3RD GEN AMD EPYC™ PROCESSORS AND VMWARE® VSPHERE+™ DELIVER HIGH-PERFORMANCE VIRTUALIZED ENVIRONMENTS

AMD EPYC™ 7003 Series Processors excel in virtualized environments powered by VMware® vSphere+™ by delivering high performance, enhanced security features, and optimal TCO.

June 2022

AMD EPYC™ processors continue to set the standard for modern datacenters that require leadership performance for complex computing challenges and easy scalability to meet growing demands. This is especially true in virtualized environments where high core density and high per-core performance can help optimize both capital and ongoing costs required to procure and maintain datacenter infrastructure.

AMD Infinity Guard[1] features helps protect sensitive data in virtualized environments. AMD Secure Encrypted Virtualization-Encrypted State (SEV-ES)[2] helps protect data in use by isolating the guests and the hypervisor from one another and encrypting both the main VM memory and all CPU register contents when that VM stops running. SEV-ES requires no code modification.

VMware® vSphere+™ is a multi-cloud workload platform that delivers the benefits of the cloud to on-premises workloads by enabling high-value cloud services that allow IT admins and developers to centralize management, supercharge productivity, and accelerate innovation for traditional and next-gen applications.

This Solution Brief describes industry trends around core counts and licensing, and demonstrates the solid value offered by the partnership between AMD and VMware.

CORE COUNTS KEEP INCREASING

In 1965, Gordon Moore observed that the number of transistors in dense integrated circuits doubles every two years. This observation has largely held true with the ongoing advent of smaller manufacturing processes and ever-larger processors packing an ever- growing number of compute cores in an ongoing race to satisfy the insatiable–and burgeoning–need for ever greater computing power.

1st Gen AMD EPYC 7001 processors debuted in June of 2017 with up to 32 CPU cores. That doubled to 64 cores when 2nd Gen AMD EPYC processors launched in August of 2019 and is expected to continue increasing in future generations.

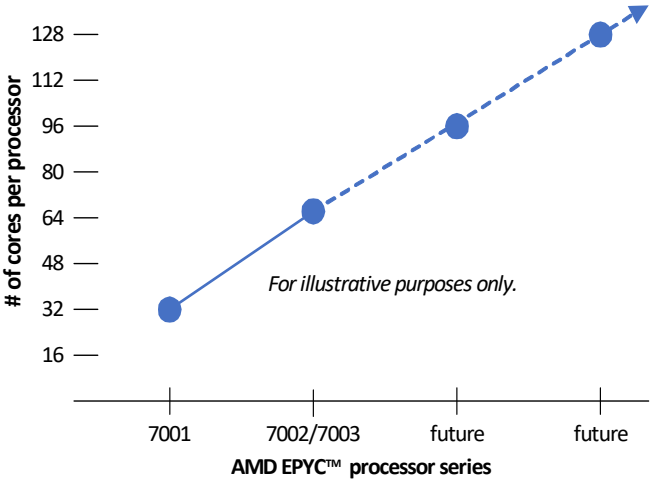

Figure 1: Evolution of core counts in AMD EPYC processors

AMD EPYC 7003 FOR HYPERCONVERGED INFRASTRUCTURE (HCI)

AMD EPYC™ Series processors provide a leadership throughput computing foundation for VMware HCI. Together AMD and VMware have fully tested solutions demonstrating excellent workload performance, which helps to lower risk and reduce implementation costs for customers.

STANDARDS-BASED ARCHITECTURE

AMD EPYC 7003 Series processors continue the company's commitment to industry standards by offering you a choice in x86 architecture. x86 compatibility means that your applications will "just work" on AMD EPYC processors.

EXCEPTIONAL SCALABILITY

Scaling is critical to HCI applications. AMD EPYC 7003 Series processors provide high bandwidth between nodes with support for up to 128 (1P) or 160 (2P) lanes of PCIe® Gen 4 I/O. Each node can take advantage of up to 64 "Zen 3" cores per socket to achieve exceptional performance and scalability in virtualized environments.

VMWARE® vSPHERE+™

VMware® vSphere+™ is the multi-cloud workload platform that brings the benefits of the cloud to on-premises workloads, enabling high-value cloud services for IT admins and developers to centralize management, supercharge productivity and accelerate innovation for traditional and next-gen applications.

