Technical Research Study

PROWESS

Harness Increased Performance, Efficiency, and Lower TCO with Dell PowerEdge Powered by AMD

Key performance indicators (KPIs) show that a hardware refresh with the latest-generation Dell PowerEdge servers and AMD EPYC™ processors can help enterprises improve the performance, efficiency, and security of their server infrastructures.

Executive Summary

Forrester Consulting reports that data centers that refresh their servers at least every three years can gain technological and business benefits compared to data centers that do not.[1] These benefits manifest themselves through higher performance, increased efficiency, and better security. Prowess Consulting investigated these benefits further by examining results from industry-standard benchmarks and environmental ratings. Based on our research, we concur with the Forrester Consulting opinion that the benefits of a server refresh can easily outweigh the costs.

If you are still wondering whether it's time to refresh your servers, you can use this study to help you decide. We examined the effects of upgrading legacy servers running on x86-based processors that are more than three years old to Dell PowerEdge servers powered by 4th Generation AMD EPYC processors. Examples of the kinds of benefits we uncovered in the course of our investigation include:

- Up to 232% higher performance per watt[2]
- Up to 48% lower processor cost[3]
- Up to 40% lower software licensing costs through 5:1 server consolidation[4]

Exploring the Value of a Server Refresh

A 2019 report by Forrester Consulting determined that in order to be more agile and productive, data centers should be refreshing their servers at least every three years.[1] The online survey showed numerous technical benefits to be gained from a server refresh, and it concluded that organizations that keep their servers modernized and updated tend to earn greater benefits from their infrastructure investments.[1] Security is also a critical concern for businesses with aging server platforms. Older-generation processors might not have the latest security features necessary to protect against modern security threats.

These findings suggest that if you are running legacy servers powered by processors more than three years old, you simply cannot afford *not* to consider a server refresh. With the innovative hardware technologies being released in 2023, Prowess Consulting believes that now is an excellent time to look at the latest server and processor offerings. In this article, we examine the performance, efficiency, and security benefits of upgrading your legacy server platforms to the latest PowerEdge servers built on 4th Gen AMD EPYC processors.

With the goal of identifying the potential benefits you could enjoy by refreshing to latest-generation server hardware, we looked at the popular combination of Dell servers and AMD processors. Our analysis indicates that upgrading to PowerEdge servers with 4th Gen AMD EPYC processors can help improve performance, efficiency, and security. To quantify these improvements, we used a variety of industry-standard benchmarks, published results, and environmental ratings. We also evaluated qualitative benefits of refreshing servers, such as the security benefits provided by current-generation servers.

Much of this study refers to a hypothetical update scenario that involves moving from a two-node cluster of 2S 2U Fujitsu® PRIMERGY® RX2540 M5 servers with two Intel® Xeon® Platinum 8280 processors each to a two-node cluster of 2S 2U Dell PowerEdge R7615 servers with a single AMD EPYC 9654P processor each. This tangible comparison helps illustrate how a server refresh can help with performance, efficiency, and security.

Total Cost of Ownership (TCO)

The total cost of owning and running a server—and its reciprocal, the value of upgrading legacy servers to the latest generation—is complex. Specific benefits from a server refresh will vary from organization to organization and from use case to use case. This study does not attempt to generate a single number that quantifies the TCO benefits of a server refresh, but we found that an upgrade from three-to-five-year-old x86 processors to 4th Gen AMD EPYC processors can provide several indicative benefits:

- Up to 40% lower software licensing costs through 5:1 server consolidation[4]
- Up to 38% lower software licensing costs per unit of performance[5]
- Up to 31% reduction in average energy cost[6]

These figures offer a sense of the cost benefits that can come with a server refresh. And while this analysis lays out specific benefits from refreshing legacy servers in the context of performance, efficiency, and security, all of these kinds of benefits have a direct bearing on the cost of ownership for servers—and the gains from refreshing them.

