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Intel® Xeon® Processor 5000 Sequence: High-Performance Computing Benchmarks

High-Performance Computing Benchmarks

Intel® Xeon® processor 5000 sequence

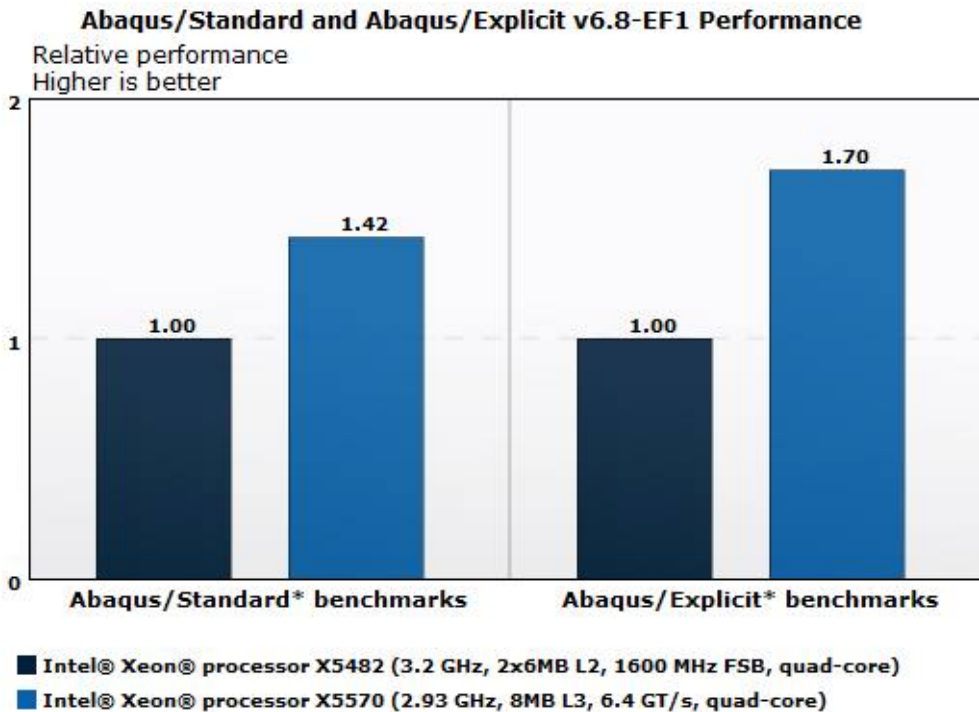


The breakthrough performance, energy efficiency and reliability of the new Intel® Xeon® processor-based systems make them the best choice for virtualization and business critical applications, enabling IT to become more efficient and responsive.

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Computer Aided Engineering

▬ Unified Finite Element analysis using Abaqus*

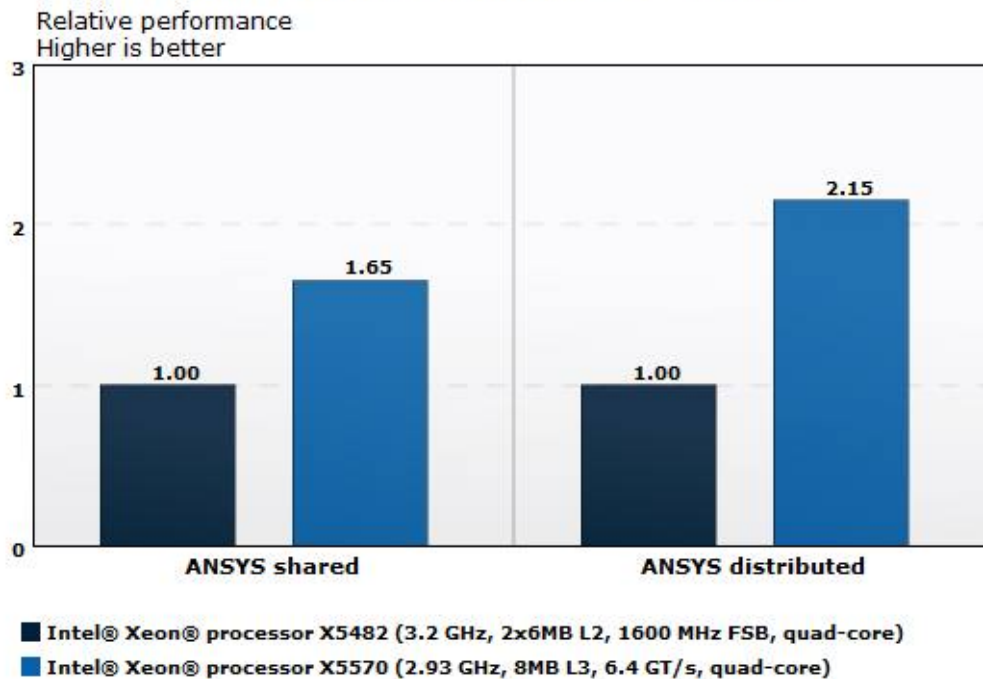


Benchmark description

The Abaqus Unified FEA product suite offers powerful and complete solutions for both routine and sophisticated engineering problems covering a vast spectrum of industrial applications. Abaqus/Standard benchmarks include linear statics, nonlinear statics, and natural frequency extraction workloads. Abaqus/Explicit benchmarks include workloads modeling high-speed dynamic impact events and quasi-static events with complicated contact conditions.

