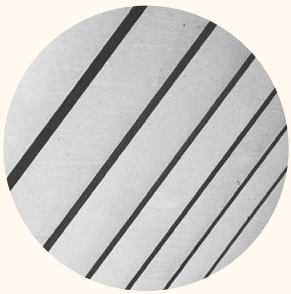
Equip your Dell EMC PowerEdge R740xd servers with Intel Optane persistent memory to support more VDI users

In a virtualized Citrix environment, adding Intel Optane persistent memory boosted VDI density with different types of users

Forty-two percent of U.S. workers worked from home full-time as of June 2020, according to a study from the Stanford Institute for Economic Policy Research.[1] Organizations supporting remote workers using rich collarboration tools such as Zoom or Teams via virtual desktop infrastructure (VDI) need to be able to meet their users' varying memory needs. So how can companies fulfill their users' virtual memory requirements without expanding their data centers?

We deployed a Citrix® VDI desktop pool on a Dell EMC™ PowerEdge™ R740xd server featuring Intel® Xeon® Gold 6248R processors. We tested the server with two different memory configurations: one with just 768 GB of traditional DRAM, and one with 1.5 TB of Intel® Optane™ persistent memory (PMem) with 384 GB of DRAM used as memory cache. With a single server running a VDI workload, we used Citrix virtual memory recommendations[2] as a sizing guide and tested three different virtual memory configurations mimicking the needs of multiple VDI users: alloting 3 GB of virtual memory for users with light workloads, 6 GB for medium workloads, and 12 GB for users running heavy workloads.

Using the Login VSI VDI benchmark, we found that at 6 GB or more of virtual memory per desktop, adding Intel Optane persistent memory allowed the Dell EMC PowerEdge R740xd to support twice the VDI users as the configuration with DRAM alone. With Dell EMC PowerEdge R740xd servers and Intel Optane persistent memory, organizations could increase the memory footprint of their servers to meet current and future needs without expanding to more servers and data center space, which could ultimately help their bottom line.



Support up to

2x the VDI users*

Extend VDI capabilities

*without adding servers**

*with Intel Optane PMem vs. DRAM alone with 6GB and 12GB virtual desktop memory requirements

How we tested

Using VMware vSphere® 7.0 Update 1, we set up a Dell EMC PowerEdge R740xd server with Intel Xeon Gold 6248R processors and used Citrix Virtual Apps and Desktops to create a VDI environment. Using the Login VSI benchmark tool, we simulated VDI users with three different amounts of virtual memory per desktop (3GB, 6GB, and 12GB), and compared performance and scalability of two memory configurations in a VDI environment: 768GB DRAM alone and 1.5TB Intel Optane PMem with 384GB DRAM. We configured the Intel Optane PMem to run in Memory Mode, where the DRAM acts as the memory cache and the Intel Optane PMem provides large memory capacity. We kept storage and network resources identical across the different memory allocation profiles, meaning the only hardware differences between the server configurations were the memory types and capacity.

Figure 1 illustrates our testbed setup. For more details about our configurations and testing, see the ***science behind the report***.

VMware vSAN server with PMem

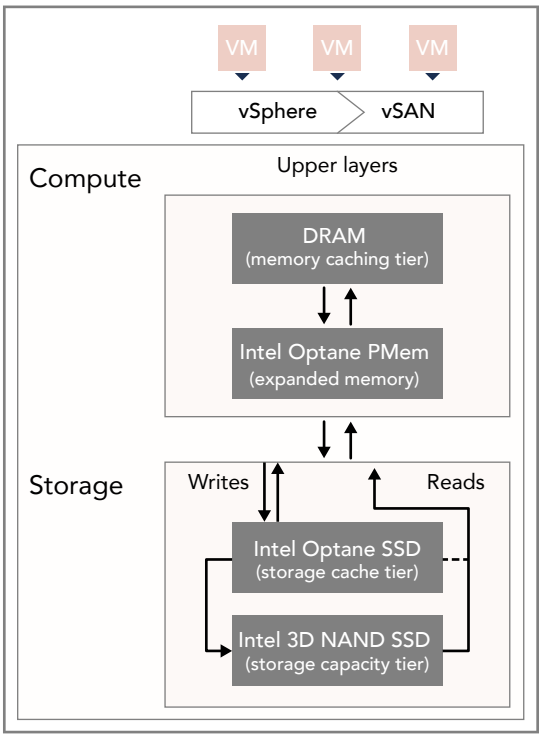


Figure 1: Intel Optane persistent memory and VMware vSAN storage tiering in a VMware vSphere server. Source: Principled Technologies.