Recent advancements in ever-smaller circuits printed on ever-larger dies have caused some to question whether the so-called "Moore's Law" still applies as the cost and complexity of single-die architectures has steadily increased. The good news is that Moore's Law is very much alive thanks to innovations such as AMD's multi-chiplet architecture introduce with 3rd Gen AMD EPYC processors that replaces monolithic processors with a number of smaller chips that each contain a portion of the overall cores and cache. AMD is not alone; other chip vendors are also increasing core counts and adapting their architectures to accommodate the ongoing demand for greater computing power.

More compute cores per processor means that each server can run more VMs and deliver outstanding performance, which gives IT managers the flexibility to optimize budget and other resources, such as by consolidating their datacenter infrastructure and footprints. This also offers the opportunity to look at new deployment models, such as cloud-native or containerized applications. Leading cloud service providers have realized the benefits of high core counts, and many of the same benefits also apply to on-premises datacenter deployments.

HYPERCONVERGED INFRASTRUCTURE (HCI)

Traditional datacenters require a three-tier architecture consisting of compute nodes that run workloads, storage nodes where data resides, and networking to connect the compute and storage nodes to each other and to the larger intranet and/or internet. Hyperconverged infrastructure (HCI) uses standard server hardware with local storage devices to combine or "converge" compute and storage resources into a high-performing, resilient, and easy-to-maintain infrastructure. This eliminates the cost and complexity of dedicated storage fabrics and external arrays. HCI is typically deployed on commercial off-the-shelf servers. Some HCI deployments also converge networking to offer "software-defined networking" (SDN). Software such as VMware® vSphere® then creates the virtual compute nodes, storage clusters, and switches to replicate a complete datacenter without the need for expensive, siloed architecture tiers.

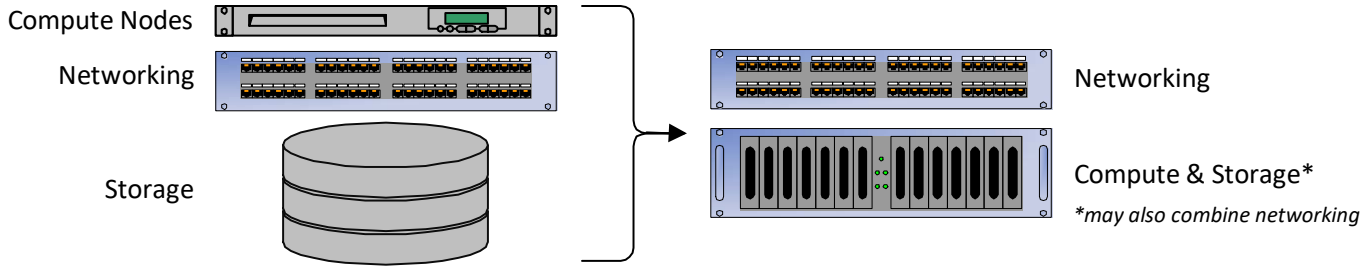

Figure 2: Hyperconverged infrastructure removes legacy architecture tiers

Virtually any workload can run on an HCI deployment using either virtual machines or containers. Some of today's common workloads include:

- Business Intelligence/Big Data/Analytics
- Productivity Apps
- Virtual Desktop Infrastructure (VDI)
- Artificial Intelligence/Machine Learning (AI / ML)
- Data Warehousing
- Relational Databases
- Container Orchestrators

HCI offers another significant advantage over traditional datacenters: The specialized talent required to manage servers is in short supply and difficult to retain once hired. HCI can help reduce the need for specialists because the software can handle the provisioning and management, thereby helping you streamline your daily operations and focus your specialized talent where it's needed most.

AMD EXCELS IN VIRTUALIZED ENVIRONMENTS

AMD EPYC processors offer the following benefits to HCI deployments:

- **Performance:** AMD EPYC processors hold more than 250 world performance records across a broad spectrum of benchmarks, workloads, and applications in both legacy and virtualized deployments. 3rd Gen AMD EPYC processors are available in 23 models that span a variety of core counts and frequencies to help you tailor your datacenter to suit your current and future workload needs.
- **Security:** Security is a topic that keeps IT administrators up at night, especially in today's era of expanding cyberattacks. AMD Infinity Guard[1] security features help protect your data by reducing potential attack vectors during both boot and runtime. Applications require no modification to take full advantage of AMD Infinity Guard features.
- **TCO:** Organizations are under constant pressure to do more with less. HCI deployments powered by AMD EPYC processors deliver numerous benefits that can help lower both initial and ongoing costs.
- **Energy Efficiency:** AMD EPYC processors power the most energy efficient x86 servers, delivering exceptional performance and reducing energy costs.[3]
- **Ecosystem:** AMD partners with a robust and growing ecosystem of industry leaders to deliver optimized solutions to help solve your most challenging problems. Combining AMD EPYC processors with industry-leading hardware, software, and services delivers optimized solutions that provide a great customer experience right out of the box by getting your operations up and running quickly and providing excellent results into the future.