[Configuration details](#)

▬ Multiphysics Finite Element analysis using ANSYS*

ANSYS Mechanical 12.0* Preview 7 Performance**Benchmark description**

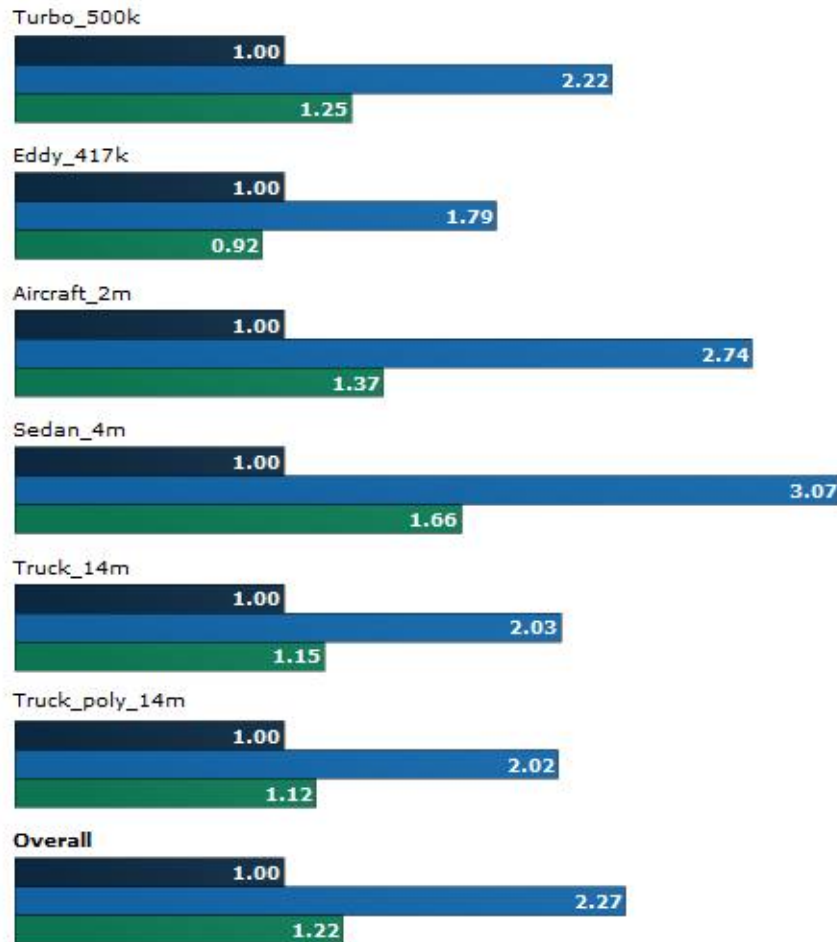
ANSYS 12* software is a comprehensive multiphysics tool combining structural, thermal, fluids, acoustic and electromagnetic simulation capabilities in a single engineering software solution. It's comprehensive range of physical models can be applied to simulation-based product development in a broad range of industries and applications. The "shared" benchmark is a suite of 8 workloads and the "distributed" benchmark is a suite of 7 workloads and they cover a representative set of structural analysis solvers and analysis types.

[Configuration details](#)

■ Computational Fluid Dynamics analysis using Fluent* (single node)

Fluent version 12.0 beta performance - SGI Altix ICE 8200EX Server*

Relative performance
Higher is better



- Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
- Intel® Xeon® processor X5570 (2.93 GHz, 8MB L3, 6.4 GT/s, quad-core)
- Quad-Core AMD Opteron* processor 2384 (2.7 GHz, 6MB L3)

Benchmark description

Fluent 12 is commercial computational fluid dynamics (CFD) package and is a product of Ansys Inc. Fluent 12 has broad physical modeling capabilities well suited to a variety of industrial applications. Fluent provides a set of standardized benchmarks covering a range of fluid flow simulations and software features. Six individual benchmarks are shown as a measure of single node performance. "Overall" performance is the geometric mean of the six individual benchmarks.

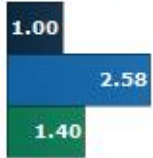
[Configuration details](#)

▬ **Computational Fluid Dynamics analysis using Fluent* (cluster aircraft_2m)**

Fluent version 12.0 beta - aircraft_2m (Cluster result)

Relative performance
Higher is better

1 Node - 8 Cores



2 Nodes - 16 Cores



4 Nodes - 32 Cores



8 Nodes - 64 Cores



■ Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
■ Intel® Xeon® processor X5560 (2.80 GHz, 8MB L3, 6.4 GT/s, quad-core)
■ Quad-Core AMD Opteron* processor 2384 (2.7 GHz, 6MB L3)

Benchmark description

Fluent 12 is commercial computational fluid dynamics (CFD) package and is a product of Ansys Inc. Fluent 12 has broad physical modeling capabilities well suited to a variety of industrial applications. Fluent provides a set of standardized benchmarks covering a range of fluid flow simulations and software features. Aircraft_2m is one test case in the Fluent 12.0 benchmark suite. Results were shown for increasing number of cluster nodes from one to eight.

