signal65

Improving Enterprise Application Performance with Nutanix and Intel

AUTHOR

Jonathan Fellows
Performance Validation Engineer | Signal65

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Overview

As companies' demands grow for IT infrastructure that can support their needs, upgrading both hardware and software are part of operational best practices. A recent Futurum Group CIO survey found that nearly 50% of respondents see Modernization as a key factor driving IT purchases in 2025. This indicates companies are ready to spend to make sure they are keeping up with the requirements that modern applications need.

Some of the challenges faced by companies include how to maintain existing applications and modernizing their infrastructure while also supporting new applications like container-native applications. By modernizing to a Hyper-Converged platform, companies can solve this problem with both new compute and storage elements. A major benefit of modernizing to a Hyper-Converged platform is that both the compute and storage elements are refreshed with the latest Intel processors together at the server refresh cycle rate. This is typically much faster (2 -3 years) than an external storage refresh cycle (3-5 years).

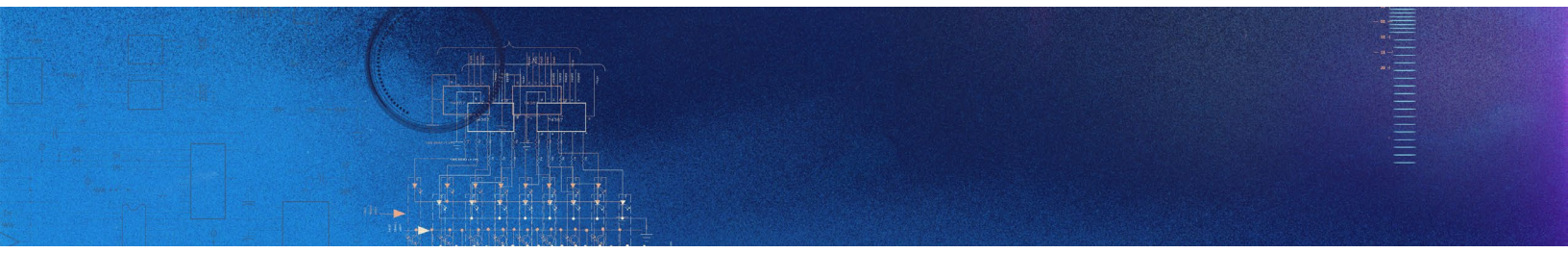
Nutanix and Intel asked Signal65 to conduct testing to determine the potential performance gains from a cluster software-only upgrade, compared to a hardware and software upgrade with a newer generation of Nutanix and Intel-based systems. Our extensive testing of systems over the past several years has shown that companies using older hardware can often experience significant gains by upgrading their infrastructure, including performance gains and the opportunity for cost savings due to higher efficiency.

Databases are a popular application deployed on virtualized, hyper-converged systems. A common database application in use is Microsoft SQL Server running on virtual machines (VMs). HammerDB is a popular benchmark tool for testing database applications including SQL Server. In this analysis, Signal 65 utilized HammerDB to test both older and newer configurations of Nutanix software together with Intel hardware. Additionally, a Kubernetes workload was added in for one test case to show how a modern workload would impact results. Important findings from this testing are summarized below.

Major Findings:

- 3.57x performance gain with new Intel 5th Generation Xeon systems + Nutanix AOS software over older hardware/software with database workloads using new Nutanix Software and Intel 5th Generation Xeon systems
    - Nutanix AOS 6.10 running on Intel 5th Gen Xeon Platinum 8562Y+ processors vs Nutanix AOS 6.5 running on Intel 2nd Gen Xeon Gold 6240 processors
- 18% performance boost with Nutanix AOS 6.10 software vs. AOS 6.5 software, both running on 2nd Gen Intel Xeon Gold 6240 systems
- 3.07x performance gain of database workload while also running a containerized workload on the Nutanix Kubernetes Platform (NKP) with Nutanix AOS 6.10 and 5th Generation Intel Xeon systems

Note: *Details on hardware and software are provided in the Appendix.*



Nutanix Cloud Platform

Nutanix provides a software solution that enables customers to manage their cloud and on-premises resources using a single management platform. Companies can save time and resources by reducing the complexity that can arise from having data and infrastructure spread across multiple environments. The Nutanix solution also enables running mainstream VM-based applications and containerized applications under Kubernetes on the same, shared infrastructure.

Nutanix Prism provides a high-level unified management view for managing multi-cloud and on premises infrastructure. Prism works alongside Nutanix's hyperconverged element manager, to provide additional data protection, RBAC, device management, security and monitoring. Additionally, Prism supports the deployment and management of Kubernetes clusters, using Nutanix's NKP (Nutanix Kubernetes Platform).

Nutanix's storage solution, AOS Storage, is software-defined storage capable of supporting on-premises, edge and public cloud deployments. Features such as data tiering, data locality, scalability, and support for NVMe storage drives provide high performance storage capable of supporting any business-critical applications.

AOS Storage has seen continuous improvements, with the latest modifications targeted towards optimizing block storage performance, crucial for attaining low-latency and maximum I/O rates demanded by database applications. Nutanix calls this Blockstore, which includes a meta-data KV store, along with the latest enhancements to optimize storage using Intel's Storage Performance Development Kit (SPDK), which provides direct device access from user space, to further enhance storage performance. Nutanix also developed its Autonomous Extent Store (AES) metadata manager to aid in reducing I/O overhead. This technology was released in AOS version 6.8. All these Nutanix technologies combined with Intel's SPDK results in significantly reduced latencies to make transaction heavy applications like Microsoft SQL Server run faster and more efficiently.

Intel Xeon Processors

Intel provides leading-edge processors and data center technologies for enterprise systems. Intel Xeon series processors have a proven level of performance that can easily meet the needs of organizations. When combined with an effective software solution such as Nutanix, Intel Xeon processors can realize their full potential. This testing highlights the performance benefits of Intel's 5th Generation Xeon 8562Y+ processor.

Test Overview

Nutanix and Intel contracted Signal65 to examine the difference in performance between older Nutanix AOS software running on 2nd Gen Intel Xeon CPUs vs newer generation 5th Gen Intel Xeon systems and updated AOS software/hardware. These configurations were chosen to represent what many Nutanix customers are currently using and how updating the AOS software together with newer hardware can dramatically improve the performance of existing workloads.

Specifically, this testing utilized the following hardware and software configurations:

- Hardware based on 2nd Generation Intel Xeon processors (Cascade Lake), along with Nutanix AOS software
  - 2nd Gen Intel Xeon 6240 CPUs with AOS 6.5/6.10, SSD drives
- Newer hardware based on 5th Generation Intel Xeon processors (Emerald Rapids), together with the latest AOS version 6.10 software
  - 5th Gen Intel Xeon Platinum 8562Y+ processors, AOS 6.10, NVMe drives

With the continued rise of container-native applications, companies need to be able to leverage platforms that can support them. Nutanix supports Kubernetes clusters which enables customers to meet their container needs. Nutanix's architecture allows for both VMs and containers to be deployed on the same physical hosts, greatly expanding options for running applications simultaneously.

Testing Setup

Workloads

The following workloads were conducted in this testing:

- A HammerDB TPC-C like workload running on Microsoft SQL Server with 16 VMs. Each SQL VM was assigned 10 vCPUs and 96GB of RAM.
- Mixed workload scenario, the HammerDB workload along with a 4 node Kubernetes cluster running a custom synthetic container workload that generated a significant CPU and memory load (~30% of cluster CPU Utilization % and ~70% of cluster RAM) using Grafana k/6.
- The same HammerDB TPC-C like workload with 6 vCPUs per SQL VM instead of 10 to showcase how new hardware/software can improve performance with a smaller footprint.