Let's take a closer look at these compelling value propositions.

PERFORMANCE

AMD EPYC processors deliver per core, per socket, and per server performance leadership across many benchmarks, workloads, and applications. 3rd Gen AMD EPYC processors are available in 23 models with from 8 to 64 cores, base frequencies from 2.0 GHz to 3.7 GHz, max boost frequencies from 3.45 GHz to 4.1 GHz,[4] and a maximum of up to 96 MB L3 cache per individual compute core (768 MB per processor) with AMD 3D V-Cache™ die-stacking technology. Processors with smaller core counts running at higher frequencies can help you maximize performance and TCO for core-based software licenses. Processors with higher core counts may be ideal for situations where the time required per cycle or to complete a task enhances team performance and/or results, such as faster time to market.

AMD EPYC processors excel in virtualized environments. Some performance highlights include:

- Powering Frontier, the world's faster supercomputer at #1 on the Top500 list for June, 2022.
- Support up to 31% more "knowledge worker" desktop sessions running VMware Horizon® while meeting Login VSI™ rating of "very good" QoS response times with servers based on 2x EPYC 7713 compared to 2x Intel® Xeon® Platinum 8380.[5]
- 2x 3rd Gen AMD EPYC 7763 servers outperform 2x 3rd Gen Intel Xeon Platinum 8380 servers on matched pair VMmark 3.1 by 52% and support 71% more VMs.[6]
- In VMware testing, the updated scheduler in vSphere 7.0 U2 can achieve up to 50% higher performance with AMD EPYC processors than vSphere 7.0 U1.

SECURITY FEATURES

Virtualized environments can lower costs and boost both performance and resource optimization but may be subject to novel threats. Solutions exist to help protect data at rest in storage and in transit across the network. Data in use was not considered a major last security concern because it was not deemed persistent. The problem is that DIMMs can retain data for up to 90 minutes after power loss or even hours if the module is cooled using readily available means—more than enough time to read the (often unencrypted) data from the module. This means that the memory, cache, and registers that run each virtual machine may be vulnerable to unauthorized access. Security breaches are the stuff of IT administrator nightmares—and a growing number of headlines as cyberattacks increase in frequency, scope, and cost.

Confidential computing can help ensure data privacy and integrity by employing hardware-based encryption when enabled on both the host and the virtual machine or container guest. The AMD Infinity Guard features built into every AMD EPYC processor includes an AMD Secure Processor that provides a hardware root of trust.

SEV-ES uses the AMD Secure Processor to issue and manage keys that encrypt each virtual machine. This helps isolate the hypervisor and guests from each other. Enabling SEV-ES on both the hypervisor and guest allows the guest OS to indicate which memory pages to encrypt. The hypervisor communicates with the AMD Secure Processor to manage the appropriate keys in the memory controller. SEV-ES also encrypts the CPU register contents when a VM stops running, thereby helping prevent CPU register information from being accessible to the hypervisor. SEV-ES can also help detect malicious modifications to a CPU register state.

VMware vSphere 7.0 U2 and above support SEV-ES for both virtual machines and containers out of the box, and both AMD and VMware continue to focus on enhancing security. Your workloads need no modification to take advantage of AMD EPYC security features.

Security often comes at the price of performance. After all, it takes more time to unlock a closed door than to open an unlocked door. Enabling the security features on AMD EPYC processors only marginally increases CPU usage with slight to negligible performance impacts. For example, the financial services industry relies on lightning-fast performance to make trades and perform other activities where a small fraction of a second can mean the difference between millions of dollars in profits… or losses. Please see AMD EPYC™ Processors Deliver High-Performance Confidential Computing to Financial Services Industry.

