant VDI capacity increases with 2TB of DRAM per node vs 1TB of DRAM with a lower cost per user

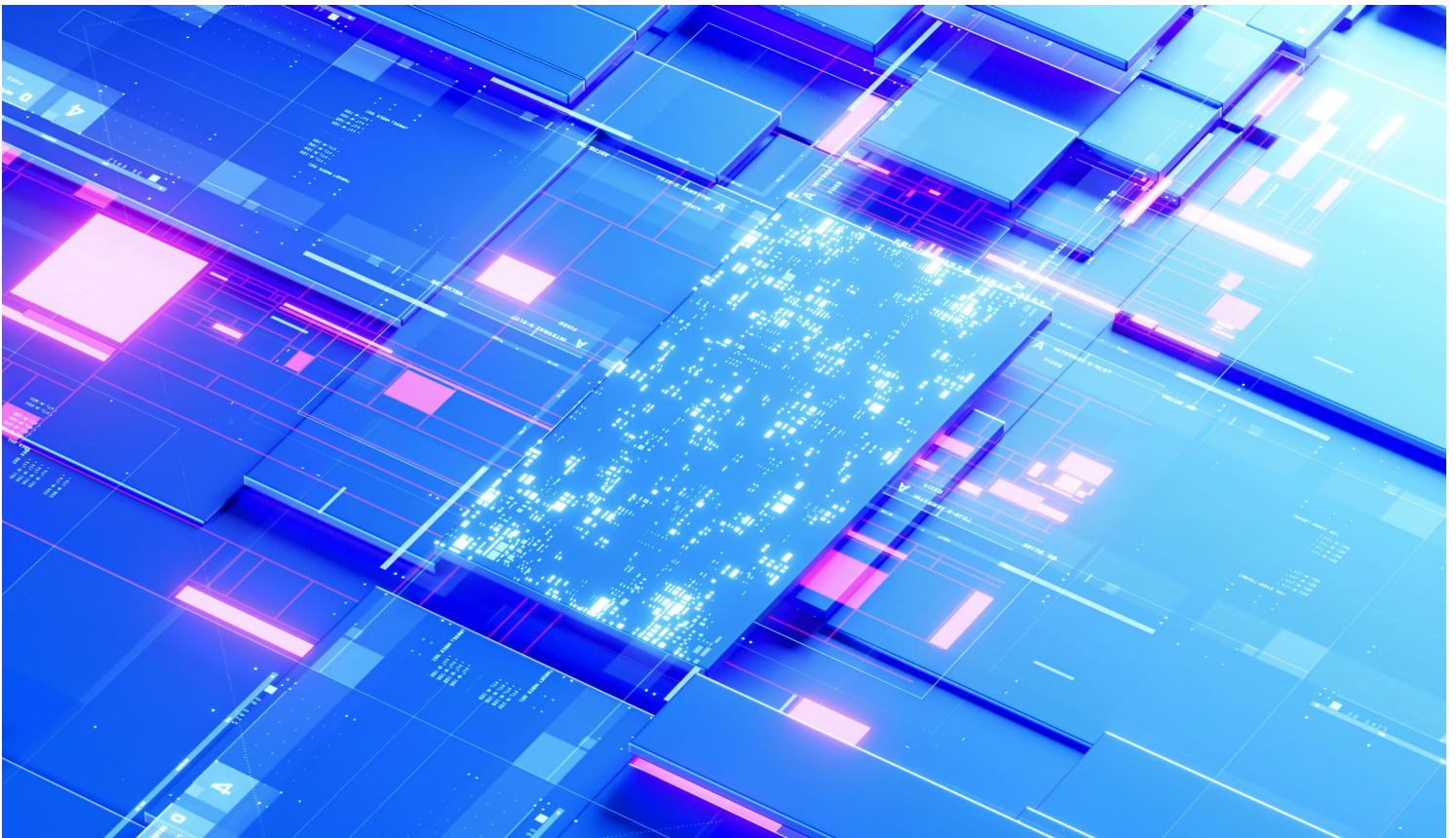
HCI for Virtual Desktops

Hyperconverged Infrastructure's ability to rapidly scale out significantly reduces overhead for IT departments compared to traditional infrastructure options. Nodes can be quickly added providing additional compute, memory and storage utilizing common elements. This also allows for the scale out of VDI instances to meet requirements for growing organizations. In the cloud, this may be as simple as requesting additional infrastructure through the cloud provider. On-premises, this can be done by physically adding another node to a cluster and provisioning more VDI instances.

With VMware vSAN, storage can be easily scaled along with CPU and memory resources. This allows for the management of all aspects of the HCI deployment through VMware vCenter, further reducing overhead and administrative costs for IT departments. Adding additional vSAN nodes also increases resiliency due to more failure tolerations, and performance gains due to more resources being available.

Why HCI works well with VDI:

- HCI can be deployed with as few as two nodes, enabling lower costs for even a small VDI environment
- The scale-out design of HCI lines up with the scale out requirements for VDI deployments
- HCI can rapidly scale compute and storage capacity as much as is required
- Operational costs and time can be saved due to reductions in administrative tasks



Testing Set Up

Intel asked The Futurum Group Labs to evaluate the performance and price / performance of several different configurations using VMware Horizon VDI together with Login VSI's Login Enterprise product. With Login Enterprise, which is a customizable workload generation tool, workloads can be created to match what a company might see in terms of typical utilization generated on their systems by users. The Login Enterprise profile used was the standard Knowledge Worker (KW) profile. The KW profile consists of Microsoft Edge, and Microsoft Word / Excel / Power Point / Outlook applications. Three different VM configurations were tested, 2 vCPU X 4 GB RAM, 2 vCPU X 8 GB RAM, and 4 vCPU X 8 GB RAM. These were chosen to test various configurations that might be used in real VDI environments.

Physical hardware tested included a 4 Node cluster using vSAN for storage. A second 5 node cluster was used to support the required Login VSI, Horizon, and other necessary infrastructure VMs. This second cluster ensures there are no unnecessary performance impacts on the tests. The specific CPUs tested were the Intel® Xeon 8462Y+, 6442Y+, and 8358. Each node was equipped with 2 TB of DRAM, except for some of the 6442Y+ configurations which used 1 TB per node. Nodes could have been configured with more system DRAM, but 1TB and 2TB were chosen for TCO purposes and previous testing consistency. All nodes had two 1.6TB P5800X cache drives along with six 3.84TB P5510 drives for storage capacity. Nodes were equipped with two Intel® Ethernet Controller E810-C for QSFP 100Gb, one for vSAN traffic and one for all other traffic. Desktop pools were created using VMware Horizon Virtual Desktop.

For additional details on the environment, please refer to the Appendix.