All VMs and Kubernetes nodes had memory overcommit enabled. The SQL VMs were created from the same template when the new hardware was being used, so the VMs were essentially the same throughout. A snapshot of the VMs was taken before running the workload and was reverted before each round of testing to maintain consistency. VMs and Kubernetes nodes were evenly distributed and pinned across physical nodes.

Hardware and Software

The equipment tested was provided by Nutanix and Intel which included a 4-node cluster, using 2 Intel Xeon processors, 6 drives per host, and 2 network switches for the cluster. The older generation configuration used AOS 6.5 for the cluster software, and 2nd Generation Intel Xeon 6240 processors. The software was then upgraded from AOS 6.5 to AOS 6.10 using the same hardware and the HammerDB workload was run again.

For the newer platform tests, the hardware was also upgraded. Drives were upgraded from SSDs to NVMe, RAM increased from 512GB to 1TB per host, network interfaces were upgraded from 10Gb/s to 25Gb/s, and Intel 2nd Gen Xeon Gold 6240 18 core processors were upgraded to 5th Gen Intel Xeon Platinum 8562Y+ 32 core processors. A 32 core processor was chosen for the 5th Gen Xeon to maximize performance potential vs a 24 or 18 core processor. Additionally, the 32 core processor is better suited to handle more intense workloads in the future with the continuous development of AI applications. While the initial cost of a 32 core processor is higher, there is the potential for greater savings in the long run due to higher efficiency leading to fewer nodes being required for the same workload.

Please refer to the appendix for additional hardware and software details.

***Signal65 Comment:** The hardware upgrades are in-line with our experiences of typical configurations from 3+ years ago to current day. The intention was to highlight potential performance gains a typical user would experience, if they upgraded a typical system purchased 3 years ago to a current generation system.*

The Role of vCPUs

For those who may be unfamiliar with a vCPU (virtualized CPU), it is a way to allocate compute resources to a VM or container. For this series of tests, 10 vCPUs were chosen for the SQL VMs to maintain consistency across tests when there were new hardware/software updates being made. The vCPU settings were left unchanged to provide as fair of an apples-to-apples comparison as possible (except for the one test case where 6 vCPUs were used). Before settling on 10 vCPUs for the SQL VMs, several tests with various vCPU and RAM VM configurations were performed on the original setup (AOS 6.5, old hardware) to find which combination gave the highest performance. 10 vCPUs with 96GB of RAM per SQL VM was the highest performing combination tested, and that VM configuration was used for all subsequent testing.

Diagram 1 below depicts the basic concept of the testing setup. Please refer to the Appendix for additional details on the setup and environment.

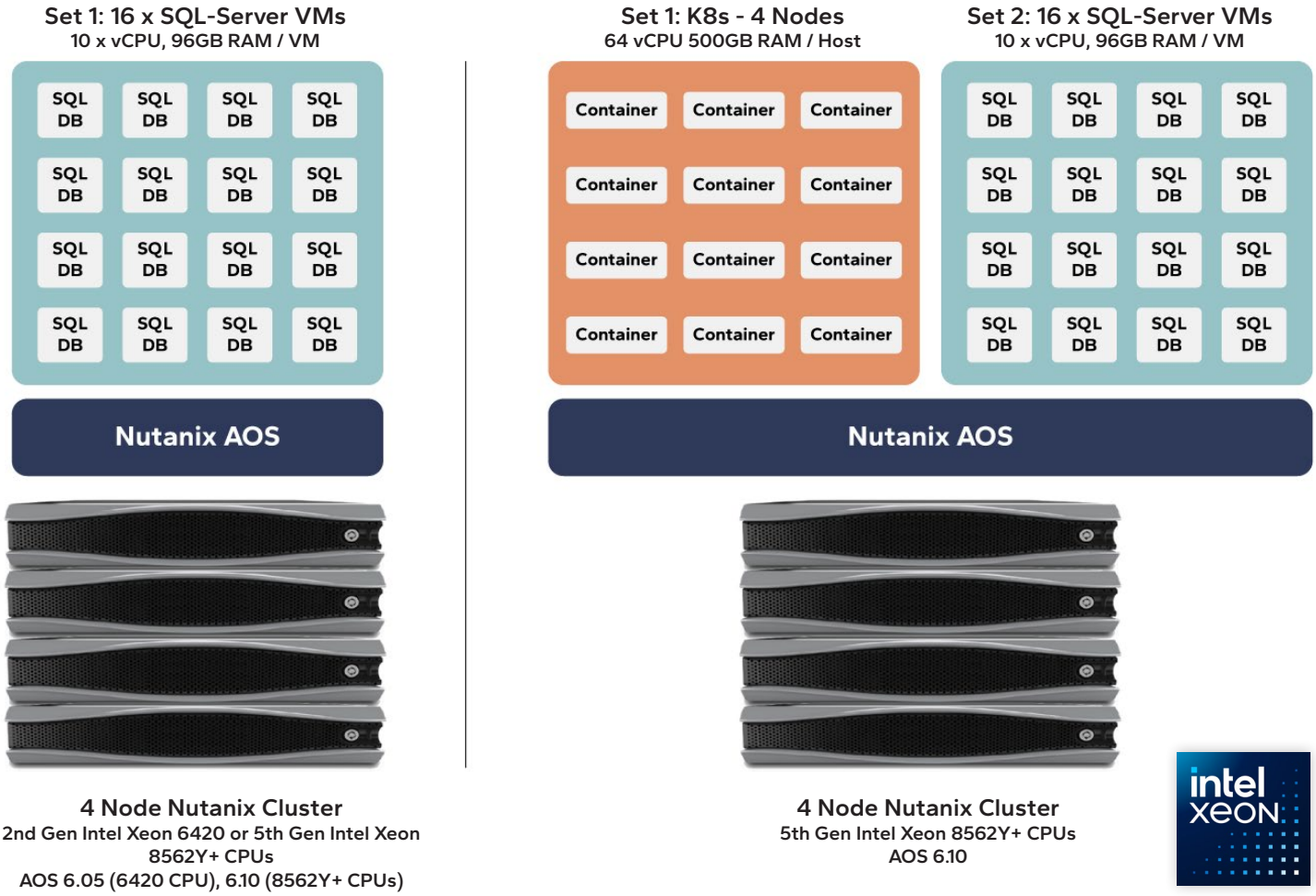


***Diagram 1:** An overview of the testing configurations*

The 5 configurations tested include:

- HammerDB SQL VM workload – 10 vCPUs per SQL VM
  - 2nd Gen Intel Xeon Gold 6240 processors – Nutanix AOS 6.5 (Old Hardware)
  - 2nd Gen Intel Xeon Gold 6240 processors – Nutanix AOS 6.10 (Old Hardware)
  - 5th Gen Intel Xeon Platinum 8562Y+ processors – Nutanix AOS 6.10 (New Hardware)
- HammerDB SQL VM workload – 10 vCPUs per SQL VM + Kubernetes Container workload
  - 5th Gen Intel Xeon Platinum 8562Y+ processors – Nutanix AOS 6.10 (New Hardware)
- HammerDB SQL VM workload – 6 vCPUs per SQL VM
  - 5th Gen Intel Xeon Platinum 8562Y+ processors – Nutanix AOS 6.10 (New Hardware)

Results Collection

The main metric collected from these tests was the sum of New Orders Per Minute (NOPM) of each SQL VM, averaged across 3 separate HammerDB runs. The results were then normalized to the lowest compared value. Total CPU Utilization % of the Cluster was also recorded and compared for each test as reported by Prism for some additional context; these data can be found in the Appendix.

Table 1, found in the Appendix, includes the normalized NOPM results from HammerDB, as well as the approximate Cluster and SQL VM CPU Utilization % collected from Prism. The CPU Utilization % data are estimated from the Prism graphs aligning with the middle of the test period, which can also be found in the Appendix.