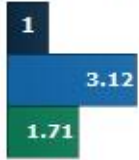
[Configuration details](#)

- **Computational Fluid Dynamics analysis using Fluent* (cluster sedan_4m)**

Fluent Version 12.0 Beta - sedan_4m (Cluster result)

Relative performance
Higher is better

1 Node - 8 Cores



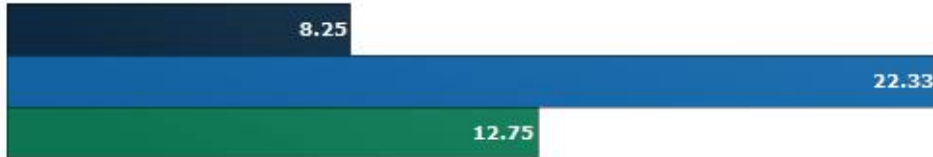
2 Nodes - 16 Cores



4 Nodes - 32 Cores



8 Nodes - 64 Cores



■ Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
 ■ Intel® Xeon® processor X5560 (2.80 GHz, 8MB L3, 6.4 GT/s, quad-core)
 ■ Quad-Core AMD Opteron* processor 2384 (2.7 GHz, 6MB L3)

Benchmark description

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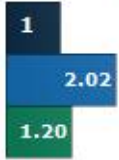
[Configuration details](#)

▬ **Computational Fluid Dynamics analysis using Fluent* (cluster truck_14m)**

Fluent version 12.0 beta - truck_14m (Cluster result)

Relative performance
Higher is better

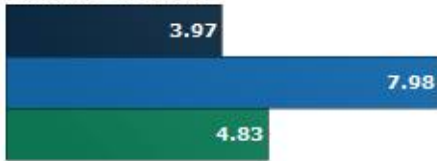
1 Node - 8 Cores



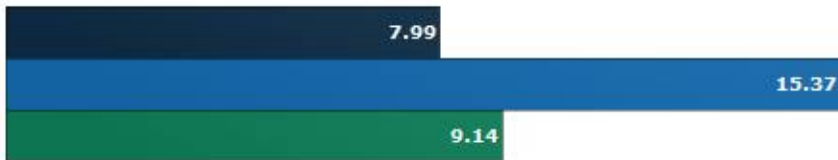
2 Nodes - 16 Cores



4 Nodes - 32 Cores



8 Nodes - 64 Cores

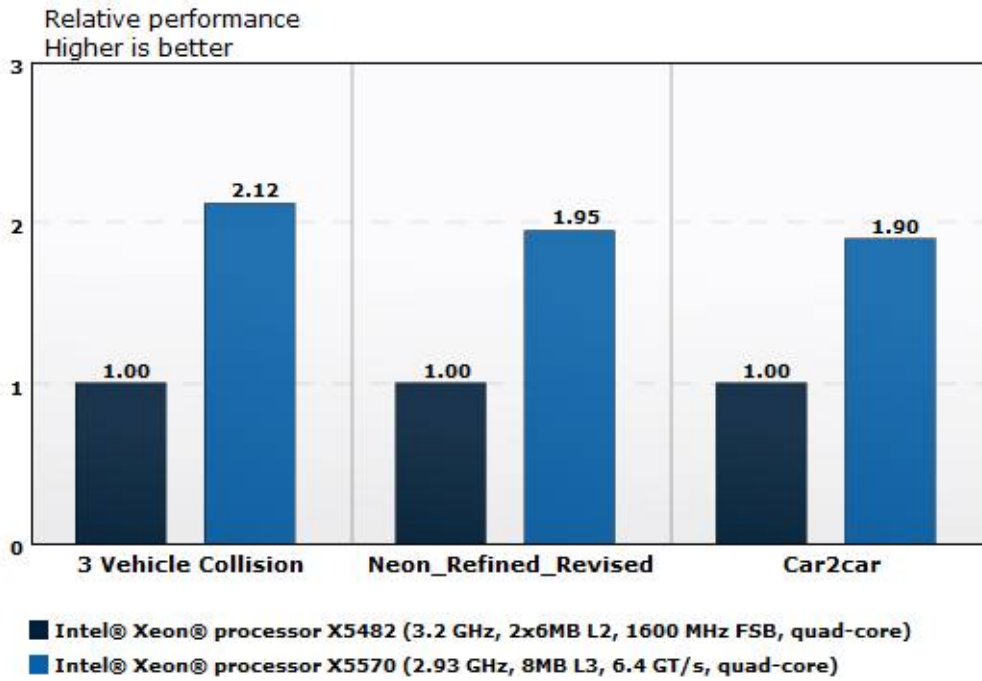


■ Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
 ■ Intel® Xeon® processor X5560 (2.80 GHz, 8MB L3, 6.4 GT/s, quad-core)
 ■ Quad-Core AMD Opteron* processor 2384 (2.7 GHz, 6MB L3)

Benchmark description

Fluent 12 is commercial computational fluid dynamics (CFD) package and is a product of Ansys Inc. Fluent 12 has broad physical modeling capabilities well suited to a variety of industrial applications. Fluent provides a set of standardized benchmarks covering a range of fluid flow simulations and software features. Truck_14m is one test case in the Fluent 12.0 benchmark suite. Results were shown for increasing number of cluster nodes from one to eight.