Testing Background

A key measurement of the Login VSI tests is an EUX score, which is calculated by Login VSI Enterprise. This score is meant to represent the "User Experience", or what an actual user would experience while using a VM in terms of response time of the logon process and applications, among other metrics. Login VSI considers a score of 7.5 or greater to represent "Very Good" performance*, so the testing was designed to achieve the highest number of users that would still result in an EUX score of 7.5 or higher. Some of the tested systems could have handled more VDI users, but the EUX drops rapidly the more users that are added to the workload when the system is close to capacity**. Also, some of the configurations ran out of memory resources which capped the number of VDI users at 950 (2TB of DRAM per node) or 465 (1TB of DRAM per node) due to the VM memory configuration of 8GB RAM.

[* Login Enterprise Feature Spotlight – EUX Score](#)

[** Login Enterprise EUX Score](#)

To measure efficiency, we calculated the cost per unit of work, which for VDI workloads equates to cost per VDI user. The cost per user EUX was also calculated to show how much it costs to provide each user a "Very Good" experience. These units of measure are more important than raw performance (number of VDI users), due to the scale-out nature of the VDI running on HCI. If a deployment requires more VDI users, simply adding additional HCI nodes will scale up the number of desktop instances linearly. Additionally, savings of even a few dollars per user can result in saving thousands of dollars when multiplied by hundreds of VDI instances.

VDI Results

EUX scores, number of users achieved, cost per user and cost per user EUX for the configurations tested are listed in Table 1 below. The configurations labeled memory limited reached the maximum number of VMs able to be powered on with that combination of VM RAM and node DRAM. Higher EUX Score is better.

System Configuration Per Node (4 Node Cluster)	VM Configuration	Number of VDI Users	EUX Score	Cost per VDI User	\$ Per User EUX
2X Intel 8358 CPU 2 TB DRAM	2 vCPU X 4GB RAM	830	7.5	\$ 1,041.17	\$ 138.82
2X Intel 8358 CPU 2 TB DRAM	2 vCPU X 8GB RAM	830	7.5	\$ 1,041.17	\$ 138.82
2X Intel 8358 CPU 2 TB DRAM	4 vCPU X 8GB RAM	720	7.5	\$ 1,065.14	\$ 142.02
2X Intel 8462Y+ CPU 2 TB DRAM	2 vCPU X 4GB RAM	1060	7.5	\$ 1,029.61	\$ 137.28
2X Intel 8462Y+ CPU 2 TB DRAM	2 vCPU X 8GB RAM	950 *	7.5	\$ 1,046.43	\$ 132.46
2X Intel 8462Y+ CPU 2 TB DRAM	4 vCPU X 8GB RAM	950 *	7.5	\$ 1,046.43	\$ 139.52
2X Intel 6442Y+ CPU 2 TB DRAM	2 vCPU X 8GB RAM	770	7.5	\$ 1,041.62	\$ 138.88
2X Intel 6442Y+ CPU 2 TB DRAM	4 vCPU X 8GB RAM	690	7.5	\$ 1,059.86	\$ 141.31
2X Intel 6442Y+ CPU 1 TB DRAM	2 vCPU X 4GB RAM	790	7.5	\$ 1,018.28	\$ 135.77
2X Intel 6442Y+ CPU 1 TB DRAM	2 vCPU X 8GB RAM	465 *	8.3	\$ 1,121.42	\$ 149.52
2X Intel 6442Y+ CPU 1 TB DRAM	4 vCPU X 8GB RAM	465 ***	8.3	\$ 1,121.42	\$ 149.52

Table 1: Intel CPU Comparison: Horizon VDI Performance (Source: The Futurum Group)

* System was Memory Limited

** 21% faster logon times and 4% better app performance as measured by Login Enterprise vs the 2 vCPU / 8GB RAM VM configuration with the same hardware

The charts below in Figures 1-3 show results comparing the 8462Y+ and 8358 with various VM configurations, 2 vCPU X 4 GB RAM, 2 vCPU X 8 GB RAM, and 4 vCPU X 8 GB RAM. Configurations labeled as "Memory Limited" reached the max number of VMs able to be powered on in that particular VM and Host configuration. Dollar amounts shown are rounded to the nearest dollar.

Note: All data is provided in the Appendix, including additional charts and pricing information.

Horizon VDI Performance 8358 vs 8462Y+ Various VM Configs

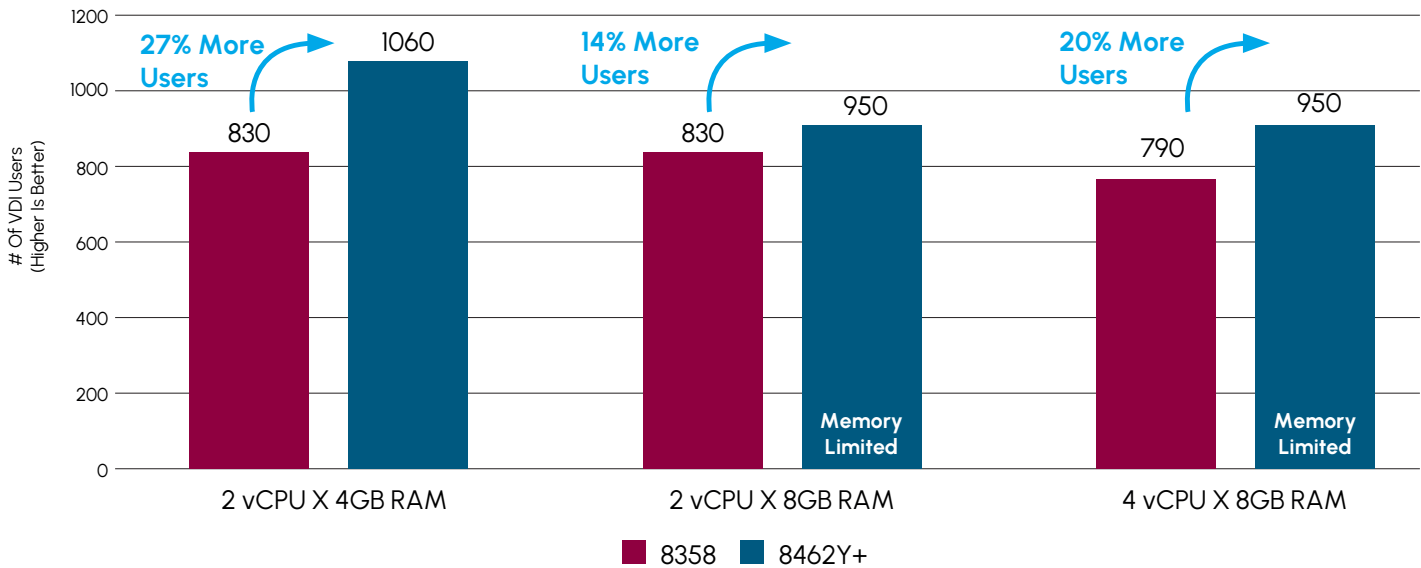


Figure 1: Horizon VDI Performance (8358 vs 8462Y+ 2TB DRAM KW Workload)

