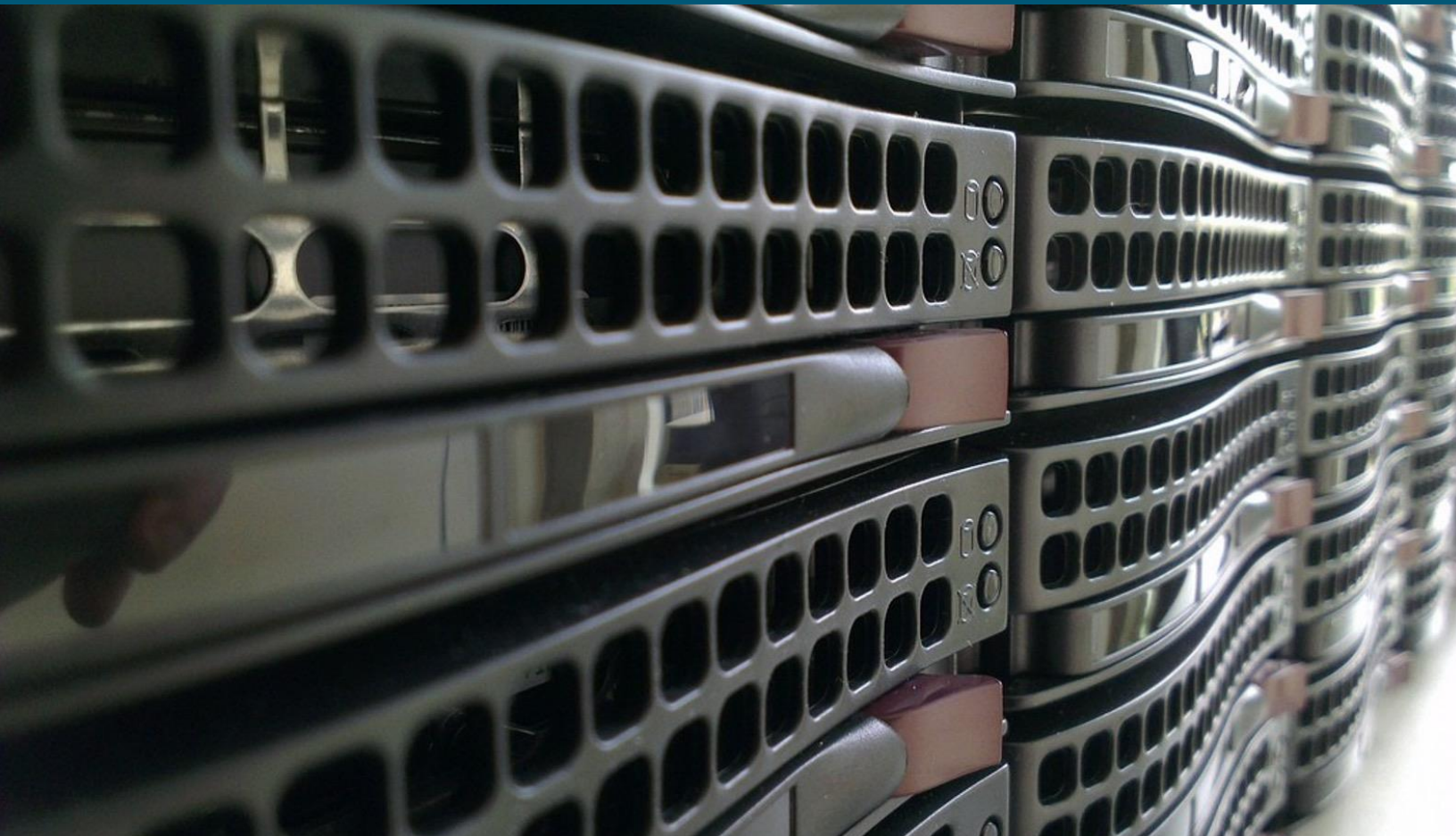


EBOOK

RIGHTSIZE HPC INFRASTRUCTURE WITH ALTAIR[®] SOFTWARE AND 3RD GEN AMD EPYC[™] PROCESSORS

SIX WAYS TO IMPROVE THE EFFECTIVENESS OF YOUR
CAE ENVIRONMENT



INTRODUCTION

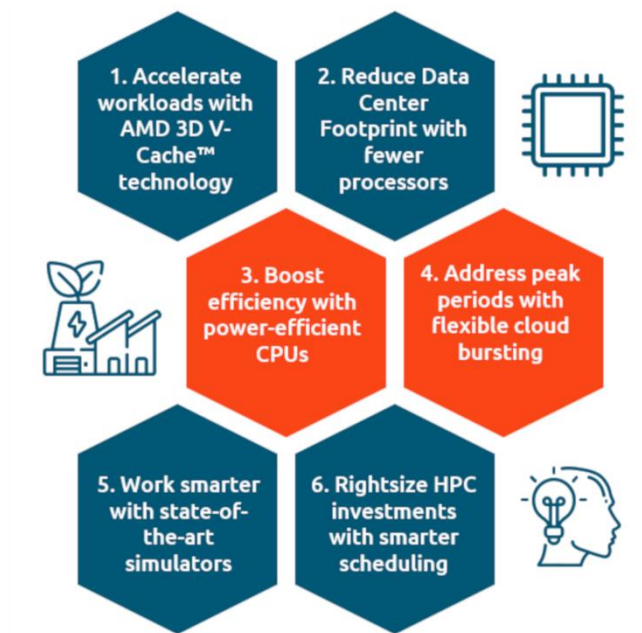
Today, manufacturers rely on HPC for everything from validating new designs to material development and selection to optimizing product performance and durability. With more complex designs, increased competition, and shorter product cycles, there is more pressure on CAE teams to deliver higher quality results faster.

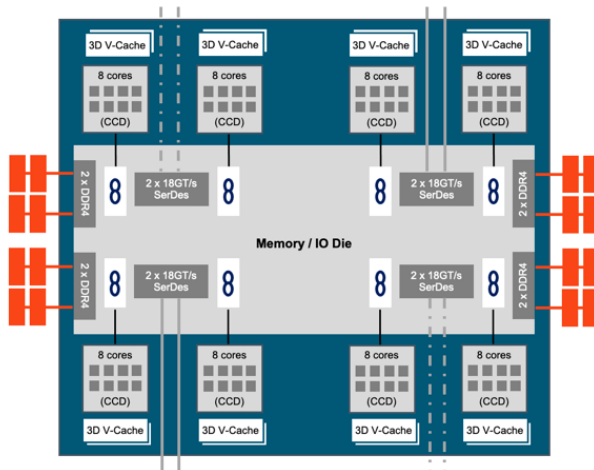
While engineers have an insatiable appetite for compute cycles, data center capacity and IT budgets are finite. Organizations need to do more with less and rightsize their HPC infrastructure.

Altair simulators and HPC middleware combined with the latest AMD EPYC™ processors provide organizations with multiple opportunities to boost productivity and reduce cost. These include:

- Leveraging new processor technologies to reduce data center footprint and speed throughput
- Boosting efficiency with power-efficient CPUs and flexible cloud bursting
- Working smarter with state-of-the-art simulators and advanced workload scheduling solutions

This document provides an overview of AMD EPYC™ and Altair HPC technologies and it introduces **six money-savers**, explaining how organizations can rightsize their HPC investments and improve the effectiveness of their simulation environments.





THE EPYC™ ADVANTAGE

AMD EPYC 7003 Series Processors with 3D V-Cache™ Technology

Built on 7nm technology, AMD EPYC processors bring together high core counts, large memory capacity, extreme memory bandwidth, large cache sizes, and massive I/O in the right ratios to enable exceptional HPC workload performance.

For CAE users, this translates into higher-quality designs, reduced simulation runtimes, and higher throughput and cost-effectiveness.

The newest members of the AMD EPYC processor family feature AMD 3D V-Cache™ technology. These processors extend the leadership of the EPYC 7003 series with an innovative 3D vertical cache that provides 96 MB of L3 cache per CCD, tripling the amount of L3 cache compared to standard EPYC 7003 processors.

