Neue Sun HPC-Systeme mit AMD Opteron CPUs

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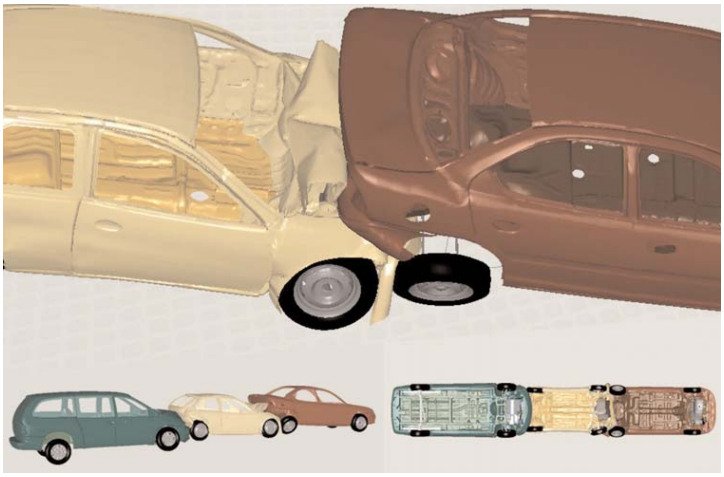
Sun x64 Systems for MCAE

Optimizing Mechanical Computer-Aided Engineering with Sun Systems Featuring the AMD Opteron™ Processor



Three-car-crash benchmark image courtesy Livermore Software Technology Corporation, using car models from FHWA/NHTSA National Crash Analysis Center at George Washington University

> *"Sun x64 systems based on the AMD Opteron™ processor offer LS-DYNA users outstanding price/performance and scalability. Sun's technical support and strategic partnership with AMD are noteworthy, and offer real value to our customers. I look forward to working closely with Sun and AMD to help ensure that LS-DYNA provides optimal parallel performance on their AMD Opteron clusters."*
>
> *— John O. Hallquist, President, Livermore Software Technology Corporation*

Key Highlights

Sun x64 servers and workstations featuring the AMD Opteron™ processor provide considerable benefits for manufacturers:

- 64-bit systems designed for high performance with excellent scalability and 32-bit compatibility
- Large memory capacity for complex models and data sets
- High compute density for consolidation of 32-bit systems
- High-speed 3D graphics for pre- and post-processing
- Choice of the Solaris™ Operating System (OS), Linux, or Microsoft Windows

Sun x64 servers and workstations

- Sun Fire™ X2100, X2200, X4100, X4200, X4500, and X4600 and rack-mount servers
- The Sun Blade™ 8000 modular system
- The Sun Grid Rack System for HPC
- Sun Ultra™ 20 and 40 workstations

High performance computing (HPC) from Sun

- Sun's comprehensive strategy to assess customer needs, architect scalable infrastructure, and provide flexible, cost-effective HPC architecture suited to the specific environment

Grid-based virtual prototyping simulation in MCAE

Numerical simulation of real-world problems has become standard practice among manufacturers worldwide, helping to reduce costs and meet short time-to-market windows. At the same time, simulation has helped improve product quality, optimize materials usage, and address increasingly stringent governmental safety and environmental regulations.

Termed virtual prototype development (VPD) or mechanical computer-aided engineering (MCAE), these simulation techniques typically employ finite element analysis (FEA) methods. Together with high performance computing (HPC) technologies, the latest Sun x64 (x86, 64-bit) systems based on the AMD Opteron processor deliver outstanding performance and scalability for MCAE and VPD applications, allowing manufacturing firms to produce better and safer products at affordable costs.

