

THE PERFECT COMBINATION: ULTIMATE PERFORMANCE AND ENERGY EFFICIENCY

AMD EPYC™ 9004 SERIES PROCESSORS

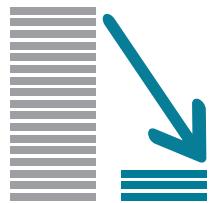
What if you could have both leadership performance and energy efficiency? When you choose 4th Gen AMD EPYC processors you can use up to 96 cores per processor to drive faster time to results, achieve quicker insights, and enjoy better business outcomes. For performance per watt, you get an estimated 24% more integer performance^{SPS-003A} and ~52% more floating-point performance^{SPS-004A} than our previous CPU generation at the same core count¹. Moving just a few servers to AMD EPYC CPUs can make a big impact. Imagine what moving a data center to AMD EPYC processor-powered servers could do for the planet. It's easy to switch because we take the mystery out of x86 CPU selection. Just choose the core count, frequency, and cache size you need—memory capacity, security features, I/O bandwidth, and more are included at no additional cost.

REFRESH AND CONSOLIDATE

- **Cut 16 servers down to 3**

To deliver 500 virtual machines with 1 core and 8 GB of memory allocated to each takes an estimated 81% fewer servers when comparing servers with two 96-core AMD EPYC 9654 with two 16-core Intel® Xeon® Gold 6130 CPUs^{SPS-005}

16 → 3



GENERAL-PURPOSE SERVER LEADERSHIP

- **Gain 3x the cloud throughput**

Comparing servers with top-of-stack integer CPUs: 2-socket 96-core EPYC 9654 processors to 2-socket 40-core Xeon Platinum 8380 CPUs^{SPS-010B}

3x



ADVANCE HIGH-PERFORMANCE COMPUTING PERFORMANCE

- **Gain 2.5x the floating-point performance**

Comparing floating-point performance for servers with two 96-core EPYC 9654 processors to two 40-core Xeon 8380 CPUs^{SPS-009C}

2.5x



CUT CO₂ EQUIVALENT EMISSIONS

- **Save up to 234 metric tons over three years**

Using eight 2-socket servers with 96-core AMD EPYC 9654-powered servers instead of 47 2-socket servers with 16-core Xeon 6130 CPUs to power 1500 virtual machines, you can save ~516 MWh of electricity over 3 years, which is the carbon sequestration of 94 acres of forest annually in the USA^{SPS-CO-016}

94 acres



ADVANCE ENERGY EFFICIENCY GOALS

- **With 2x the top-of-stack performance per watt**

Comparing 2-socket servers with 96-core EPYC 9654 CPUs to 2-socket servers with 40-core Xeon 8380 CPUs running the SPECpower_ssj® 2008 workload^{SPS-018}

2x

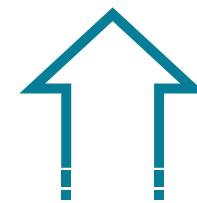


ADVANCE YOUR IT INVESTMENT

- **With est. ~55% more integer and est. ~96% more floating-point performance per core**

Comparing 2-socket servers with 32-core EPYC 9374F CPUs to 2-socket servers with 32-core Xeon 8362 CPUs^{SPS-016A, SPS-025A}

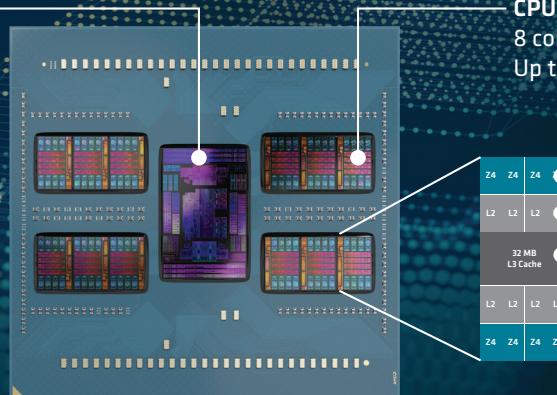
+~96%



1. Comparing servers with two 64-core AMD EPYC 9534 vs two 64-core AMD EPYC 7763

AMD EPYC 9004 SERIES ARCHITECTURE

I/O die
12 memory controllers
PCIe® Gen 5 controllers
Infinity Fabric™ controllers
SATA controllers
CXL™ controllers
AMD Secure Processor



