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HIGH-VALUE CAE SOLUTIONS FOR MANUFACTURING

HPE Apollo Systems with AMD EPYC processors deliver HPC solutions that enhance product development and time-to-market.

TABLE OF CONTENTS

MEETING MANUFACTURING CHALLENGES WITH CAE

As manufacturers of all sizes struggle with cost and competitive pressures, and as products become smarter, more complex, and highly customized, the use of computer-aided engineering (CAE) is growing. Figure 1 depicts how a CAE solution addresses a manufacturer's business challenges and customer requirements.

Using CAE, engineers can design and test ideas for new products without having to physically build many expensive prototypes. This helps manufacturers to lower costs, enhance productivity, improve quality, and reduce time-to-market by primarily focusing on designs that have the best potential for market success. CAE also helps drive innovation and enhance collaboration throughout the supply chain, while mitigating risks and costs associated with potential product failure and associated litigation.

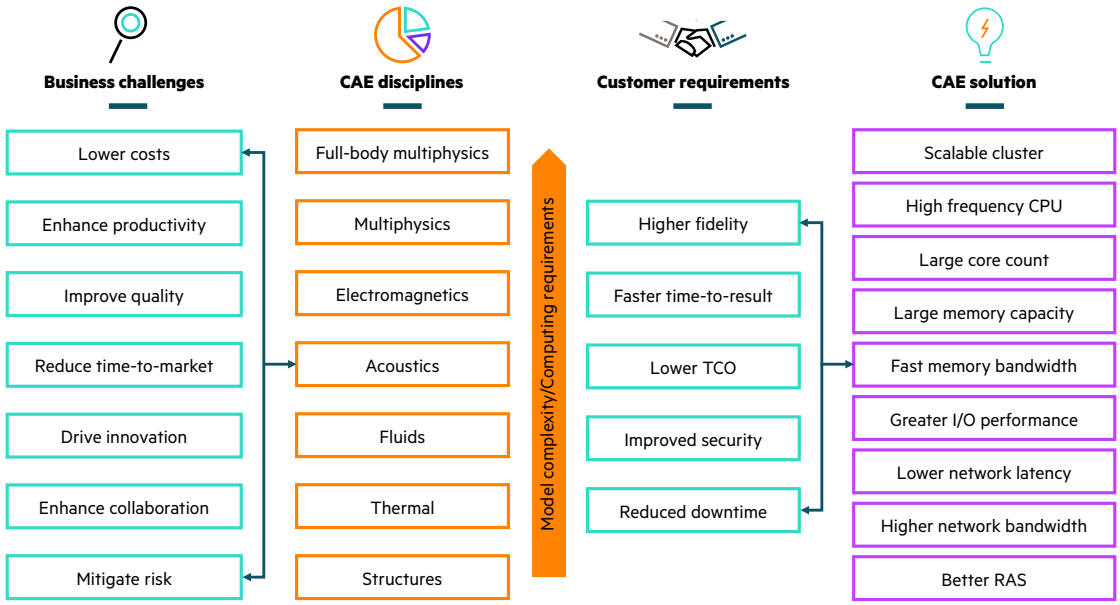


FIGURE 1. Manufacturing business challenges and requirements addressed with CAE

Manufacturers need to deliver ever more complex products, get to market faster, and continuously innovate and improve product quality—all with limited resources.

Multiphysics design optimization studies are extremely challenging.

Of the CAE disciplines, the most demanding is multiphysics because it combines several CAE applications such as structural analysis, fluid mechanics, mechanical dynamics, electromagnetics, and so on. These comprehensive, high-fidelity simulations can help accurately predict how complex products behave in real world environments. Iterative design exploration studies are also being extensively used to simulate, design, and optimize complex systems. Multiphysics design optimization studies need very detailed geometric models and large meshes over thousands of operating scenarios. This puts enormous stress on the HPC infrastructure.

High-frequency and high-core-count processors with large memory are needed.

HPE is the market leader in HPC systems with 37.2% market share.[2]

CUSTOMER REQUIREMENTS FOR HPC SOLUTIONS

Manufacturers of all sizes need a highly reliable, secure HPC solution that scales and performs at very high levels to deliver faster time-to-results on larger and more complex simulation models. This solution must also foster collaboration throughout the supply chain, as well as lower complexity and the total cost of ownership (TCO), including capital and operational (facilities, labor, and expensive CAE software license) costs.