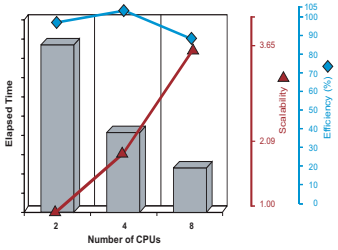
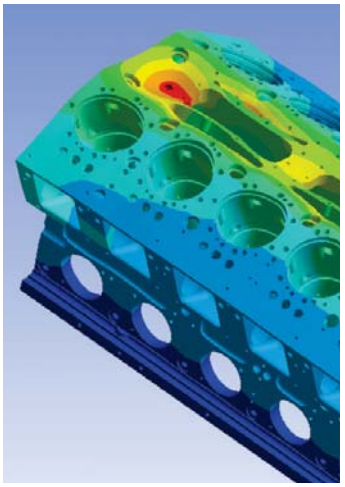


Figure 1: Scalability of the three-car-crash benchmark run on a single Sun Fire X4600 server with eight 3.0 GHz Opteron processors

"We are excited about the performance and value that Sun's AMD Opteron solutions can provide to our ANSYS customers. We are already seeing larger ANSYS models being solved faster in desktop environments because of this hardware technology and our optimized solver for 64-bit computing"

Michael J. Wheeler, Vice President and General Manager, Mechanical Business Unit,

ANSYS, Inc.



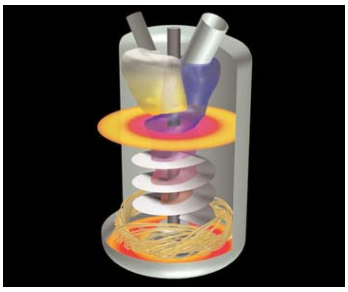
Deformation contours on an engine block, courtesy of ANSYS, Inc.

Widespread acceptance of simulation

As design complexity and computational capabilities have increased, leading manufacturers have accepted simulation as part of the early design process, with prototyping and testing done to ultimately verify designs. Simulation studies at the leading automotive and aerospace companies consist mainly of the following technologies:

- **Crash/occupant safety** applications such as LS-DYNA (Livermore Software Technology Corporation) and PAM-CRASH (ESI Group) account for most of auto makers' numerically-intensive computing cycles.
- **Noise, vibration and harshness (NVH)** applications are also popular, providing modal analysis in the form of frequency response simulations.
- **Computational fluid dynamics (CFD)** applications are commonly used for steady-state or transient analysis of external airflow, engine underhood, underbody, interior climate control, instrument panel thermal management, and combustion. Popular applications include FLUENT (ANSYS Inc.), STAR-CD (CD-adapco), CFX (ANSYS, Inc.), and Exa/PowerFLOW.
- **Structures and Nonlinear FEA** applications typically include MSC.Nastran, MSC.Marc (MSC.Software), ANSYS (ANSYS, Inc.), or ABAQUS (ABAQUS, Inc.) for linear/nonlinear structural integrity studies.

Other applications are also gaining increasing attention, including stochastic/probabilistic simulations, multi-disciplinary optimization (e.g. Engineous Software's iSIGHT), and collaboration (e.g. Engineous' FIPER). These various MCAE applications place different demands on computer system architecture. Crash simulation is CPU intensive, with little demand on other resources. NVH puts



Crutcher mixer CFD simulation using FLUENT, FIELDVIEW image courtesy of Intelligent Light

large demands on all resources, including CPU, memory, I/O bandwidth, and storage. CFD is typically CPU, memory, and memory-bandwidth intensive. Adaptive meshing has become common in CFD, metal forming, and crash simulations, generating considerable computational demand.

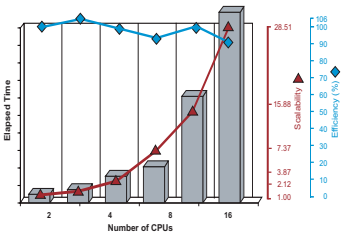


Figure 2: Scalability of the FLUENT CFD benchmark run on a Sun Blade 8000 modular system with four 4-processor Sun Blade X8400 server modules

Typical 3D production models today can consist of as many as 3-20 million elements in CFD simulations, 300,000-1,000,000 elements for crash studies, and 30,000-1,000,000 elements in linear/nonlinear structural analysis. These larger, more complex models increasingly require 64-bit computing architecture to achieve good performance. Large SMP servers are often employed, and clusters of smaller Solaris or Linux systems are also popular.

