

ALTAIR® RADIOSS™ AND AMD 3D V-CACHE™ TECHNOLOGY STRUCTURAL ANALYSIS FOR CRASH AND IMPACT

Powered by 4th Gen AMD EPYC™ Processors with AMD 3D V-Cache™ technology

June 2023

AT A GLANCE

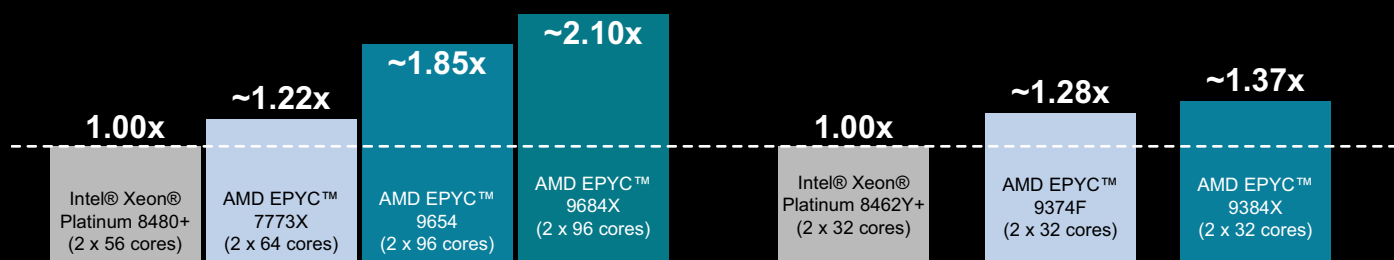
2P systems powered by 32- and 96-core 4th Gen AMD EPYC™ processors with AMD 3D V-Cache™ technology demonstrate outstanding per-core and comparable competitive and generational performance uplifts on Altair® Radioss™.

PERFORMANCE HIGHLIGHTS

A single 2P 96-core 4th Gen AMD EPYC 9684X system with AMD 3D V-Cache technology demonstrates a ~2.10x uplift vs. a comparable single 2P Intel® Xeon® Platinum 8480+ system² on a composite average of Altair Radioss workloads. On a per-core basis, a 2P 32c AMD EPYC 9384X system outperforms a 2P 32-core Intel Xeon Platinum 8462Y+ system by ~1.37x.

2P AMD EPYC™ 9684X vs. 2P INTEL XEON PLATINUM 8480+
(COMPARABLE² - COMPOSITE AVERAGE, NORMALIZED TO 8480+)

2P AMD EPYC™ 9384X vs. 2P INTEL XEON PLATINUM 8462Y+
(32-CORE - COMPOSITE AVERAGE, NORMALIZED TO 8462Y+)



KEY TAKEAWAYS

A 2P server powered by 4th Gen AMD EPYC 9684X (96-core) processors delivered a composite average Altair Radioss competitive performance uplift of ~2.10x compared to a 2P server powered by a comparable Intel Xeon Platinum 8480+ (56-core) processors. On a per-core basis, a 2P server powered by 32-core AMD EPYC 9384X processors outperformed a 2P server powered by 32-core Intel Xeon Platinum 8462Y+ processors by ~1.37x.

4th Gen AMD EPYC 9004X processors with AMD 3D V-Cache technology are available in 1P and 2P configurations and feature:

- Up to 1,152MB L3 cache vs. 384MB in standard 4th Gen AMD EPYC processors.
- Up to 4 links of Gen 3 Infinity Fabric™ at up to 32 Gbps.
- 12 memory channels that support up to 6TB of DDR5-4800 memory.
- Support for PCIe® Gen 5 at up to 32 Gbps.
- AVX-512 instruction support for enhanced HPC and ML performance.
- AMD Infinity Guard technology to defend your data.³

IN THIS BRIEF

- AMD 3D V-Cache™ Technology..... **Page 2**
- System Configuration..... **Page 2**
- Test Methodology..... **Page 3**
- For Additional Information..... **Page 3**
- References..... **Page 3**

AMD 3D V-CACHE™ TECHNOLOGY

Some AMD EPYC 9004 Series Processors include AMD 3D V-Cache™ die stacking technology that enables more efficient chiplet integration. AMD 3D Chiplet architecture stacks L3 cache tiles vertically to provide up to 96MB of L3 cache per die (and up to 1152 MB L3 Cache per socket) while still providing socket compatibility with standard AMD EPYC™ 9004 Series Processor models.