About the virtual desktop memory scenarios we tested

We allotted varying amounts of virtual desktop memory per virtual desktop to reflect the different memory requirements users might have for their specific workloads. For more examples of typical virtual desktop workload sizing, visit ***https://docs.microsoft.com/en-us/windows-server/remote/remote-desktop-services/remote-desktop-workloads***.

Light workloads

3GB (1.5GB reserved)

Users who often use basic productivity apps typically require around 3GB memory per desktop.

Medium workloads

6GB (6GB reserved)

Users who require 6GB per desktop use more memory-hungry tools and work with large files and/or high-resolution media.

Heavy workloads

12GB (12GB reserved)

Users who could be a good fit for 12GB per desktop perform activities similar to those with a 6GB memory profile, but do more multitasking, use larger files, and frequently use videoconferencing apps.

Intel Optane persistent memory modules

According to Intel, Intel Optane PMem "can help businesses fuel innovation with increased capacity and unique memory modes, lower overall TCO while maximizing VM densities, and increase memory security with automatic hardware-level encryption."[3]

To learn more about Intel Optane persistent memory, visit ***https://www.intel.com/content/www/us/en/architecture-and-technology/optane-dc-persistent-memory.html***.

Support more VDI users with Intel Optane persistent memory

Light workloads: 3 GB of virtual memory per user

In this test, we allocated 3 GB of virtual memory per desktop (1.5GB reserved) and used the Power Worker workload of the Login VSI benchmark to determine maximum user density. First, we found that the configuration with 768GB DRAM alone supported 256 desktops, while the configuration with 1.5 TB of Intel Optane PMem with 384GB DRAM supported 10 additional sessions—for a total of 266—while also slightly improving desktop latency by 9.9 percent. The Intel Optane PMem configuration was capable of supporting more users, and at the same time, it delivered similar virtual desktop response times (see Figures 2 and 3). Figure 4 shows that both configurations reached maximum CPU utilization at these user counts.

With traditional DRAM alone, memory became a bottleneck that caused CPU overhead to reduce the number of VDI sessions. This means that by adding Intel Optane persistent memory to Dell EMC PowerEdge R740xd servers, organizations can expand their virtual desktop capacity to support more users working from home without the expense of adding many new servers.

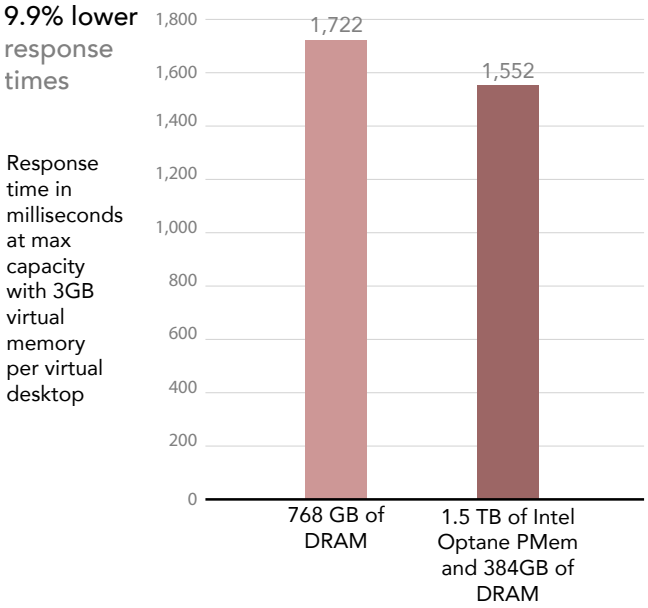


Figure 3: Response times at max capacity with 3 GB of virtual memory per user. Lower is better. Source: Principled Technologies.