Horizon VDI Cost Per User 8358 vs 8462Y+ Various VM Configs

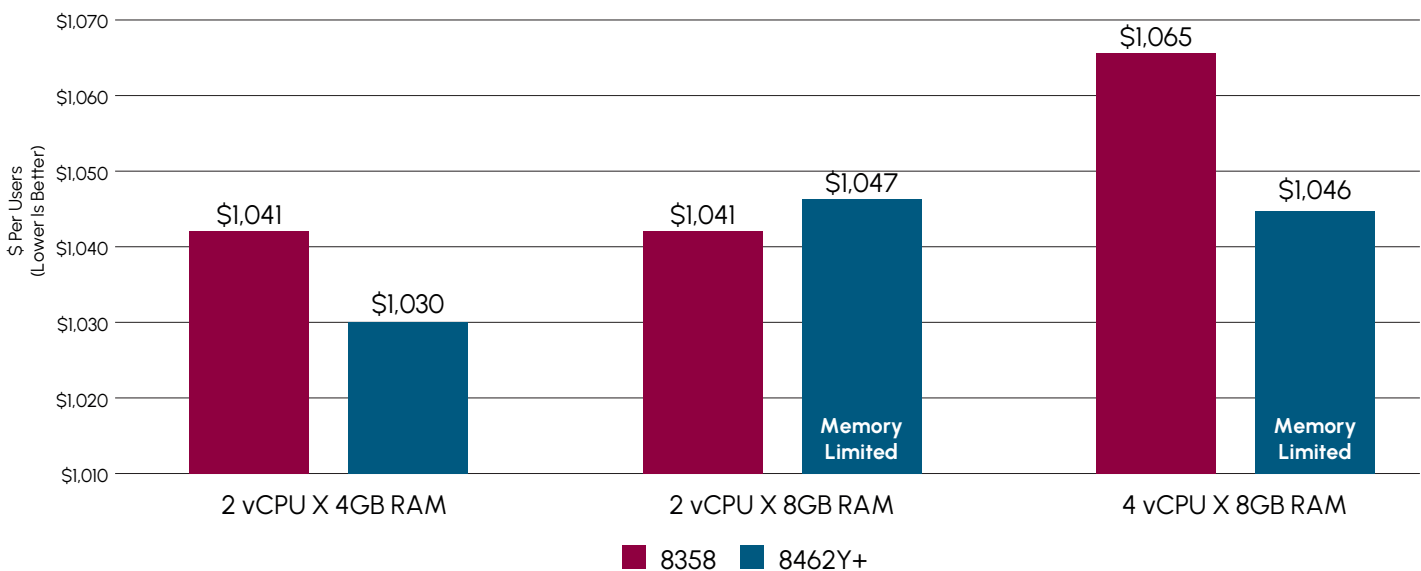


Figure 2: Horizon VDI Cost Per User (8358 vs 8462Y+ 2TB DRAM KW Workload)

Horizon VDI Cost Per User 8358 vs 8462Y+ Various VM Configs

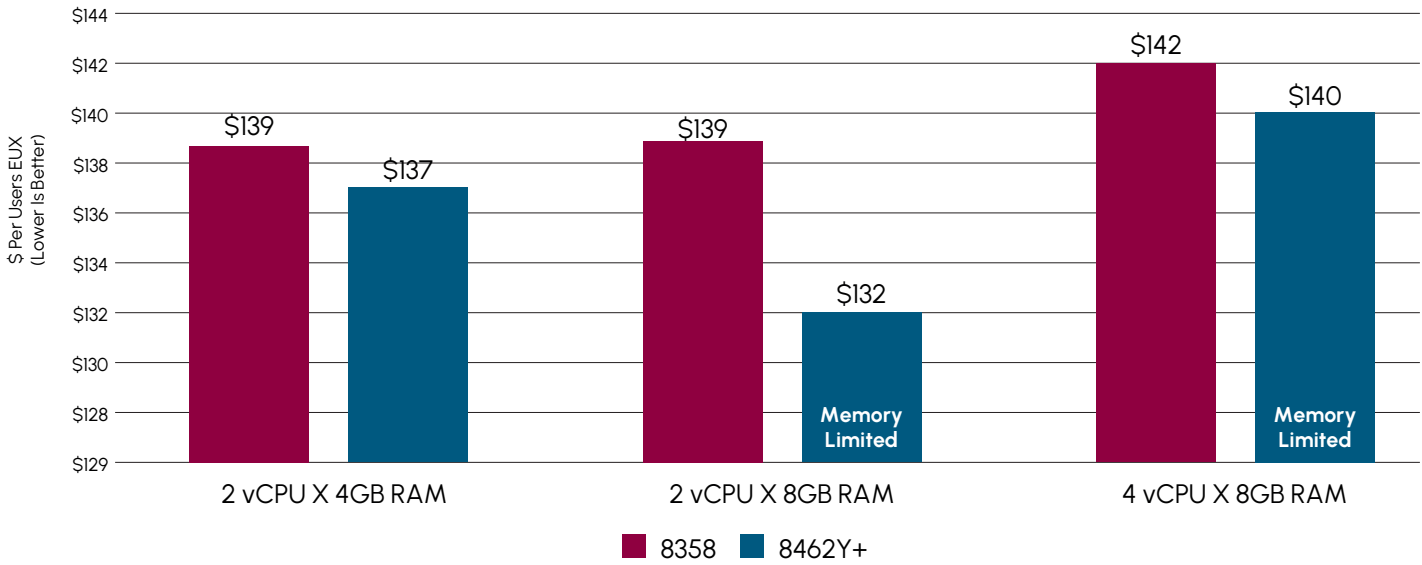


Figure 3: Horizon VDI Cost Per User EUX (8358 vs 8462Y+ 2TB DRAM KW Workload)

The 8462Y+ CPU outperformed the 8358 in total number of users for every VM configuration. The cost per user and cost per user EUX is similar or lower for the various configurations for the 8462Y+ vs the 8358. Again, the 8462Y+ cost per user likely would have gone down along with the cost per user EUX for the two memory limited configurations if the systems had more memory available.

Figures 4-6 below show results comparing the 6442Y+ with various VM and system memory configurations. Configurations labeled as memory limited reached the max number of VMs able to be powered on in that particular VM and Host configuration. The number of users achieved would have been higher in these cases if more system memory was available as seen by the results of the 2TB of DRAM per node configurations. (The 6442Y+ was not tested with 2TB of system DRAM in the 2X4 VM configuration because it was CPU limited with 1TB, more DRAM would not be beneficial in this case.)