Results Analysis

The key takeaways from analysis of the results are summarized below:

- 3.57x the performance with 5th Generation Intel Xeon Platinum based systems on AOS 6.10 vs 2nd Generation Intel Xeon Gold based systems on AOS 6.5
- 2.65x gain in performance with 5th Generation systems on AOS 6.10 vs 2nd Generation systems on AOS 6.5, even when dropping the number of virtual CPUs assigned to the HammerDB VMs from 10 to 6. More than doubling the performance with a lower resource footprint.
- Running a mixed workload with both database and Kubernetes applications resulted in a 3.07x performance gain in the HammerDB workload with 5th Generation systems on AOS 6.10 vs 2nd Generation systems on AOS 6.5.
- 18% increase in performance by updating the AOS software from 6.5 to 6.10 on the 2nd Generation systems.

The performance gains can be seen by increases in normalized New Orders per Minute (NOPM). Immediately noticeable when looking at Figure 1 below is how the newer hardware/software configurations outperformed the older hardware/software configurations. (Older configuration(s) are on the left in all charts. AOS version is assumed to be 6.10 unless otherwise labeled.)

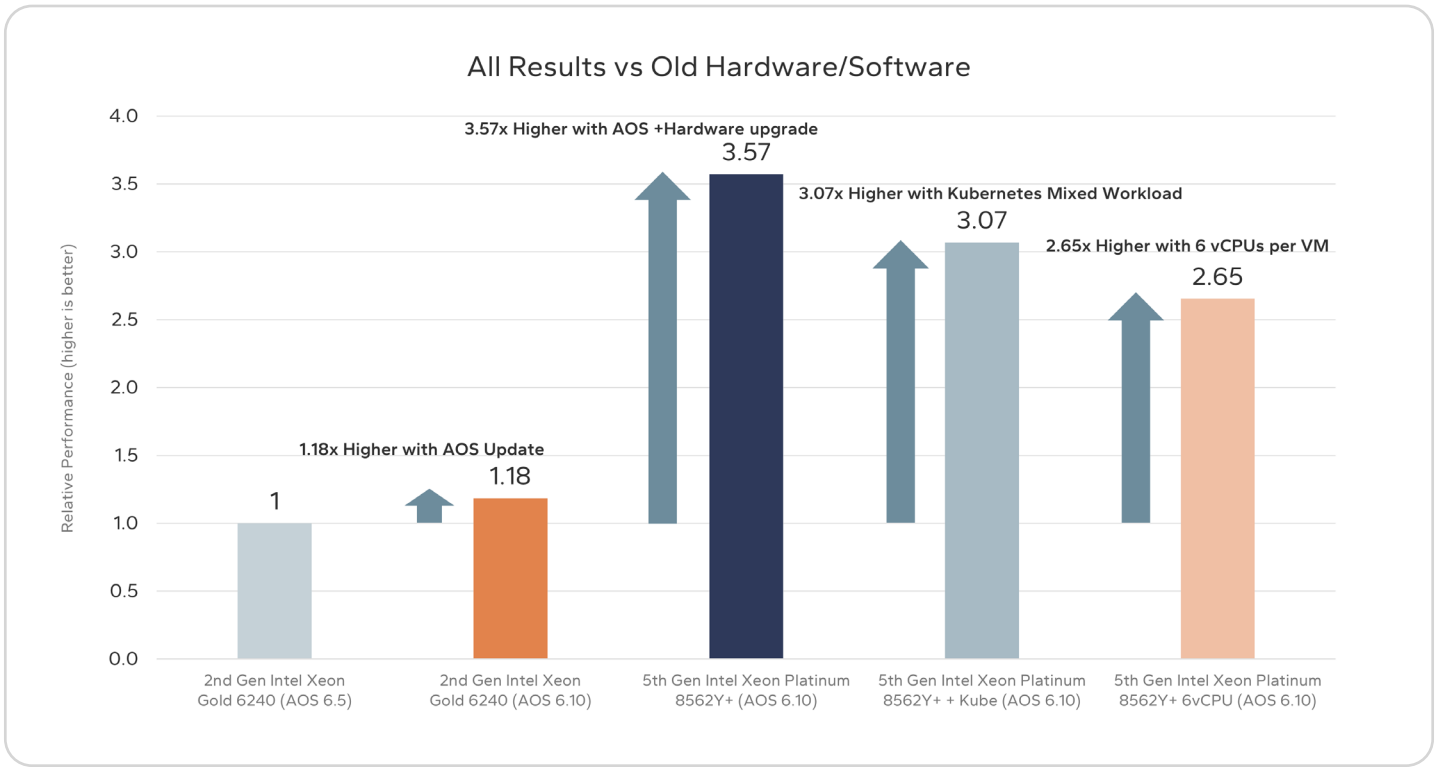


Figure 1: *Summary of All HammerDB Results vs Old Hardware/Software Normalized to 6240 CPU with AOS 6.5*

Signal65 Comment: : In our experience with similar tests, upgrading not just CPUs and software, but SSD drives to NVMe, increased system RAM and faster network connections will provide a major performance boost to any storage workload. These results are what can be expected with all the different upgrades that were done.

AOS 6.5 vs AOS 6.10

AOS software, described above on page 2, was tested both with the older 6.5 and newer 6.10 versions. The new version of AOS had several changes which helped to improve storage efficiency. Improving storage efficiency should theoretically make a storage workload perform better. When examining in detail the performance results of Nutanix AOS 6.5 and 6.10 software on the older generation hardware configuration, AOS 6.10 clearly provides a performance advantage over AOS 6.5.