An upgrade from three-to-five-year-old x86 processors to 4th Gen AMD EPYC processors can deliver up to:

40% lower software licensing costs through 5:1 server consolidation[4]

38% lower software licensing costs per unit of performance[5]

31% reduction in average energy cost[6]

Boost Performance

A server refresh can help you lower TCO while delivering the insights you need when you need them. Newer processors can deliver higher performance per core, meaning you can run the most demanding AI and high-performance computing (HPC) workloads while still lowering your power consumption and physical footprint.

Get Higher Performance Per Core and Per Watt

Based on SPEC® benchmarking results comparing high-performance processors from several generations, we found that refreshing the two-socket Fujitsu PRIMERGY RX2540 M5 server with two Intel Xeon Platinum 8280 processors (28 cores) to a PowerEdge R7615 server with a single AMD EPYC 9654P processor (96 cores) could deliver up to twice the performance (102% higher) per core.[7]

Raw performance is an important pillar in understanding the full story of a server's capabilities and cost of ownership. For example, virtualization continues to be a vital workload for many businesses, and while mere computational horsepower alone cannot capture how good a server might be for hosting virtual machines (VMs), it is still an important factor. With that fact in mind, we used VMmark® 3.x benchmarking results to analyze this same refresh scenario looking specifically at performance/watt for virtualization workloads. A refresh from servers powered by three-to-five-year-old x86 processors to 4th Gen AMD EPYC processors can provide up to 232% higher performance per watt for virtualization workloads.[2]

A single AMD EPYC 9654P processor has more cores than two Intel Xeon Platinum 8280 processors combined. However, even accounting for this difference in core count, the refreshed servers powered by a 4th Gen AMD EPYC processor can provide up to 93% higher performance/watt/core than the legacy servers powered by three-to-five-year-old x86 processors.[2] Higher performance per watt and per core mean that you can either shrink your energy costs or server footprint for the same performance, or increase performance while holding power consumption and server footprint the same.

An upgrade from three-to-five-year-old x86 processors to 4th Gen AMD EPYC processors can deliver up to:

102% higher performance/core[7]

232% higher performance/watt[2]

93% higher performance/watt/core[2]

Increase Efficiency

IT budgets are being cut everywhere, and IT organizations are being told to do more with less. In short, improving the efficiency of hardware is critical to companies of all sizes.

Reducing capital expenditures (CapEx) is often the first consideration for organizations seeking to increase efficiency with a server refresh. Reduced costs upfront get reflected in lower amortized costs over the life of a server. The good news from our investigation is that upgrading to servers powered by current-generation processors can actually cost less than the legacy systems originally did.

Consider again the example of the legacy Fujitsu PRIMERGY RX2540 M5 servers running 2nd Gen Intel Xeon Platinum 8280 processors being refreshed to PowerEdge R7615 servers powered by 4th Gen AMD EPYC 9654P processors. Pricing servers is complex and multidimensional, but the majority of the price comes from the processors and the memory. If we hold memory roughly even between these two systems, processor price can give a rough idea of the relative prices of the two servers.

The two 2nd Gen Intel Xeon Scalable processors in each legacy server have a total MSRP of $22,920, compared to an MSRP of $11,805 for the single 4th Gen AMD EPYC processor in each new server.[3] The representative 48% lower price can translate directly into lower system cost for the newer server—or, more likely, it can help absorb some of the cost of putting more memory into the new server to increase system efficiency, such as by hosting more VMs.

Improve License Efficiency

Using fewer servers to do the same amount of computing offers a number of savings opportunities, notably by reducing costs for software licensed by the server core. Licensing costs can end up forming a sizeable plurality if not an outright majority of the TCO of a server. Reducing the number of cores that you need to license can be a powerful way to reduce licensing costs.