An affordable CAE solution that reduces TCO and maximizes value from CAE software licenses is a scalable HPC cluster with:

- High-frequency processors enabling significant per-core performance
- High core count to complete jobs faster
- Large memory capacity, fast memory bandwidth, and high ratios of cache per core to further improve compute performance
- High I/O performance
- Low network latency and high network bandwidth to ensure better scaling
- Reliability, availability, and serviceability (RAS) to minimize downtime costs

As the market leader in HPC systems with 37.2% market share,[1] Hewlett Packard Enterprise delivers one of the industry's most comprehensive CAE solutions across compute, interconnect, software, storage, and services delivered on-premises, hybrid, or as a service. By teaming up with AMD, HPE delivers exceptional performance, flexibility, and choice on a range of CAE applications as shown in Figure 2.

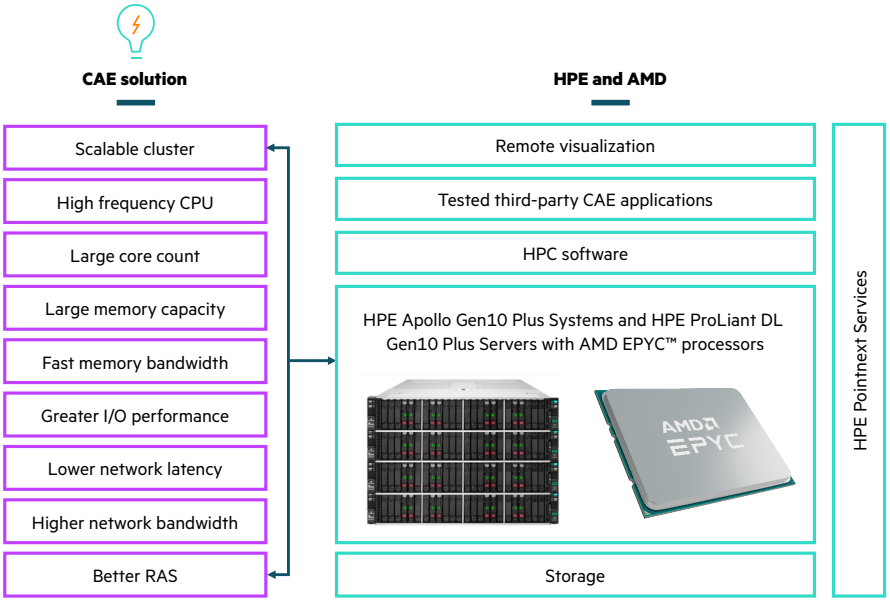


FIGURE 2. High-level view of the HPE and AMD CAE solution

[1, 2] Hyperion Research SC20 Virtual Market Update—November 2020—hyperionresearch.com/wp-content/uploads/2020/11/SC20-HPC-Market-Update_11.17.20.pdf

HPE Apollo 2000 Gen10 Plus System with 4x HPE ProLiant XL225n Gen10 Plus Servers powered by AMD EPYC achieved ten world records on SPECpower_ssj®2008, making it the most energy-efficient multinode server in the world.[3]

THE HPE AND AMD SOLUTION FOR CAE

HPE provides a complete end-to-end solution stack shown in Figure 2 that is flexible and customizable to meet manufacturing client's business requirements. This stack provides a large portfolio of supported and tested third-party CAE application software, a broad range of system software, server, and storage platforms, delivered with high-value services and remote visualization.

Remote visualization: Enhances security by keeping critical data within the data center; boosts productivity and collaboration with anytime, anyplace/any location access to graphic-intensive models; helps lower costs by centralization, improving system manageability and helping optimize resource (software licenses, hardware, and so on) utilization; and promotes retention of highly skilled staff with better work-life balance and location flexibility.

CAE applications: HPE and AMD have excellent relationships with independent software vendors (ISVs). HPE and AMD have computer scientists who help ISVs test and optimize their applications. Major CAE applications supported and tested include Altair RADIOSS®, Ansys® Fluent®, Ansys® Mechanical™, Ansys® LS-DYNA®, Ansys® CFX®, MSC® Nastran®, Siemens® STAR-CCM+®, OpenFOAM®, Dassault Systèmes SIMULIA® Abaqus® FEA, and ESI® Virtual Performance Solutions® (VPS) to name just a few.