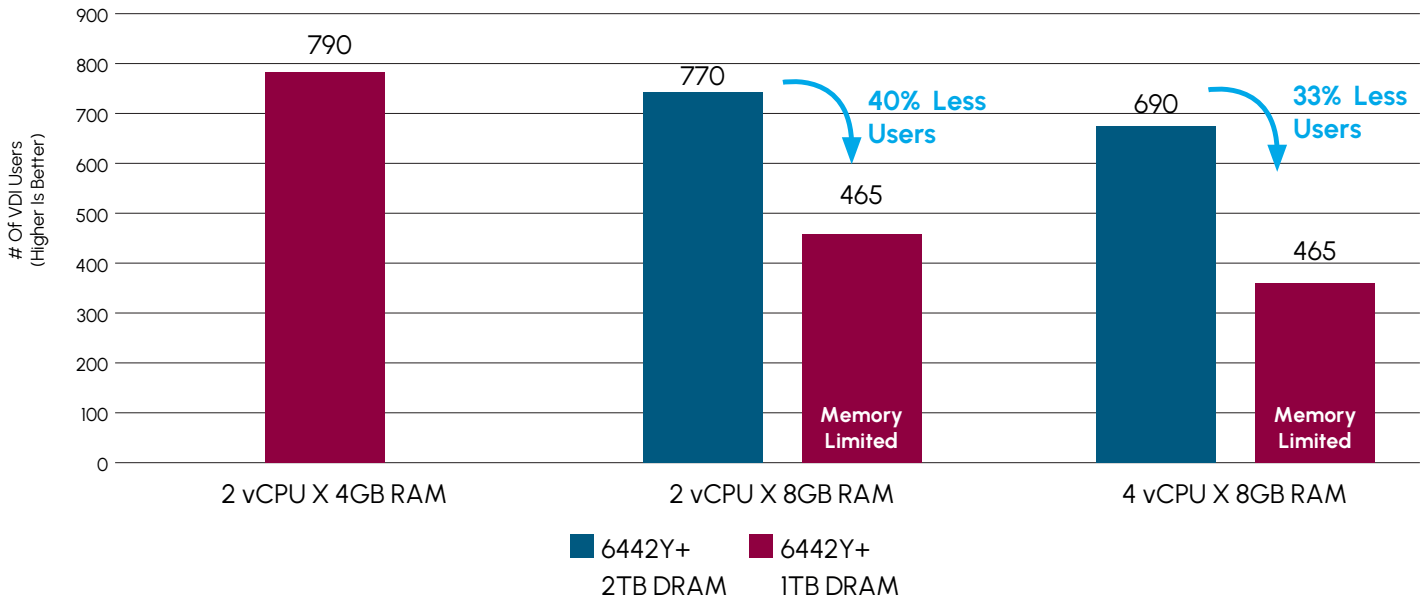


Figure 4: Horizon VDI Performance (6442Y+ 2TB/1TB DRAM KW Workload)

Horizon VDI 6442Y+ Various VM Configs

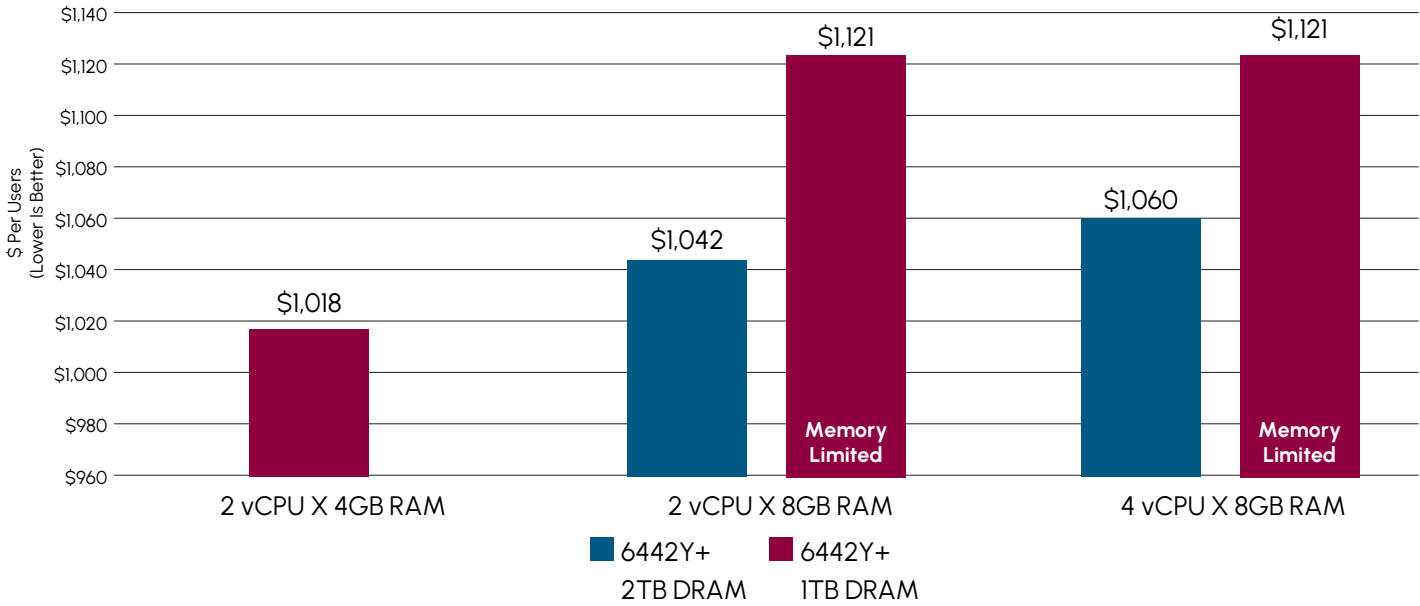


Figure 5: Horizon VDI Cost Per User (6442Y+ 2TB/1TB DRAM KW Workload)