Configuration details- **Crash Simulation analysis using LS-DYNA* (single node)**

LS-DYNA - version mpp971 Single node Performance**Benchmark description**

LS-DYNA is a general purpose transient dynamic finite element program capable of simulating complex real world problems, for use in various industries, including Automobile Design, Aerospace, Manufacturing, and Bioengineering. Benchmark data sets and cluster performance quotations are available from the independent web site www.topcrunch.org. The www.topcrunch.org benchmarks associated with structural dynamics (LS-DYNA) address domain decomposition, message passing, load balancing, and dynamic memory allocation in automotive crash safety analysis. The chart above shows single node benchmark performance comparisons of automotive crash simulation for single vehicle barrier crash, 3 vehicle rear end crash, and 2 vehicle head-on crash (neon_refined_revised, 3 vehicle collision, car2car).

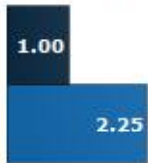
[Configuration details](#)

- **Crash Simulation analysis using LS-DYNA* (cluster - 3 vehicle collision)**

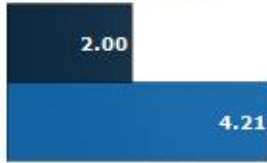
LS-Dyna - 3 vehicle collision - SGI Altix ICE 8200EX* Cluster result

Relative performance
Higher is better

1 Node - 8 Cores



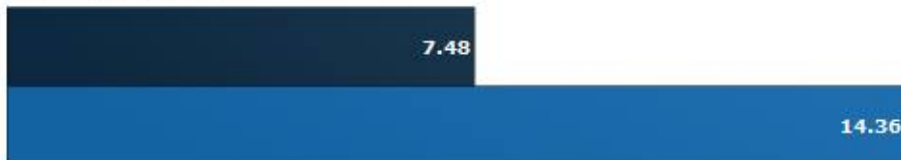
2 Nodes - 16 Cores



4 Nodes - 32 Cores



8 Nodes - 64 Cores



■ Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
■ Intel® Xeon® processor X5570 (2.93 GHz, 8MB L3, 6.4 GT/s, quad-core)

Benchmark description

LS-DYNA is a general purpose transient dynamic finite element program capable of simulating complex real world problems, for use in various industries, including Automobile Design, Aerospace, Manufacturing, and Bioengineering. Benchmark data sets and cluster performance quotations are available from the independent web site www.topcrunch.org. The www.topcrunch.org benchmarks associated with structural dynamics (LS-DYNA) address domain decomposition, message passing, load balancing, and dynamic memory allocation in automotive crash safety analysis. The chart above shows cluster benchmark performance comparisons of automotive crash simulation for 3 vehicle rear end crash (3 vehicle collision). The simulation involves a minivan crashing into rear of a compact car, which in turn crashes into rear of a mid-size car. Results were shown for increasing number of cluster nodes from one to eight.

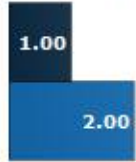
[Configuration details](#)