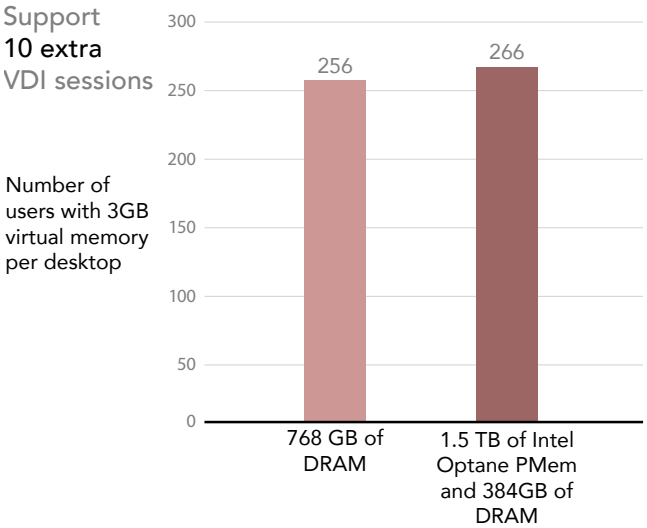


Figure 2: VDI users supported with 3 GB of virtual memory per user. Higher is better. Source: Principled Technologies

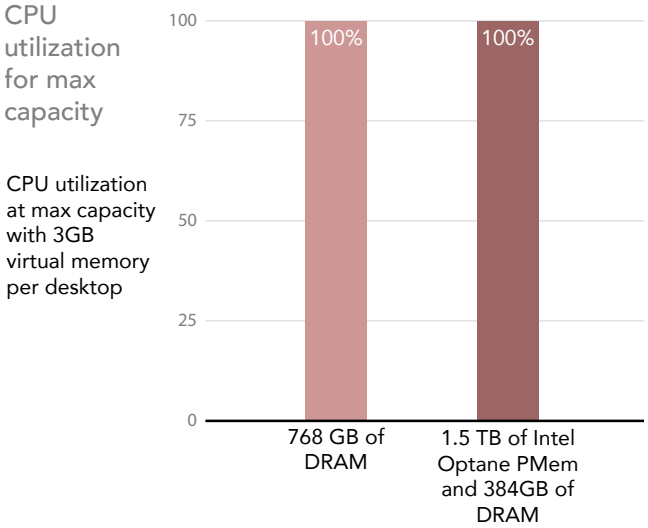


Figure 4: CPU utilization at max capacity with 3 GB of virtual memory per user. Source: Principled Technologies.

About Dell EMC PowerEdge R740xd servers

The Dell EMC PowerEdge R740xd is powered by Intel® Xeon® Scalable processors. It features 24 DIMM slots and up to 271 TB of storage between its front, mid, and rear bays, and includes the iDRAC9 management tool, SupportAssist for proactive customer support, and an out-of-band management architecture.

Learn more at ***https://www.dell.com/en-us/ work/shop/povw/poweredge-r740xd***.

Medium workloads: 6 GB of virtual memory per user

Provisioning and reserving 6 GB of virtual memory per user showed that by adding Intel Optane persistent memory to the Dell EMC PowerEdge R740xd, you can more than double the VDI user density (see Figure 5). This enormous boost in supported desktops is in part because Intel Optane persistent memory allows the server to use CPU resources more effectively; as Figure 7 shows, the traditional DRAM configuration failed to use the majority of processor resources available. The Intel Optane PMem configuration doubled the number of supported desktops while still maintaining acceptable response times of 1,308 milliseconds (see Figure 6); well below the 1,730ms threshold where users may notice a drop in performance according to the Login VSI benchmark.