- Up to 64 cores/128 threads per socket
- Up to 4.10 GHz boost clock speed¹
- Up to 768 MB L3 cache, up to 96 MB per individual core
- 8 DDR4 memory channels per socket
- Up to 3200 MT/s memory speed
- 128 PCIe Gen4 lanes per socket

¹ This refers to the AMD EPYC 72F3 part. 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.

1. ACCELERATE SIMULATION WORKLOADS WITH AMD EPYC™ WITH 3D V-CACHE™ TECHNOLOGY

Realize Dramatic Productivity Gains for Selected CAE Workloads

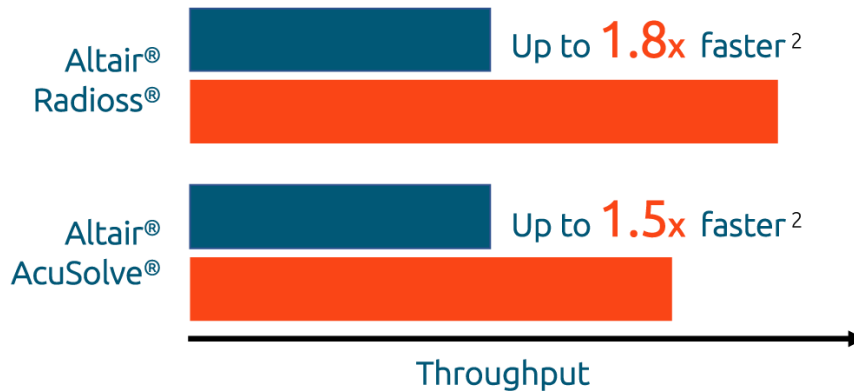
Faster simulations mean that engineers can more thoroughly explore design parameters in a shorter amount of time. Better application performance brings multiple advantages, including:

- Higher-quality products
- Fewer warranty issues
- Less physical prototyping
- Lower manufacturing costs
- Faster time to market



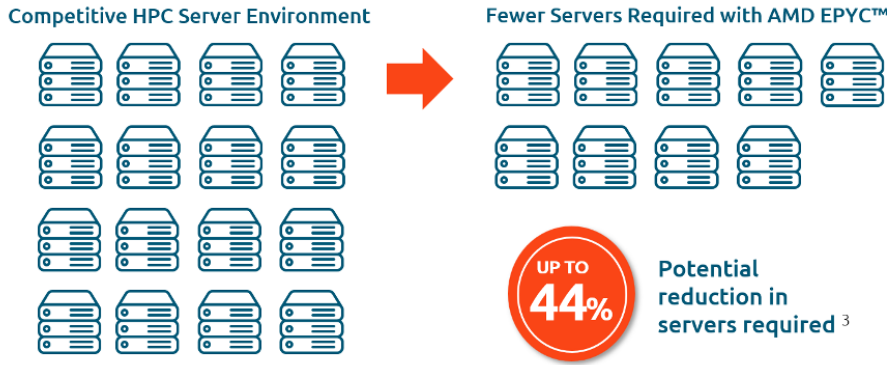
Running simulations faster and reducing turnaround time directly impacts the bottom line. For many workloads, larger cache is a key factor in reaching results faster.

In published Altair benchmarks, standard finite-element analysis (FEA) and computational fluid dynamics (CFD) workloads ran anywhere between up to **1.5x** and **1.8x** faster using **Altair® AcuSolve®** and **Altair® Radioss®** on the latest AMD EPYC™ processors with AMD V-Cache™ technology.²



² These results compared the latest AMD EPYC 7003 series processors with AMD 3D V-Cache to earlier AMD 7003 series processors. See the article [Breakthrough Computing Performance with Altair and 3rd Gen AMD EPYC™ Processors with AMD 3D V-Cache™ Technology](#) for details

2. REDUCE DATA CENTER FOOTPRINT USING FEWER, HIGHER THROUGHPUT AMD EPYC™ PROCESSORS



Help Reduce Server, Power, and Cooling Costs with a Highly Efficient Architecture

Productivity is critical, but so too is reducing cost and data center real estate. With the performance gains described above, design organizations can not only achieve higher levels of productivity – they can potentially reduce their data center footprint by up to 44%.³ By running Altair solvers on the latest AMD EPYC™ processors organizations can deploy fewer servers while achieving the same overall throughput.