Horizon Cost Per User EUX 6442Y+ Various VM Configs

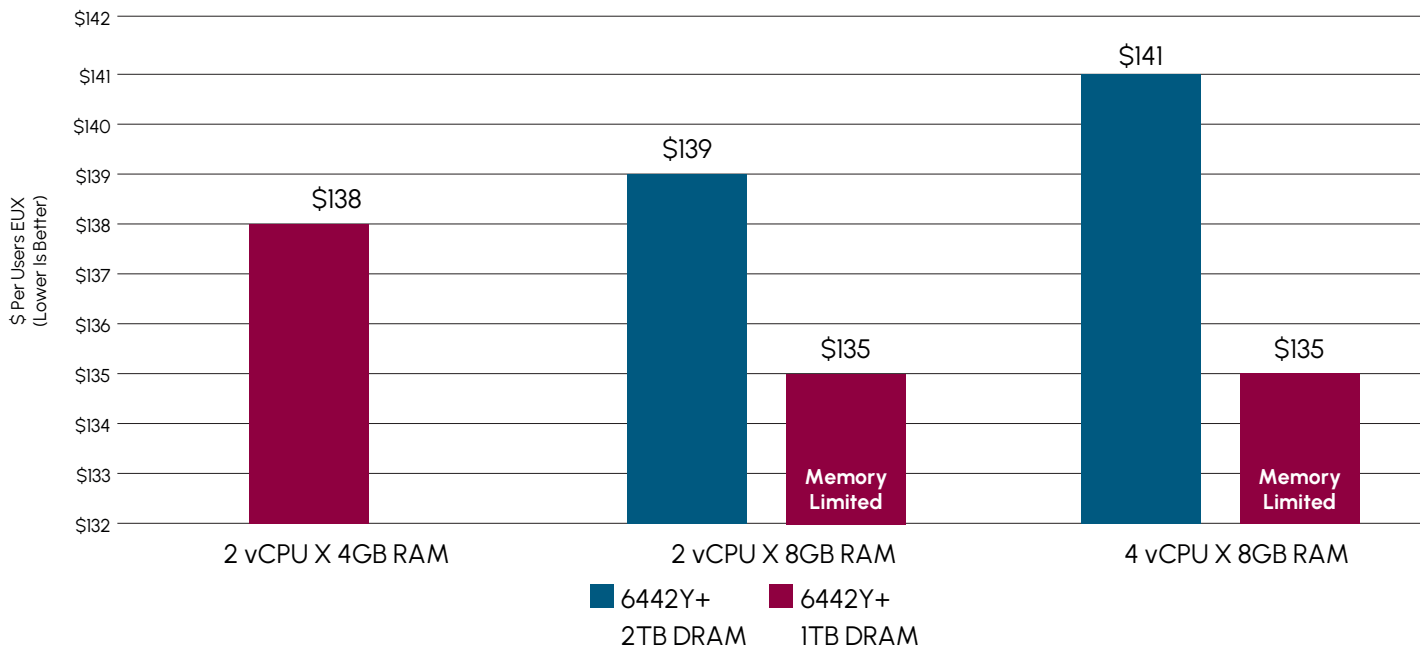


Figure 6: Horizon VDI Cost Per User EUX (6442Y+ 2TB/1TB DRAM KW Workload)

Different amounts of system memory greatly affect the number of VDI users that are supported with the 6442Y+ when the VMs are given 8GB of RAM. Using only 1TB of system DRAM results in the highest cost per user out of all configurations tested. However, the EUX score is higher due to less CPU utilization, and therefore a lower \$ per User EUX in those particular scenarios.

Futurum Group Comments: *One interesting data point is that giving more vCPUs to the VMs does not always increase performance, which can be seen by a drop in VDI capacity in most of the 4X8 vs 2X8 VM configurations.*

Results Analysis

Making the decision of what CPU to use for a VDI environment can be a complex process. The findings of our testing should help simplify the task in that the 4th generation of Intel CPUs outperforms the 8358 in terms of number of users supported at similar or lower costs per user. The lower core count of the 6442Y+ lessens the number of users supported, but it still performed very well overall and companies needing less VDI capacity should consider this model.

VDI Performance

Companies looking to upgrade their existing CPUs or those who are needing new CPUs for their VDI environments should consider the following results from our testing:

8462Y+ Performance Highlights:

- 8462Y+ was able to support an additional 230 users (28% increase) over the 8358 (2X4 VM Configuration)
- 8462Y+ was able to support 120 more users than the 8358 (14% increase) and achieved a higher EUX of 7.9 vs 7.5. (2X8 VM Configuration), even while memory limited
- 8462Y+ saw an increase of 160 users (20% increase) vs the 8358 (4 X 8 VM configuration)

6442Y+ Performance Highlights:

- 6442Y+ supported nearly as many users as the 8358 (790 vs 830) with the lowest cost per user of all configurations tested at \$1018 / user (2X4 VM Configuration)
- 6442Y+ configurations supported significantly more users with 2 TB DRAM per node vs with 1 TB DRAM per node (8GB of RAM VM configurations), at a lower cost per user

Figure 1 details how the 4th generation Platinum CPU shows large improvements over the 3rd generation. VDI capacity is increased anywhere between 14% up to 27% depending on the configuration. The largest increase in VDI capacity, 27%, was in the 2X4 VM configuration. If more than 2TB of DRAM per node were available, the 8GB of RAM configurations could have seen even larger increases in capacity with the 8462Y+ vs the 8358, more in line with the 2X4 configuration. Based on these results, companies looking to have the largest VDI capacity would certainly be better off going with the 4th generation CPU and 2TB of DRAM per node.

When looking at the 6442Y+ performance, Figure 4, readily observable is the 1TB DRAM configurations hitting a cap of 465 users. Using 1TB of DRAM per node (4TB total in a 4 node cluster) will only support this many VDI instances when they are configured with 8GB of RAM. If companies are considering the 6442Y+ with 8GB of RAM per VM, it would be very beneficial to use 2TB of DRAM per node to make full use of the CPU capacity of this model. For organizations that do not need large VDI capacity using the 6442Y+ when it is memory, but not CPU limited, results in a higher EUX score meaning the users will have a better overall experience. For companies considering the 1 TB of DRAM per node configuration, the VDI capacity is almost as high as the 8358 and has a lower cost per user in the 2X4 VM configuration.

Price Performance

Cost Per User and Cost Per User EUX Highlights:

- The older 8358 CPU is less cost effective (higher cost per user and cost per user EUX) in almost every case vs the 8462Y+
- Using 2TB of system DRAM can significantly lower the cost per user of the 6442Y+ CPU (8GB RAM VM configurations)
- 6442Y+ with a 2X4 VM configuration had the lowest cost per user of all configurations at \$1,018 per user
- The majority of costs were from software (licensing, etc.), and were not hardware related

From a cost per user perspective, companies would be better off in most cases going with the 8462Y+ or 6442Y+ vs the 8358. The only instance where the cost per user was higher for the 8462Y+ vs 8358 was when there were memory limitations in the 2 vCPU X 8GB RAM VM configuration. This cost per user metric would almost certainly improve (lower cost per user) if more system memory were available since more users could be achieved with an EUX of at least 7.5. When looking at the 6442Y+ cost per user results, using 2 TB of system DRAM per node vs 1TB significantly lowers the cost per user by ~10% when VMs are configured with 8GB of RAM.

Considering the Cost per User EUX metrics, again companies would be better off choosing the 4th generation of CPUs, either the 8462Y+ or 6442Y+, in nearly every case vs the older 8358. For the best user experience per \$, the 8462Y+ with a 2 X 8 VM configuration would be the best choice, even though it is memory limited in this scenario.

Summary

VDI environments continue to be a popular solution for companies looking to provide virtual desktops for their employees in a centrally managed environment. As companies grow, more VDI capacity is needed to sustain productivity. Performance needs also continue to change and might require more CPU resources than in the past. The testing performed by The Futurum Group Labs found several important insights about the performance of 4th gen models of Intel CPUs.

First, using 8462Y+ Intel Xeon CPUs provides a significant improvement over the 8358 in terms of overall VDI capacity, and does so at a similar or lower cost per user. Second, the 6442Y+ CPUs are almost as efficient as the 8358 with 4GB of VM RAM, and using more system DRAM significantly increases the VDI capacity with these CPUs when VMs have 8GB of RAM. For companies looking to expand VDI capacity or improve the user experience for their VDI users, the 4th generation of CPUs are generally a better choice over the 8358.