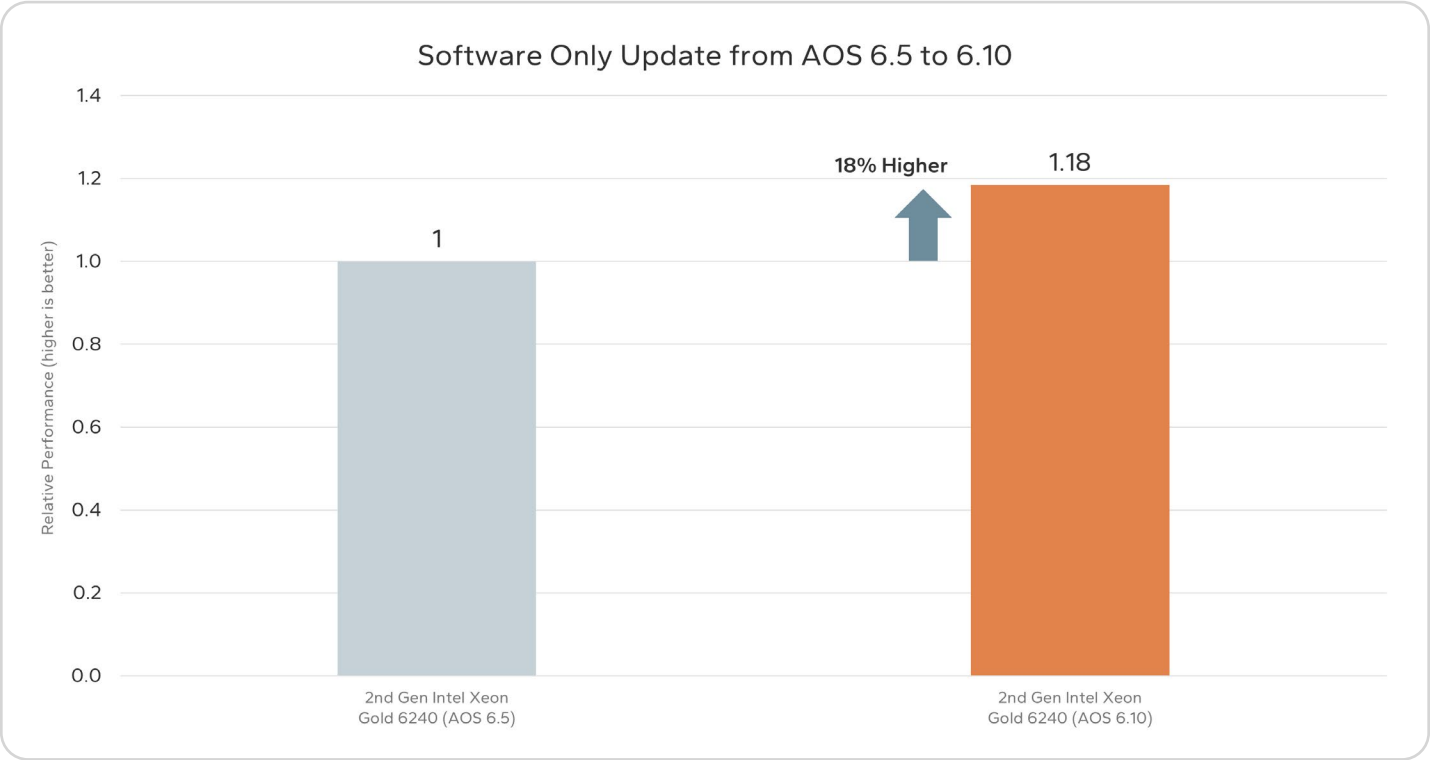


Figure 2: *HammerDB results with 2nd Gen Intel Xeon Gold Processors and Old Hardware Normalized to AOS 6.5*

Upgrading the cluster AOS software, and only the software, resulted in an 18% increase in performance with the HammerDB SQL Server workload. With an 18% increase in performance, the total CPU utilization for the cluster was only slightly more with the updated software, ~5%. This indicates the software update helps to make storage run faster, and more efficiently. Since updating AOS is a relatively simple process, the impact of taking a short amount of time to have an 18% increase in performance is something Nutanix customers should seriously consider if they have not already done so.

SQL + Kubernetes

Adding on a Kubernetes workload to the HammerDB SQL Server workload showcases a more modern approach to how companies run their applications. Using the same HammerDB workload, along with the Kubernetes container workload, the HammerDB results were still 3.07x the older hardware/software configuration (AOS 6.10). As referenced before companies can now run container applications using Nutanix's NKP, while also getting better performance out of their current applications. Total Cluster CPU Utilization % was ~80% with this combined workload, leaving some additional headroom for other operations if needed.

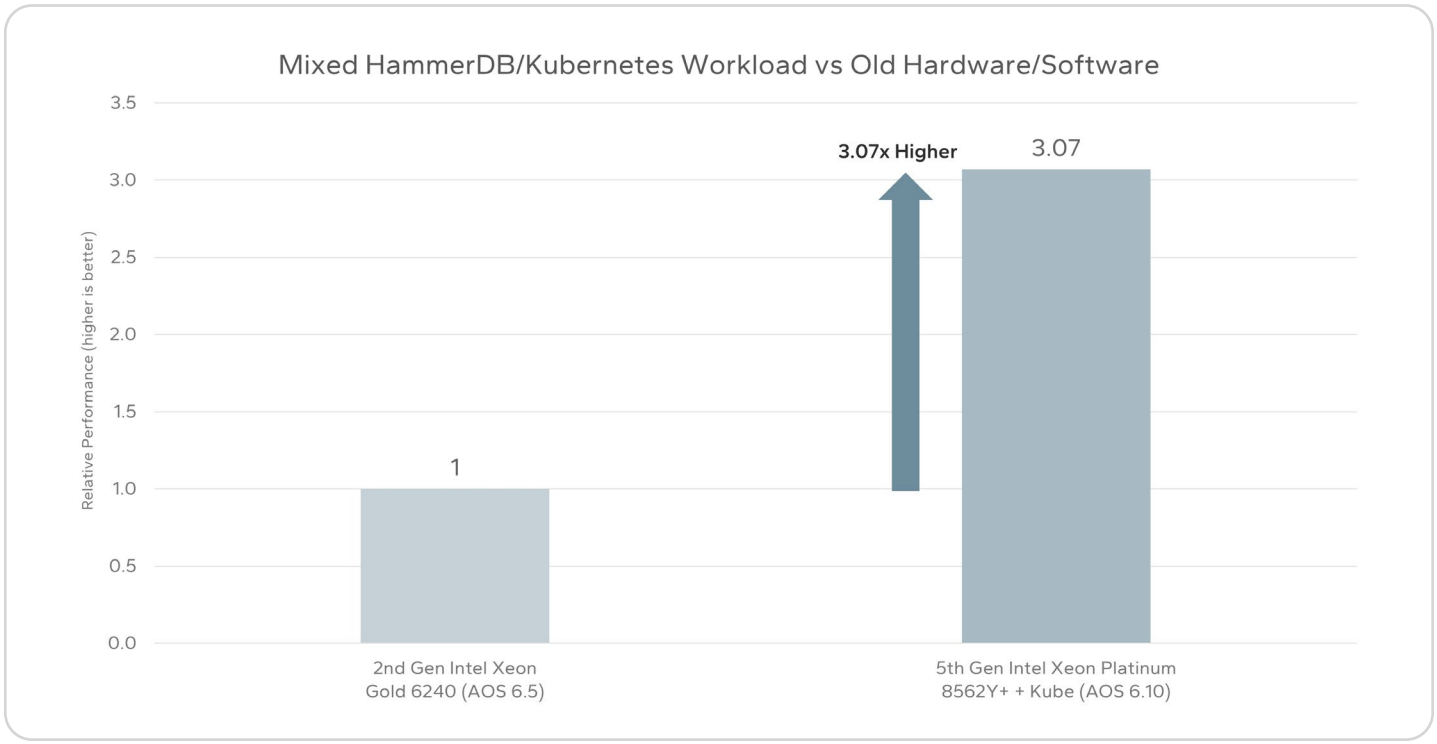


Figure 3: *Normalized HammerDB results with Mixed Kubernetes workload vs Old Hardware/Software*

Lowering vCPUs and Lowering Costs

An additional test was performed where the vCPUs were lowered from 10 to 6 in the SQL VMs to demonstrate the efficiency of the newer hardware configuration, while keeping the number of applications the same. Even with lowering the number of vCPUs, results were still 2.65x the performance of the older hardware on AOS 6.05.