The cost savings can be considerable. Fewer servers translates into fewer server racks, fewer network drops, reduced power consumption, less administration, and a lower data center footprint, potentially leading to facilities-related savings.

³ Calculation is based on the Altair Radioss benchmark presented on the previous page. A throughput increase of 1.5x corresponds to a 33% reduction in required infrastructure $(1-(1/1.5))$ to achieve the same aggregate throughput. Similarly, a 1.8x throughput gain corresponds to a ~44% reduction in infrastructure - $(1-(1/1.8)) = 44\%$.

3. HELP REDUCE CARBON EMISSIONS, POWER, AND COOLING WITH ENERGY-EFFICIENT AMD EPYC™ PROCESSORS

A 30x Increase in Energy Efficiency Goal by 2025

According to the International Energy Agency Goal, modern data centers consume approximately 200 terawatt-hours (TWh) of electricity per year, accounting for nearly 1% of global energy demand. Reducing an HPC data center's energy use is not just good for business— it can be good for the planet.



Today, AMD EPYC processor-powered systems deliver the industry's best throughput per watt, holding the top spots in the industry-standard SPECpower_ssj® 2008 benchmark.⁴ Moreover, midway through 2022, AMD is on track to achieve an ambitious goal to deliver a 30x increase in energy efficiency for AMD processors and accelerators powering servers for HPC and AI training from 2020 to 2025.

Green Provisioning in Altair® PBS Professional®

Altair workload managers play an essential role in further enhancing energy efficiency. Green provisioning features in **Altair PBS Professional** provide energy-aware scheduling that places jobs to reduce power consumption, automatically shutting down nodes when they are not in use.⁵

Servers powered by AMD EPYC™ lead the latest SPECpower_ssj® 2008 benchmark rankings, delivering the highest overall energy efficiency expressed in ssj_ops/watt.⁶



⁴ See EPYC-028 – AMD EPYC provides leading results on SPECpower_ssj® 2008 benchmark

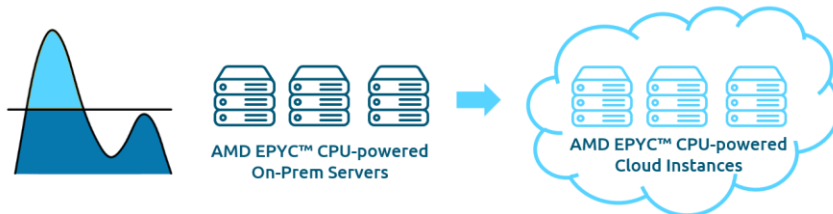
⁵ [Altair Unveils PBS Professional® 10, Adds Green Provisioning Feature, Improves Performance and Administrator Controls](#)

⁶ See EPYC-028

4. ADDRESS PEAK UTILIZATION WITH FLEXIBLE CLOUD BURSTING

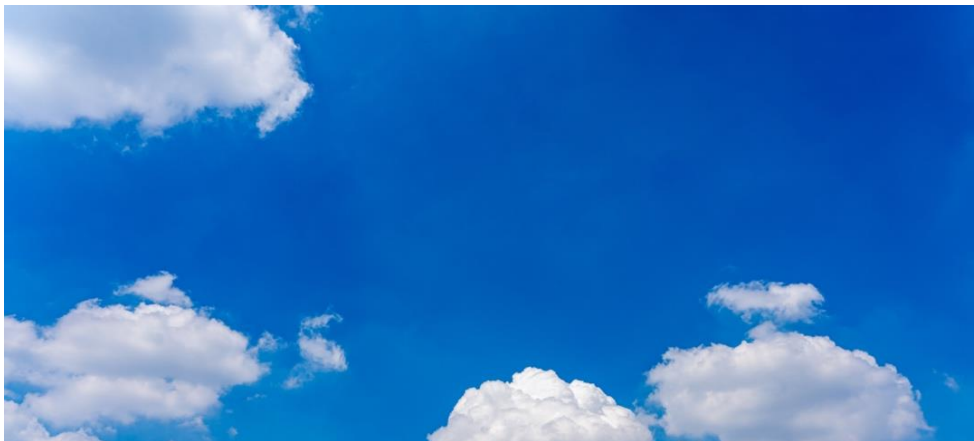
Tap AMD EPYC™ CPU-powered Cloud Instances