Futurum Group Comments: *Achieving the highest possible VDI capacity for the best price is the essence of price performance. The 8462Y+ is better than the 8358 CPU in nearly every way. VDI capacity is higher for every configuration tested, the cost per user EUX is lower, and in all but one case when system memory was the limiting factor, the cost per user is lower. These combined facts show that companies should choose the 8462Y+ over the 8358, no matter what their needs are.*

These findings can help guide companies, whether large enterprises or smaller organizations, to make the choice that is best for their needs. Keeping up with changing demands for VDI environments requires the use of the highest performing CPUs for the lowest cost possible. Regardless of if companies choose either the 8462Y+ or 6442Y+ CPUs, the benefits are clear over the 8358.

Appendix

The KW profile was run using a 30 minute "Load Test". The KW profile used a 15 minute logon period and a 30 minute Load Test for a total of 45 minutes. The results collected were the median of 3 runs for each configuration. The tested environment was configured with a 4-node HCI deployment, along with vSAN and ESXi managed through vCenter. Each node had 2 CPU sockets with 2TB of DRAM, except for 2 of the 6442Y+ configurations which used 1TB of DRAM. VM configurations included: 2 vCPUs with 4GB of RAM, 2 vCPUs with 8GB of RAM, and 4 vCPUs with 8GB of RAM.

Test Environment Details

Testing was performed from August 2023 through February 2024, based upon equipment availability. The test environment utilized the following hardware, software and applications outlined below.

Hardware and Infrastructure

- A Test cluster of 4-nodes, with a 5-node cluster for supporting automation, Figure 7 below
- VMware vSphere 8.0 U2, with vSAN Advanced (ESXi + vSAN on hosts, with vCenter server)
- ESXi 8.0 U2 Build 22380479; vCenter 8.0 U2 Build 22385739
- Multiple VMs configured as required to support Horizon Virtual Desktop as required

A high-level overview of the test configuration is shown in Figure 7 below.

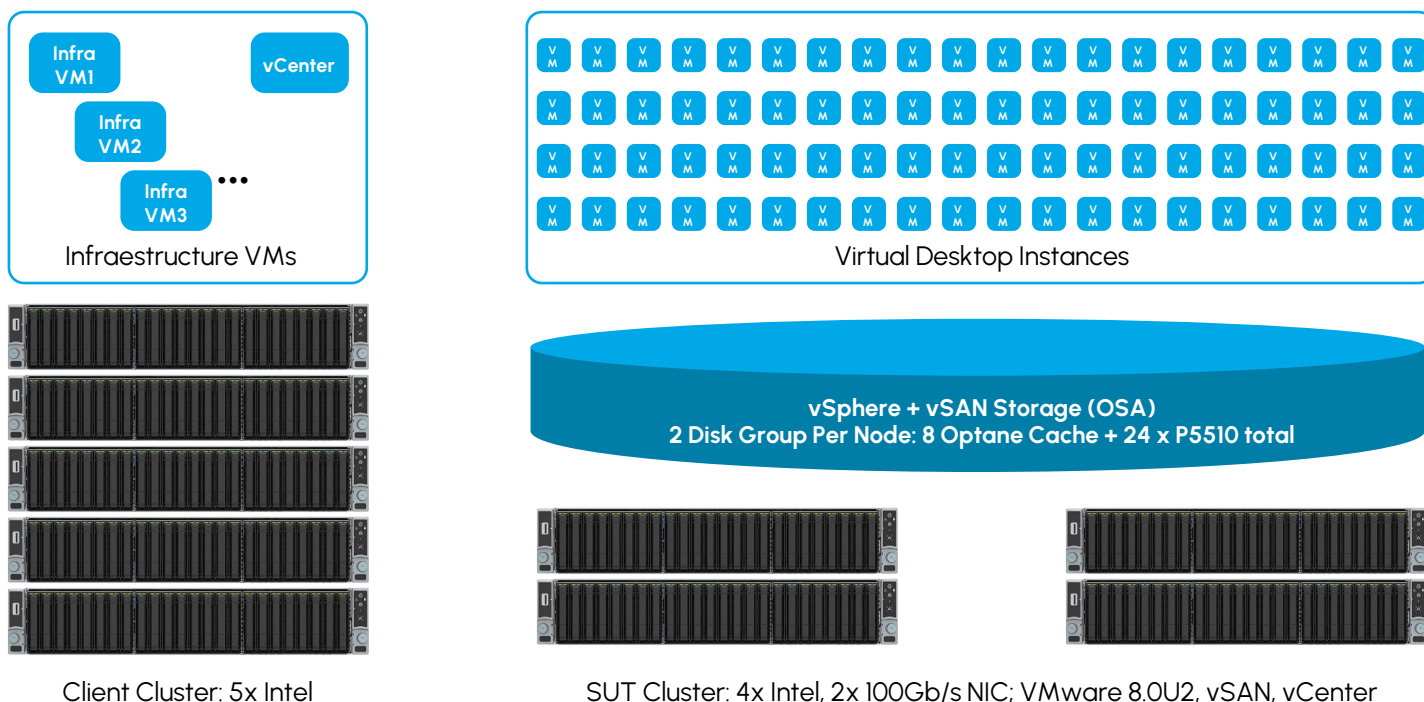


Figure 7: Test Setup for Horizon VDI

Windows, VMware and LoginVSI Version

- VDI Client OS: Windows 11 Pro for Workstations 21H2
- Server OS for VM's: Windows Server 2022 Enterprise
- VMware Horizon 8 Desktop, Version 2303
- VMware 8.0U2; ESXi build 22380479; vCenter build 22385739
- Login Enterprise, version 5.7.2

SUT Cluster Configuration

- 1 cluster, 4-node HCI cluster for VDI apps with vSAN storage
- Intel Server configuration:
 - 2 socket Ice Lake 8358 CPU, 2 socket Sapphire 8462Y+, 2 Socket Sapphire 6442Y+
 - Support for 32 DIMM slots
 - 2 Intel E810-CQDA2 100G NICs per host
 - 8358, 8462Y+ – 2 TB DRAM
 - 6442Y+ – 1 TB DRAM and 2TB DRAM test dependent
- Intel vSAN configuration: 2 disk groups per node, each with 1 Optane cache + 3 Intel capacity SSDs
 - 2 x 1.6TB P5800X Optane NVMe SSDs
 - 6 x 3.84TB D7-P5510 NVMe SSDs

Client Cluster Configuration – Infrastructure Applications

- One, 5-node HCI cluster of Intel systems was used for supporting infrastructure
 - System hardware and VMware licenses were not included in pricing
 - All required supporting infrastructure ran on Client Cluster
 - Client hosts also used the same ESXi versions as SUT hosts
- Infrastructure VM's included following:
 - 1 required Horizon VM to support managing virtual desktops
 - 1 required Windows VM with PDC role, along with AD, DHCP and DNS services
 - Other required VM's, including vCenter and Login VSI Enterprise Appliance / Launchers