AMD EPYC 9004 Series Processors with AMD 3D V-Cache technology employ industry-leading logic stacking based on copper-to-copper hybrid bonding “bumpless” chip-on-wafer process to enable over 200X the interconnect densities of current 2D technologies (and over 15X the interconnect densities of other 3D technologies using solder bumps),^{4,5} which translates to lower latency, higher bandwidth, and greater power and thermal efficiencies.

SYSTEM CONFIGURATION

AMD SYSTEM CONFIGURATION					
CPU	2x AMD EPYC 7773X	2 x AMD EPYC 9374F	2 x AMD EPYC 9384X	2x AMD EPYC 9654	2 x AMD EPYC 9684X
Frequency: Base Boost ⁶	2.20 GHz 3.50 GHz (up to)	3.85 GHz 4.10 GHz (up to)	3.10 GHz 3.90 GHz (up to)	2.40 GHz 3.55 GHz (up to)	2.55 GHz 3.70 GHz (up to)
Cores	64 cores/socket (128 threads)	32 cores/socket (64 threads)	32 cores/socket (64 threads)	96 cores/socket (192 threads)	96 cores/socket (192 threads)
L3 Cache	768 MB per CPU	256 MB per CPU	768 MB per CPU	384 MB per CPU	1152 MB per CPU
Memory	1.0 TB (16x) Dual-Rank DDR4 3200 64 GB DIMMs 1 DPC	1.5 TB (24x) Dual-Rank DDR5 4800 64 GB DIMMs 1 DPC			
NIC	25 Gb Ethernet CCX512-A ConnectX-5 (fw 16.35.2000)				
InfiniBand	200 Gb HDR ConnectX-6 VPI (fw 20.35.2000)				
Storage: OS Data	Samsung MZQL21T9HCJR-00A07 1.92 TB				
BIOS Version	1009B	1007D			
BIOS Settings	SMT=OFF; NPS=4; Determinism=Power				
OS	RHEL 8.7 (kernel 4.18.0-425.3.1.el8.x86_64)				
OS Settings	amd_iommu=ON; iommu=pt; mitigations=off; clear caches; NUMA balancing=0; THP=on; CPU governor=Performance; C2 states=disabled				

Table 1: AMD system configurations

INTEL SYSTEM CONFIGURATION		
CPU	2x Intel Xeon Platinum 8480+	2x Intel Xeon Platinum 8462Y+
Frequency: Base Boost	2.00 GHz 3.80 GHz (up to)	2.40 GHz 4.10 GHz (up to)
Cores	56 cores per socket (112 threads)	32 cores per socket (64 threads)
L3 Cache	105 MB per CPU	60 MB per CPU
Memory	1.0 TB (16x) Dual-Rank DDR5 4800 64 GB DIMMs 2 DPC	
NIC	25 Gb Ethernet CCX512-A ConnectX-5 (fw 16.35.2000)	
InfiniBand	200 Gb HDR ConnectX-6 VPI (fw 20.35.2000)	
Storage: OS Data	Samsung MZQL21T9HCJR-00A07 1.92 TB	
BIOS Version	ESE110Q-1.10	
BIOS Settings	Hyperthreading=Off, Profile = Maximum Performance	
OS	RHEL 8.7 (kernel 4.18.0-425.3.1.el8.x86_64)	
OS Settings	processor.max_cstate=1; intel_idle.max_cstate=0; iommu=pt mitigations=off; clear caches; NUMA Balancing=0; randomize_va_space 0; THP=ON; CPU Governor=Performance	

Table 2: Intel system configurations

TEST METHODOLOGY

These benchmark cases represent typical Radioss application usage and cover a range of sizes. The uplift is calculated as the ratio of the systems under test (sut) to the reference systems (ref). In this Performance Brief, the Intel Xeon Platinum 8480+ and Intel Xeon Platinum 8462Y+ processors are the ref systems, and 4th Gen AMD EPYC processors are the sut. The 4th Generation AMD EPYC processors tested include both standard AMD EPYC 9004 and AMD EPYC 9004X models with AMD 3D V-Cache technology. The total amount of variability between individual runs was <1%. The results presented in this Performance Brief are the composite average per-processor uplifts running the Taurus FFB50, Venza Battery, Neon, and dropsander benchmarks. The systems tested were configured as shown in Tables 1 and 2, above.