TOTAL COST OF OWNERSHIP

AMD EPYC processors deliver compelling TCO thanks to high core counts and resulting VM density, exceptional per-core performance, outstanding performance per unit of licensing cost (per socket or per core), and built-in security features. In general, HCI deployments can be optimized for:

- **Maximizing VM/container density:** The high core counts found in certain AMD EPYC 7003 Series processor models can mean more virtual machines, containers, and/or virtual desktops per server. This helps reduce the up-front costs by allowing you to do more with fewer servers, thereby saving both the upfront server costs and the ongoing power, cooling, management, and real estate costs associated with those servers.

- **Optimizing performance per processor core:** Applications that are licensed on a per-core basis may benefit from AMD EPYC processors with lower core counts running at higher frequencies.

Assume that your HCI deployment needs to deliver 1,000 units of VMmark® performance: Dividing the total score by the score per server reveals the number of servers required to achieve that score. This example compares a dual-socket system powered by 64-core AMD EPYC 7763 processors against a dual-socket system powered by 40-core Intel® Xeon® Platinum 8380 processors. In this example, the AMD EPYC solution requires an estimated:[7]

- 38% fewer servers
- 33% less server space
- 38% lower power cost
- 38% lower 3-year TCO

The AMD EPYC 7763 solution also provides estimated savings of 527.32 metric tons of CO2e which is an estimated Greenhouse Gas Emission savings emissions avoided equivalent to 582,681 pounds of coal not burned in the USA or carbon sequestration equivalent of 633 acres of forest in the USA.

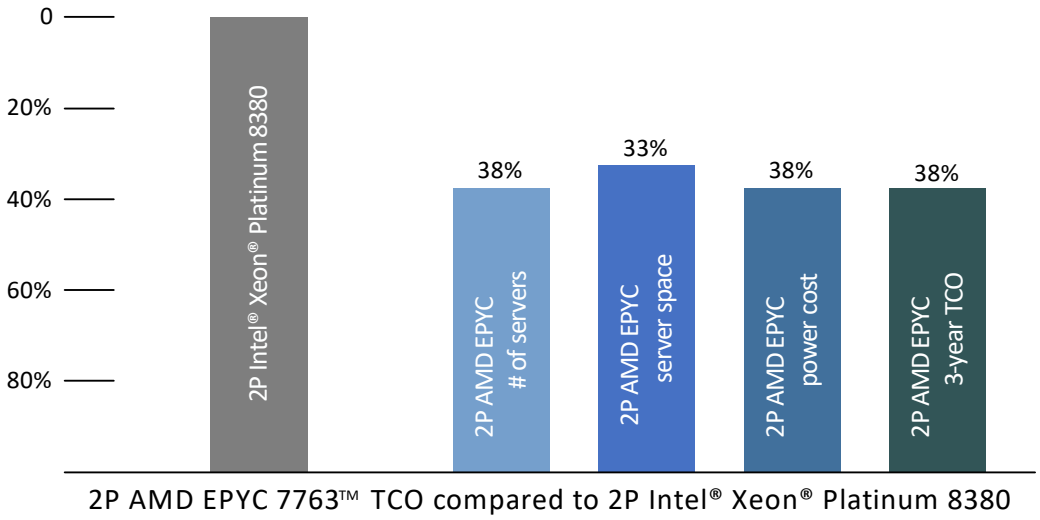

Figure 3: Sample AMD EPYC 2P 7763 TCO estimated savings compared to Intel Xeon 8380 to deliver 1000 units of performance on VMmark® 3.1

ENERGY EFFICIENCY

The emissions reductions in the previous example bring up the importance of environmental stewardship and data center sustainability. Ongoing increases in computing performance open the doors for exploration and research, which can mean increasing energy consumption and greenhouse gas emissions (GHG). AMD aims to increase the energy efficiency of AMD processors and accelerators powering servers for artificial intelligence-training and high-performance computing by 30x from 2020 to 2025. Nearly midway through 2022, AMD continues to be on-track toward achieving the goal, having reached 6.8x improvement in energy efficiency compared to 2020 using an accelerated compute node powered by one 3rd Gen AMD EPYC CPU and four AMD Instinct MI250x GPUs. This goal equates to a 97 percent reduction in energy use per computation and represents more than a 2.5x acceleration of the industry trends from 2015- 2020 as measured by the worldwide energy consumption for these computing segments.[8]

AMD EPYC processors have set dozens of world records for energy efficiency, which can reduce GHG emissions and may require fewer servers. The June 2022 Green500 supercomputers list update showed AMD EPYC processors and AMD Instinct accelerators power the most efficient supercomputers in the world, including four of the top five, eight of the top ten, and 17 of the top 20 most efficient. Meanwhile, the performance delivered by servers powered by AMD EPYC servers plays an important role in advancing research on climate change. Analyzing massive and complex data sets is helping researchers and scientists better able to understand the causes of climate change and predict the impacts of extreme weather.