Application Workload

- The application workload tool, Login VSI Enterprise was used to generate an application workload
- Login VSI Enterprise version 5.7.2
- Knowledge Worker (KW) profile application workload applications:
 - Edge Browser
 - MS Excel
 - MS Outlook
 - MS PowerPoint
 - MS Word
- The Login Enterprise KW profile was used with the following VMware settings per VM
 - Per VM CPU and RAM settings were test dependent
 - 2 vCPU and 4 GB vRAM, full 4 GB memory reservation
 - 2 vCPU and 8 GB vRAM, full 8 GB memory reservation
 - 4 vCPU and 8 GB vRAM, full 8 GB memory reservation
 - Windows 11 OS with VMware tools installed (Windows 11 Pro for Workstations 21H2)
 - VMware Horizon agent installed (agent for Horizon 8 2309)
- Multiple VMs configured as required to support Horizon Virtual Desktop as required
 - Horizon version 2309 - Build 22629722

Test Overview

- Setup HCI infrastructure per HCI hardware and VMware recommendations
 - vSAN storage policy utilized was 'vSAN Default' which uses RAID-10, without deduplication, compression or encryption enabled.
- Setup and deploy Microsoft Domain and Active Directory, along with DHCP and DNS servers
 - A single primary domain controller (PDC) was configured with AD, DHCP and DNS
- Setup and deploy required VMware Horizon infrastructure applications on "Client Cluster"
 - Horizon 8 controller
- Setup initial virtual desktop VM
 - Create a "golden image" Windows 11 VM
 - Optimize for Horizon VDI per recommendations
 - Install required applications (listed previously)
 - Add group policy object and other customization required for Login Enterprise
- Create Login VSI "Launcher VMs" on "Client Cluster" as required
- Utilize Horizon manager to create clones of "golden image" VM on "SUT Cluster" as needed
- Use "Login Enterprise" tool to generate application workload on "SUT Cluster" per test

Test Results

Results of the testing, cost per VDI user, and cost per user EUX are shown in Figures 7, 8 and 9 below.