- **Crash Simulation analysis using LS-DYNA* (cluster - car2car)**

LS-Dyna - Car2Car - SGI Altix ICE 8200EX* Cluster result

Relative performance
Higher is better

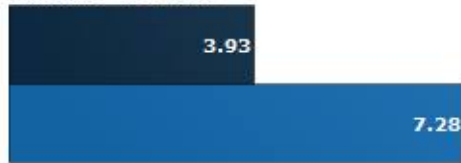
1 Node - 8 Cores



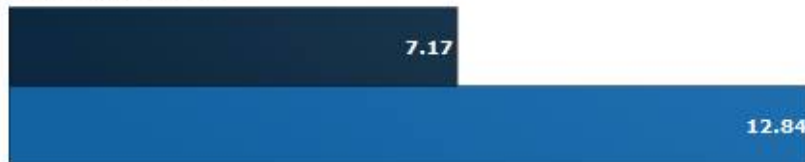
2 Nodes - 16 Cores



4 Nodes - 32 Cores



8 Nodes - 64 Cores



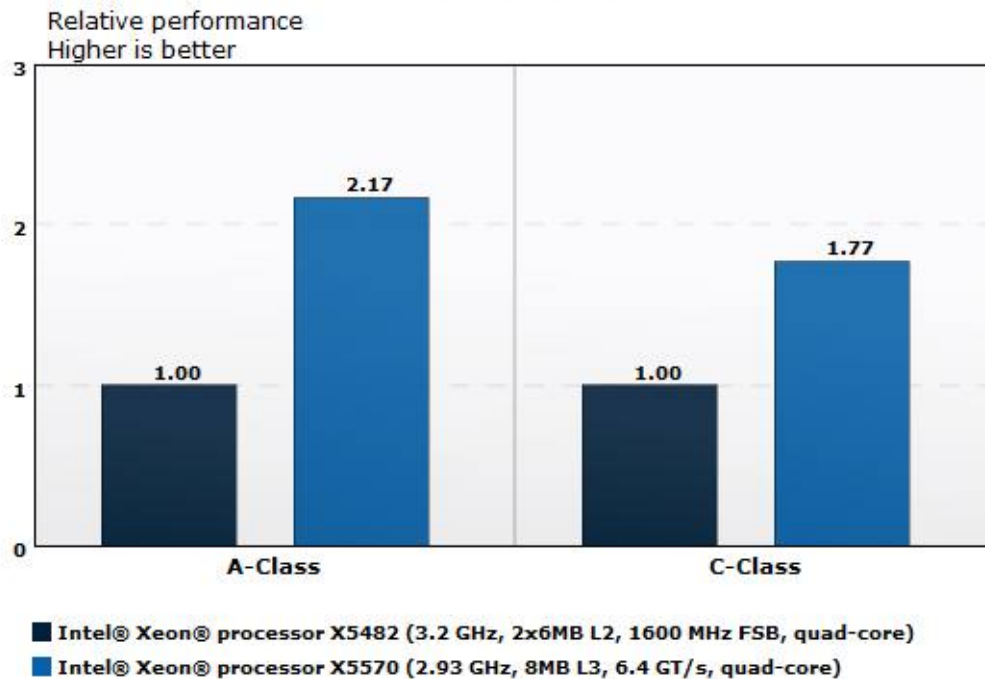
■ Intel® Xeon® processor X5482 (3.2 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
■ Intel® Xeon® processor X5570 (2.93 GHz, 8MB L3, 6.4 GT/s, quad-core)

Benchmark description

LS-DYNA is a general purpose transient dynamic finite element program capable of simulating complex real world problems, for use in various industries, including Automobile Design, Aerospace, Manufacturing, and Bioengineering. Benchmark data sets and cluster performance quotations are available from the independent web site www.topcrunch.org. The www.topcrunch.org benchmarks associated with structural dynamics (LS-DYNA) address domain decomposition, message passing, load balancing, and dynamic memory allocation in automotive crash safety analysis. The chart above shows cluster benchmark performance comparisons of automotive crash simulation for the head-on crash of two minivans (Car2Car). Results were shown for increasing number of cluster nodes from one to eight.

[Configuration details](#)

▬ **Computational Fluid Dynamics analysis using Star-CD* (single node)**

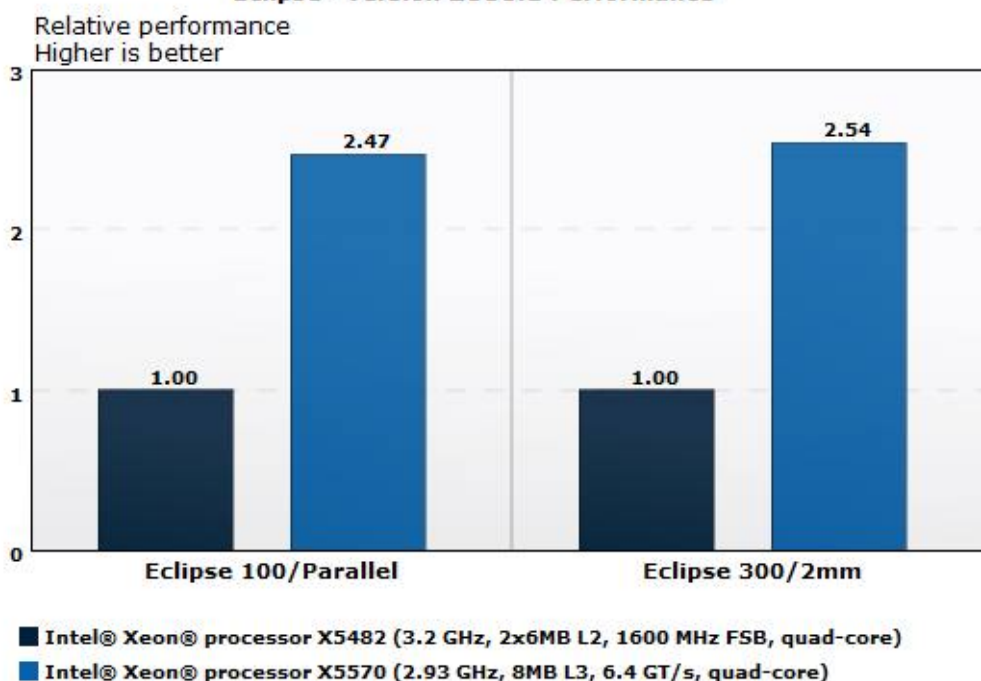
Star-CD 4.06 Performance**Benchmark description**

STAR-CD* provides a platform for industrial CFD simulation. Going beyond just a CFD code, the latest release, STAR-CD V4, introduces the capability to perform structural analysis calculations using a methodology based upon its CFD solver technology, a comprehensive solution for flow, thermal and stress simulation has been available in a single general-purpose commercial finite-volume code. STAR-CD V4 is fully polyhedra enabled and by using the latest polyhedra-solver technology, STAR-CD V4 delivers significant benefits in speed, robustness and usability.