VMware also provides resources and tools designed to help reduce datacenter environmental impacts. Please see VMware vSAN and VMware Cloud on AWS – the Sustainable Transition for your Datacenter for more information.

ECOSYSTEM

No processor exists in a vacuum, and AMD EPYC is no exception. AMD is proud to collaborate with a large and growing ecosystem of technology partners who innovate, develop, and launch solutions that meet or exceed the demands of today and tomorrow.

Reliability and simplicity are the key to successful HCI deployments. A number of OEM vendors offer VMware-certified vSAN ReadyNodes powered by AMD EPYC processors. A vSAN ReadyNode™ is a validated server configuration that uses a tested and certified hardware form factor for vSAN deployment that is jointly recommended by both the server OEM and VMware, making them ideal building blocks for hyperconverged deployments.

vSAN ReadyNodes give you the peace of mind of knowing that your applications will just work. Choosing vSAN ReadyNodes powered by AMD EPYC processors will help you achieve all of the benefits described in this Solution Brief. AMD and VMware work closely with our partners to deliver the virtualization solutions you need to solve your most challenging problems. Please visit AMD Solutions for HCI and Virtualization and AMD Data Center Partner Ecosystem for more information.

ABOUT VMWARE® vSPHERE+

VMware® vSphere+™ is the multi-cloud workload platform that brings the benefits of cloud to on-premises workloads. vSphere+ combines industry-leading virtualization technology, an enterprise-ready Kubernetes® environment, and high-value cloud services to transform existing on-premises deployments into SaaS-enabled infrastructure that centralizes management, supercharges productivity, and accelerates innovation. With vSphere+, IT admins and developers can easily build, run, manage, protect, and secure their traditional and next-gen applications. vSphere+ can be purchased through a flexible subscription plan that better aligns with the business.