CPU die
8 cores per die
Up to 12 dies per processor

CPU die detail
8 'Zen 4' cores
1 MB L2 cache per core
Shared 32 MB L3 cache

SYSTEM-ON-CHIP FEATURES

- Up to 128 PCIe Gen 5 lanes in a 1P configuration; up to 160 lanes in a 2P configuration, and up to 12 'bonus' PCIe Gen 3 lanes in a 2P configuration
- Of the 128 PCIe lanes, up to 32 are configurable as on-chip SATA controllers to access massive disk capacity
- Of the 128 PCIe lanes, up to 64 are configurable as CXL 1.1+ for cache-coherent memory expansion
- 12 memory controllers with capability for up to two DIMMs per channel to yield up to 6 TB of main memory per CPU—50% more than any other x86 processor^{EPYC-033}
- 2, 4, 6, 8, 10, and 12-channel memory interleaving to help optimize for both small and large memory configurations
- Integrated security processor that supports confidential computing with features including secure root of trust, secure memory encryption(SME), and secure encrypted virtualization (SEV)²
- 'Zen 4' core that delivers up to ~14% more instructions per clock compared to our previous generation and is further "hardened at the core" to help protect your most valuable asset—your data^{EPYC-038}
- New AVX-512 instructions with 256-bit data paths support higher frequencies than our prior generation, plus they include VNNI and BFLOAT16 to match industry standards.

ADVANCING PROCESSOR ARCHITECTURE

For three processor generations, our innovative, hybrid multi-die architecture has enabled us to leap ahead of the competition in core density and performance. We have decoupled the process technologies between CPU and I/O functions so that each can advance at its own pace. This means delivering more innovations to your data center quickly. Our innovation delivers the world's highest-performing server CPUs^{SP5-013A} with the highest estimated performance per core available anywhere,^{SP5-014} all based on our 'Zen 4' design and 5nm process technology.

AMD INFINITY ARCHITECTURE

The heart of the AMD Infinity Architecture is a leadership interconnect that supports extraordinary levels of scale at every layer. Components communicate using AMD Infinity Fabric™ technology—a connection that is used within cores, between cores, and with off-chip components—to connect 'Zen 4' processor cores, memory, PCIe® Gen 5 I/O, and security mechanisms. As a result, the architecture delivers breakthrough performance and efficiency to deliver on the promise of next-generation computing.

SYSTEM-ON-CHIP DESIGN

Our all-in philosophy means that every offering in our product line has the same built-in features. This takes the mystery out of CPU selection. Just choose the core count, cache size, and frequency your workload requires, and the rest are included at no extra cost. Our system-on-chip design means that servers don't have to include additional chip sets to handle I/O, helping reduce complexity and power consumption (see sidebar).

POWERED BY OUR NEW 'ZEN 4' CORE

Our core CPU design is constantly being improved to deliver more instructions per cycle, implement new instructions, improve energy efficiency, and incorporate more hardening against security attacks. Our 'Zen 4' core helps drive 2.1x the integer and 2.2x the floating-point top-of-stack performance compared to our prior-generation processors.^{SP5-001C, SP5-002C}



ADVANCING EFFICIENCY

Performance and efficiency are the defining metrics of our time. In today's world, you need high performance to get the job done, but that's no longer enough. You need to do it all while using less energy to help reduce your data center's carbon footprint.

Moving just a few servers to AMD EPYC CPUs can make a big impact. For example, it takes just 8 new 2-socket, 96-core AMD EPYC 9654 powered servers to deliver 1500 virtual machines, each with one core and 8 GB of memory compared to 47 four-year-old 16-core Xeon 6130 powered servers. The AMD EPYC solution uses an estimated 89% fewer servers and 57% less power, saving ~516,633 kWh of electricity over three years, resulting in the carbon sequestration equivalent of 94 acres of US forest annually. SPSTC0-016 Imagine what moving your data center to AMD EPYC processor-powered servers can do for the planet. Or more: How many servers are there in the world? What could be the benefit for the planet? Switching to EPYC CPUs could be epic.

Our 4th Gen processors are #1 in key industry-recognized energy efficiency benchmarks. SPS-072 On the metric of performance per watt, the AMD EPYC 9004 Series improves upon the prior generation with an estimated 24% more integer SPS-003A and 52% more floating-point performance SPS-004A with the same core count (servers with two 64-core AMD EPYC 9534 compared to two 64-core AMD EPYC 7763).

More efficiency means more flexibility. You can use fewer servers for the same work; or accomplish more work with the same number of servers and get the job done faster. Whatever you decide, EPYC CPUs help make your data center more efficient and help you achieve your sustainability goals.