HPC system software: HPE offers HPC customers a complete and modular software portfolio, which consists of HPE developed software solutions, combined with best-of-breed solutions from business partners and open source software providers. This portfolio is validated, integrated, and performance-enhanced by HPE so manufacturers can select the right software mix for their CAE efforts—all from one source including operating system, cluster management, job schedulers and resource managers, HPC tools and libraries, and more.

AMD Optimizing CPU Libraries (AOCL): AOCL are a set of numerical libraries optimized for the AMD EPYC processor family. They have a simple interface to take advantage of the latest hardware innovations to accelerate the development and performance of CAE applications.

HPE Apollo 2000 Gen10 Plus System: The HPE Apollo 2000 Gen10 Plus System pictured in Figure 3 is a density-enhanced, multiserver with shared power and cooling resources that delivers high levels of efficiency and system scaling. The 2U chassis supports up to four HPE ProLiant XL225n Gen10 Plus Servers each with up to two 2nd or 3rd generation AMD EPYC processors. The HPE Apollo 2000 Gen10 Plus System provides storage and compute flexibility, increased power capability, and support for 240W+ processors.

HPE Apollo 2000 Gen10 Plus System

- Up to 4 x AMD EPYC CPU-based servers per 2U chassis
- 2 x AMD EPYC 7002 or 7003 series processors per server
- Up to 64 cores and 128 threads per CPU
- 2 TB memory per server (8 TB in 2U)—16 x 128 GB
- Eight memory channels for superior throughput
- Up to 3200 MT/s DDR4 memory
- Up to 32 MB shared L3 cache per core (7003 series)
- Up to 16 MB shared L3 cache per core (7002 series)
- Hot Plug SFF SATA/SA and NVMe storage options
- Comprehensive management tools (APM/RCM)
- Security anchored in HPE iLO 5 and Silicon Root of Trust
- 2 x 3000W power supplies, N+N redundancy
- Enhanced thermal efficiency for HPC workloads
- Optional internal RAID controllers

HPE Apollo 2000 Gen10 Plus System front view with multiple storage options

HPE Apollo 2000 Gen10 Plus System rear view with up to 4 hot-pluggable dual-processor servers per chassis for maximum density and flexibility

FIGURE 3. HPE Apollo 2000 Gen10 Plus System specifications

[3] HPE ProLiant XL225n Gen10 Plus achieves 10 records on SPECpower_ssj2008—hpe.com/psnow/doc/a50001386enw

Only HPE offers industry-standard servers with firmware anchored into silicon with HPE iLO 5 and Silicon Root of Trust. Tied into the Silicon Root of Trust is the AMD Secure Processor, a dedicated security processor embedded in the AMD EPYC system on a chip (SoC). This, along with secure recovery and firmware runtime validation at start up, helps limit security breaches and system disruption if code is compromised.

Manufacturers can also take advantage of optional HPE Apollo Platform Manager (APM), a rack-level power and system management solution for HPE Apollo servers providing an enhanced graphical interface for ease of system management.[4] An optional HPE Apollo 2000 Rack Consolidation Module kit allows HPE iLO aggregation at the chassis level that can be daisy-chained to connect to a top of rack (ToR) management switch.

Storage: Fast I/O is also critical for CAE applications to ensure that file and network I/O do not become bottlenecks. HPE Apollo 2000 Gen10 Plus Systems offer PCIe® Gen4, providing twice the throughput[5] of the previous generation. HPE offers a variety of high-performance PCIe options, including 200 Gbps HPE HDR InfiniBand adapters, multiport 100GbE adapters,[6] and high-performance NVMe SSDs. Multiple storage options are available inside the chassis ranging from 0 to 24 (SFF) SAS/SATA.

Additionally, HPE offers the Cray ClusterStor E1000—a storage solution based on Lustre parallel file system technology to address unique data management, throughput, and archiving challenges associated with extremely large datasets.