To cite just one example, a study conducted by Dell Technologies showed that the latest-generation PowerEdge R7625 server with 4th Gen AMD EPYC processors offers 5:1 server consolidation compared to legacy servers using 1st Gen Intel Xeon Scalable processors. Specifically, 380 VMs running on five 2S legacy servers using 10 Intel Xeon Platinum 8180 processors (28 cores, 205 W) could be successfully migrated to one 2S 2U PowerEdge R7625 server powered by two AMD EPYC 9654 processors (96 cores, 360 W).[4]

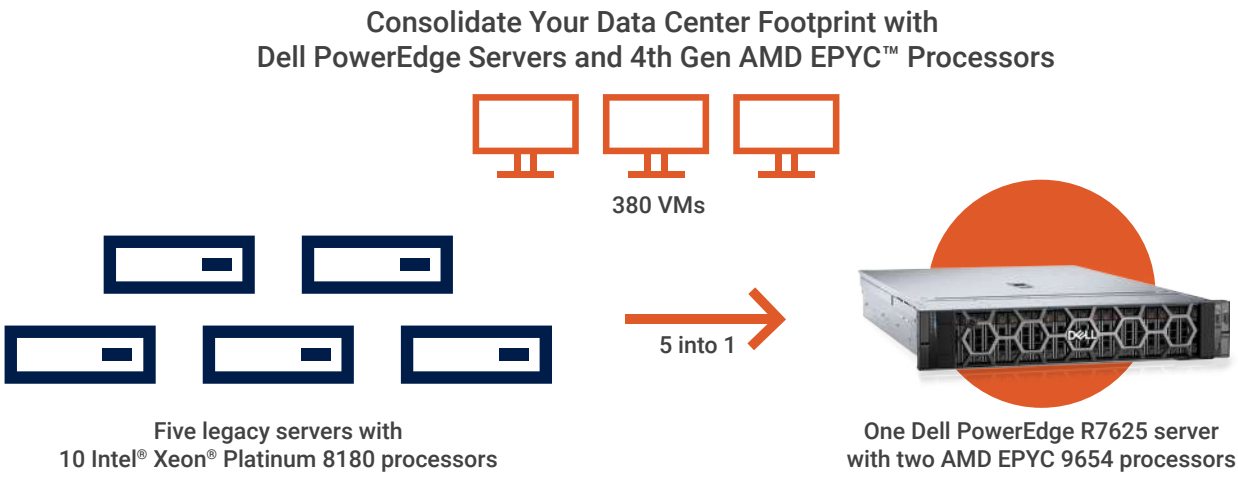

Figure 1 | Dell PowerEdge servers and 4th Gen AMD EPYC processors can help consolidate your data center footprint[4]

The refreshed server uses 31% fewer cores, which can help reduce virtualization licensing costs. For example, you could reduce the number of VMware® licenses from 10 licenses for the five legacy 2S servers to six licenses for the new 2S server, a 40% cost savings on VMware licensing.[4]

In another example, the newer-generation processors were more performant than the three-to-five-year-old processors they replaced and so could provide the same level of performance using fewer cores. In this case, the lower core count due to the refresh lowered VMware licensing costs per unit of performance by up to 38%.[5]

Streamline Infrastructure Costs

Beyond savings on software costs, consolidating your servers with a refresh can save money on your physical infrastructure too. For example, fewer servers consume fewer networking resources, which can help reduce the cost of your networking infrastructure. A smaller number of servers also takes up less rack space, which can help reduce the footprint in your own data center—or it can translate directly into lower monthly costs if you use a co-location facility to host your data center (such as with a 5:1 server consolidation).[4]

Manage Power Consumption

Consolidating workloads from legacy servers to the newest-generation hardware can also lower power consumption. In our example, the 10 legacy processors in the consolidation scenario illustrated in Figure 1 are rated to have a combined maximum power draw of 2,050 W, compared to the total 720 W maximally drawn by the newest-generation processors, which represents a 64% reduction in power consumption by the processors.

Even if your server refresh plans call for keeping the same number of servers from generation to generation, you have options. If you anticipate needing additional performance, you could replace a legacy two-socket server with a newer two-socket model and gain the benefits of the higher core count in newest-generation processors. Alternatively, you could replace a two-socket legacy server with a single-socket server that provides similar performance but consumes less power. For example, VMmark benchmarking for the server-upgrade path discussed earlier recorded average usage for the Fujitsu PRIMERGY RX2540 M5 server running 2nd Gen Intel Xeon Platinum 8280 processors at 1,425.14 W and an average power draw for the PowerEdge R7615 server powered by a 4th Gen AMD EPYC 9654P processor of 982.42 W, demonstrating a drop of 31% in average power consumption.[8]