ADVANCING SECURITY

Physical and virtual threats pose a risk throughout your organization and extend to your customers. AMD Infinity Guard¹⁰⁻¹⁸³ security features are a synergy between hardening in the 'Zen 4' CPU core and the dedicated, embedded security processor designed to help maintain a secure compute environment from power-on to run time.

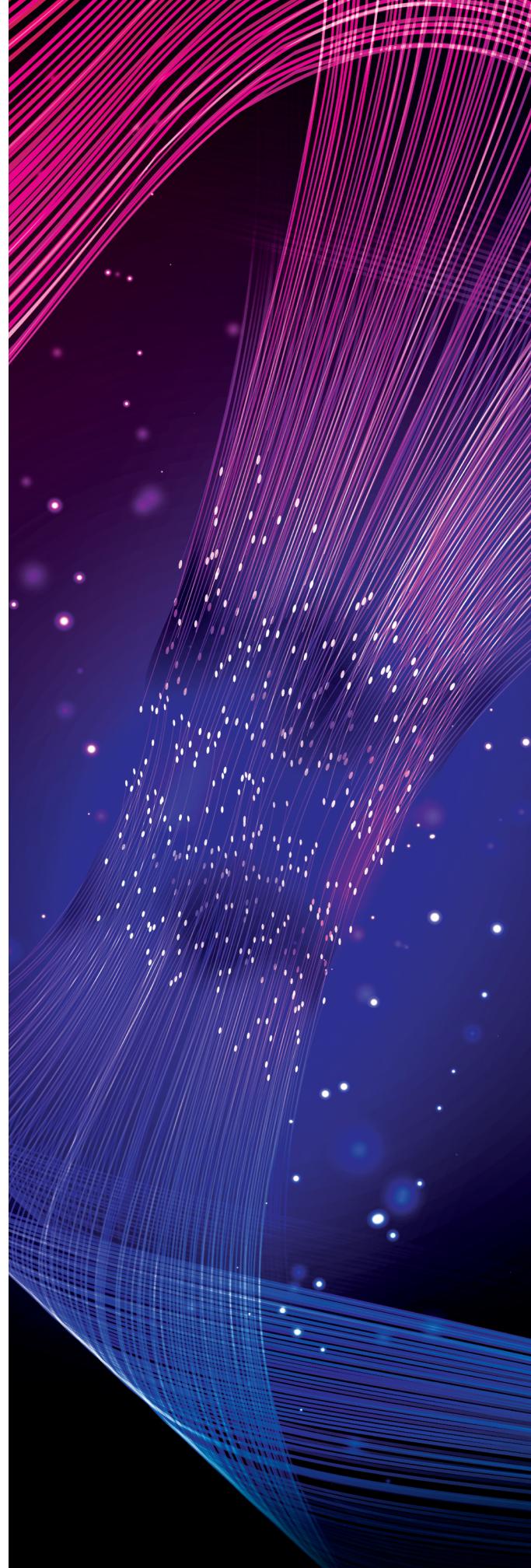
The AMD Secure Processor scrutinizes the boot process and helps manage up to 1006 unique encryption keys known only to the security processor. Combined, these technologies help decrease potential attack surfaces as software is booted and executed and processes your data.

Our "hardened-at-the-core" security is the outcome of a continuous improvement process. For example, when we released our 2nd Gen processors with AMD Secure Memory Encryption (SME) and Secure Encrypted Virtualization (SEV), the processor architecture incorporated cache memory tagging that associates memory to the thread that 'owns' it, helping to repel side-channel attacks. Over time, we have increased the number of encryption contexts in SEV so you can accommodate more confidential virtual machines. We have helped protect virtual machine states from malicious or compromised hypervisors with AMD Secure Encrypted State (SEV-ES), and we have added AMD Secure Nested Paging (SEV-SNP) to help prevent attacks such as data replay, memory remapping, and more—all to help create confidential, isolated execution environments for virtual machines. With the larger physical memory enabled by 4th Gen AMD EPYC processors, we have increased the page table depth that can be encrypted.