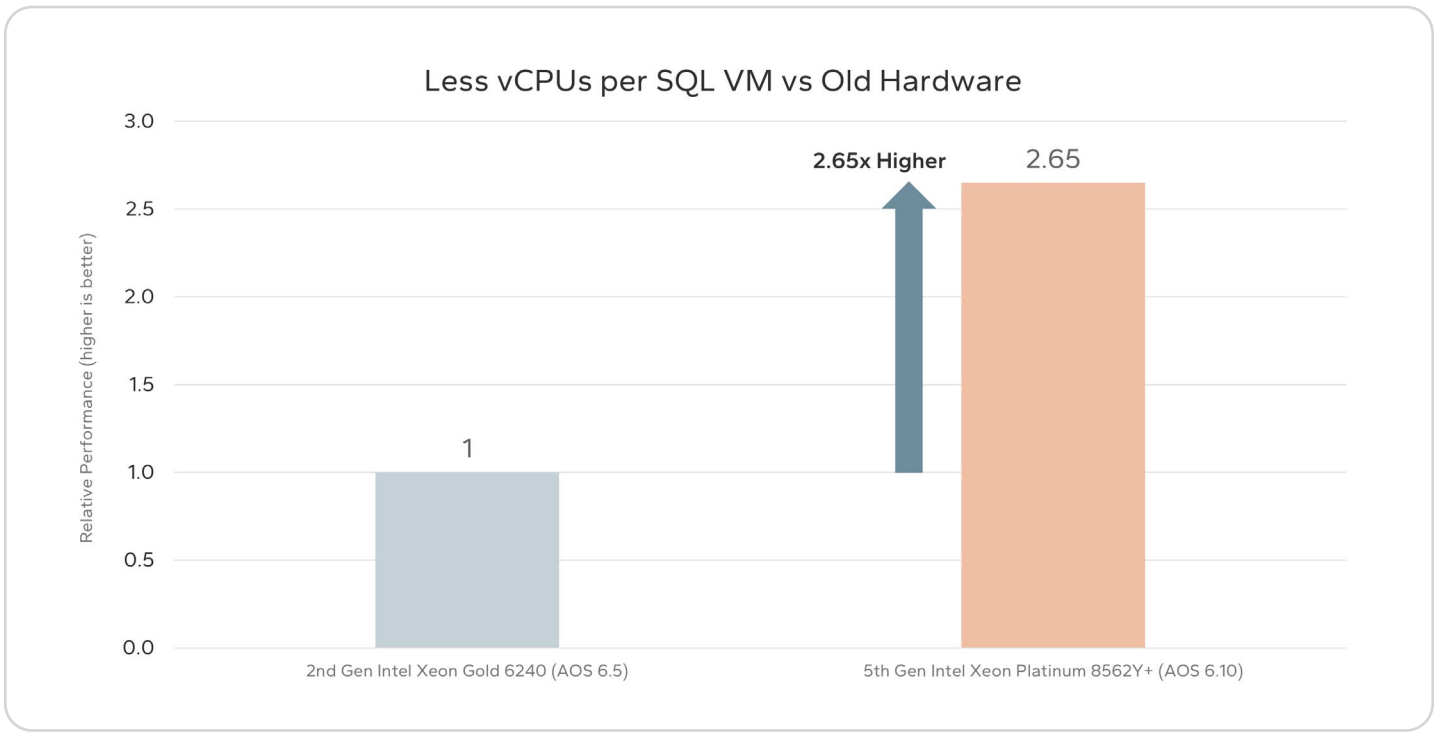


Figure 4: *HammerDB results with 6 vCPUs assigned to SQL VMs vs 10 vCPUs Normalized to 6240 AOS 6.5*

Licensing costs for Microsoft SQL Server could be significantly lowered by upgrading to newer generation hardware/software. Depending on the type of plan companies choose to license their SQL applications, Pay-As-You-Go pricing incurs charges based on the number of vCPUs assigned to SQL VMs. Upgrading hardware/software leads to a performance increase.

In this example companies can lower their CPU allocation to SQL applications by 40%, and still attain better performance compared to their old setup. Cost savings could be significant, given the high-licensing cost per CPU core allocated. Lowering the number of vCPUs assigned to the SQL VMs also frees up more resources for other operations, which can help to improve overall efficiency.

Summary

As hardware and software technology change, it is imperative that companies leverage the most efficient stack in order to maintain parity or even gain advantages versus their competitors. As our testing showcased, combining 3 years of software changes with 3 years of hardware changes can result in significant efficiency benefits.

When used together – new Nutanix software together with Intel Xeon processors and hardware updates combine to provide a solution that greatly outperforms previous generations of Nutanix software and Intel Xeon processors. More importantly, the performance gains enable companies to run more than their applications over 3X faster, thereby offering the possibility of cost savings through consolidation, or significantly expanding applications in the same footprint.

The testing done by Signal65 contracted by Nutanix and Intel clearly show the multiple benefits that come with upgrading both hardware and software.

- Updating AOS from 6.5 to 6.10 showed an 18% performance increase on older hardware, a simple change that provides a significant amount of gain.
- Newer 5th Gen Intel Xeon processors and other hardware upgrades provide up to 3.57x the performance of the older hardware/software configuration.
- Adding on a Kubernetes container workload alongside the SQL workload still produced 3.07x the SQL performance of the older configuration.

While there are challenges associated with large scale hardware upgrades and software updates, the performance and cost savings benefits are clear. Here Signal65 has shown that Nutanix and Intel together provide an effective, high-performance solution that provides significant benefits compared to the older software and hardware. Beyond just performance, companies could see cost savings if they chose to consolidate multiple cluster workloads onto fewer.

Additionally, as container applications become more popular, having the right software and hardware to support both container and VM based applications is important. If companies are using older Nutanix software and Intel equipment, updating to the latest generation of hardware and software enables companies to run both VMs and containers on Nutanix systems. This practice may help provide reduce IT management cost, complexity and training.

In short, the benefits to upgrading both hardware and software are significant, and should be considered by all current Nutanix customers.

Appendix

Nutanix Configuration details:

- Nutanix CVMs were set to have 16 cores and 48 GiB of RAM per physical host on both AOS 6.5 and 6.10 on both clusters
- The same Prism Central was used between the two clusters running on a separate, dedicated host
- The 2nd Gen Intel Xeon Configuration (Old) was deployed with AOS 6.5.5.1 and then updated to 6.10
- The 5th Gen Intel Xeon Configuration (New) was deployed with AOS 6.10

Cascade Lake Configuration (Old) - 1 cluster, 4-node HCI cluster with following config per node:

- Intel Based servers
- 2 socket Intel® Xeon® Gold 6240 CPU @ 2.60GHz
- 512 GB RAM
- 6 x 3.84TB SSD (Intel S4510/S4610/S4500/S4600 Series SSDs)
- 2 x Silicon 10GbE, 2-port, NIC (Intel 82599ES)

Emerald Rapids Configuration (New) - 1 cluster, 4-node HCI cluster with the following config per node:

- Intel Based servers
- 2 socket Intel® Xeon® Platinum 8562Y+ @ 2.80GHz
- 1024 GB RAM
- 6 x 3.2TB NVMe Drives
- 1 x Intel E810-XXV Dual Port 10/25GbE SFP28 Adapter

HammerDB Configuration

HammerDB was set to use 14 virtual users per VM with 10 vCPUs, 8 virtual users per VM with 6 vCPUs.

The test included a 2 minute warm up period followed by a 5 minute test period, and a 1 minute ramp down.

SQL Server VM Configuration

16 VMs, 4 per physical host - pinned, 10vCPU / 6vCPU (test dependent), 96GB RAM

Storage configuration for the SQL VMs was done following HammerDB guidelines, separate disks for the DB, Logs, and Temp directories.

Kubernetes Configuration

4 Node Kubernetes Cluster deployed on the same 5th Gen Intel Xeon 4 node physical cluster, 1 Kubernetes node per physical node - pinned, 500GB RAM and 64 vCPUs per node.

The container workload ran for a total of 30 minutes. The SQL test was started approximately in the middle of this workload for the combined workload test.