A server refresh allows you to take advantage of the latest advancements in management features, which you can use to improve performance, efficiency, and sustainability across your data center. For example, Dell OpenManage Enterprise Power Manager can help optimize the energy usage and power consumption of PowerEdge servers and servers from other top server vendors. You can use its real-time monitoring to identify power-hungry applications and devices or "zombie servers" that are running but not in use. Hardware and software telemetry helps you configure policies that will automatically take steps to reduce energy consumption or set power caps at the rack or group level. Predictive analytics can help identify power-usage trends so that you can proactively make changes to lower power consumption. For example, you can schedule low-demand workloads outside of regular business hours and take advantage of off-peak electricity rates.

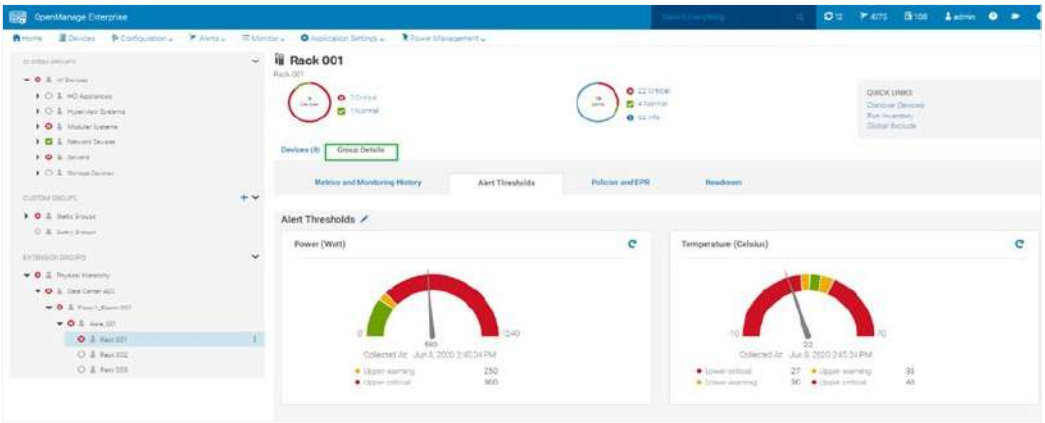

Figure 2 | Dell OpenManage Enterprise Power Manager lets you set up alerts for excessive power usage and temperature

Cost-Effective Ways of Keeping Your Servers Cool

The latest-generation Dell PowerEdge servers include high-efficiency cooling technologies designed to reduce the amount of power needed to cool your servers. PowerEdge servers are designed with Dell Smart Cooling, which uses state-of-the-art thermal and mechanical simulation tools to ensure optimal cooling and sustained system performance.

- Multi Vector Cooling (MVC) intelligently adapts to changing environments and configurations by regulating the speed of PowerEdge servers' case fans so that they use less energy, which also helps increase the lifespan of the servers.
- Dell Smart Flow is a PowerEdge server chassis design that pairs a larger air intake with less obstructed internal airflow, which helps to move more air more efficiently.

- Dell Direct Liquid Cooling technology is available for the latest PowerEdge servers. Liquid cooling used alone or combined with air cooling provides highly efficient temperature management for processors with high thermal design power (TDP) limits.

Improve Sustainability

Dell PowerEdge servers can help "green up" your data center. As of July 2023, PowerEdge servers are the only Silver-rated data center servers listed in the Global Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT™).[9] EPEAT ranks qualifying products as Gold, Silver, or Bronze according to a set of required and optional criteria for environmental and social responsibility; in achieving Silver ranking, PowerEdge servers meet all the required criteria and at least half of the optional criteria set out by EPEAT.[10]

Dell PowerEdge servers are the
only data center servers given an EPEAT™ Silver rating
for environmental and social responsibility.[9]

Harden Security

With the increasing frequency and severity of cyberattacks, organizations must be proactive in ensuring that their security measures align with the latest cybersecurity standards. An upgraded server platform allows you to implement the latest multi-layered security, deploy advanced platform monitoring and management capabilities, and enable hardware security features.