For customers requiring a parallel file system based on standard server building blocks, HPE also offers HPE Parallel File System Storage. HPE Parallel File System Storage embeds IBM Spectrum Scale, a General Parallel File System (GPFS) for the enterprise. It is a software-defined storage solution built on cost-effective HPE ProLiant DL Gen10 Plus servers and offers a broad set of enterprise storage features including enterprise-grade data availability (backup and disaster recovery), data accessibility (NFS, SMB, HDFS, Object storage), and data compliance (audit log, industry certifications). Key features include:

- Leading parallel file system based on HPE ProLiant DL Gen10 Plus servers
- Starts as low as 27 TB in just four rack units and scales to more than 25 PB in a single file system[7]
- InfiniBand EDR/HDR or 100/200GbE connectivity
- Comprehensive support services (hardware and software) from HPE Pointnext Services
- Built with AMD EPYC 7002 series processors with PCIe Gen4

Services: HPE offers a spectrum of services to meet manufacturing CAE requirements—from services like application tuning to more integrated advisory service offerings such as project management, on-site consulting, technical account management, and solution architecture consulting.

THE "EPYC" ADVANTAGE

Built on 7 nm technology, AMD EPYC processors bring together high core counts, large memory capacity, extreme memory bandwidth, large cache sizes, and massive I/O with the right ratios to enable exceptional HPC workload performance. For CAE workloads, this translates into excellent flexibility and the opportunity to optimize many CAE applications to deliver breakthrough performance. This helps manufacturers improve quality, innovation, and time-to-market.

AMD EPYC 7002 series processors were introduced in August 2019. These processors were game-changers, delivering industry-leading clock frequencies, latency, memory bandwidth, and cache per core.[8] The latest AMD EPYC 7003 series processors extend this leadership even further, offering exceptional single core performance and a new high-frequency 32 core (75F3) part ideal for CAE workloads. Both of these processor families deliver optimal performance enabling customers to select the processor that best meets their needs.

[4] h20195.www2.hpe.com/v2/GetDocument.aspx?docname=c04111481

[5] PCIe 4.0 delivers 16.0 GT/s, twice the transfer speed of PCIe 3.0—en.wikipedia.org/wiki/PCI_Express

[6] HPE HDR InfiniBand adapters are based on standard Mellanox ConnectX-6 technology

[7] 25 PB is a current testing limitation—not an architectural limitation.

[8] en.wikipedia.org/wiki/Epyc

AMD EPYC processors deliver exceptional performance and scalability for CAE workloads.

- World's first 7 nm x86 server CPU
- Highest available x86 server core count to maximize parallelism
- World's first PCIe Gen4 capable x86 server CPU
- Eight memory channels per socket
- World's first x86 server processor with DDR4 3200 memory support
- Leadership L3 cache per core

AMD EPYC 7003 series

AMD EPYC 7003 series processors introduced in March 2021 offer several advantages over the 7002 series.[9] Among these advantages are:

- A unified 8 core cache complex sharing a single 32 MB L3 cache per CCD providing up to twice the directly accessible L3 cache per core with low latency
- Up to a 19% improvement in instructions per cycle (IPC)
- A faster Infinity Fabric™, clocked at 1600 MHz enabling synchronous transfers with the 3200 MT/sec DDR memory
- Advanced chip-level security enhancements (SME, SEV-ES, SEV-SNP)

AMD EPYC 7003 series processors are a drop-in upgrade, fully compatible with EPYC 7002 series systems.[10] Customers can deploy systems with either EPYC 7002 series processors or 7003 series processors depending on their needs.

An ideal architecture for CAE workloads

The unique architecture shown in Figure 4 is the key to the EPYC processor's throughput advantage. The 9-die system on a chip (SoC) featuring 8 CCDs (core complex die) provides up to 8 cores and 32 MB of cache per CCD. This design places large amounts of L3 cache close to compute cores delivering optimal throughput. The advanced 7 nm process enables clock frequencies to scale to up to 4.10 GHz with max. boost enabled, helping maximize performance.[11]

While other processors share relatively small amounts of L3 cache across multiple cores, AMD EPYC processors offer up to 256 MB of L3 cache and provide a direct path between each core and associated L3 cache to speed throughput and help reduce latency.[12] This combination of high L3 cache per core, direct channels to cache, multiple memory channels, and fast memory combines to deliver exceptional throughput.