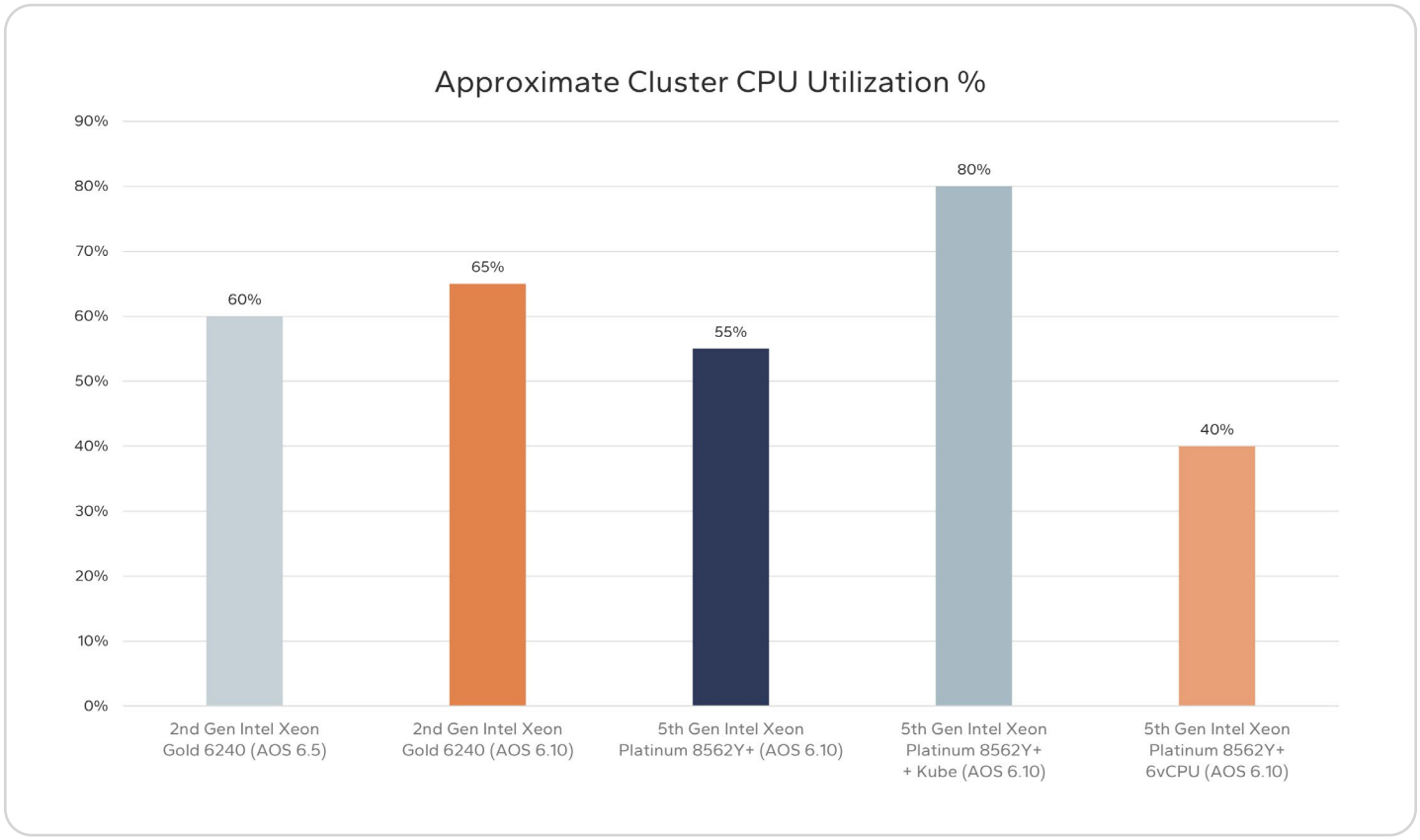
Grafana k/6

4 worker pods were created, one pod per Kubernetes node, a custom workload definition was used to generate CPU and memory load on the cluster.

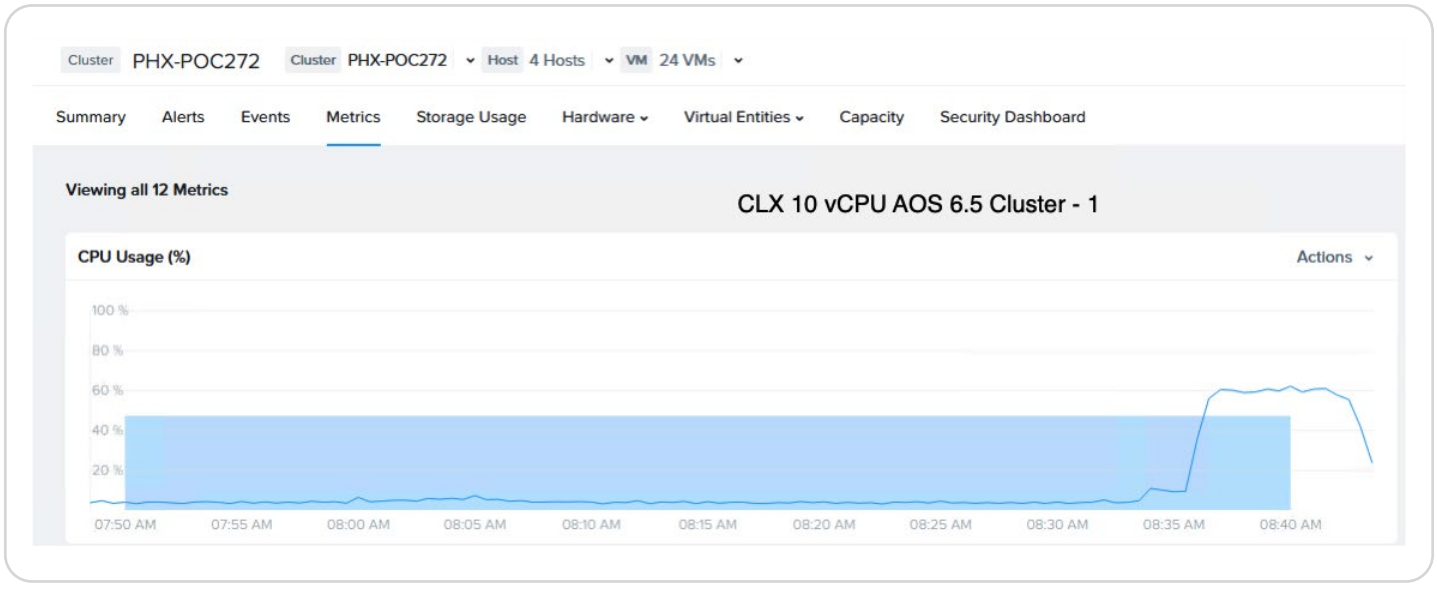
Results Data

Configuration	**HammerDB Results** (Normalized to 6240 w/ AOS 6.5)	**HammerDB Results** (Normalized to 6240 w/ AOS 6.10)	**Change from 6240 w/ AOS 6.5**	**Change from 6240 w/ AOS 6.10**	**Cluster CPU Utilization %**
Xeon Gold 2nd Gen 6420 CPU AOS 6.5	1	N/A	N/A	N/A	~60%
Xeon Gold 2nd Gen 6420 CPU	1.18	1	1.18x	N/A	~65%
Xeon Platinum 5th Gen 8562Y+ CPU	3.57	3.01	3.57x	3.01x	~55%
Xeon Platinum 5th Gen 8562Y+ CPU – 6vCPU per SQL VM	2.65	2.24	2.65x	2.24x	~40%
Xeon Platinum 5th Gen 8562Y+ CPU w/ Kubernetes	3.07	2.69	3.07x	2.69x	~80%