Workloads for Star-CD (A-class, C-class):

The key workloads for Star-CD benchmark are A-Class and C-Class. The A-class (resp. C-class) workloads simulate the turbulent, steady-state flow around an A-Class (resp. C-class) Mercedes* car. Both workloads use the Conjugate Gradient Solver. A-class uses a trimmed hexahedral mesh made of 6 million cells while C-class uses a polyhedral mesh of 10 million cells.

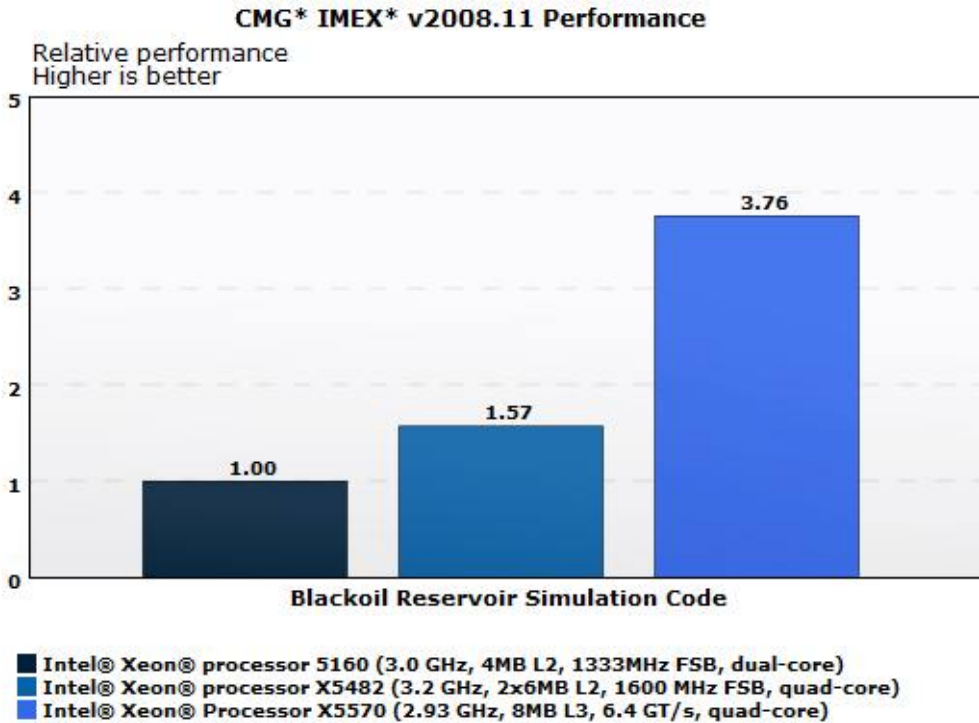
[Configuration details](#)

Energy- **Reservoir Simulation using Schlumberger Eclipse*****Eclipse* version 2008.1 Performance**

Benchmark description

Eclipse* has been the leading commercial reservoir simulation software for over 25 years because of its breadth of capabilities, parallel scalability, utility computing, and unmatched platform coverage. Eclipse Version 2008.1 continues to deliver accurate, high performance solutions for all of today's complex reservoir systems. The two workloads shown demonstrate Eclipse capabilities in handling black oil and compositional simulations. Eclipse 100* is a one million cell black-oil model, and Eclipse 300* is a two million cell compositional model.

[Configuration details](#)

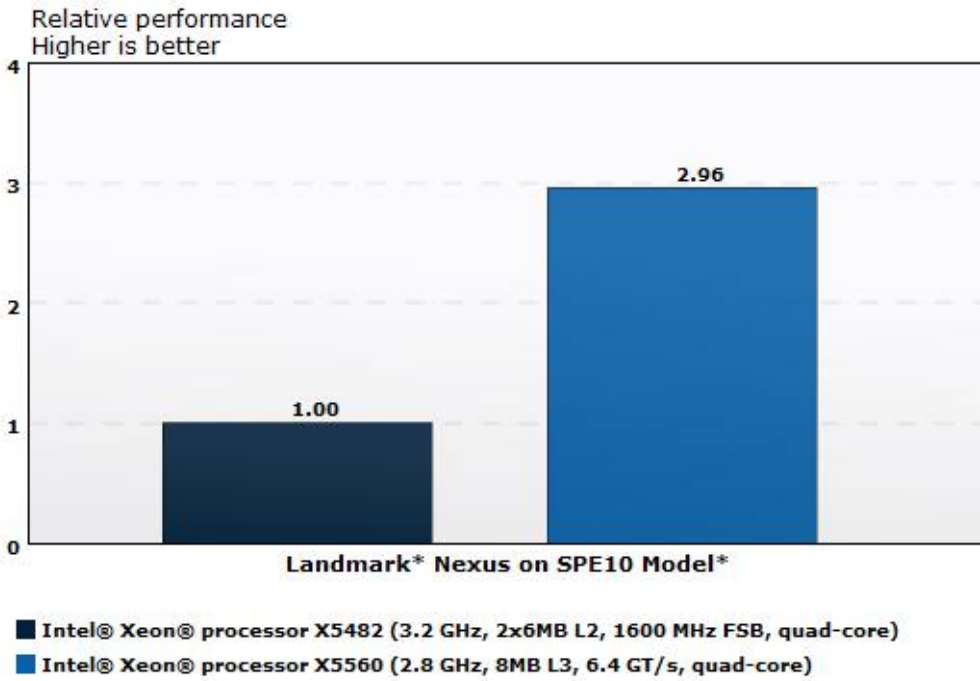
■ Reservoir Simulation using CMG* IMEX***Benchmark description**