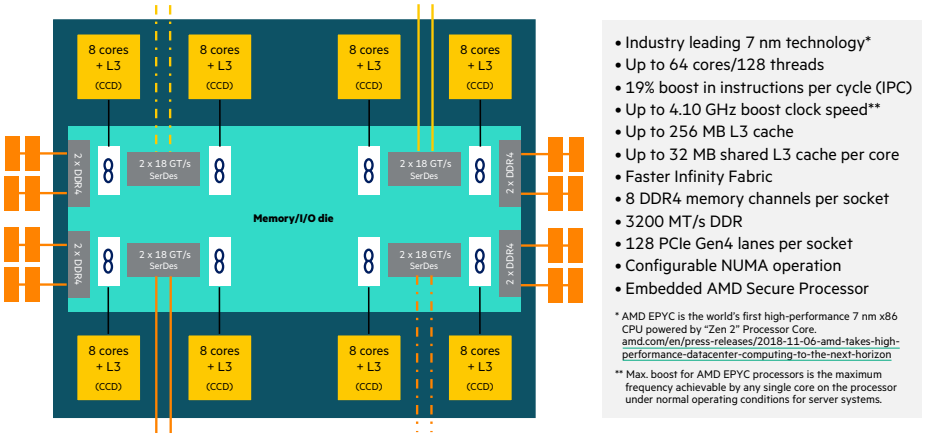


FIGURE 4. AMD EPYC high-level processor design

AMD EPYC processors are the choice of next-generation exascale supercomputers[13] with high core-count (up to 64 cores/processor) to improve scaling, throughput, and elapsed time. Yet, they are affordable, offering superior performance and easily fitting the budgets of small- or medium-sized CAE environments typically found among Tier-1 and Tier-2 suppliers.

For the most demanding CAE workloads, high-frequency AMD EPYC 7Fx2 series and 7xF3 series processors shown in Table 1 can further help improve performance, time-to-market, and TCO for manufacturers with:

- Industry-leading per-core performance to optimize license efficiency.[14]
- Large L3 cache-per-core (up to 32 MB) for reduced analysis runtime.
- 8 x DDR4 high-speed memory channels and dedicated L3 cache per core, enabling more concurrent analyses per server.

[9] amd.com/en/press-releases/2021-03-15-amd-epyc-7003-series-cpus-set-new-standard-highest-performance-server

[10] For HPE Apollo 2000 Gen10 Plus Systems a BIOS update is required when upgrading to 7003 series processors. Also, minimum operating system requirements include Red Hat® Enterprise Linux® (RHEL) 8.3, SUSE Linux Enterprise Server (SLES) 12 SP5, or SLES 15 SP2.

[11] 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.

[12] CCX is a term used in AMD CPUs and stands for Core Complex. It refers to a group of up to four CPU cores in 7002 series processors or up to eight cores in 7003 series processors and their CPU caches (L1, L2, and L3). The number of cores per CCX varies by processor. In the case of other parts, CCX contain two or more cores amd.com/system/files/documents/high-performance-computing-tuning-guide-amd-epyc7003-series-processors.pdf.

[13] AMD EPYC-based systems have been chosen as the basis of exascale supercomputers. Design wins include Frontier, a collaboration between the U.S. Department of Energy, ORNL, and HPE expected to be delivered in 2021. AMD EPYC processors will also power El Capitan, a collaboration between U.S. DOE, LLNL, and HPE expected in early 2023.

[14] Highest per core performance claim based on 3rd generation EPYC 75F3/74F3/73F3 (23-/24-/16-cores) having the highest SPECrate®2017_fp_base score divided by total core count, of all SPEC publications as of June 2, 2021.

TABLE 1. AMD EPYC 7Fx2 and 7xF3 series high-frequency processors

EPYC model	Cores/ threads	Base speed	Boost speed[15]	L3 cache	Power (Watts)	L3 cache per core
AMD EPYC 7002 Series						
7532[16]	32/64	2.4 GHz	Up to 3.30 GHz	256 MB	200	8 MB
7F72	24/48	3.20 GHz	Up to 3.70 GHz	192 MB	240	8 MB
7F52	16/32	3.50 GHz	Up to 3.90 GHz	256 MB	240	16 MB
7F32	8/16	3.70 GHz	Up to 3.90 GHz	128 MB	180	16 MB
AMD EPYC 7003 Series						
75F3	32/64	2.95 GHz	Up to 4.0 GHz	256 MB	280	8 MB
74F3	24/48	3.20 GHz	Up to 4.0 GHz	256 MB	240	10.7 MB
73F3	16/32	3.50 GHz	Up to 4.0 GHz	256 MB	240	16 MB
72F3	8/16	3.70 GHz	Up to 4.1 GHz	256 MB	180	32 MB