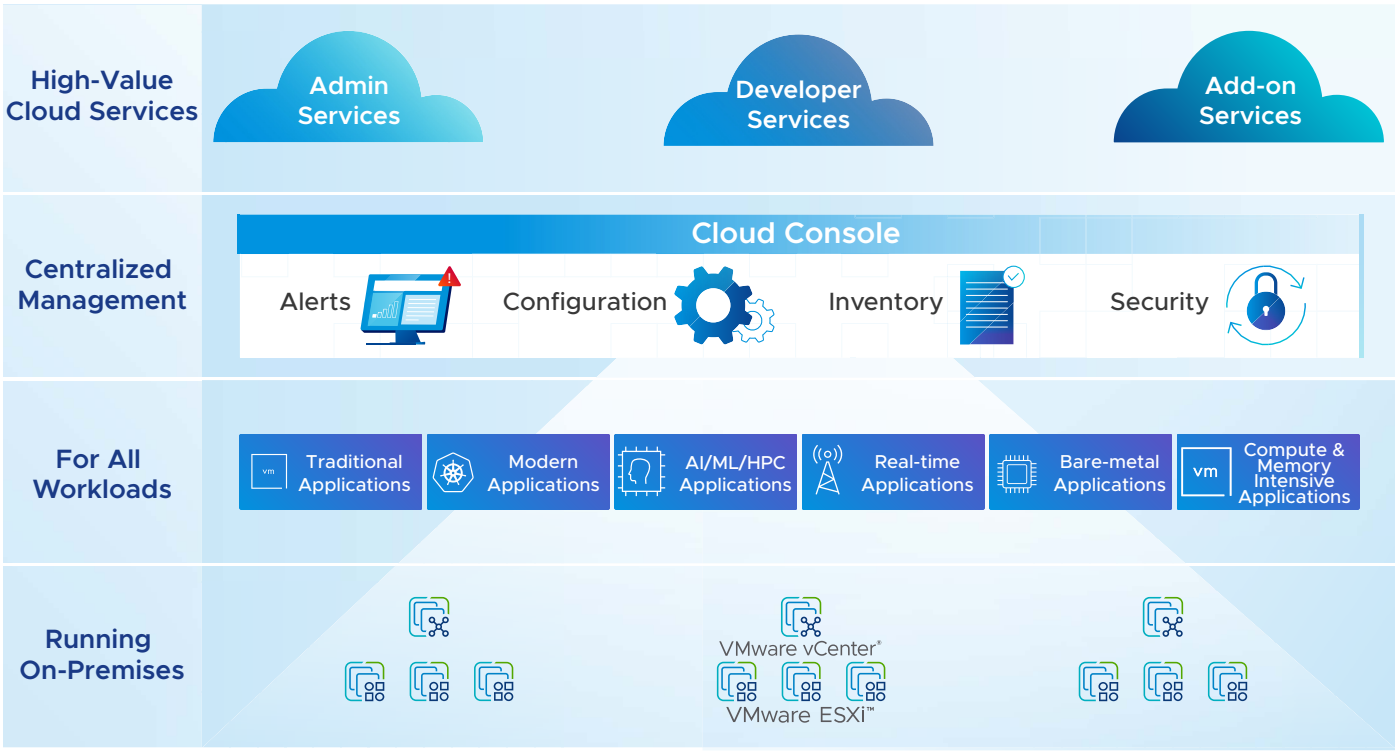

Figure 4: Overview of VMware vSphere+

Some of the key benefits of vSphere+ include:

- Supercharge productivity with Admin Services
- Accelerate innovation with Developer Services
- Transform on-premises Infrastructure with Cloud Integration

SUPERCHARGE PRODUCTIVITY WITH ADMIN SERVICES

The admin services in vSphere+ supercharge productivity by:

- Enhancing operational efficiency via the centralized VMware Cloud Console management and governance, which facilitates administering a distributed IT landscape.
- Simplifying vCenter lifecycle management through cloud-enabled automation and remediation of configuration drift.
- Monitoring global inventory, alert status, and security posture.
- Provisioning virtual machines to any vSphere cluster.

ACCELERATE INNOVATION WITH DEVELOPER SERVICES

The developer services in vSphere+ accelerate innovation by:

- Transforming your existing virtual infrastructure into an enterprise-ready, self-service Kubernetes platform with robust complete observability and management.
- Streamlining platform management with integrated logging, registry, monitoring, ingress, and more.
- Centralizing platform operations with a multi-cloud management plane that helps increase security and governance of your Kubernetes clusters.

TRANSFORM ON-PREMISES INFRASTRUCTURE WITH CLOUD INTEGRATION

vSphere+ integrates your on-premises infrastructure with the cloud to:

- Bring the benefits of the cloud and enhance your existing vSphere deployments in place without disrupting your workloads.
- Activate add-on hybrid cloud services that can expedite disaster recovery, ransomware protection, capacity planning, and more. (Integration with add-on services is in development).
- Easily access the integrated VMware Cloud Disaster Recovery ransomware and disaster recovery service.
- Gain the flexibility of OpEx-based consumption, while helping improve ROI from existing investments.

AMD EPYC AND VMWARE

The strategic partnership between AMD and VMware continues to yield innovations that deliver the performance, security features, and value our customers need. The accelerating pace of application development requires the kind of rapid infrastructure scalability and adaptability that only virtualized solutions can deliver. HCI continues to replace legacy equipment silos with standard servers that combine compute, storage, and software-defined networking without many of the bottlenecks found in legacy datacenters. vSphere+ further enhances flexibility by integrating on-premises and cloud-based resources. AMD and VMware collaborate to carefully test and qualify solutions to help ensure the highest possible levels of performance, security, and TCO optimization. Together, we jointly validate silicon and solutions, optimize for our joint customers, and align with datacenter and cloud releases. Our many VMmark world records across several categories are a testament to the powerful combined value of this partnership.

REFERENCES

1. AMD Infinity Guard features vary by EPYC™ Processor generations. Infinity Guard security features must be enabled by server OEMs and/or Cloud Service Providers to operate. Check with your OEM or provider to confirm support of these features. Learn more about Infinity Guard at https://www.amd.com/en/technologies/infinity-guard. GD-183
2. See https://developer.amd.com/sev/ for additional information.
3. EPYC-028: As of 2/2/22, of SPECpower_ssj® 2008 results published on SPEC's website, the 55 publications with the highest overall efficiency results were all powered by AMD EPYC processors. More information about SPEC® is available at http://www.spec.org. SPEC and SPECpower are registered trademarks of the Standard Performance Evaluation Corporation.