Holistically Address Security with PowerEdge Servers

We found that PowerEdge servers are designed from the ground up with security in mind, and they thus provide holistic security. Holistic security for servers refers both to the defenses that OEMs such as Dell Technologies provide to protect servers from attack and to the design ideals that help support actions in response to attacks that succeed. PowerEdge servers are designed to conform to the US National Institute of Standards and Technology (NIST) Cybersecurity Framework. The NIST Cybersecurity Framework consists of standards, guidelines, and best practices for organizations through five phases of cyberattacks: identification, protection, detection, response, and recovery.

A subset of this framework is the zero-trust paradigm for cybersecurity. Zero-trust is a cyber-protection paradigm that assumes all users and devices are untrusted until proven otherwise. For Dell hardware, this paradigm starts with its immutable hardware root of trust, hardware-based encryption that is used to verify subsequent operations within the server, such as booting. This verification establishes a chain of trust that extends throughout the server lifecycle, from deployment through maintenance to decommissioning. If a step in the boot process fails verification, the server shuts down so that automatic BIOS recovery can begin.

Similarly, PowerEdge servers use digital signatures on firmware updates to attest to the authenticity of the firmware running on a given server. Organizations can also use Dell management tools to maintain server firmware to a specified baseline. OpenManage Enterprise is a platform-management solution that can detect deviations from the baseline. Organizations can then use the Integrated Dell Remote Access Controller (iDRAC) management controller to schedule repairs for the next time servers are rebooted for maintenance.

OpenManage Enterprise also helps deploy end-to-end security across all servers in an organization in other ways. Centralized management provided by the software uses real-time monitoring to detect potential threats, examine server activity, track user access, and analyze security logs. This makes it easier to identify and respond to potential threats before they can cause significant damage.

OpenManage Enterprise can help you quickly recover from a security breach with data backup and restoration capabilities. We highly recommend scheduling regular backups and restoration checks, which can help minimize the impact of an attack and ensure your data is protected.

Harness Hardware-Based Security with AMD EPYC Processors

4th Gen AMD EPYC processors offer a suite of hardened security technologies called AMD Infinity Guard, designed to complement your existing software- and hardware-based security. These built-into-the-silicon features can help you extend protections holistically across your x86 server platforms, regardless of what workloads they are running, who is accessing them, or where they are physically located.

AMD Infinity Guard consists of five CPU-enforced security technologies:

1. **AMD Secure Processor** works with the immutable Dell hardware root of trust to secure BIOS boot, ensuring that only validated and verified components are allowed to boot up and run.
2. **Secure Memory Encryption (SME)** helps protect against threats that target system memory, such as memory-scraping attacks. Even if an attacker gains access to system memory, they are unable to read or modify the encrypted data.
3. **AMD Shadow Stack** protects in-memory data against return-oriented programming (ROP) attacks. This feature supports Microsoft hardware-enforced stack protection.
4. **Secure Encrypted Virtualization (SEV)** blocks attacks against VMs by keeping guest operating systems and the hypervisor environment isolated from each other. The **SEV Encrypted State (SEV-ES)** extension adds another layer of protection for data in use.
5. **SEV-Secure Nested Paging (SEV-SNP)** helps protect the integrity of the hypervisor, ensuring that a corrupted VM cannot access the hypervisor's memory.

Insights and Support for Complex Infrastructures

Management decisions that optimize your IT environment can help you gain even more benefits from a server refresh. For example, Dell Live Optics is a tool that lets you see into file systems, storage and database servers, on-premises and cloud environments, workloads, and data-protection operations. You can use these insights to get your server platforms running as performantly and efficiently as possible.

The last thing you want to happen after upgrading your servers is a disruption to resource availability and user productivity. However, achieving a seamless transition to the latest and emerging technologies might require a higher level of expertise than you have available in-house. In that case, you might choose to engage additional IT support, such as Dell ProSupport for Enterprise.

Conclusion

Organizations that adopt a modernized server strategy, which includes a three-year hardware refresh cycle, can lower the TCO of their server estates. This lower cost of ownership can manifest itself both through aggregated costs and benefits for their overall server performance, efficiency, and security.