While actual CAE application performance depends on the models and solvers used, Figure 5 shows relative SPECrate2017_fp_base scores per core comparing 2nd and 3rd generation EPYC processors with alternative processors having similar core counts on dual-processor systems.[17]

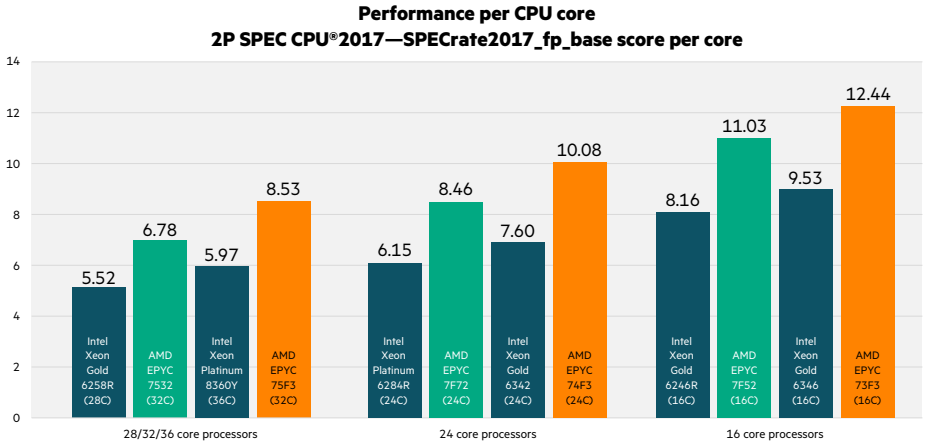


FIGURE 5. EPYC 7Fx2 and 7xF3 series high-frequency parts vs. best-in-class competitors

EPYC processors' superior performance is a result of high-frequency processors, fast DDR4 memory supporting 3200 MT/s, eight memory channels per processor, and large amounts of L3 cache per core. The green bar in Figure 5 represents high-frequency AMD EPYC 7002 series processors (7xF2) while the orange bar represents the latest EPYC 7003 series processors. In the case of AMD EPYC 7003 series processors, performance is further enhanced by the availability of a single 32 MB cache shared by all cores in a CCD and an up to 19% increase in instructions per cycle (IPC) due to enhancements in the "Zen 3" design.

Finally, for many memory-intensive CAE workloads such as computational fluid dynamics (CFD) and computational structural mechanics (CSM), 7Fx2 processors benefit from large amounts of physical memory and L3 cache per core. Memory-intensive CAE workloads such as computational fluid dynamics (CFD) and computational structural mechanics (CSM) are sensitive to memory and L3 cache performance.

[15] 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

[16] There is no 32-core high-frequency part in the EPYC 7002 series of processors, but the 32 core EPYC 7532 is still an excellent choice for CAE workloads.

[17] SPEC, and SPECrate are trademarks of the Standard Performance Evaluation Corporation. All rights reserved. All stated results are as of June 2, 2021. See spec.org for more information. All benchmarks referenced were conducted on 2P systems, so the core counts referenced are across both processors. Configurations as follows:

Intel® Xeon® Gold 6258R (56C) scoring 309 SPECrate2017_fp_base (309/56 = 5.52 score/core)—spec.org/cpu2017/results/res2020q3/cpu2017-20200915-23979.html

AMD EPYC 7532 (64C) scoring 434 SPECrate2017_fp_base (434/64 = 6.78 score/core)—spec.org/cpu2017/results/res2020q3/cpu2017-20200622-23004.html

Intel® Xeon® Platinum 8360Y (72C) scoring 430 SPECrate2017_fp_base (430/72 = 5.97 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210426-25861.html

AMD EPYC 75F3 (64C) scoring 546 SPECrate2017_fp_base (546/64 = 8.53 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210409-25543.html

Intel Xeon Gold 6248R (48C) scoring 295 SPECrate2017_fp_base (295/48 = 6.15 score/core)—spec.org/cpu2017/results/res2020q3/cpu2017-20200915-23989.html