   Links to these 55 results are:
   1 http://www.spec.org/power_ssj2008/results/res2020q4/power_ssj2008-20200918-01047.html
   2 http://www.spec.org/power_ssj2008/results/res2020q4/power_ssj2008-20200918-01046.html
   3 http://www.spec.org/power_ssj2008/results/res2021q2/power_ssj2008-20210324-01091.html
   4 http://www.spec.org/power_ssj2008/results/res2020q2/power_ssj2008-20200519-01031.html
   5 http://www.spec.org/power_ssj2008/results/res2021q1/power_ssj2008-20210309-01077.html
   6 http://www.spec.org/power_ssj2008/results/res2020q2/power_ssj2008-20200407-01022.html
   7 http://www.spec.org/power_ssj2008/results/res2021q2/power_ssj2008-20210408-01094.html
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4. Max boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems. EPYC-18

5. Login VSI™ Pro v4.1.40.1 comparison based on AMD internal testing as of 11/01/2021 measuring the median "knowledge worker" VSIMax desktop sessions per server using VMware ESXi 7.0u2a and VMware Horizon 8 on a server using 2x AMD EPYC 7763, 7713, 7663, 75F3, 7543, 7453, 74F3, 7443, 73F3, 7343, and 72F3 versus a server with 2x Intel Xeon Platinum 8380, Platinum 8352V, Gold 6342, and Gold 6346 for up to ~31% more performance. Results may vary. MLN-160

6. VMmark® 3.1 matched pair comparison based on best performing systems published at https://www.vmware.com/products/vmmark/results3x.html as of 6/22/2021, 2x AMD EPYC™ 7763 scored 21.58 @ 24 tiles (https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2021-05-04-Lenovo-ThinkSystem-SR665.pdf) which performs 52% better than the top "Ice Lake" 2x Intel® Xeon® Platinum 8380 that scored 14.19 @ 14 tiles (https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2021-04-20-Fujitsu-PRIMERGY-RX2540M6.pdf). 2x AMD EPYC 7H12 scored 18.23 @ 19 tiles, (https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2020-11-17-Lenovo-ThinkSystem-SR665.pdf). VMmark is a registered trademark of VMware in the US or other countries.. MLN-102

7. MLNTCO-018: This scenario contains many assumptions and estimates and, while based on AMD internal research and best approximations, should be considered an example for information purposes only, and not used as a basis for decision making over actual testing. The Bare Metal Server Greenhouse Gas Emissions TCO (total cost of ownership) Estimator Tool compares the selected AMD EPYC™ and Intel® Xeon® CPU based server solutions required to deliver a TOTAL_PERFORMANCE of 1000 units of VMmark® 3.1.1 (vSAN storage using 4 matched hosts), with uniform hosts performance based on the published scores for Intel Xeon and AMD EPYC CPU based servers. This estimation reflects a 3 year time frame.
This analysis compares a 2P AMD EPYC EPYC_7763 powered server with a score of 39.01 @ 40 Tiles; link to score - https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2021-08-10-DellEMC-PowerEdge-R6525.pdf; to a 2P Intel Xeon Platinum_8380 based server with a score of 24.26 @ 26 Tiles; link to score - https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/vmmark/2021-06-08-HPE-ProLiant-DL380-Gen10Plus.pdf.
Both AMD EPYC and Intel based servers use the same cost for the following elements of the analysis: server chassis size of 2RU at a cost of $2500 per chassis; internal storage $380; physical servers managed per admin: 30; fully burdened cost per admin $110500; server rack size of 42; space allowance per rack of 27 sq feet; monthly cost of data center space $20 per sq foot; cost per kW for power $0.12; power drop per rack of 8kW; and a PUE (power usage effectiveness) of 2.
The EPYC powered solution is estimated to take: 26 total 2P EPYC_7763 powered servers at a hardware only acquisition cost of $30244 per server, which includes $7890 per CPU, total system memory of 2048GB, which is 16GB of memory / core and a total system memory cost of $11584; internal storage cost of $380. The total estimated AMD EPYC hardware acquisition cost for this solution is $786344. Each server draws ~1019.4336kWhr per month. For the 3 years of this EPYC powered solution analysis: the total solution power cost is ~$229005 which includes the PUE factor; the total admin cost is ~$287301, and the total real estate cost is ~$116640, using 6 racks. The total 3 TCO estimate for the AMD solution is $1419290.
The Intel based solution is estimated to take 42 total 2P Platinum_8380 powered servers at a hardware only acquisition cost of $30702 per server, which includes $8099 per CPU, total system memory of 2048GB, which is 25.6GB of memory / core and a total system memory cost of $11584; internal storage cost of $380. The total estimated Intel hardware acquisition cost for this solution is $1289484. Each server draws ~1015.8336kWhr per month. For the 3 years of this Intel based solution analysis: the total solution power cost is ~$368625 which includes the PUE factor; the total admin cost is ~$464100, and the total real estate cost is ~$174960 using 9 racks. The total 3 TCO estimate for the Intel solution is $2297169.
AMD EPYC powered servers have an estimated $877879 lower 3 year TCO.
Delivering 1000 estimated score of VMmark 3.1.1, with uniform hosts performance produces the following estimated results: the AMD EPYC solution requires 38% fewer servers [1-(AMD server count / Intel server count)]; 33% less space [1-(AMD rack count / Intel rack count)]; 38% less power [1-(AMD power cost / Intel power cost)]; providing a 38% lower 3 year TCO [1-(AMD TCO / Intel TCO)].
AMD EPYC_7763 powered servers save ~1163502kWh of electricity for the 3 years of this analysis. Leveraging this data, using the Country / Region specific electricity factors from the '2020 Grid Electricity Emissions Factors v1.4 – September 2020', and the United States Environmental Protection Agency 'Greenhouse Gas Equivalencies Calculator', the AMD EPYC powered server saves ~527.32 Metric Tons of CO2 equivalents. This results in the following estimated savings based on United States data, Emissions Avoided equivalent to one of the following:
- 114.43 USA Passenger Cars Not Driven for 1 year; or
- 179.29 USA Trash Bags of Waste Recycled vs. Landfill; or
- 582691.23 Pounds of Coal Not Burned in USA.
or Carbon Sequestered equivalent to:
- 8701 Tree Seedlings Grown for 10 years in USA; or