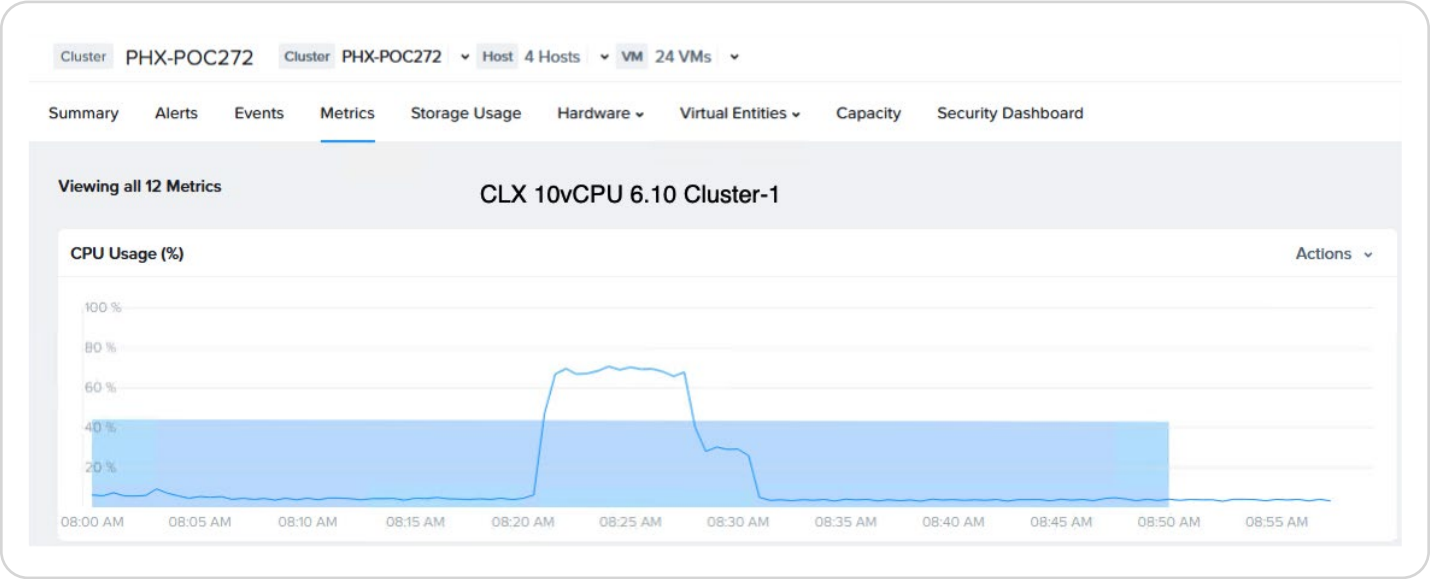
Table 1: *Summary of Results*



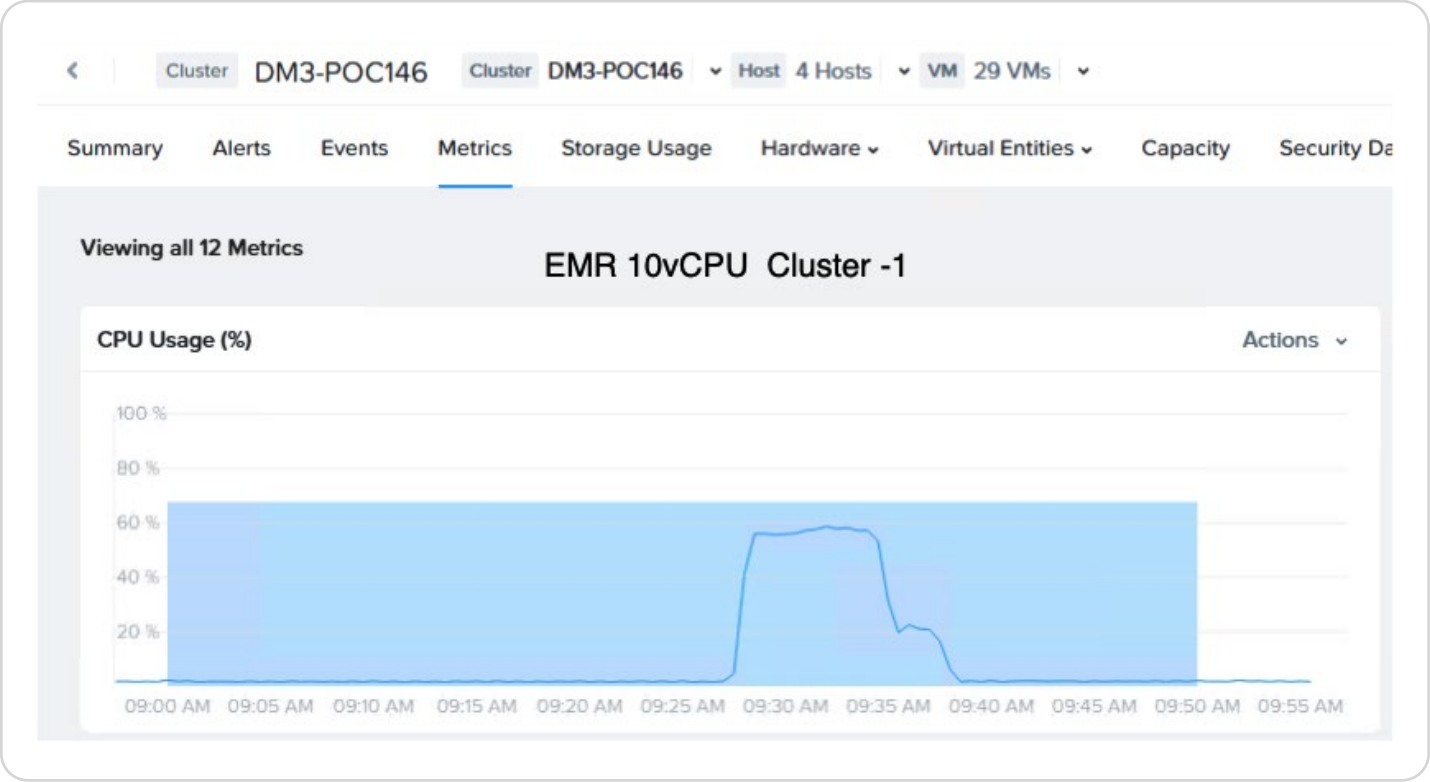
Approximate Cluster CPU Utilization % Reported by Prism