AMD EPYC 7F72 (48C) scoring 406 SPECrate2017_fp_base (406/48 = 8.46 score/core)—spec.org/cpu2017/results/res2020q2/cpu2017-20200316-21224.html

Intel Xeon Gold 6342 (48C) scoring 365 SPECrate2017_fp_base (365/48 = 7.60 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210510-26250.html

AMD EPYC 74F3 (48C) scoring 484 SPECrate2017_fp_base (484/48 = 10.08 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210510-25992.html

Intel Xeon Gold 6246R (32C) scoring 261 SPECrate2017_fp_base (261/32 = 8.16 score/core)—spec.org/cpu2017/results/res2020q4/cpu2017-20201023-24242.html

AMD EPYC 7F52 (32C) scoring 353 SPECrate2017_fp_base (353/32 = 11.03 score/core)—spec.org/cpu2017/results/res2020q2/cpu2017-20200316-21248.html

Intel Xeon Gold 6346 (32C) scoring 305 SPECrate2017_fp_base (305/32 = 9.53 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210510-26199.html

AMD EPYC 73F3 (32C) scoring 398 SPECrate2017_fp_base (398/32 = 12.44 score/core)—spec.org/cpu2017/results/res2021q2/cpu2017-20210510-26213.html

Table 2A and 2B illustrate the unique advantages of EPYC 7002 and 7003 series processors over comparable competitive offerings across multiple points of comparison.

TABLE 2A. AMD EPYC 7002 series processors provide superior memory capacity, bandwidth, and L3 cache per core

	AMD EPYC 7F52[18]	Intel Xeon Gold 6246R[19]
Number of cores	16	16
Total L3 cache	256 MB	35.75 MB
L3 cache/core	16 MB	2.23 MB
Memory speed	3200 MT/s	2933 MT/s
Memory channels	8	6
Base clock (GHz)	3.50 GHz	3.40 GHz
Boost clock (GHz)[20]	Up to 3.90 GHz	Up to 4.10 GHz
Max. memory	4 TB	1 TB[21]

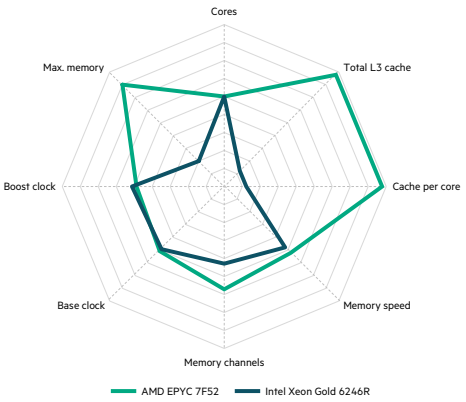
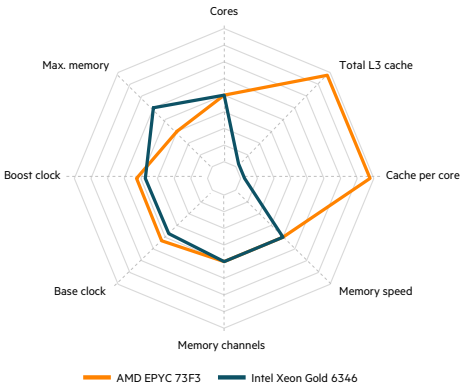


TABLE 2B. AMD EPYC 7003 series processors provide superior clock speed, L3 cache, and L3 cache per core

	AMD EPYC 73F3[22]	Intel Xeon Gold 6346[23]
Number of cores	16	16
Total L3 cache	256 MB	36 MB
L3 cache/core	16 MB	2.25 MB
Memory speed	3200 MT/s	3200 MT/s
Memory channels	8	8
Base clock (GHz)	3.50 GHz	3.10 GHz
Boost clock (GHz)[24]	Up to 4.00 GHz	3.60 GHz
Max. memory	4 TB	6 TB[25]



[18] amd.com/en/products/cpu/amd-epyc-7f52

[19] ark.intel.com/content/www/us/en/ark/products/199353/intel-xeon-gold-6246r-processor-35-75m-cache-3-40-ghz.html

[20] 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.

[21] See Intel Xeon Gold 6246R processor specs at ark.intel.com/content/www/us/en/ark/products/199353/intel-xeon-gold-6246r-processor-35-75m-cache-3-40-ghz.html

[22] amd.com/en/products/cpu/amd-epyc-73f3

[23] ark.intel.com/content/www/us/en/ark/products/212457/intel-xeon-gold-6346-processor-36m-cache-3-10-ghz.html

[24] 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.