Many crash and CFD simulation codes are particularly well parallelized and scalable, making 12-16 processor Solaris or Linux clusters ideal for same-day or overnight results.

Most structural analysis codes do not scale as well to large numbers of processors, and engineers frequently employ four-processor systems (with a few using eight processors).

Deploying Sun x64 systems for manufacturing applications

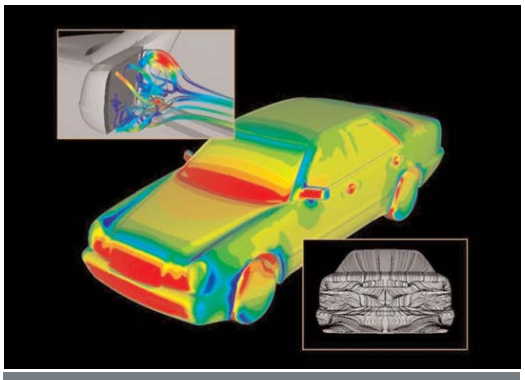
Sun x64 servers and workstations based on the AMD Opteron processor are now rapidly gaining in popularity in MCAE and other high performance and technical computing (HPTC) markets. These affordable network- and grid-ready systems offer excellent performance, price/performance, a choice of operating systems, and both 32- and 64-bit compatibility. The result is leading 64-bit performance for MCAD and MCAE applications with acceleration for unmodified 32-bit x86 applications.

Sun x64 systems offer a balanced architecture that is designed for performance while leveraging innovative aspects of AMD Opteron processor technology. Multiple point-to-point HyperTransport technology interconnects couple AMD Opteron processors to large pools of low-latency memory, eliminating front-side-bus (FSB) bottlenecks and accelerating the most challenging compute- and memory-intensive applications. AMD Opteron processors also provide an integrated memory controller that lets available memory scale with the number of installed processors, for greater memory addressability and low-latency memory access.

Multi-core and multi-processor Sun Fire and Sun Blade servers are ideal for parallel MCAE applications (such as crash and CFD codes). With excellent floating point performance, large memory support, and high-bandwidth I/O and networking, these systems can provide considerable scalability, in both stand-alone and clustered configurations.

With support for up to eight AMD Opteron processors, the Sun Fire™ X4600 server offers excellent single-system scalability. For example, the leading crash code LS-DYNA scales well to eight CPUs in the public-domain "three-car-crash" 2004 benchmark (Figure 1). Clusters of multi-processor servers can also be built using gigabit Ethernet, Myrinet, or Infiniband interconnects. Figure 2 illustrates the scalability of a Sun Blade™ 8000 modular system equipped with four 4-socket Sun Blade X8400 server modules on a FLUENT CFD benchmark. Clusters of 1-2 processor Sun Fire X2100, X2200, X4100, and X4200 servers can also offer excellent scalability (STAR-CD, Figure 3).

Beyond large simulation codes, manufacturing environments also require powerful engineering workstations with interactive and visually realistic 3D graphics capabilities. "Pre-processing" and "post-processing" demand high levels of interactivity and visual realism as well as large memory support to facilitate manipulation and visualization of complex models. Equipped with a range of 3D NVIDIA Quadro graphics accelerators, the Sun Ultra™ 20 and Ultra 40 workstations are ideally suited to these tasks. At night or during off-hours, these 3D MCAD workstations can be pooled together using Sun N1™ Grid Engine software to provide a cost-effective MCAE simulation cluster.