FOR ADDITIONAL INFORMATION

Please see the following additional resources for more information about 4th Gen AMD EPYC features, architecture, and available models:

- [AMD EPYC™ 9004 Series Processors](#)
- [AMD EPYC™ Products](#)
- [AMD EPYC™ Tuning Guides](#)

REFERENCES

1. “Technical Computing” or “Technical Computing Workloads” as defined by AMD can include: electronic design automation, computational fluid dynamics, finite element analysis, seismic tomography, weather forecasting, quantum mechanics, climate research, molecular modeling, or similar workloads. GD-204
2. The Intel Xeon Platinum 8480+ is the highest-performing processor listed in the Performance General-Purpose category for 4th Gen Intel Xeon CPU models at https://download.intel.com/newsroom/2023/data-center-hpc/Intel-4th-Gen-Xeon_product_SKUs.jpg.
3. 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
4. Based on calculated areal density and based on bump pitch between AMD hybrid bond AMD 3D V-Cache stacked technology compared to AMD 2D chiplet technology and Intel 3D stacked micro-bump technology. EPYC-026
5. Based on AMD internal simulations and published Intel data on “Foveros” technology specifications. EPYC-027
6. Maximum 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

AUTHORS

Alvaro Fernandez and Ashok Manikonda contributed to this Performance Brief.

RELATED LINKS

- [Altair*](#)
- [Altair Radioss*](#)
- [Altair Radioss Datasheet*](#)
- [AMD EPYC™ Processors](#)
- [AMD EPYC Technical Briefs and Tuning Guides](#)

**Links to third party sites are provided for convenience and unless explicitly stated, AMD is not responsible for the contents of such linked sites and no endorsement is implied.*

AMD EPYC 9004 FOR CFD

4th Gen AMD EPYC CPUs deliver excellent per-core performance by taking advantage of fast CPU frequencies, low latency memory, and a unified cache structure. Design engineers can use AMD EPYC processors to perform complex finite element analysis tasks with ground-breaking high-performance computing and robust security features to deliver excellent results.

“ZEN 4” CORE & SECURITY FEATURES

Support for up to:

- 96 physical cores, 192 threads
- 1152 MB of L3 cache per CPU
- 96 MB of L3 cache per CCD
- 6 TB of DDR5-4800 memory
- Up to 128 1P, up to 160 2P PCIe® Gen 5 lanes

Infinity Guard security features³

- Secure Boot
- Encrypted memory with SME

ALTAIR®

Altair® delivers comprehensive, open-architecture solutions for data analytics & AI, computer-aided engineering, and high-performance computing (HPC), enable design and optimization for high performance, innovative, and sustainable products and processes in an increasingly connected world.

ALTAIR® RADIOSS™

Altair Radioss benchmarks provide hardware performance data measured using sets of benchmark problems selected to represent typical usage.

DISCLAIMERS

The information contained herein is for informational purposes only and is subject to change without notice. While every precaution has been taken in the preparation of this document, it may contain technical inaccuracies, omissions and typographical errors, and AMD is under no obligation to update or otherwise correct this information. Advanced Micro Devices, Inc. makes no representations or warranties with respect to the accuracy or completeness of the contents of this document, and assumes no liability of any kind, including the implied warranties of noninfringement, merchantability or fitness for purposes, with respect to the operation or use of AMD hardware, software or other products described herein. No license, including implied or arising by estoppel, to any intellectual property rights is granted by this document. Terms and limitations applicable to the purchase or use of AMD's products are as set forth in a signed agreement between the parties or in AMD's Standard Terms and Conditions of Sale.

COPYRIGHT NOTICE

©2023 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, EPYC, Infinity Fabric, AMD 3D V-Cache, and combinations thereof are trademarks of Advanced Micro Devices, Inc. Altair, the Altair logo, and Radioss are trademarks or registered trademarks, of Altair. Red Hat is a trademark or registered trademark of Red Hat, Inc. PCIe is a registered trademark of PCI-SIG Corporation. Other product names used in this publication are for identification purposes only and may be trademarks of their respective companies.