IMEX, CMG's full featured Black Oil simulator, models the flow of three phase fluids in gas, gas-water, oil-water, and oil-water-gas reservoirs. It models in one, two, or three dimensions, including complex heterogeneous faulted structures. It also models primary, secondary, and pseudo-miscible and polymer injection processes in naturally or hydraulically fractured reservoirs. The workload is a Black-oil Water Flood simulation with CMG IMEX app. Simulated 545K Cells with 50 wells simulated for 15 years.

[Configuration details](#)

■ Reservoir Simulation using Landmark Nexus*

Landmark* Nexus R5000 Performance



Benchmark description

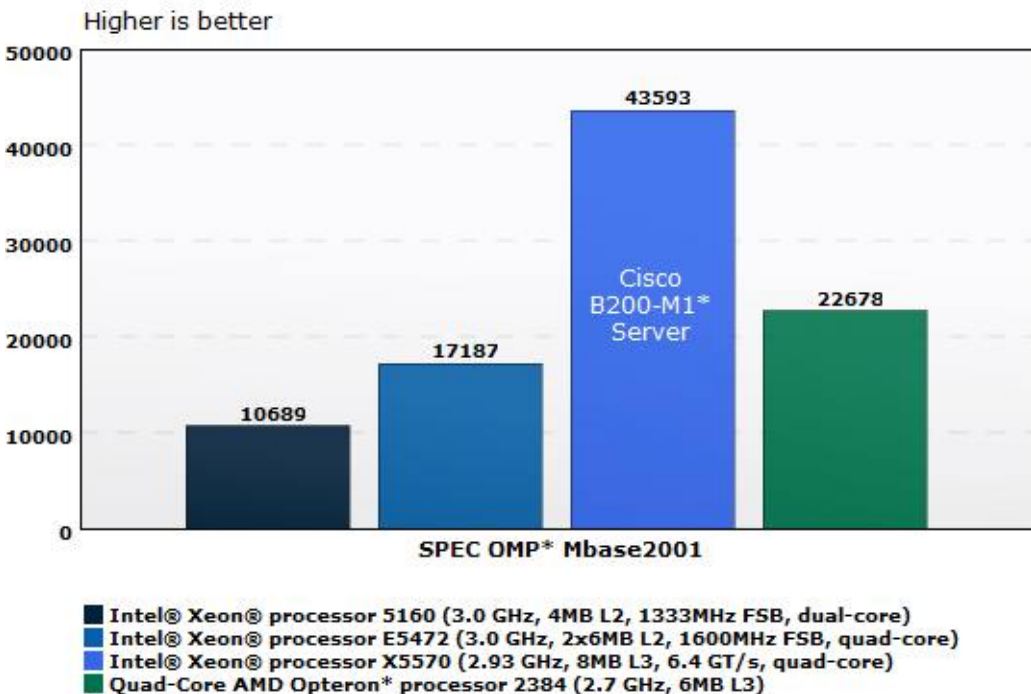
Landmark's Nexus* is a major reservoir simulation software that enables fully implicit, fully coupled surface-to-subsurface simulation at unprecedented speed and accuracy. SPE10* is an industry-standard reservoir model derived from an actual oil reservoir in the North Sea.

[Configuration details](#)

Parallel Systems

OpenMP* and shared-memory systems performance using SPEC OMP2001*

OpenMP* Performance



Benchmark description

SPEC OMP* (OpenMP Benchmark Suite) is a SPEC* (www.spec.org) benchmark suite for evaluating performance based on OpenMP (<http://www.openmp.org>) applications. The focus is to deliver systems performance to real scientific and engineering applications.