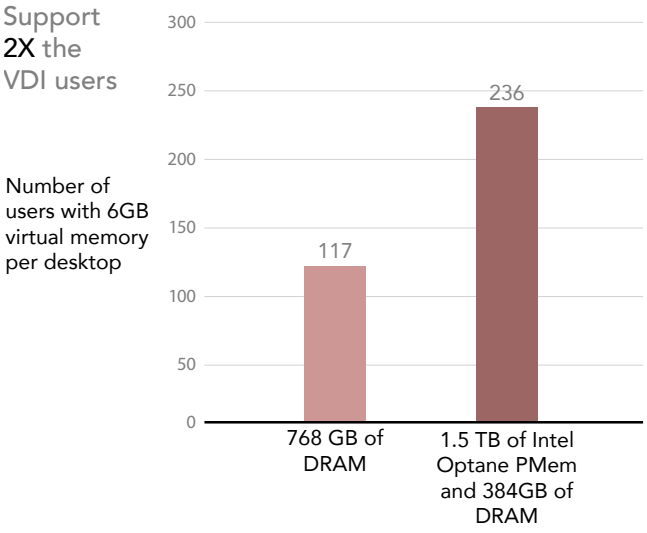


Figure 5: VDI users supported with 6 GB of virtual memory per user. Higher is better. Source: Principled Technologies.

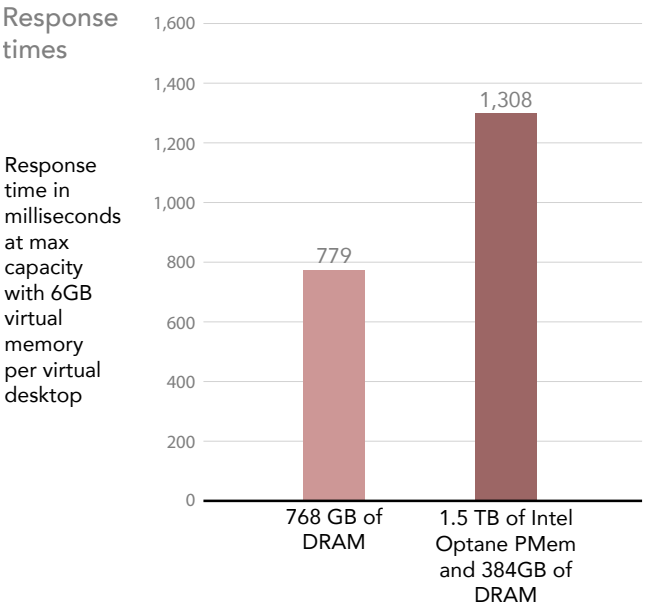


Figure 6: Response times at max capacity with 6 GB of virtual memory per user. Lower is better. Source: Principled Technologies.

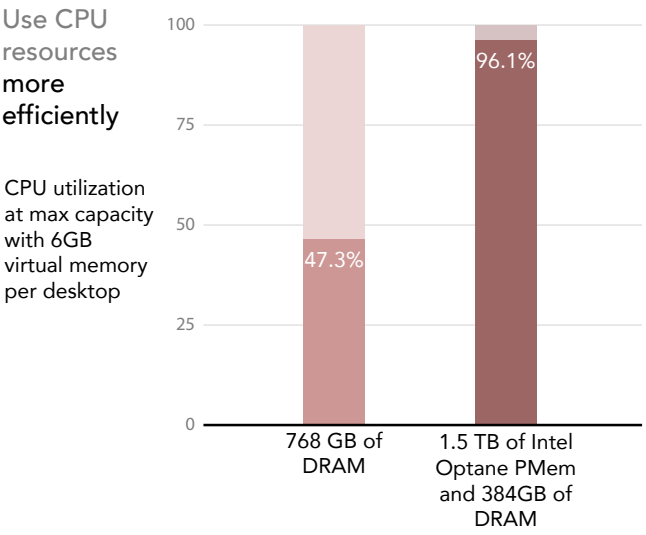


Figure 7: CPU utilization at max capacity with 6 GB of virtual memory per user. Source: Principled Technologies.

Heavy workloads: 12 GB of virtual memory per user

Next, we increased the virtual memory amount for each VDI user to 12 GB (12 GB reserved). As in the 6GB memory tests, power users allotted 12 GB of virtual memory benefited from adding Intel Optane persistent memory. As Figures 8 and 9 show, the desktop session count doubled with only a minimal increase in desktop response time. Again, the Intel Optane PMem configuration was able to make more efficient use of available CPU resources (see Figure 10).

Figure 8: VDI users supported with 12 GB of virtual memory per user. Higher is better. Source: Principled Technologies.