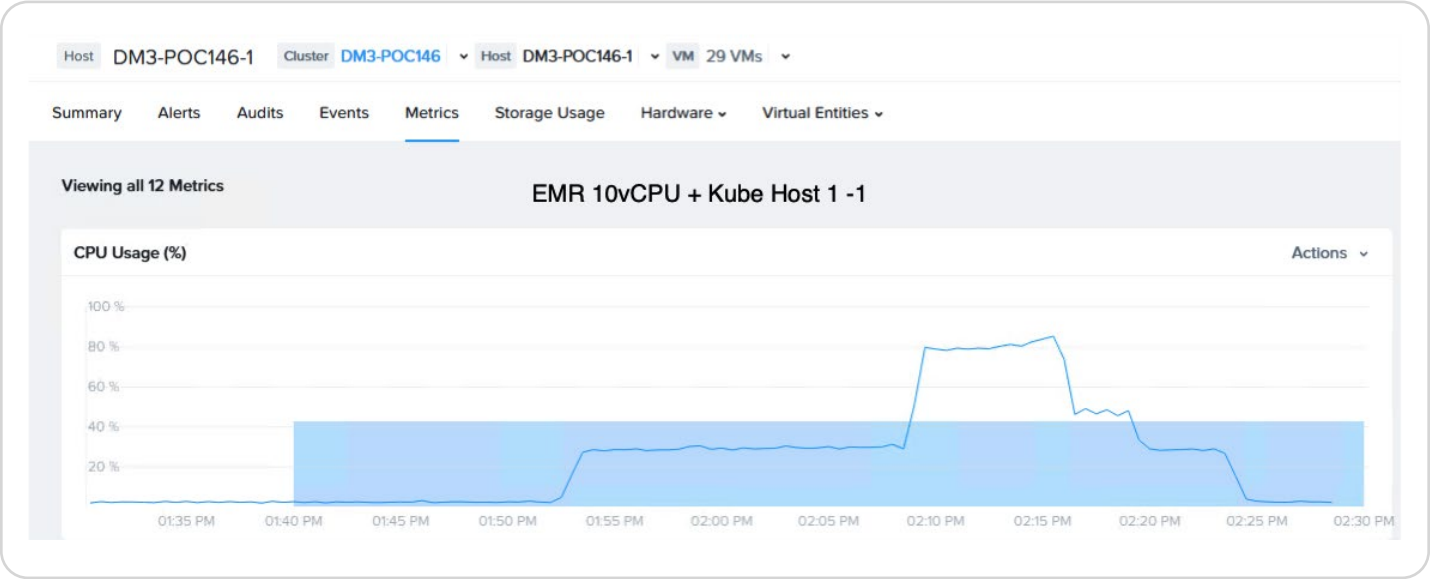
Cluster Metrics 6240 AOS 6.5



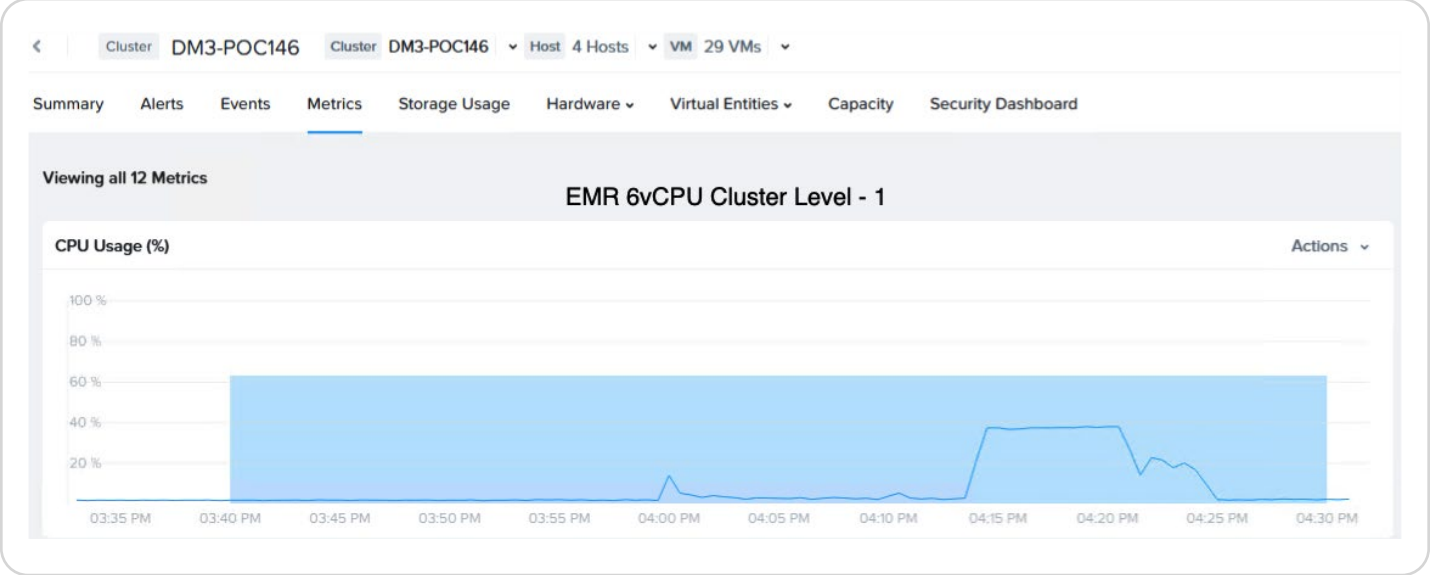
Cluster Metrics 6240 AOS 6.10



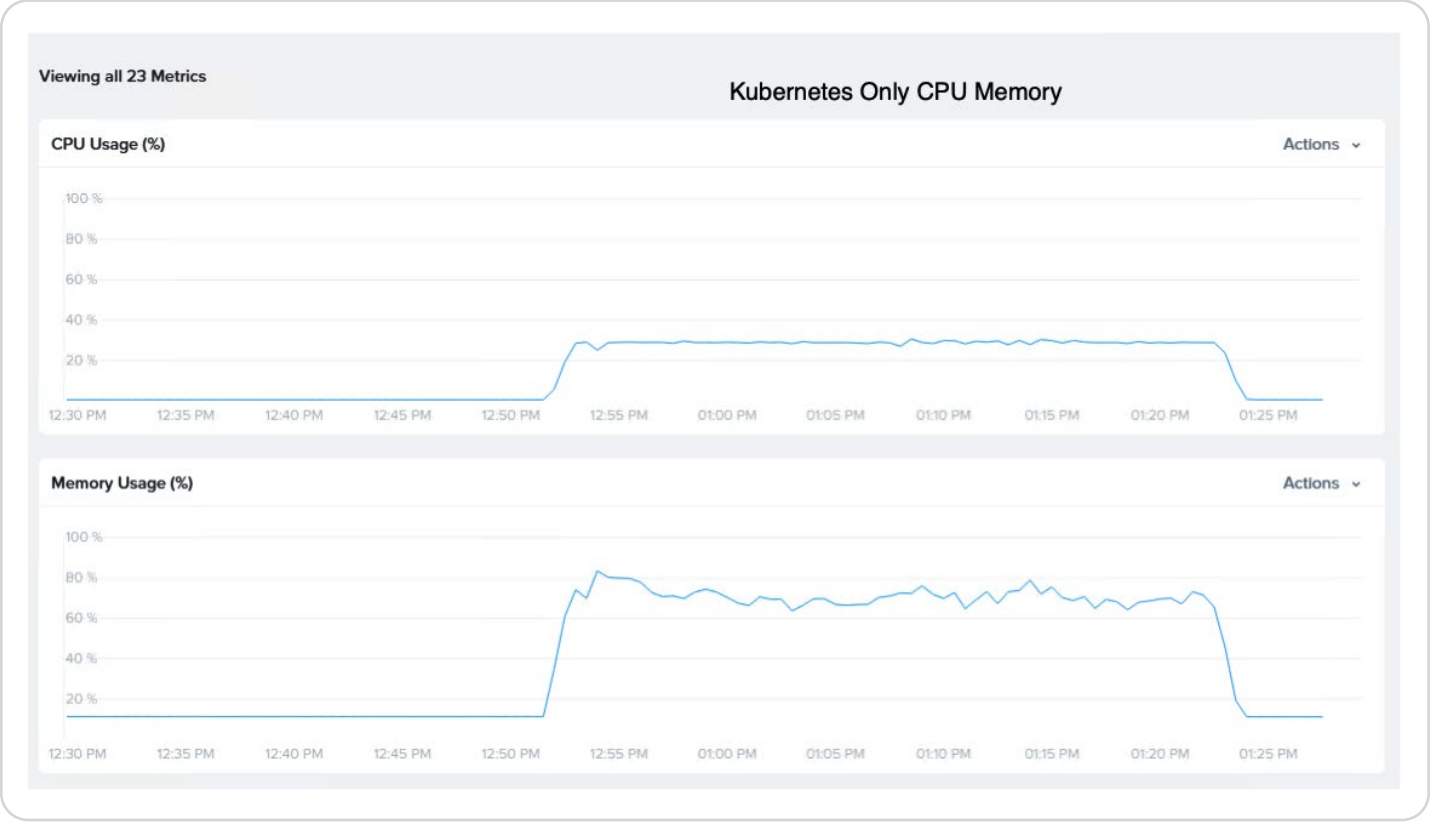
Cluster Metrics 10vCPU 8562Y+



Cluster Metrics 8562Y+ + Kube



Cluster Metrics – 6vCPU 8562Y+



Kubernetes Only Metrics

All equipment was provided by Intel and Nutanix. All physical set up was done by Nutanix personnel. Kubernetes cluster was deployed by Nutanix personnel. Signal65 personnel accessed test equipment remotely. SQL VMs were created and used by Signal65. The Kubernetes workload was set up and run by Signal65.

Important Information About this Report

CONTRIBUTORS

Jonathan Fellows
Performance Validation Engineer | Signal65

PUBLISHER

Ryan Shrout
President and GM | Signal65

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