Mercedes E-class CFD simulation using STAR-CD, courtesy CEI/EnSight

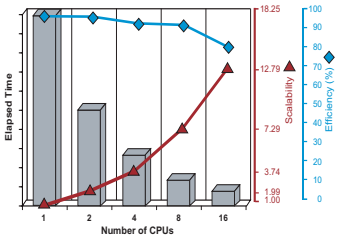


Figure 3: Scalability of STAR-CD turbulent flow around an A-class car, by a cluster of Sun Fire X2100 servers with Opteron processors (gigabit Ethernet)

Sun high performance computing (HPC) solutions

With increasingly complex designs and globally dispersed operations, manufacturers need to rapidly deploy effective tools to help them collaborate with multiple teams and partners while getting the most from their computational resources. Sun HPC solutions can simplify infrastructure by allowing disparate systems to be pooled and managed as a common computing resource. In particular, MCAE users profit from optimized system utilization and throughput along with maximized user productivity.

Ultimately, Sun HPC solutions help drive innovation, providing the resources to get high-quality products to market more quickly while reducing costs and providing a rapid return on investment. The benefits of this approach include:

- Increased performance, scalability, and agility
- Reduced risk and time to deployment
- Eco-responsibility and greater density
- A scalable and open architecture

Figure 4: Sun provides a full line of x64 servers ideal for demanding MCAE and HPC applications

Along with a complete and innovative family of workstations and servers (Figures 4 and 5), Sun provides the modular infrastructure that organizations need to rapidly deploy more competitive solutions:

- Industry-leading x64 rack-mount servers, including the Sun Fire X2100, X2200, X4100, X4200, and X4600 servers providing from one to eight sockets for dual-core AMD Opteron processors.
- The Sun Fire X4500 server, integrating powerful AMD Opteron processors with massive data storage and throughput, delivering very high storage density (up to 24 TB) and throughput at a very low cost per gigabyte.
- The Sun Blade 8000 modular system, delivering the performance, capacity, and I/O to support high-performance, large-memory applications, allowing entire grids or clusters to be consolidated into a single chassis.
- The Sun Grid Rack System for HPC, featuring a choice of high-performance x64 servers in a factory-integrated and tested computer cluster, developed by Sun experts to lower risk, speed deployment, and deliver high performance in a scalable, flexible HPC grid.
- Common architecture, preserving investments and promoting the longevity of deployments, Sun x64 servers make it easy to upgrade the components most likely to change while retaining investments in other infrastructure.

Learn More:
Contact your Sun Sales Representative to learn more about Sun x64 systems based on the AMD Opteron processors, or visit: sun.com/x64

- Sun N1™ management software, such as Sun N1 Grid Engine distributed resource management (DRM) software and Sun N1 System Manager help harness, consolidate, and manage even very large numbers of systems.
- Sun Ultra™ 20 and 40 workstations, provide excellent computational performance characteristics and a range of available high-resolution NVIDIA Quadro graphics accelerators to drive high-performance multi-display 3D MCAD and visualization applications.

Figure 5: Sun Ultra 20 and Ultra 40 workstations are ideal for MCAD, MCAE, and visualization (STAR-CD simulation of McLaren Formula 1 racer, image courtesy of McLaren International)

Feature	Sun Ulra 20 and 40 Workstations	Sun Fire X2100 and X2200 Servers	Sun Fire X4100 and X4200 Servers	Sun Fire X4500 Server	Sun Fire X4600 Server	Sun Blade 8000 Modular System
Sockets for AMD Opteron processors	One (Ultra 20)/ Two (Ultra 40)	One (X2100) / Two (X2200)	Two	Two	Four, upgradeable to eight	Four per Sun Blade x8400 server module (40 per chassis)
Memory	Up to 8 GB (20) Up to 32 GB (40)	Up to 8/64 GB (8/32 GB per socket)	Up to 32 GB (16 GB per socket)	Up to 16 GB (8 GB per socket)	Up to 128 GB (16 GB per socket)	Up to 64 GB per server module
Form factor	Tower	1 RU	1 RU/2 RU (X4200)	4 RU	4 RU	19 RU (per chassis)

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