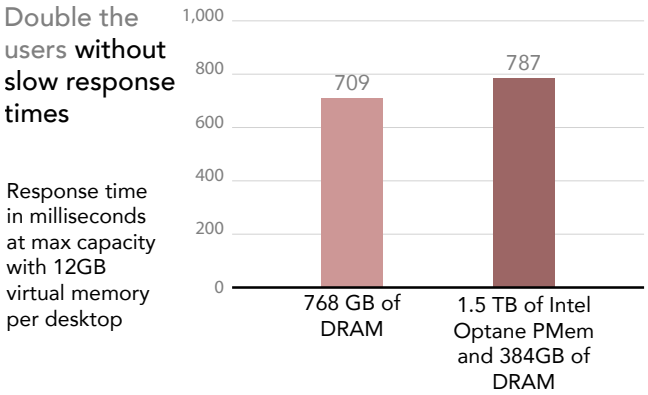


Figure 9: Response times at max capacity with 12 GB of virtual memory per user. Lower is better. Source: Principled Technologies.

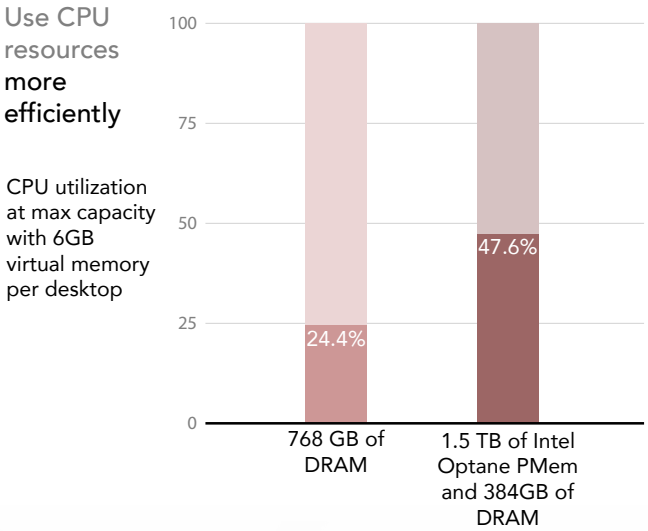


Figure 10: CPU utilization for max capacity with 12 GB of virtual memory per user. Source: Principled Technologies.

Intel Xeon Gold 6248R processors

This processor has 24 cores and a core frequency of 3.0 GHz. To learn more about this processor and other Intel Xeon Scalable offerings, visit ***https://ark.intel.com/content/www/us/en/ark/products/199351/intel-xeon-gold-6248r-processor-35-75m-cache-3-00-ghz.html***.

Extrapolating to multiple servers (running a Medium workload with 6 GB virtual memory per user)

Though we tested with a single Dell EMC PowerEdge R740xd actively running the VDI workload, we expect the benefit of Intel Optane persistent memory to scale as you add more server nodes, assuming your storage and network resources are not a bottleneck. Figure 11 extrapolates the results of our testing into four-node, eight-node, and twelve-node desktop counts. The benefit of adding Intel Optane persistent memory becomes clear when you consider the additional number of server nodes you would have to purchase, store, and manage to achieve the same user density possible with Intel Optane. Reducing the number of servers in your data center reduces expenses related to data center space, power and cooling, software licensing, maintenance, and networking and storage connectivity. Because of the shift to working from home, users' memory needs may be increasingly scaling up to support additional apps they may not have used previously, such as videoconferencing and collaboration apps. Adding Intel Optane persistent memory to the Dell EMC PowerEdge R740xd can ensure your workers have enough memory now and as their needs continue to increase, allowing organizations to future-proof their data center for whatever comes next.