Another way to rightsize infrastructure is to practice “peak-shaving,” leveraging cloud-based compute resources to offload workloads during peak periods. This can result in lower on-premises infrastructure costs, higher throughput, and a more flexible and agile HPC environment.



Shave workload peaks and right size infrastructure by automatically shifting workloads to AMD EPYC™ powered cloud instances during busy periods

Altair HPC solutions virtually eliminate the complexity of tapping the latest AMD EPYC processors in the cloud with tools such as **Altair® Control®** and **Altair® Navops®**. CAE users can tap high-performance AMD EPYC processors in their preferred cloud using an intuitive cloud-bursting GUI built into **Altair® PBS Professional®**.⁷



⁷ See [Cloud Bursting with Altair PBS Professional](#)

5. WORK SMARTER WITH STATE-OF-THE-ART SOLVERS

A Rich Variety of Simulation Techniques

Often overlooked in efficiency discussions is the quality of the simulation tools themselves. Altair solvers also allow users to employ different numerical methods depending on the nature of the simulation and required fidelity.

Engineers that need only rough approximations for an electromagnetic simulation may use standard ray tracing models (SRT) but use more sophisticated and compute-intensive techniques (accounting for shooting and bouncing rays, for example) where higher fidelity is required.⁸ By providing a variety of simulation techniques, Altair tools help engineers perform faster analysis and use hardware and software resources more efficiently.

Use Resources More Efficiently

Altair simulators deliver outstanding scalability, taking full advantage of the inherent parallelism of the latest AMD EPYC™ processors. For example, Altair® Radioss® employs a hybrid massively parallel processing (HMPP) model – combining both shared memory processing (SMP) and single program multiple data (SPMD) parallelism techniques implemented via MPI. By employing HMPP, simulations can scale across 512 cores, keeping AMD EPYC processors fully utilized and minimizing simulation runtimes.



⁸ Details on different simulation techniques are explored in the article [Antenna Modeling and Simulation Techniques](#).

6. RIGHTSIZE YOUR HPC INVESTMENT WITH SMARTER SCHEDULING

Improve Utilization, Reduce Infrastructure Requirements

Given the outsized impact of scheduling on performance, workload monitoring and scheduling should be at the top of every HPC cluster administrator's "to do" list. Altair workload managers complement and extend the capabilities of both Altair simulators and AMD EPYC™ hardware. With configurable NUMA settings, AMD EPYC processors can be partitioned into multiple virtual processors, each having its own dedicated processor cores, cache, and memory channels.⁹

With topology-aware scheduling and core-affinity features in Altair PBS Professional, engineers can wring every ounce of performance out of their HPC infrastructure. In some cases, throughput could potentially be improved simply by using scheduling policies to place workloads optimally across available server resources.

If you can't measure it, you can't manage it - Using tools such as **Altair Breeze™** and **Altair Mistral™** can help customers understand how simulations use infrastructure and tune scheduling policies to maximize throughput and utilization. With smarter scheduling, customers can take full advantage of the advanced features of AMD EPYC processors to realize higher throughput, improve efficiency, and rightsize their HPC investments.



**Topology-aware scheduling, configurable NUMA modes,
core & thread affinity, power-aware scheduling**

⁹ See the [AMD EPYC Tuning Guide for 7003 series processors](#), March 2022 – Section 2.2.2. NUMA Nodes per Socket (NPS).

Altair is a global leader in computational science and artificial intelligence (AI) that provides software and cloud solutions in simulation, high-performance computing (HPC), data analytics, and AI. Altair enables organizations across all industries to compete more effectively and drive smarter decisions in an increasingly connected world – all while creating a greener, more sustainable future.

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