- 633 Acres of USA Forests in 1 year.
The 2020 Grid Electricity Emissions Factors v1.4 – September 2020 data used in this analysis can be found at https://www.carbonfootprint.com/docs/2020_09_emissions_factors_sources_for_2020_electricity_v14.pdf and the US EPA Greenhouse Gas Equivalencies Calculator used in this analysis can be found at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
AMD processor pricing based on 1KU price as of Sept 2021. Intel® Xeon® Scalable Gen 1 and Gen 2 CPU data and pricing from https://ark.intel.com as of September 2021. Intel Xeon Gen3 Scalable Ice Lake pricing and data from https://newsroom.intel.com/wp-content/uploads/sites/11/2021/05/3rd-Gen-Intel-Xeon-Scalable-Processor-SKU-Stack-with-RCP.pdf on 09/01/2021. All pricing is in USD.
VMmark® is a registered trademark of VMware in the US or other countries.
AMD EPYC performance numbers based on the identified benchmark reported scores or the user provided score where indicated. Product and company names are for informational purposes only and may be trademarks of their respective owners.
Results generated by: AMD EPYC™ BARE METAL SERVER and GREENHOUSE GAS EMISSIONS TCO ESTIMATION TOOL; VERSION: 3.47

8. Calculation includes 1) base case kWhr use projections in 2025 conducted with Koomey Analytics based on available research and data that includes segment-specific projected 2025 deployment volumes and datacenter power utilization effectiveness (PUE) including GPU HPC and machine learning (ML) installations, and 2) AMD CPU socket and GPU node power consumptions incorporating segment-specific utilization (active vs. idle) percentages and multiplied by PUE to determine actual total energy use for calculation of the performance per Watt.

   6.79x = (base case HPC node kWhr use projection in 2025 x AMD 2022 perf/Watt improvement using DGEMM and typical energy consumption + Base case ML node kWhr use projection in 2025 *AMD 2022 perf/Watt improvement using ML math and typical energy consumption) /(2020 perf/Watt * Base case projected kWhr usage in 2025). For more information on the goal and methodology, visit https://www.amd.com/en/corporate-responsibility/data-center-sustainability.

RELATED LINKS

- Request Your Free HCI Assessment*
- vSAN ReadyNode™ Sizer*
- VMware Cloud Infrastructure TechZone*
- AMD Solutions for HCI and Virtualization
- AMD EPYC™ Processors
- VMware Tuning Guides for AMD EPYC Processors

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