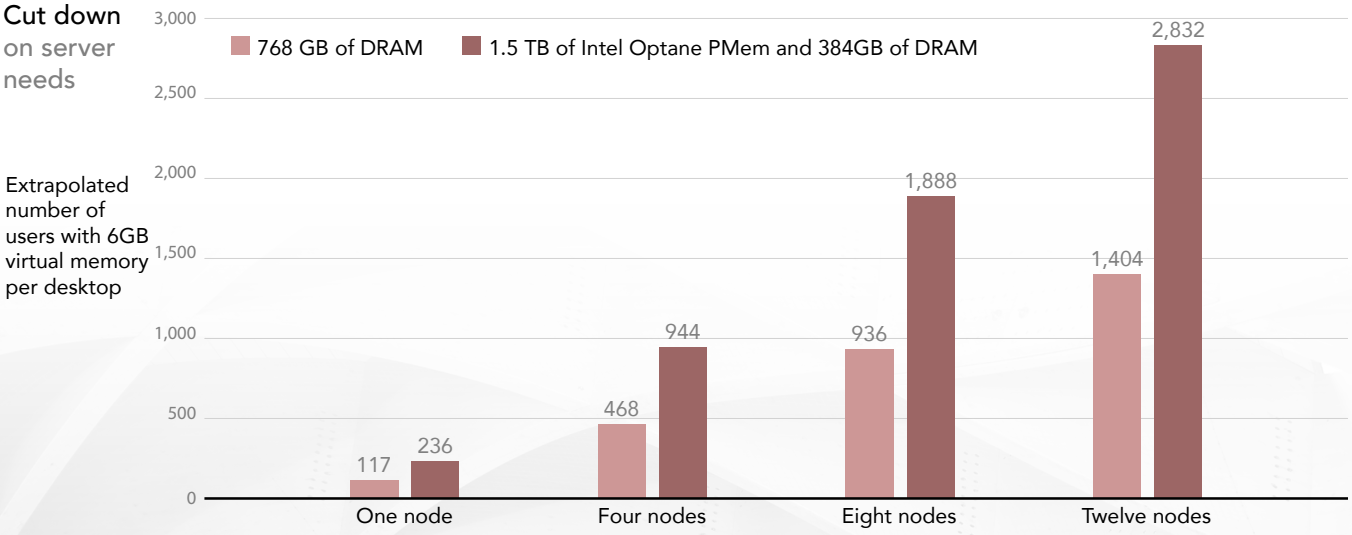


Figure 11: Extrapolated number of VDI users supported with 6 GB of virtual memory per user (results taken from single-node testing). Higher is better. Source: Principled Technologies

Intel Optane SSD DC P4800X Series

In our tests, we used Intel Optane SSD DC P4800X Series drives to accelerate storage performance. According to Intel, Optane SSDs offer an "industry-leading combination of high throughput, low latency, high QoS, and high endurance…to break through data access bottlenecks by providing a new data storage tier."[4]

To learn more about the Intel Optane SSD DC P4800X Series, visit ***https://www.intel.com/content/www/us/en/products/docs/memory-storage/solid-state-drives/data-center-ssds/optane-ssd-dc-p4800x-p4801x-brief.html***.

Conclusion

In hands-on testing, we compared VDI performance of a Dell EMC PowerEdge R740xd server with DRAM alone to the same configuration with added Intel Optane persistent memory. To help organizations dig into the differences they might see according to their users' memory needs and the processors they use, we tested these memory configurations across three different user memory requirements. Adding 1.5 TB of Intel Optane PMem to the server allowed it to support up to twice as many VDI users as using DRAM alone. These results indicate that Dell EMC PowerEdge R740xd servers with Intel Optane persistent memory could help organizations supporting an influx of VDI users—many with increasingly demanding memory needs—do so more efficiently and without the need to expand to more servers and data center locations.

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1 Nicholas Bloom, "How working from home works out," accessed November 4, 2020, ***https://siepr.stanford.edu/research/publications/how-working-home-works-out***.

2 Citrix, "Citrix VDI Handbook and Best Practices," accessed January 29, 2021, https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-15-ltsr/downloads/handbook-715-ltsr.pdf.

3 Intel, "Intel Optane DC Persistent Memory," accessed November 4, 2020, ***http://intel.com/optanepersistentmemory***.

4 Intel, "Product Brief: Intel Optane SSD DC P4800X/P4801X Series," accessed November 4, 2020, ***https://www.intel.com/content/www/us/en/products/docs/memory-storage/solid-state-drives/data-center-ssds/optane-ssd-dc-p4800x-p4801x-brief.html***.

Read the science behind this report at http://facts.pt/lPlA8ux ►

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