ADVANCING REAL WORKLOAD PERFORMANCE

The AMD Infinity Architecture helps make real workloads run exceptionally well on servers with AMD EPYC processors. Whether you need to accelerate computation, speed access to data, or help defend against ever-changing security threats, 4th Gen AMD EPYC processors have what it takes to get up and running quickly, to help drive better, energy-efficient business outcomes with the confidence of modern security features to support confidential computing. Performance like this helps you:

- **GET THE MOST OUT OF SOFTWARE LICENSES.** If your software licensing fees are on a per-core basis, use our high-frequency processors to gain excellent per-core performance to help maximize what you get out of your licenses. For example, you gain an estimated ~55% higher integer and est.~96% more floating-point performance per core with 2-socket servers based on 32-core EPYC 9374F compared to 32-core Xeon 8362 CPUs.[SP5-016A](#) [SP5-025A](#)
- **ACCELERATE YOUR SUPPLY CHAIN.** Software such as the SAP® Sales and Distribution Benchmark (SD) require servers to do more activities in parallel. A high core count, improvements in the ‘Zen 4’ core, plus large cache and memory capacities help speed enterprise resource planning software. For example, 2-socket servers based on 96-core EPYC 9654 processors support 3.1x the number of users compared 40-core Xeon CPUs running the SAP Sales and Distribution 2-tier benchmark.[SP5-056](#)
- **MAKE MARKET-DRIVEN DECISIONS.** Data analytics software relies on massive in-memory databases and highly parallelized processing. With the powerful combination of 12 DDR-5 memory channels, up to 192 threads, and a large L3 cache, you can process more information faster. Consider that you can deliver ~1.5x the decision-support query performance running the Microsoft SQL Server® DSS workload on a server with a single 96-core EPYC 9654 compared to one 64-core EPYC 7763.[SP5-040](#)
- **SPEED USER APPLICATIONS.** Java® software is highly parallelized, and can take advantage of the core density and memory bandwidth of our 4th Gen AMD EPYC processors. You can gain 70% more SPECjbb®2015 max-jOPS performance with 2-socket servers with 32-core EPYC 9374F CPUs compared to 32-core Xeon 6338 CPUs running the SPECjbb®2015-MultijVM workload.[SP5-067](#)
- **CREATE A BETTER PRIVATE CLOUD.** AMD EPYC processors deliver leadership virtualization performance through high core counts and high memory bandwidth and capacity. Plus, our Infinity Guard security features help keep workloads isolated. On the VMware® VMmark® benchmark with matched pairs, a 2-node, 2-socket, 96-core EPYC 9654 CPU-powered cluster has 2.8x the VMmark score and 3.1x the virtual machine (tile) capacity compared to a 2-node, 2-socket 40-core Xeon 8380 CPU-powered cluster.[SP5-049B](#)
- **DELIVER BETTER USER EXPERIENCES.** Virtual desktop infrastructure needs excellent response time. This is supported by a higher core count in AMD EPYC processors, fast PCIe 5.0 lanes that deliver high throughput, and fast communication between the CPU and GPU that renders complex images. Get the same VDI performance with ~1/2 the servers for 4000 “knowledge worker” desktop sessions (VSI_{max}) when they are equipped with two 96-core EPYC 9654 CPUs compared to two 40-core Xeon 8380 processors.[SP5-054](#)





**"[With AMD EPYC
servers], our power
consumption reduced by
50 percent. But we had
ten times the capacity
to grow."**

CHOON BOON TAN
**MANAGING DIRECTOR AND HEAD OF CLOUD
ENGINEERING & SERVICES**
DBS SINGAPORE^{GD-181}

YOUR DATA—ANYWHERE

As an IT practitioner, you know how important it is to achieve the best possible balance between performance and efficiency. With the revolutionary AMD Infinity Architecture that delivers efficiency, performance, memory, and security features, we can help you guard your most important assets, accelerate your workloads, and modernize your data center so that you can move at the speed of your business.

AMD EPYC processor-powered servers are everywhere, with instances available from all of the major cloud providers so that you can extend your on-premises infrastructure into the cloud with the same performance and efficiency that you enjoy in the data center and at the edge. You can count on the major providers rapidly adopting this newest and best generation of AMD EPYC processors ever.

READY TO MAKE THE SWITCH?

Visit [amd.com/epyc](https://www.amd.com/en/claims/epyc)

FOOTNOTES

For details on the footnotes used in this document, visit [amd.com/en/claims/epyc](https://www.amd.com/en/claims/epyc) and <https://www.amd.com/en/claims/epyc4>. For a complete list of world records see [amd.com/worldrecords](https://www.amd.com/worldrecords).

GD-183 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-181 All performance and cost savings claims are provided by DBS and have not been independently verified by AMD. Performance and cost benefits are impacted by a variety of variables. Results herein are specific to DBS and may not be typical.

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