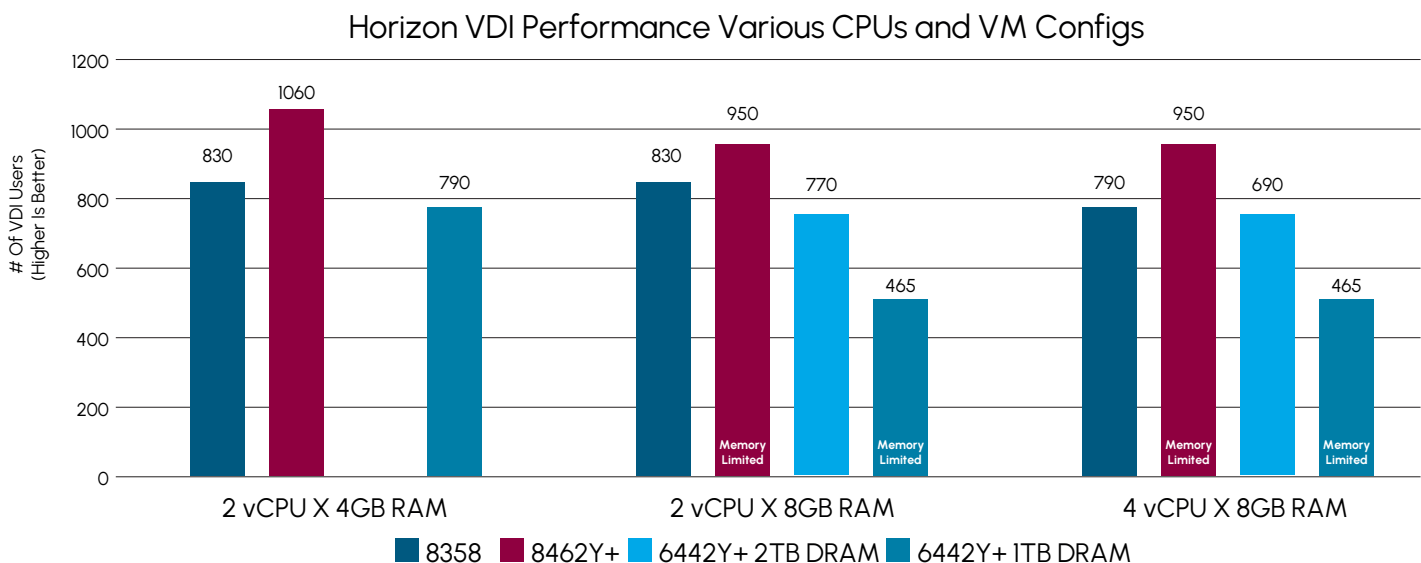


Figure 8: Horizon VDI Performance Comparison

Horizon VDI Cost Per User Various CPUs and

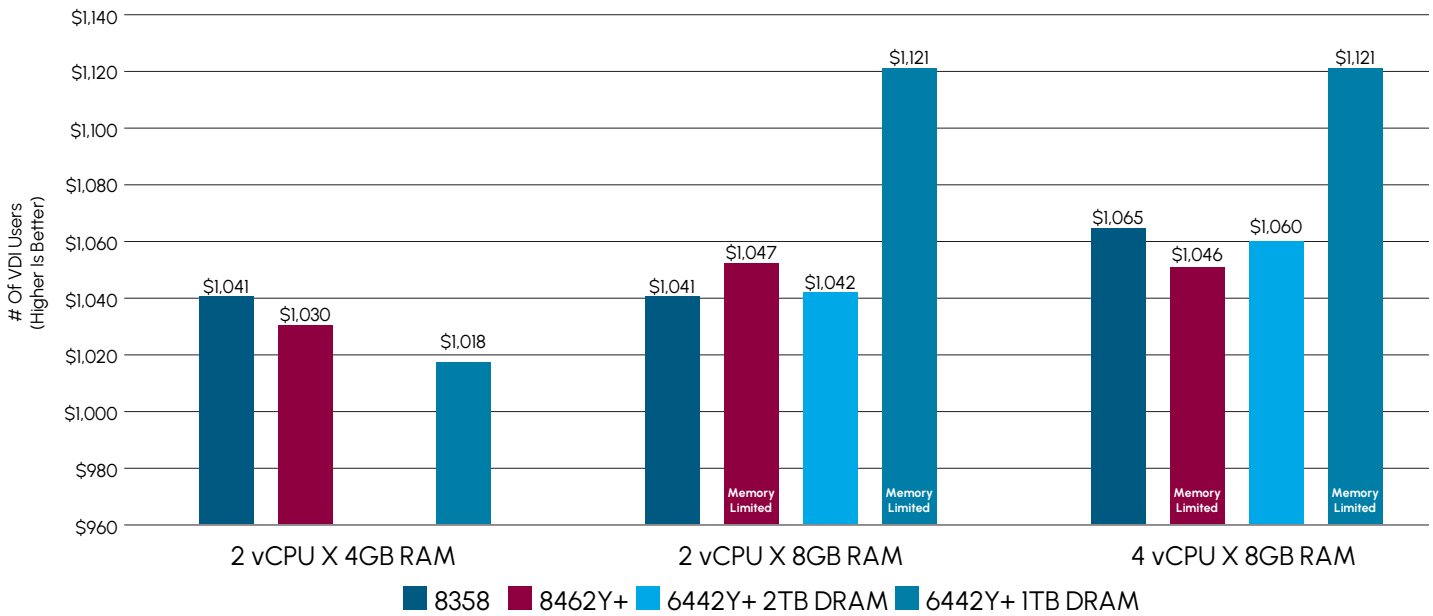


Figure 9: Horizon VDI Cost Per User Comparison

Horizon VDI Cost Per User Various CPUs and

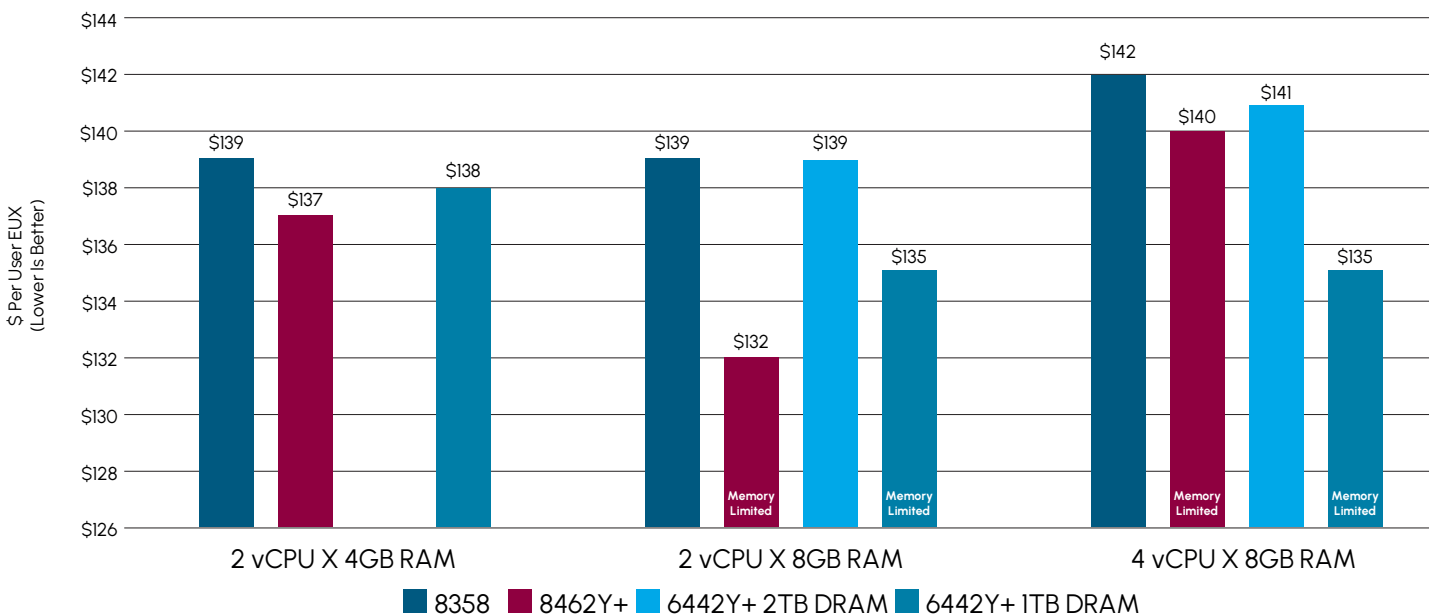


Figure 10: Horizon VDI Cost Per User EUX Comparison

TCO Pricing Data

To provide comparable estimated pricing using widely available pricing data, we utilized ThinkMate.com¹, configuring servers consistent with our testing. We varied processors, system memory, and in some cases storage components. When tested components were not available on ThinkMate, we used pricing data from other sources (i.e. NewEgg, Amazon, etc.). When using previous generation of a current product which was no longer available, we used pricing for the current generation product, which was very similar to previous gen pricing. This methodology was applied consistently across the configurations tested.

VMware Horizon pricing was calculated using the following sku(s) and pricing available from CDW: (HAH-CRCUB-36PT0-CIS & HAH-ADCUA-36PT0-CIS, per the VMware Horizon Packaging and Licensing white paper².

All pricing data was obtained during Sep-Nov 2023 & Feb 2024 and was accurate at the time of publication. All Costs are calculated for a 3-year period of ownership or TCO.

Pricing does not include Windows 11, Zoom, or Office Professional Plus client licensing.

System Configuration	VM Configuration	# Horizon Users	HW Costs incl 3 yr Support	SW Costs incl 3 yr Support	Total cost - 3 years	\$ / Horizon User
Intel 8462Y+ 2TB KW 2x8	2 vCPU X 8GB RAM	950	\$154,023	\$840,089	\$994,112	\$1,046.43
2X Intel 8358 CPU - 2 TB DRAM	2 vCPU X 4GB RAM	830	\$130,200	\$733,972	\$864,172	\$1,041.17
2X Intel 8358 CPU - 2 TB DRAM	2 vCPU X 8GB RAM	830	\$130,200	\$733,972	\$864,172	\$1,041.17
2X Intel 8358 CPU - 2 TB DRAM	4 vCPU X 8GB RAM	720	\$130,200	\$636,699	\$760,899	\$1,065.14
2X Intel 8462Y+ CPU - 2 TB DRAM	2 vCPU X 4GB RAM	1060	\$154,023	\$937,362	\$1,091,385	\$1,029.61
2X Intel 8462Y+ CPU - 2 TB DRAM	2 vCPU X 8GB RAM	950	\$154,023	\$840,089	\$994,112	\$1,046.43
2X Intel 8462Y+ CPU - 2 TB DRAM	4 vCPU X 8GB RAM	950	\$154,023	\$840,089	\$994,112	\$1,046.43
2X Intel 6442Y+ CPU - 2 TB DRAM	2 vCPU X 8GB RAM	770	\$121,135	\$680,914	\$802,049	\$1,041.62
2X Intel 6442Y+ CPU - 2 TB DRAM	4 vCPU X 8GB RAM	690	\$121,135	\$610,170	\$731,305	\$1,059.86
2X Intel 6442Y+ CPU - 1 TB DRAM	2 vCPU X 4GB RAM	790	\$121,135	\$698,600	\$804,439	\$1,018.28
2X Intel 6442Y+ CPU - 1 TB DRAM	2 vCPU X 8GB RAM	465	\$105,839	\$415,623	\$521,462	\$1,121.42
2X Intel 6442Y+ CPU - 1 TB DRAM	4 vCPU X 8GB RAM	465	\$105,839	\$415,623	\$521,462	\$1,121.42

1 - <https://www.thinkmate.com/systems/storage>

2 - <https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/docs/vmw-horizon-pricing-and-packaging-whitepaper.pdf>

Important Information About this Report

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