[25] See Intel Xeon Gold 6346 Processor specs at ark.intel.com/content/www/us/en/ark/products/212457/intel-xeon-gold-6346-processor-36m-cache-3-10-ghz.html. Note that 6 TB maximum memory assumes the use of Intel® Optane™ Persistent Memory. With DRAM, maximum memory capacity is 4 TB (same as the EPYC 73F3)

HPE Apollo 2000 Gen10 Plus Systems deliver sustained high performance across multiple cores.

CAE users can improve performance, solve very high-fidelity multiphysics problems, and reduce TCO with a smaller data center footprint.

AMD POWERED HPE SERVERS—PURPOSE BUILT FOR CAE

CAE applications such as computational fluid dynamics (CFD) and finite element analysis (FEA) have different computing requirements. CFD algorithm solutions are often memory bound and benefit from servers with large amounts of memory, multiple memory channels and large amounts of L3 cache per core.

Implicit FEA involves computationally expensive sparse matrix inversion, which is typically limited by memory size and bandwidth. Explicit FEA problems, such as crash and transient non-linear analysis, need high processor performance—these workloads benefit from higher core-counts and high-frequency processors with large amounts of cache.

Depending on the type of CAE problem, mixing and matching of large core-count processors with high frequencies, very high cache per core, high memory bandwidth, and massive I/O are essential to solving CAE problems. The HPE Apollo Gen10 Plus System with AMD EPYC processors delivers a broad range of unique choices for manufacturers to help optimize their high-fidelity CAE environments. High core-count EPYC processors can deliver high throughput per node for CAE applications that benefit from multicore parallelism. Lower-core count EPYC processors with high frequencies and high cache-per-core offer high performance per-core, helping to efficiently utilize per-core software licenses.

INDUSTRY LEADING PERFORMANCE

HPE internal results on ISV provided standard benchmarks, done in May/June 2020, showed higher performance for HPE systems with AMD's EPYC 7002 series processors versus a similarly configured 4-node, 2-socket system with an alternative processor.[26] The results are shown in Table 3.

TABLE 3. HPE system benchmarking with 7002 series processors—May/June 2020

CAE solution	Application	AMD versus alternative
Crash analysis	Ansys LS-DYNA	Performance improvement—Up to 66%
CFD	OpenFOAM	Performance improvement—Up to 127%
CFD	Ansys Fluent	Performance improvement—Up to 45%

HPE continue to run a variety of internal benchmarks comparing EPYC 7002 and 7003 series processors to alternative CPUs using standard CAE applications on HPE servers. EPYC processors generally delivery superior performance for most of the application workloads benchmarked.

[26] For a review of the HPE internal ISV standard benchmarks shown in Table 3 carried out in May/June 2020 as well as additional benchmarks involving EPYC 7003 series processors, contact your HPE representative.

WHY HPE AND AMD FOR CAE

As the scale and scope of CAE continue to grow, manufacturers need reliable partners with deep HPC and manufacturing expertise. Together with AMD, HPE provides a comprehensive portfolio of high-performance systems and software, high-value services, and an outstanding ecosystem of performance-optimized CAE applications to help manufacturing customers reduce costs, improve quality, productivity, and time-to-market.

Worldwide, many manufacturing companies are already using these CAE solutions from HPE. As CAE becomes an even more integral part of the entire supply chain and product lifecycle, HPE Apollo 2000 Gen10 Plus Systems powered by AMD EPYC processors can deliver excellent CAE application performance to help manufacturers solve their most complex problems, innovate faster, and improve productivity and profitability.

As a market-leading CAE platform vendor, HPE delivers a unified compute and storage solution designed to simplify system and data management, reduce costs and complexity, and scale to deliver the exceptional performance needed for the next-generation of CAE solutions in manufacturing.

LEARN MORE AT

hpe.com/servers/apollo2000

To learn more about HPE Apollo 2000 Gen10 Plus Systems, please visit hpe.com/servers/apollo2000

To learn more about AMD EPYC 7003 series processors, please visit amd.com/en/processors/epyc-7003-series

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a50002334ENW, July 2021, Rev. 1