Research conducted by Prowess Consulting found that refreshing your servers to the latest-generation Dell PowerEdge servers and AMD EPYC processors can:

- Improve performance/watt by up to 232% after upgrading from 2nd Gen AMD EPYC processors[2]
- More than double performance/core after upgrading from 2nd Gen Intel Xeon Scalable processors[7]

Refreshing your servers can also improve efficiency in a number of ways, with:

- Up to 5:1 server consolidation after upgrading from 1st Gen Intel Xeon Scalable processors, helping with server-license efficiency[4]
- Up to 38% lower VMware vSphere® licensing costs per unit of performance[5]
- Up to 31% lower average power consumption after upgrading from 2nd Gen Intel Xeon Scalable processors[6]

Moreover, newer environmentally and socially responsible server infrastructures can help reduce power and cooling costs for your data center.[9]

Finally, refreshing to newer servers can help holistically improve security for your server estate. Crucially, new servers with the latest-generation processors can help you adopt a zero-trust paradigm through features such as the Dell hardware root of trust and AMD Secure Processor, which require cryptographic authentication for each step of the server-boot process in order to head off attacks through compromised firmware. And features like AMD SME, SEV, and SEV-ES can help protect server operating systems and the VMs that depend upon them from low-level attacks.

Learn More

Learn more about Dell PowerEdge servers with 4th Gen AMD EPYC processors.

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Appendix

Table A1 | Benchmarks and registry used for this study

Registry and benchmarks	Description
Electronic Product Environmental Assessment Tool (EPEAT™)	Registry of products that meet the EPEAT environmental and social responsibility criteria. Qualifying products are given a rating of Bronze, Silver, or Gold.
SPEC CPU® 2017 Results	Measures and compares compute-intensive performance.
VMmark® 3.x	Measures power-performance for mixed virtualized workload environments.

[1] Tech Republic. "Forrester: Why Faster Refresh Cycles and Modern Infrastructure Management are Critical to Business Success." Forrester Consulting report sponsored by Dell Technologies. December 2018.

[2] Results based on VMmark® 3.x server power-performance results as of July 2023, comparing a 2S 2U Fujitsu® PRIMERGY® RX2540 M server with two Intel® Xeon® Platinum 8280 processors to a 1S 2U Dell PowerEdge R7615 server with an AMD EPYC 9654P processor. **Intel Xeon Platinum 8280 processor:** 28 cores, 205 W, server PPKW score = 6.329/kW, 0.0565/kW/core. **AMD EPYC 9654P processor:** 96 cores, 360 W, server PPKW score = 21.0179/kW, 0.1094/kW/core. Source: "VMmark 3.x server power-performance results."

[3] **Intel Xeon Platinum 8280 processor MSRP** = $11,460.00. Source: Intel. "Intel® Xeon® Platinum 8280 Processor." Accessed July 2023. (Note: Archived copies of this website on the Internet Archive do not contain pricing information prior to the present; current pricing was thus used for this analysis.) **AMD EPYC 9654P processor MSRP** = $11,805. Source: Paul Alcorn. "AMD 4th-Gen EPYC Genoa 9654, 9554, and 9374F Review: 96 Cores, Zen 4 and 5nm." Tom's Hardware. November 2022. (Note: Processor specification available on list pricing details for 1,000-unit purchases only.)

[4] Results based on VMmark® 3.x benchmarking conducted by Dell Technologies as of March 2023. 380 VMs on ten 2S servers with two Intel® Xeon® Platinum 8180 processors were migrated to two 2S 2U Dell PowerEdge R7625 servers with two AMD EPYC 9654 processors. Source: Dell. "Save Time, Rack Space, and Money—5:1 Server Consolidation Made Possible with the Latest AMD EPYC Processors." April 2023. VMware vSphere® virtualization software can be licensed by either the core or the socket. The most cost-efficient method of calculating licenses in this scenario is to use the per-socket method, which requires one vSphere license per processor with up to 32 cores per processor. This results in two licenses per legacy server (28 cores/processor, 2 processors/server) and six licenses per new server (96 cores/processor, 2 processors/server). Source: VMware. "License Usage Calculation." June 2023.