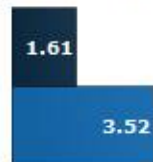
[Configuration details](#)

▬ Performance of compute intensive applications using MPI* with SPEC MPI2007*

SPEC MPI2007* on SGI Altix ICE 8200EX* cluster

Higher is better

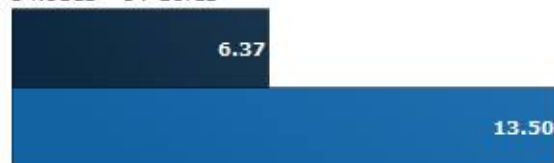
2 Nodes - 16 Cores



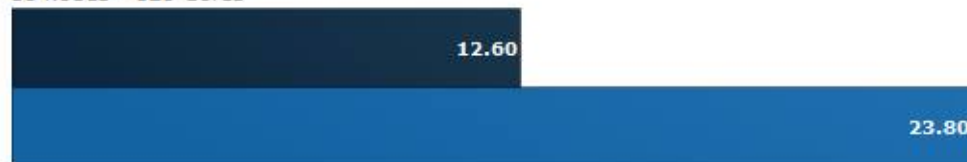
4 Nodes - 32 Cores



8 Nodes - 64 Cores



16 Nodes - 128 Cores



■ Intel® Xeon® processor E5472 (3.0 GHz, 2x6MB L2, 1600 MHz FSB, quad-core)
 ■ Intel® Xeon® processor X5570 (2.93 GHz, 8MB L3, 6.4 GT/s, quad-core)

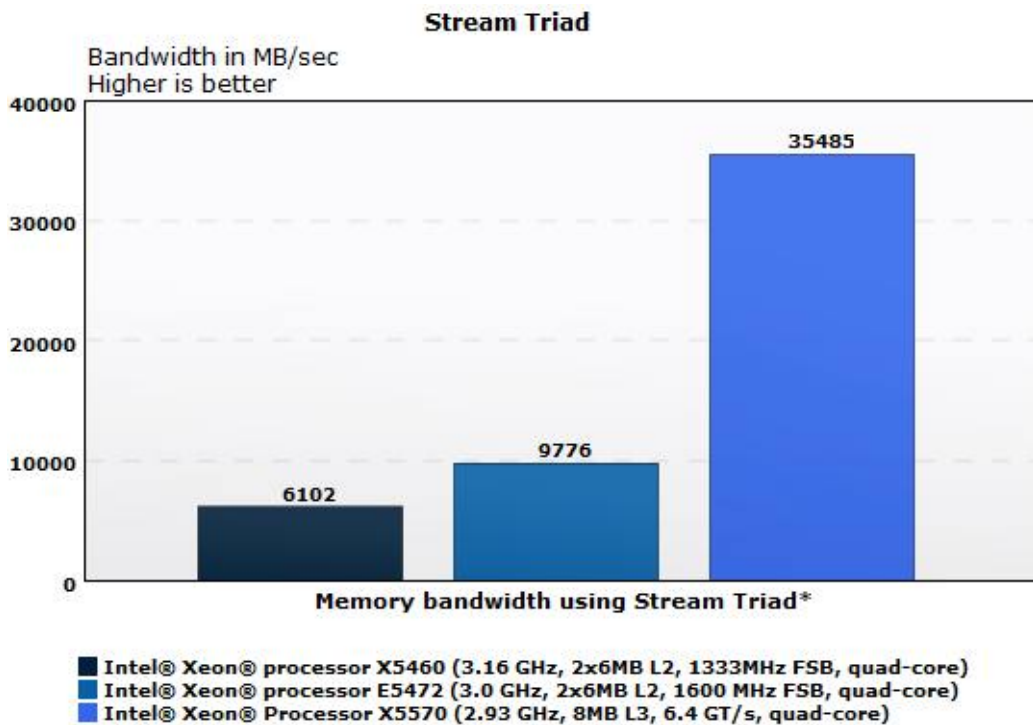
Benchmark description

SPEC MPI2007 is a SPEC (www.spec.org) benchmark suite for evaluating MPI-parallel, floating point, compute intensive performance across a wide range of cluster and SMP hardware. SPEC MPI2007 focuses on performance of compute intensive applications using the Message-Passing Interface (MPI).

[Configuration details](#)

Bandwidth

▬ Memory bandwidth using Stream Triad*



Benchmark description

The Stream Triad* benchmark measures sustainable memory bandwidth in megabytes per second by utilizing four computational loops on a user-definable input array size. These loops are Copy, Scale, Add, and Triad. The selected array size must be at least 4x the sum of all the last level processor caches. This forces the CPU to bypass the caches and go out to the memory subsystem for each transaction allowing for a more representative measure of memory bandwidth. Typically Stream Triad result is quoted as a measure of bandwidth even though all four measures are very close. Metric is megabytes per second.

Configuration details

New Intel® Xeon® processor 5500 series based servers

The Intel® Xeon® processor 5500 series can dramatically advance the efficiency of IT infrastructure and provide unmatched business capabilities. This groundbreaking intelligent server technology features:

- Intelligent Performance that automatically optimizes performance to fit business and application requirements.
- Automated Energy Efficiency that scales energy usage to the workload to achieve optimal performance/watt.
- Flexible virtualization that offers best-in-class performance and manageability in virtualized environments to strengthen IT infrastructure and reduce costs.

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supporting Intel® HT Technology and an Intel® HT Technology-enabled chipset, BIOS, and operating system. Performance will vary depending on the specific hardware and software you use. For more information including details on which processors support Intel® HT Technology, see www.intel.com/products/ht/hyperthreading_more.htm.

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