[5] Results based on SPECrate® floating point (SPECfp) and integer (SPECint) testing as of July 2023, comparing a two-node cluster of 2S 2U Fujitsu® PRIMERGY® RX2540 M5 servers with two Intel® Xeon® Platinum 8280 processors each to a two-node cluster of 1S 2U Dell PowerEdge R7615 servers with a single AMD EPYC 9654P processor each. **Fujitsu PRIMERGY RX2540 M5 server with Intel Xeon Platinum 8280 processors:** 28 cores, 4 VMware vSphere® licenses. SPECfp = 283; SPECint = 342; ; geometric mean of scores per core = 311.10, 77.77/vSphere license. **Dell PowerEdge R7615 server with AMD EPYC 9654P processor:** 96 cores, 6 VMware vSphere licenses. SPECfp = 704; SPECint = 825; geometric mean of scores per core = 762.10, 127.01/vSphere license. Comparison of blended performance for both servers taken from the ratio of their respective geometric means per vSphere license. Source: "SPEC CPU2017 Results." vSphere virtualization software can be licensed by either the core or the socket. The most cost-efficient method of calculating licenses in this scenario is to use the per-socket method, which requires one vSphere license per processor with up to 32 cores per processor. Source: VMware. "License Usage Calculation." June 2023.

[6] Results based on details from VMmark® 3.x server power-performance results as of July 2023, comparing a two-node cluster of 2S 2U Fujitsu® PRIMERGY® RX2540 M servers with two Intel® Xeon® Platinum 8280 processors each to a two-node cluster of 1S 2U Dell PowerEdge R7615 servers with a single AMD EPYC 9654P processor each. **Intel Xeon Platinum 8280 processor:** 28 cores, 205 W, server average power consumption = 1,425.14 W, source: VMware. "VMmark® 3.1 Results." March 2019. **AMD EPYC 9654P processor:** 96 cores, 360 W, server average power consumption = 982.42 W, source: VMware. "VMmark® 3.1.1 Results." March 2023.

[7] Results based on SPECrate® floating point (SPECfp) and integer (SPECint) testing as of July 2023, comparing a two-node cluster of 2S 2U Fujitsu® PRIMERGY® RX2540 M5 servers with two Intel® Xeon® Platinum 8280 processors each to a two-node cluster of 1S 2U Dell PowerEdge R7615 servers with a single AMD EPYC 9654P processor each. **Fujitsu PRIMERGY RX2540 M5 server with Intel Xeon Platinum 8280 processors:** 28 cores, 280 W. SPECfp = 283, 2.526/core; SPECint = 342, 3.0535/core; geometric mean of scores per core = 2.7777. **Dell PowerEdge R7615 server with AMD EPYC 9654P processor:** 96 cores, 360 W. SPECfp = 704, 7.3333/core; SPECint = 825, 4.2968/core; geometric mean of scores per core = 5.6134. Comparison of blended performance for both servers taken from the ratio of their respective geometric means. Source: SPEC. "SPEC CPU2017 Results."

[8] Results based on details from VMmark® 3.x server power-performance results as of July 2023, comparing a two-node cluster of 2S 2U Fujitsu® PRIMERGY® RX2540 M servers with two Intel® Xeon® Platinum 8280 processors each to a two-node cluster of 1S 2U Dell PowerEdge R7615 servers with a single AMD EPYC 9654P processor each. **Intel Xeon Platinum 8280 processor:** 28 cores, 205 W, server average power consumption = 1,425.14 W, source: VMware. "VMmark® 3.1 Results." March 2019. **AMD EPYC 9654P processor:** 96 cores, 360 W, server average power consumption = 982.42 W, source: VMware. "VMmark® 3.1.1 Results." March 2023.

[9] Global Electronics Council. EPEAT™ product registry. Product name: Dell PowerEdge servers. Product type: All servers. Manufacturer: Dell. Location of use: All. EPEAT Tier: Silver. Status: Active. Accessed May 2023.

[10] Global Electronics Council. "EPEAT™ Policy Manual." July 2023.

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